# Heat Network Technical Assurance Scheme

New Build Heat Networks

Technical Specification

Substation

Phase 3: Construction

**HNTAS-NB-TS-SS-P3**

# Version History

| Revision | Notes | Date |
|---|---|---|
| V0.4 | Draft issue | 05/12/25 |

# 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.

# Note on Phase 4: Operation (initial) and Phase 5: Operation (ongoing)

The New Build Technical Specification and Assessment Procedures Overview (Phase 0) documents indicate that there are separate New Build Code Documents for Phase 4: Operation (initial) and Phase 5: Operation (ongoing).

These documents have since been consolidated to reduce the number of Code Documents, so the Phase 4: Operation documents cover requirements for New Build networks during both initial and ongoing operation.

This change does not impact the assessment of New Build networks in operation, which still occurs:

- after 1 year of operation; and
- after 2 years of operation.

# 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 a New Build Heat Network in Phase 3: Construction.

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 – New Build Heat Networks – Scheme Rules – Assessment Regime (HNTAS-NB-SR-XX-AS) document.

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# Code Document Structure

## Technical Specifications

| Document Type | Element | | Part/Phase | | | | |
|---|---|---|---|---|---|---|---|
| | | | Overview | Phase 1: Feasibility | Phase 2: Design | Phase 3: Construction | Phase 4: Operation |
| | | | P0 | P1 | P2 | P3 | P4 |
| Technical Specification | Energy Centre | EC | HNTAS-NB-TS-EC-P0 | HNTAS-NB-TS-EC-P1 | HNTAS-NB-TS-EC-P2 | HNTAS-NB-TS-EC-P3 | HNTAS-NB-TS-EC-P4 |
| | District Distribution Network | DD | HNTAS-NB-TS-DD-P0 | HNTAS-NB-TS-DD-P1 | HNTAS-NB-TS-DD-P2 | HNTAS-NB-TS-DD-P3 | HNTAS-NB-TS-DD-P4 |
| | Substation | SS | HNTAS-NB-TS-SS-P0 | HNTAS-NB-TS-SS-P1 | HNTAS-NB-TS-SS-P2 | HNTAS-NB-TS-SS-P3 | HNTAS-NB-TS-SS-P4 |
| | Communal Distribution Network | CD | HNTAS-NB-TS-CD-P0 | HNTAS-NB-TS-CD-P1 | HNTAS-NB-TS-CD-P2 | HNTAS-NB-TS-CD-P3 | HNTAS-NB-TS-CD-P4 |
| | Consumer Connection | CC | HNTAS-NB-TS-CC-P0 | HNTAS-NB-TS-CC-P1 | HNTAS-NB-TS-CC-P2 | HNTAS-NB-TS-CC-P3 | HNTAS-NB-TS-CC-P4 |
| | Consumer Heat System | CH | HNTAS-NB-TS-CH-P0 | HNTAS-NB-TS-CH-P1 | HNTAS-NB-TS-CH-P2 | HNTAS-NB-TS-CH-P3 | N/A |

*Table 1: New Build Network Technical Specification structure*

# Scope

This document specifies the HNTAS Requirements for a Substation within a New Build Heat Network in Phase 3: Construction.

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 – New Build Heat Networks – Technical Specification – Substation – Overview (HNTAS-NB-TS-SS-P0) document.

# New Build Heat Networks

There are three stages within Phase 3: Construction, which are Stage 4: Construction Design, Stage 5: Installation, and Stage 6: Commissioning. This is outlined in Figure 1.

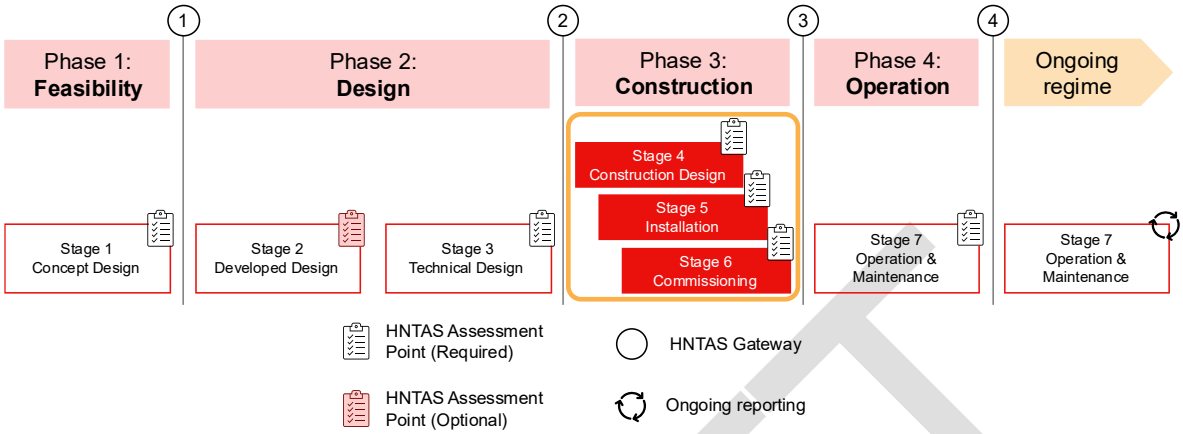


*Figure 1: HNTAS New Build regime phases and stages*

## Sequence of activities within Phase 3: Construction

During Phase 3: Construction, there are three Stages which typically overlap. Within these three Stages, there are multiple activities that are precedent on one another (and hence need to be completed prior to other activities commencing).

For example:

- prior to the installation of equipment, Technical Submittals need to be produced;
- prior to the commissioning of equipment:
  - the necessary equipment needs to be installed;
  - pre-commissioning cleaning activities need to be completed;
  - commissioning methodologies need to be produced.

Figure 2 illustrates an example sequence of activities for a typical project. This illustrates the activities of both the Responsible Party and the Assessor. Prior to the activities being undertaken, the Responsible Party and the Assessor shall agree:

- the sequence of activities; and
- where mid-stage assessments are necessary.

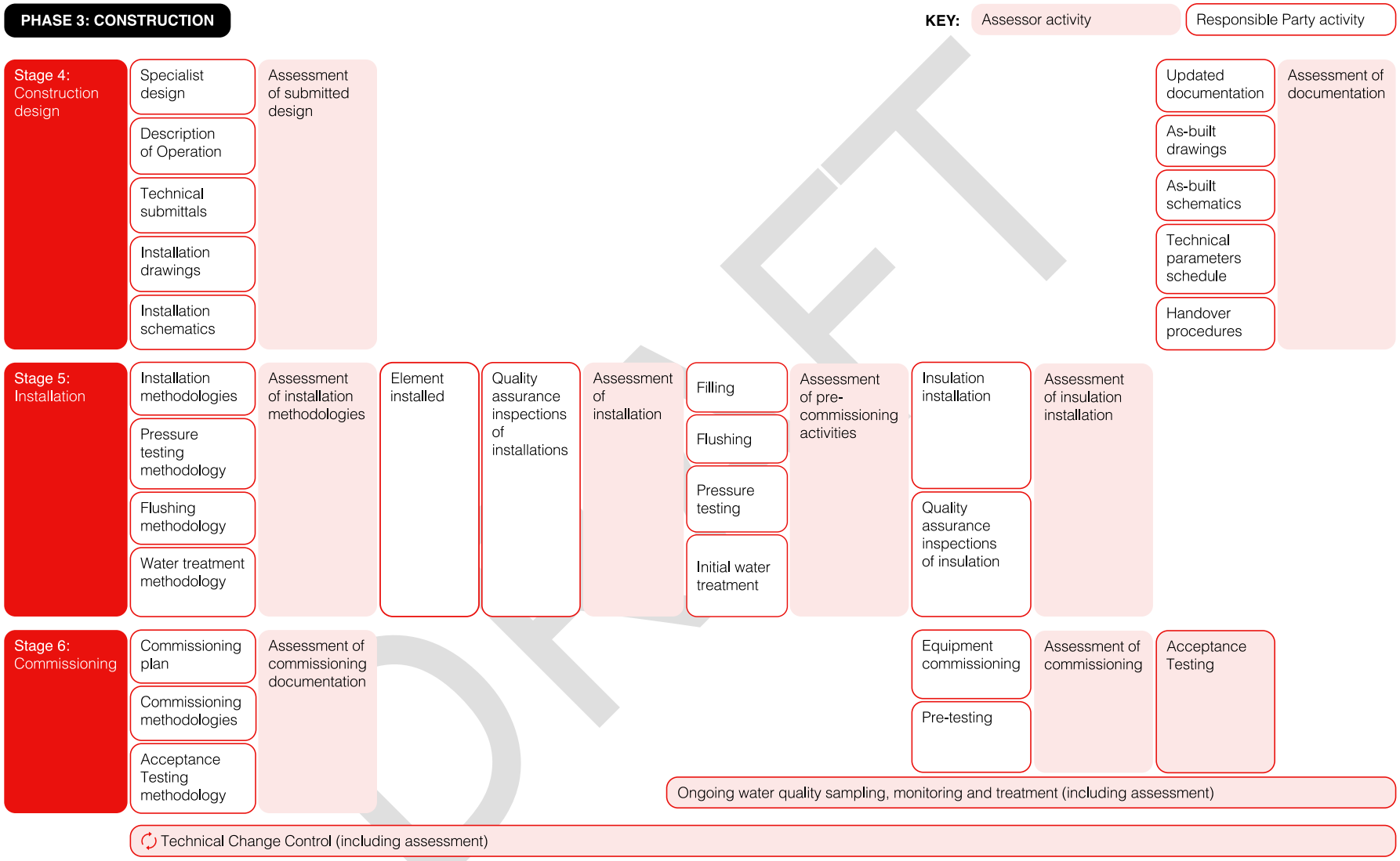


*Figure 2: Example sequence of activities during Construction Phase, with activities of a Responsible Party and Assessor outlined*

# 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)
- BS 5970:2012: Thermal Insulation of Pipework, Ductwork, Associated Equipment and Other Industrial Installations in the Temperature Range of -100 °C to +870 °C – Code of Practice (BSI, 2012)

## 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.

# 4. Requirements for Stage 4: Construction Design

## 4.1. Technical Requirements

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

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 4.1.1. | Specialist Heat Network design items undertaken during the Construction Design stage shall be undertaken in accordance with:<br><br>1. the specification and performance requirements outlined within the Assessed Technical Design; and<br><br>2. any identified HNTAS Technical Requirements at the Technical Design stage which are applicable to the specialist contractor design item. | | SS-S4-E01 |
| 4.1.2. | Prior to the procurement of equipment, Technical Submittals shall be produced in accordance with the applicable technical standard(s). | TS1 4.6.1<br>TS1 4.6.2<br>TS1 4.6.3<br>TS1 4.9.3<br>TS1 4.13.1<br>TS1 4.17.3 | SS-S4-E13 |
| 4.1.3. | The design of the pressure safety system(s) shall be developed in accordance with the applicable technical standard(s). | TS1 4.6.4 | SS-S4-E11 |
| 4.1.4. | The pressure characteristics of the system shall be documented in accordance with the applicable technical standard(s).<br><br>*Note: it is expected that this assessment is undertaken with consideration for the other Elements present in the Heat Network.* | TS1 4.6.6 | SS-S4-E23 |
| 4.1.5. | The Description of Operation shall be developed to sufficiently communicate the operating procedures for the Substation in accordance with the applicable technical standard(s). | TS1 4.8.1 | SS-S4-E02 |

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 4.1.6. | The Description of Operation shall be supplemented with a points schedule, which shall contain all points (inputs and outputs).<br>Each applicable point shall contain a label, which can be referenced to the associated Installation Schematic and the Description of Operation. | TS1 4.17.2 | SS-S4-E03<br>SS-S4-E15 |
| 4.1.7. | The Resilience Strategy shall be updated throughout the Construction Phase in accordance with the applicable technical standard(s). | TS1 4.9.1<br>TS1 4.9.2<br>TS1 4.9.5 | SS-S4-E23 |
| 4.1.8. | The repair and replacement strategy shall be updated in accordance with the applicable technical standard(s). | TS1 4.9.6<br>TS1 4.15.1 | SS-S4-E23 |
| 4.1.9. | A filling, flushing, and water treatment/conditioning methodology shall be produced in accordance with the applicable technical standard(s). | TS1 4.11.1<br>TS1 4.11.2<br>TS1 4.11.4 | SS-S4-E17 |
| 4.1.10. | The design of the Substation shall include suitable provision of flushing points.<br>This provision shall ensure that no "dead legs" are left un-flushed, and that all sensitive equipment can be bypassed during the flushing process. | | SS-S4-E14<br>SS-S4-E15 |
| 4.1.11. | Water Quality documentation shall be updated in accordance with the applicable technical standard(s). This shall include:<br>• the Water Quality Strategy;<br>• the Water Quality Recording Programme. | TS1 4.11.1<br>TS1 4.11.2 | SS-S4-E23 |
| 4.1.12. | A methodology for pipework pressure testing shall be developed in accordance with the applicable technical standard(s). | TS1 4.14.1 | SS-S4-E18 |
| 4.1.13. | Where remote control and monitoring of the Substation is specified, this shall be coordinated with the Distribution Network installation to ensure that the communication infrastructure can be installed at the same time. | | |

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 4.1.14. | Prior to the installation of the Substation, installation drawings and schematics shall be produced in accordance with the applicable technical standard(s). | TS1 4.17.4 | SS-S4-E14<br>SS-S4-E15 |
| 4.1.15. | Changes to the design of the system which arise during the Construction Phase shall be controlled in accordance with the Technical Change Control Procedure. | | |
| 4.1.16. | Changes shall be documented in accordance with the Technical Change Control Procedure in the Change log. | | SS-S4-E16 |
| 4.1.17. | Agreed changes during the Construction Phase shall be reflected in Installation documentation. This includes drawings, models, specifications, schedules, and Technical Submittals. | | SS-S4-E19 |
| 4.1.18. | Following the installation of the Substation, as-installed drawings and schematics shall be produced in accordance with the applicable technical standard(s).<br>The as-installed drawings and schematics shall be affixed to the wall of each plant room. | TS1 4.17.5<br>TS1 4.17.6 | SS-S4-E21 |
| 4.1.19. | Following the installation and commissioning of the Substation, the Technical Parameters Schedule shall be completed with accurate information and references to relevant documentation. | | SS-S4-E20 |
| 4.1.20. | Substation documentation shall be updated throughout the Construction Phase in accordance with the applicable technical standard(s). | TS1 4.12.4<br>TS1 4.17.1<br>TS1 4.17.4 | SS-S4-E23 |
| 4.1.21. | Prior to handover, written procedures outlining the implementation of the Disaster Recovery Plan shall be provided in accordance with the applicable technical standard(s). | TS1 4.9.5 | SS-S4-E23 |

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 4.1.22. | An O&M manual shall be produced in accordance with the applicable technical standard(s).<br>*Note: it is expected that the O&M manual is produced with consideration for the other Elements present in the Heat Network.* | TS1 4.17.2 | SS-S4-E22 |

*Table 2: Technical Requirements for the Substation at Stage 4: Construction Design*

## 4.2. Performance Monitoring Requirements

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

| Performance Monitoring Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 4.2.1. | Prior to the procurement of equipment, thermal energy meters and other utility meters shall be specified in accordance with the applicable technical standard(s). | TS1 4.12.1<br>MMS 1.1<br>MMS 1.4 | SS-S4-E09<br>SS-S4-E10 |
| 4.2.2. | Prior to the procurement of equipment, the Automatic and Remote Monitoring System (ARMS) shall be specified in accordance with the applicable technical standard(s). | TS1 4.12.2<br>MMS 2.1 | SS-S4-E08 |
| 4.2.3. | The KPI schedule shall be updated throughout the Construction Phase.<br>The KPI schedule shall contain:<br>1. the identified applicable KPIs to be measured and reported by the Metering and Monitoring System;<br>2. the thresholds for each KPI in operation (based on the level of information available at this stage);<br>3. the Monitoring Points required to measure each KPI. | TS1 4.12.4<br>MMS 4.1.12 | SS-S4-E05 |
| 4.2.4. | The Monitoring Points Schedule shall be updated.<br>The Monitoring Points Schedule shall contain:<br>1. the required Monitoring Points to measure KPIs;<br>2. the location of each Monitoring Point (which identifies the applicable Element);<br>3. a unique ID code, which follows a determined naming convention. | TS1 4.12.4<br>MMS 4.1.13 | SS-S4-E06 |

| Performance Monitoring Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 4.2.5. | The Metering and Monitoring Strategy shall be updated throughout the Construction Phase in accordance with the applicable technical standard(s). | TS1 4.12.4 | SS-S4-E04 |

*Table 3: Performance Monitoring Requirements for the Substation at Stage 4: Construction Design*

## 4.3. Key Failures

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

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 4.3.1. | Project-specific information is not used when undertaking specialist design items.<br>For example, the incorrect use of temperatures, pressures, flow rates etc. | Specialist design items not compatible with the network or unsuitable due to different design information being utilised. | SS-S4-E01 |
| 4.3.2. | Equipment specified is not in accordance with the design criteria of the Assessed Technical Design.<br>For example, the equipment specified does not have sufficient temperature/pressure rating for the temperature/pressure profile of the network, a lower pipework grade specified, or the thermal conductivity of the specified insulation differs to the design requirement. | Installed equipment may not be suitable to operate at the design and operating criteria. This may reduce the performance of the Substation, increased risk of KPI thresholds not being achieved and could put equipment at greater risk of premature failure.<br>Lower pipework specification could result in the installed pipework not being suitable for Technical Design characteristics of the wider network, which could increase the risk of premature failure. | SS-S4-E13 |
| 4.3.3. | Material of equipment specified is not compatible with the water treatment strategy.<br>For example, equipment specified contains materials which requires a different pH range to that required by the other specified equipment and/or specified in the water treatment strategy. | Equipment not operating within required water quality parameters, leading to risk of equipment failure and/or poor water quality, risking KPIs not being achieved. | SS-S4-E13 |
| 4.3.4. | Technical Submittal does not contain sufficient project specific or equipment specific design information.<br>Examples of missing information include | Increased risk of equipment procurement that is not in accordance with the Assessed Technical Design. Increased risk that equipment will be commissioned and operated to criteria which differs to | SS-S4-E13 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| | operating temperature/pressures, pressure/temperature ratings, materials of equipment, differential pressure requirement (e.g. valves), maximum/minimum flowrates, design capacity, specific commissioning/operating set points. | the Technical Design requirement, which could lead to KPI thresholds not being achieved. | |
| 4.3.5. | Plate heat exchanger temperature control strategy (e.g. PICV control) outlined with the Description of Operations would result in unstable temperatures. | Unstable performance of the Substation during commissioning and operation. This may result in KPI thresholds not being achieved. | SS-S4-E02 |
| 4.3.6. | Control System points schedule does not contain all required points. | Control System points are not installed and commissioned as the control strategy required, which could result in the Substation not operating as the design required. | SS-S4-E03 |
| 4.3.7. | Metering and Monitoring System is not in line with the Metering and Monitoring Technical Design.<br>Specifically, it does not contain the following:<br>• The required Monitoring Points to measure KPIs<br>• The ability measure, extract, record, and store data at the required frequency<br>• The ability to calculate and report on KPIs | Network specified and installed does not have the ability to measure, extract, record and store the necessary performance data at the required frequency or is unable to calculate the KPIs. Risking the ability to monitor performance and report on KPIs. | SS-S4-E04<br>SS-S4-E05<br>SS-S4-E06<br>SS-S4-E07<br>SS-S4-E08<br>SS-S4-E09<br>SS-S4-E10<br>SS-S4-E12 |
| 4.3.8. | Equipment specified for Monitoring Point (e.g. thermal energy meter, utility meter, sensor) not compatible with ARMS. | ARMS unable to extract data from Monitoring Point, and therefore cannot record and store the necessary data to calculate KPIs. | SS-S4-E08<br>SS-S4-E09 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 4.3.9. | Heat and utility meters sized incorrectly. | Inaccurate measurement of performance data due to incorrect sizing of heat and/or utility meter. | SS-S4-E10 |
| 4.3.10. | Thermal energy meter not correctly specified for heat transfer fluid. | Inaccurate measurement of performance data due to inappropriate specification of thermal energy meter. | SS-S4-E09 |
| 4.3.11. | Changes to the Technical Design are not managed appropriately, resulting in design changes (e.g. equipment specification, pipework routing etc.) that does not conform with the Technical Design intent. | Changes that are not signed-off may negatively impact the performance of the Substation, which could lead to construction of the Heat Network not being in accordance with the design intent, which could risk KPI thresholds not being achieved. | SS-S4-E16<br>SS-S4-E19 |
| 4.3.12. | As-installed schematics and drawings do not accurately reflect the installation. | Inaccurate documentation being used during operation and maintenance, inhibiting the ability to effectively operate, and undertake maintenance and replacement of the Substation over its lifecycle. | SS-S4-E20 |

*Table 4: Key Failures for the Substation at Stage 4: Construction Design*

## 4.4. 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-S4-E01 | Specialist design documentation | Design documentation of specialist design items.<br><br>Contents will be dependent on the design item, but shall include, where applicable, specification, calculations, schematics, and drawings. |
| SS-S4-E02 | Description of Operation | Detailed overview of the network controls strategy.<br><br>Shall detail:<br>• Control strategy for each piece of equipment, with set points where applicable<br>• How equipment will be sequenced, including the points used for sequencing and any further criteria, such as time intervals, that shall be implemented for equipment sequencing.<br>• Equipment changeover schedule<br>• Automated equipment exercising regimes<br>• Anti-stagnation control<br>• Water quality parameter values and sensor details (if applicable)<br>• Remote monitoring login details |
| SS-S4-E03 | Description of Operation points schedule | A points schedule outlining all points that are to be monitored by the Control System (BMS or equivalent) shall be included. Data logging frequency shall be specified for each point<br><br>The nomenclature for each point shall be clear so that each point is distinct. For sensors, each sensor shall be identifiable to its label on-site, on the Control System and on schematics and drawings.<br><br>This shall include:<br>• Meters<br>• Sensors<br>• Faults and alarms<br>• Set points for equipment controlled by the Control System<br>• Enable/disable status |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| | | • Emergency shut off status. |
| SS-S4-E04 | Metering and Monitoring Strategy | The 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.<br>The strategy shall also include:<br>1. KPI Schedule (item SS-S4-E05)<br>2. Monitoring Points Schedule (item SS-S4-E06)<br>3. Monitoring Points unique ID code naming methodology (item SS-S4-E07)<br>4. Schematic with labelled Monitoring Points<br>5. Data flow diagram (item SS-S4-E12)<br>6. ARMS specification (item SS-S4-E08)<br>7. Monitoring Points specification (thermal energy meters, utility meters, sensors) (items SS-S4-E09 & SS-S4-E10) |
| SS-S4-E05 | KPI Schedule | A schedule of all KPIs required to be measured by the Metering and Monitoring System.<br>The KPI schedule shall contain:<br>1. The identified applicable KPIs to be measured and reported by the Metering and Monitoring System<br>2. The thresholds for each KPI in operation (based on the level of information available at this stage)<br>3. The Monitoring Points required to measure each KPI |
| SS-S4-E06 | Monitoring Points Schedule | A schedule of all Monitoring Points required to measure KPIs.<br>The Monitoring Points Schedule shall contain:<br>1. All required Monitoring Points to measure KPIs<br>2. Location of each Monitoring Point (which identifies the applicable Element) |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| | | 3. A unique ID code, which follows a determined naming convention<br>4. Serial number<br>5. Postal address and plot number<br>6. Photographic evidence of point and on-site label<br>7. Communications address for ARMS<br>8. Date commissioned<br>9. Initial reading<br>10. Date of last calibration |
| SS-S4-E07 | Unique ID code naming convention | Methodology used to label each Monitoring Point with a unique ID code. |
| SS-S4-E08 | ARMS Specification | Shall provide description of the intended system operation and the materials, products to be used, standard of work required, performance requirements and the condition of which the work is to be executed. |
| SS-S4-E09 | Monitoring Point Specification | Specification for each type of Monitoring Point (thermal energy meter, utility meter, sensors etc.).<br>Shall provide description of the intended system operation and the materials, products to be used, standard of work required, performance requirements and the condition of which the work is to be executed. |
| SS-S4-E10 | Meter sizing calculations | Shall outline the inputs, methodology and calculations used to size pipework applicable meters. |
| SS-S4-E11 | Pressure safety system specification | Written description of the specification of the pressure safety system.<br>Shall outline:<br>• the items used (e.g. Safety Relief Devices);<br>• setpoints of the items used;<br>• their locations in relation to:<br>  ○ sources of pressure (e.g. heat generation sources, pressurisation equipment);<br>  ○ isolation points. |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| SS-S4-E12 | Data flow diagram(s) | Diagrams illustrating the route of data flow from the Monitoring Point to the ARMS, including hierarchy of Monitoring Points. |
| SS-S4-E13 | Technical submittals | Documentation for all equipment that is intended to be procured.<br>Shall contain the site-specific design information used to inform the equipment selection and required for installation, commissioning and operation of equipment.<br>Shall include a cover page detailing the reviewers' names, revision number, status and date of approval of the technical submittal. |
| SS-S4-E14 | Installation drawings | The installation drawings shall contain information needed by tradespeople on site to install the works and the following:<br>• The precise locations and sizes of all items of equipment and pipework, using specific objects representing actual intended or procured equipment, in positions that have been spatially coordinated between engineering services, architecture and structure.<br>• All supports and fixings required to install the works.<br>• Spatial allowances for installation and commissioning methodologies, and access for maintenance and replacement.<br>Where applicable, any required builders works details and manufacturer drawings shall be produced in accordance with the Technical Design. |
| SS-S4-E15 | Installation schematics | The Installation Schematics shall contain information needed by tradespeople on site to install the works and the following:<br>• All functional, sensing, control and measuring items to be installed. This includes flushing provision, air vents and drainage provision, isolation valves, sensors (pressure, temperature, flow).<br>• All pipework sizes, pressures and flow rates adjusted for any changes during construction.<br>All items shall be labelled with references to schedules. |
| SS-S4-E16 | Change log | Log of all changes to the Technical Design. |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| SS-S4-E17 | Filling, flushing, and water treatment/conditioning methodology | Filling methodology detailing the:<br>• methodology for sampling of mains water;<br>• parameter limits for initial fill water quality;<br>• approximate volume of network to be filled.<br>Flushing methodology detailing:<br>• type of flushing to be carried out (e.g. closed loop or open loop);<br>• methodology for isolating sensitive equipment from the flushing process;<br>• duration network shall be flushed for;<br>• flushing velocity required;<br>• methodology for providing circulation;<br>• methodology for measuring the flushing velocity;<br>• methodology for draining and disposing of contaminated water.<br>Treatment/conditioning methodology detailing the:<br>• method of water treatment/conditioning;<br>• type of chemicals/biocides/inhibitors to be used (if applicable);<br>• duration of treatment/conditioning. |
| SS-S4-E18 | Pressure testing methodology | Methodology detailing how the Substation will be pressure tested. This shall provide detail for all types of pressure test to be carried out. For each type of pressure test, this shall include:<br>• the type of pressure test;<br>• the design pressure;<br>• the test pressure;<br>• the method for achieving the test pressure;<br>• the duration of the pressure test.<br>A methodology for pressure testing of equipment that has been tested by the manufacturer is not required. Confirmation from the manufacturer that the equipment has been pressure tested is acceptable. This shall detail the pressure the equipment has been pressure tested to. |
| SS-S4-E19 | Installation documentation with changes outlined | Updated installation drawings and schematics with changes to the design reflected on the documentation. |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| SS-S4-E20 | Technical Parameters Schedule | Schedule which outlines all technical parameters in one location, with reference to applicable documents. |
| SS-S4-E21 | As-installed drawings and schematics | Final as-built drawings and schematics reflecting the exact installation of the Substation. Any changes made during the installation that deviate from the Installation schematics and drawings shall be reflected. |
| SS-S4-E22 | O&M manual | Documentation containing all relevant information for the operation and maintenance of the system.<br>Shall include contents as set out in TS1 4.17.2. |
| SS-S4-E23 | Updated documentation throughout Construction Phase | Updated revisions of all Substation documentation, including:<br>• Description of Operation - all changes made during the construction phase to the controls philosophy shall be reflected in the updated revision. This typically includes:<br>  ○ Controls set points<br>  ○ Points labelling<br>  ○ Alarms<br>  ○ High/low limits<br>• Control System points schedule<br>• Substation drawings<br>• Substation schematic<br>• System pressure assessment<br>• Resilience Strategy, including:<br>  ○ Disaster Recovery Plan, including written procedures outlining its implementation<br>• Repair and replacement strategy<br>• Water Quality Strategy<br>• Water Quality Recording Programme<br>• Metering and Monitoring Strategy<br>• Monitoring Points Schedule<br>• KPI Schedule<br>• Data flows diagram |

*Table 5: Evidence Requirements for the Substation at Stage 4: Construction Design*

# 5. Requirements for Stage 5: Installation

## 5.1. Technical Requirements

The applicable HNTAS Technical Requirements in Table 6 shall be fulfilled.

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 5.1.1. | The Substation, including the Metering and Monitoring System, shall be installed in accordance with the Assessed Construction Design. | | SS-S5-E01 |
| 5.1.2. | The Substation, including the Metering and Monitoring System, shall be installed in accordance with the applicable technical standard(s). | TS1 5.12.1<br>TS1 5.12.2<br>TS1 5.14.4<br>TS1 5.14.5<br>TS1 5.14.6<br>TS1 5.16.1<br>TS1 5.16.5 | SS-S5-E01 |
| 5.1.3. | Ancillary equipment shall be installed in accordance with the applicable technical standard(s). | TS1 5.15.1 | SS-S5-E01 |
| 5.1.4. | All persons performing installation activities shall have received training and certification. | | |
| 5.1.5. | Quality assurance inspections shall be undertaken and documented throughout each stage of the installation process to confirm that requirements 5.1.1 - 5.1.3 are fulfilled.<br>Photographs (where applicable) shall be clearly presented with no blur. | | SS-S5-E02 |
| 5.1.6. | The Substation shall be filled and treated/conditioned in accordance with the applicable technical standard(s). | TS1 5.11.1<br>TS1 5.11.2<br>TS1 5.11.4<br>TS1 5.11.6<br>TS1 5.11.7 | SS-S5-E05<br>SS-S5-E06 |
| 5.1.7. | Pressure testing of pipework shall be carried out in accordance with the Assessed pressure testing methodology and the applicable technical standard(s). | TS1 5.14.13 | SS-S5-E03<br>SS-S5-E04 |
| 5.1.8. | The Substation shall be flushed in accordance with the applicable technical standard(s). | TS1 5.11.3<br>TS1 5.11.5<br>TS1 5.11.8 | SS-S5-E05<br>SS-S5-E06 |

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 5.1.9. | The risk to water quality posed by stagnation shall be assessed and mitigated in accordance with the applicable technical standard(s). | TS1 5.11.9<br>TS1 5.11.10 | SS-S5-E05<br>SS-S5-E06 |
| 5.1.10. | Substation insulation shall be installed in accordance with the Assessed Construction Design. | | SS-S5-E07 |
| 5.1.11. | Substation insulation shall be installed in accordance with the applicable technical standard(s). | TS1 5.13.1<br>TS1 5.13.2<br>TS1 5.13.3<br>TS1 5.13.4 | SS-S5-E07 |
| 5.1.12. | Substation pipework shall be labelled upon completion of the insulation and cladding installation in accordance with the applicable technical standard(s). | TS1 5.14.10 | SS-S5-E07 |
| 5.1.13. | Quality assurance inspections of the installation of the Substation insulation shall be undertaken and documented prior to cladding or covering by building finishes in accordance with the applicable technical standard(s). | TS1 5.13.5 | SS-S5-E08 |

*Table 6: Technical Requirements for the Substation at Stage 5: Installation*

## 5.2. Performance Monitoring Requirements

The Metering and Monitoring System shall be installed in accordance with the Technical Requirements set out in Section 5.1.

## 5.3. Key Failures

The applicable Key Failures listed in Table 7 shall not be present.

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 5.3.1. | Incorrect plumbing during installation (e.g. plate heat exchangers being plumbed in co-current arrangement, rather than counter-current, thermal stores plumbed in parallel rather than in series). | Network unable to operate as per the design intent, impacting the ability to achieve KPIs.<br>For example, the efficiency of heat transfer could be reduced in a plate heat exchanger. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.2. | Additional bypasses present, or not installed as per design. This includes:<br>1. Low loss headers, fixed/flow-controlled bypass across flow and return, equipment located across flow and return (e.g. dosing pot)<br>2. Permanent/fixed flushing bypasses (as opposed to temporary flushing points) | Bypasses installed that are not required, which could increases return temperatures if the bypasses are left open, which would increase network flow rates and energy consumption. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.3. | Dead legs larger than three pipe diameters installed. | Stagnant areas of water which can increase risk of bacterial growth, reducing the water quality of the Substation and the network. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.4. | Ancillary equipment to aid with commissioning, operation, and maintenance of network (including water quality maintenance) not installed as per the design and specification (e.g. vent and drain provision, strainers, isolation valves, gauges, test points). | Lack of flushing points, isolation, and drainage available during pre-commissioning activities.<br>Lack of maintainability of Heat Network in operation.<br>Air vents not installed at network high points could lead to the formation of air pockets.<br>Drain cocks not installed at network low points which would not allow for safe drainage of the network at its low points. | SS-S5-E01<br>SS-S5-E02 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 5.3.5. | Spatial requirements not allowed for during installation in relation to:<br><br>1. Ensuring sufficient and safe maintenance requirements for all equipment (including ancillary equipment and thermal energy meters)<br><br>2. Ensuring sufficient access and egress routes for maintenance and replacement | Lack of maintainability and ability for replacement of Heat Network in operation.<br><br>Equipment installed at high-level would create a health and safety risk for operators during maintenance activities. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.6. | Incorrect or insufficient equipment and/or pipework support installed. | Premature equipment failure due to insufficient support installed. Pipework creep as a result of unsupported equipment and pipework.<br><br>Increased maintenance requirements due to equipment failure, such as pump bellows. A lack of support on pumps could cause significant vibration and noise. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.7. | Pressurisation unit, expansion provision and/or vacuum degassing unit not installed as per design and/or manufacturers. This includes not providing the required minimum separation distance between connections to the network and using the incorrect connections. | Pressurisation and expansion system, and/or vacuum degasser unit not operating correctly, risking outages and network downtime. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.8. | Pressure testing done incorrectly, or not done at all.<br><br>For example, the pressure reached is lower or higher than the test pressure required. | Increased likelihood of equipment failure due to incorrect pressure testing, or no testing at all. This could result in increased REPEX. | SS-S5-E03<br>SS-S5-E04 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 5.3.9. | Monitoring Points installed in an inaccessible location (e.g. behind ceiling panel/wall without access hatch), or Monitoring Point display located with poor accessibility (at height), preventing safe access, maintenance, and replacement. | Lack of maintainability and ability for replacement of Monitoring Points in operation.<br>Equipment installed at high-level creating a health and safety risk for operators during maintenance activities. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.10. | Monitoring Points not installed, or not installed in the correct location as per the design. | Unable to measure the required performance data due to Monitoring Points not being installed.<br>Where Monitoring Points are installed but not as per the design intent, this could lead to inaccurate data being recorded. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.11. | Monitoring Points not installed correctly, to enable complete accurate readings to be made.<br>For example, temperature sensors not installed correctly, flow sensor installed on incorrect pipework and/or incorrect orientation, manufacturers requirements in relation to proximity to adjacent valves/pipework bends not followed, spool pieces not used during install. | Unable to measure or inaccurate performance data being measured. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.12. | Infrastructure not installed to enable all required Monitoring Points to connect to the ARMS. | ARMS unable to extract data from Monitoring Point, and therefore cannot record and store the necessary data to calculate KPIs. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.13. | Not all required Monitoring Points are connected to the ARMS. | ARMS unable to extract the required data from all Monitoring Points, and therefore cannot record and store the necessary data to calculate KPIs. | SS-S5-E01<br>SS-S5-E02 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 5.3.14. | Sensors not installed as per design (e.g. pressure sensors, temperature sensors, ambient temperature sensors). | Insufficient sensors installed within Substation to enable the hydraulic design and controls intent to work as intended. This could result in unstable flow temperatures and a lack of heat provision to the network due to the missing sensors.<br><br>This would also result in a lack of performance monitoring available in Substation. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.15. | Insulation thickness and/or material not installed as per design specification. | Increased heat losses as a result of the incorrect material or thickness installed. This could result in the network heat losses not meeting the KPI threshold. | SS-S5-E07<br>SS-S5-E08 |
| 5.3.16. | Poor insulation installation workmanship, including:<br><br>1. Missing insulation on pipework/valves/ancillaries<br><br>2. Damaged insulation<br><br>3. Overtightened pipe supports<br><br>4. Vapour seal not complete<br><br>5. Incorrect bore size of insulation | Increased heat losses as a result of poor installation. This could result in the network heat losses not meeting the KPI threshold. | SS-S5-E07<br>SS-S5-E08 |
| 5.3.17. | Inappropriate installation of pipe supports:<br><br>1. Direct pipe supports installed, and when installed, BS 5970 (BSI, 2012) "non-preferred option" for pipe hanger insulation not followed | Use of incorrect pipework supports, or not using pipework supports at all could result in, for example, elevated heat losses and or pipework creep over time. | SS-S5-E07<br>SS-S5-E08 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| | 2. Incorrect material installed<br><br>3. Non-pre insulated pipe supports installed<br><br>4. Incorrect spacing of pipe supports<br><br>5. Standard density of insulation used as pipe support | | |
| 5.3.18. | Poor coordination of pipework meaning that the design insulation specification cannot be installed. | Increased heat losses from areas where insulation thickness has been reduced. Insulation becoming damaged as a result of poor installation could result in an inconsistent vapour seal. This could result in the heat losses not meeting the KPI threshold. | SS-S5-E01<br>SS-S5-E02 |
| 5.3.19. | Protective cladding not installed on insulation. | Damage to insulation during maintenance activities. This could increase heat losses from the network, and result in the heat losses not achieving the KPI threshold. | SS-S5-E07<br>SS-S5-E08 |
| 5.3.20. | Substation floor not, or incorrectly, painted and sealed. | Excessive dust build up at major equipment such as pumps. This could void warranties due to the presence of dust and may result in premature equipment failure. | SS-S5-E01<br>SS-S5-E02 |

*Table 7: Key Failures for the Substation at Stage 5: Installation*

## 5.4. Evidence Requirements

The applicable Evidence Items listed in Table 8 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-S5-E01 | Installation offered for inspection | The installation shall be offered following completion of the install for an inspection. |
| SS-S5-E02 | Quality assurance inspection records | Shall include inspection records, photographs of the installed Substation, a snagging log with remedial actions undertaken to fix these, justification for non-compliances with requirements.<br>Photographs shall be presented clearly with no blur. Where equipment has been installed, close-up photographs shall be provided of the installation. Where equipment has a visible setting or set point, photographs shall ensure that this setting is clearly visible. |
| SS-S5-E03 | Pressure testing activities offered for witnessing | The pressure testing activities shall be offered for on-site witnessing. |
| SS-S5-E04 | Pressure testing certification | Certification for each pressure test shall be provided, which provides, as a minimum:<br>• the type of pressure test;<br>• the date of test;<br>• the design pressure;<br>• the test pressure;<br>• the time the test commenced;<br>• the time the test pressure was reached;<br>• the duration held at test pressure;<br>• the name of the operative performing the test;<br>• the pressure gauge calibration certificate. |
| SS-S5-E05 | Water treatment/conditioning activities offered for witnessing | The water treatment/conditioning activities shall be offered for on-site witnessing. |
| SS-S5-E06 | Water treatment records | Records for the filling, flushing, and sampling of the network shall be provided. This shall include:<br>Filling: Date system was filled, number of fill water samples, location of fill water samples, value of each fill water parameter. |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| | | Flushing: type of flushing, date of flushing, equipment isolated or removed from the network during flushing, time flushing was commenced, duration network was flushed for, required flushing velocity, flushing velocity reached, method of velocity measurement, flushing circulation methodology, confirmation that contaminated water was drained and disposed of correctly.<br><br>Treatment/conditioning: type, date and duration of activities, type of chemicals/biocides/inhibitors used (if applicable).<br><br>Sampling: Date samples were taken, type of samples taken, number of samples taken, location of samples taken, value of each parameter of sampled water. |
| SS-S5-E07 | Installation of insulation offered for inspection | The installation of the insulation in a Substation shall be offered to the Assessor for an inspection following completion of the install. |
| SS-S5-E08 | Quality assurance inspection records (insulation installation) | Shall include inspection records, photographs of the installed Substation, a snagging log with remedial actions undertaken to fix these, justification for non-compliances with requirements.<br><br>Photographs shall be presented clearly with no blur. |

*Table 8: Evidence Requirements for the Substation at Stage 5: Installation*

# 6. Requirements for Stage 6: Commissioning

## 6.1. Technical Requirements

The applicable HNTAS Technical Requirements in Table 9 shall be fulfilled.

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 6.1.1. | A commissioning plan shall be produced with appropriate coordination with the other Elements present in the Heat Network in accordance with:<br>• the commissioning plan produced during the Construction Design Stage; and<br>• the applicable technical standard(s). | TS1 6.17.2<br>TS1 6.17.4<br>TS1 6.17.5 | SS-S6-E01 |
| 6.1.2. | Commissioning methodologies for the Substation, including the Metering and Monitoring System, shall be developed in accordance with the applicable technical standard(s). These shall include commissioning methodologies for all equipment that requires commissioning. | TS1 6.8.1<br>TS1 6.8.2<br>TS1 6.8.4<br>TS1 6.12.5<br>TS1 6.17.1<br>TS1 6.17.2 | SS-S6-E02 |
| 6.1.3. | Pre-commissioning activities shall be completed on the Distribution Network that will provide heat to the Substation prior to commissioning of the Substation commencing.<br>Pre-commissioning activities shall include:<br>• filling;<br>• pressure testing; and<br>• flushing; and<br>• pre-commissioning cleaning. | | SS-S6-E05 |
| 6.1.4. | The Distribution Network which provides heat to the Substation shall be capable of providing the required flow temperature and differential pressure at the Substation intake at a stable level prior to commencing the commissioning of the Substation. | | SS-S6-E05 |

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 6.1.5. | The Substation, including the Metering and Monitoring System, shall be commissioned in accordance with the commissioning methodologies and the applicable technical standard(s).<br>The commissioning shall allow the Substation to operate within acceptable thresholds for all applicable KPIs. | TS1 6.8.1<br>TS1 6.8.2<br>TS1 6.8.4<br>TS1 6.8.5<br>TS1 6.8.6<br>TS1 6.8.13<br>TS1 6.12.5 | SS-S6-E0<br>SS-S6-E07 |
| 6.1.6. | The control system shall be checked to ensure that sensors are working correctly in accordance with the applicable technical standard(s). | TS1 6.8.3<br>TS1 6.12.3 | SS-S6-E08<br>SS-S6-E09<br>SS-S6-E10 |
| 6.1.7. | Water quality parameters shall be recorded after pre-commission cleaning activities via:<br>• sampling; and<br>• continuous monitoring where applicable for the system,<br>prior to practical completion in accordance with the applicable technical standard(s). | TS1 6.11.1<br>TS1 6.11.3<br>TS1 6.11.4 | SS-S6-E03 |
| 6.1.8. | Water quality KPIs shall be maintained within acceptable limits in accordance with the applicable technical standard(s). | TS1 6.11.2 | SS-S6-E04 |
| 6.1.9. | Prior to Acceptance Testing, a methodology and criteria shall be produced in accordance with the applicable technical standard(s). | TS1 6.8.15 | SS-S6-E11 |

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 6.1.10. | Pre-testing shall be carried out prior to the Acceptance Test. The aim of pre-testing is to carry out trial Acceptance Tests to identify any performance problems with the Substation operation that would result in non-conformance with the applicable technical standard(s).<br><br>Where issues are identified during pre-testing, these shall be resolved and recorded in a failure log.<br><br>A pre-testing report shall be produced, containing the failure log, which demonstrates the performance of the Substation achieves the required criteria as outlined within the [HNTAS Acceptance Testing Standard]. | TS1 6.8.1<br>TS1 6.8.4<br>TS1 6.8.5<br>TS1 6.8.7<br>TS1 6.8.9<br>TS1 6.8.10<br>TS1 6.8.16 | SS-S6-E12 |
| 6.1.11. | Acceptance Testing of the Substation shall be undertaken in accordance with the applicable technical standard(s) to demonstrate that the Substation operates in accordance with its design intent, Description of Operation, and acceptable thresholds for all applicable KPIs. | TS1 6.8.1<br>TS1 6.8.4<br>TS1 6.8.7<br>TS1 6.8.8<br>TS1 6.8.9<br>TS1 6.8.10<br>TS1 6.8.16 | SS-S6-E13 |
| 6.1.12. | After the Acceptance Test, performance data shall be provided to demonstrate the performance during the Acceptance Test. The data shall be in its raw form as a minimum, and in a usable format (e.g. .csv, .xlsx). | | SS-S6-E14 |

| Technical Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 6.1.13. | As new phases of a Heat Network are brought become operational, an assessment shall be carried out to determine if a full Acceptance Test is necessary to confirm that the system can operate in all modes of operation with the additional heat demands of the new phase.<br><br>An additional Acceptance Test might be necessary if the heat demand of new phase is significant compared to the heat demand that the Substation has been tested and certified. Where this is necessary, requirements 6.1.9 - 6.1.12 shall be met.<br><br>If a full Acceptance Test is not required, it shall be demonstrated that the distribution pumps can meet the minimum differential pressure requirement at the index point(s) of the system. | TS1 6.8.10<br>TS1 6.8.11 | SS-S6-E1<br><br>*As necessary:*<br>SS-S6-E11<br>SS-S6-E12<br>SS-S6-E13<br>SS-S6-E14 |
| 6.1.14. | The condition of equipment and pipework shall be determined, and remedial actions undertaken where necessary, in accordance with the applicable technical standard(s). | TS1 6.16.1<br>TS1 6.16.2<br>TS1 6.16.3<br>TS1 6.16.4<br>TS1 6.16.5<br>TS1 6.16.6 | SS-S6-E16 |
| 6.1.15. | The handover procedures shall be followed in accordance with the applicable technical standard(s). | TS1 6.17.8<br>TS1 6.17.9<br>TS1 6.17.10 | SS-S6-E19 |

*Table 9: Technical Requirements for the Substation at Stage 6: Commissioning*

## 6.2. Performance Monitoring Requirements

The applicable Performance Monitoring Requirements in Table 10 shall be fulfilled.

| Performance Monitoring Requirement | | Applicable technical standard(s) | Evidence Requirement(s) |
|---|---|---|---|
| 6.2.1. | Monitoring Points shall be clearly labelled with references in accordance with the applicable technical standard(s) and that match the Monitoring Points Schedule and KPI Schedule. | TS1 4.12.1<br>TS1 4.12.4<br>MMS 4.1.13 | SS-S6-E17 |
| 6.2.2. | Commissioning checks shall be carried out on all Monitoring Points in accordance with the applicable technical standard(s).<br>The check shall also to ensure that all data required to enable KPIs to be calculated and reported during Acceptance Testing is available on the ARMS before Acceptance Testing and what is being recorded at the Monitoring Point is being correctly reported to the ARMS.<br>The checks shall ensure that:<br>• the data required for all applicable KPIs to be calculated and reported during Acceptance Testing is available on the ARMS prior to Acceptance Testing; and<br>• measurements taken at each Monitoring Point are correctly extracted, recorded, transformed, and reported by the ARMS. | TS1 4.12.2<br>TS1 6.8.14<br>TS1 6.12.1<br>TS1 6.12.2 | SS-S6-E18 |

*Table 10: Performance Monitoring Requirements for the Substation at Stage 6: Commissioning*

## 6.3. Key Failures

The applicable Key Failures listed in Table 11 shall not be present.

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 6.3.1. | Failure to develop realistic commissioning plan which allows sufficient time for commissioning and/or failure to appoint personnel to carry out commissioning. | Insufficient time to carry out commissioning of the Substation and lack of competent persons to commission equipment, which could lead to the Substation not performing as the design intended and KPIs not being achieved. | SS-S6-E01 |
| 6.3.2. | Pressure mitigation measures not commissioned properly (e.g. high pressure shut offs not set correctly, pump speed limits not implemented). | This can result in maximum differential pressure or pressure rating of equipment being exceeded, risking equipment failure & void warranties. May also present health and safety risk to operatives. | SS-S6-E05<br>SS-S6-E0<br>SS-S6-E14 |
| 6.3.3. | Commissioning not in line with design specification (e.g. PHE outlet temperature not commissioned to design set point, pumps commissioned to fixed flow). | Substation, equipment and network not performing as per design intent. This can result in void warranties and KPI thresholds not being achieved (e.g. high PHE outlet temperature increasing heat losses, excessive parasitic (pump) energy). | SS-S6-E05<br>SS-S6-E0<br>SS-S6-E14 |
| 6.3.4. | Pressurisation unit not commissioned in-line with the design requirements (for example, incorrect set point). | Set point lower than design criteria can result in air ingress into the network, which can impact water quality and the performance of equipment. A set point higher than design criteria can cause high operating pressures, risking equipment pressure ratings and causing health and safety risks. | SS-S6-E05<br>SS-S6-E0<br>SS-S6-E14 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 6.3.5. | Controls not implemented as per Description of Operations, implemented poorly and/or not optimised during the commissioning stage (e.g. network pump control strategy not implemented properly, shunt pump flowrate set excessively, three port valves not tuned correctly to design parameters). | Substation not operating as per design intent. Examples include reduced network efficiency due to high return temperatures and increased parasitic energy consumption due to increased network flow rates. | SS-S6-E14 |
| 6.3.6. | Commissioning that requires optimisation during the commissioning phase not optimised to meet the Description of Operations (e.g. PICV valves not tuned correctly to design parameters, heat generation sequencing time intervals not optimised). | Substation not operating as per design intent. This could, for example, lead to reductions in flow temperature due to heat generation equipment not being enabled when it is needed, or equipment cycling when they enable and disable too quickly. | SS-S6-E14 |
| 6.3.7. | Not all required Monitoring Points are connected to the ARMS. | ARMS unable to extract the required data from all Monitoring Points, and therefore cannot record and store the necessary data to calculate KPIs. | SS-S6-E0<br>SS-S6-E07<br>SS-S6-E08 |
| 6.3.8. | 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-S6-E18 |
| 6.3.9. | Incorrectly allocated meters (serial number of meter is allocated to the wrong meter). | Incorrectly allocated data to meter, resulting in inaccurate representation of Monitoring Point. | SS-S6-E17 |
| 6.3.10. | 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-S6-E18 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 6.3.11. | 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-S6-E18 |
| 6.3.12. | ARMS not operational and connected to all required Monitoring Points prior to acceptance test. | Unable to measure, extract, record, and store data during acceptance test, which prevents being able to calculate KPIs to demonstrate acceptable performance prior to handover to achieve Certification. | SS-S6-E18 |
| 6.3.13. | Insufficient testing and demonstration of Substation operation prior to handover (including proving alarms/fault integration and emergency features with BMS). | Substation not operating as per design intent. Safety risk due to alarms and shut offs not tested. | SS-S6-E10<br>SS-S6-E11<br>SS-S6-E13 |
| 6.3.14. | Substation performance not tested in all modes of operation. | Performance issues during network operation.<br>For example, unstable flow temperatures during transition of heat demand, which could reduce the reliability of the Substation and result in KPIs not being achieved. | SS-S6-E10<br>SS-S6-E11<br>SS-S6-E13 |
| 6.3.15. | Poor water quality management during construction phase (lack of sampling, analysis and issue identification and rectification). | This can result in, for example, reduced equipment efficiency due to poor water quality, increased equipment failure rate due to poor water quality and increased maintenance requirement due to poor water quality. | SS-S6-E03<br>SS-S6-E04 |
| 6.3.16. | Substation not fully circulated during long construction phases. | Poor water quality due to lack of circulation in Substation and increased risk of bacteria growth due to stagnant water. | SS-S6-E03<br>SS-S6-E04 |

| Key Failure | | Outcome to avoid | Evidence Requirement(s) |
|---|---|---|---|
| 6.3.17. | Insufficient and/or incorrect O&M documentation and handover to system operator (e.g. inaccurate as-built drawings, inaccurate setpoints on Description of Operation, missing information from O&M manual). | Unclear system requirements to O&M contractor. System maintenance not carried out in accordance with system requirements. | SS-S6-E19 |
| 6.3.18. | Metering and Monitoring System documentation not included within the O&M manual. This includes all design documentation, updated to reflect any changes during construction. These are Metering and Monitoring Strategy, KPI schedule, Monitoring Point schedule, schematics, data flow diagrams. | Difficulty in understanding installed Metering and Monitoring System for future O&M operatives, risking the ability to be able to accurately measure performance and report on KPIs. | SS-S6-E18<br>SS-S6-E19 |

*Table 11: Key Failures for the Substation at Stage 6: Commissioning*

## 6.4. Evidence Requirements

The applicable Evidence Items listed in Table 12 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-S6-E01 | Commissioning plan | A document outlining the intended plan and programme for commissioning of the Substation.<br>This shall include the critical path for commissioning of the Substation.<br>Where updates are made to the programme, the updated commissioning plan shall be made available.<br>*Note the commissioning plan may be a wider Heat Network commissioning plan that contains multiple Elements.* |
| SS-S6-E02 | Commissioning methodology | Methodology for the commissioning of equipment that requires commissioning procedures.<br>Methodology shall include all specific criteria that the equipment is to be commissioned to. This shall include, for example, temperature, pressure and/or flow rate set points for equipment. |
| SS-S6-E03 | Water quality sampling schedule | A schedule outlining the intended dates that samples shall be taken for monitoring the water quality of the Substation and network it shall provide heat to.<br>*This may be provided as part of the Water Quality Recording Programme for the system.* |
| SS-S6-E04 | Water quality sample results | Results shall be provided for all water quality samples taken, clearly outlining the sample location for each set of results.<br>Results shall also be provided to show the trends for each water quality parameter over time. This shall be in a format where the trend and minimum/maximum limits (where applicable) can be identified (e.g. graphical format). |
| SS-S6-E05 | Distribution Network commissioning records | Evidence demonstrating that Distribution Network pre-commissioning activities have been undertaken. This shall include:<br>• Pressure testing<br>• Flushing<br>Evidence demonstrating that the temperature and differential pressure at the Substation intake are achieving design criteria. |
| SS-S6-E06 | Substation equipment | Commissioning certificates for any equipment that requires a commissioning procedure. |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| | commissioning certificates | This shall outline the required design criteria for the equipment that requires commissioning and the final commissioned value for each criteria. |
| SS-S6-E07 | Substation equipment commissioning activities offered for witnessing (e.g. heat pump commissioning) | Commissioning activities for the Substation shall be offered for on-site witnessing. |
| SS-S6-E08 | Control System points schedule | A schedule outlining all points that are to be monitored by the Control System.<br>The nomenclature for each point shall be clear so that each point is readily identifiable.<br>This shall include meters, sensors, faults and alarms, set points for equipment controlled by the Control System, emergency shut off status. |
| SS-S6-E09 | Control System commissioning and points check record sheet | A document containing a register of all Control System points which details the status of each point following a test to demonstrate the functionality of each point. |
| SS-S6-E10 | Control System points check offered for witnessing | The Control System points check shall be offered for on-site witnessing. |
| SS-S6-E11 | Acceptance testing methodology | Methodology outlining the intended procedure for demonstrating the Substation performance and criteria for achieving performance. |
| SS-S6-E12 | Pre-testing report | A report following completion of pre-testing shall be provided.<br>This shall demonstrate the performance of the Substation is acceptable for Acceptance Testing to be undertaken.<br>The report shall contain a failure log of any issues identified and resolved during pre-testing. |
| SS-S6-E13 | Acceptance Test offered for witnessing | The Substation Acceptance Test shall be offered for on-site witnessing. |
| SS-S6-E14 | Acceptance Test data | Performance data required to demonstrate fulfilment with the requirements of the Acceptance Test shall be provided for the entire duration of the Substation Acceptance Test.<br>For example, this includes:<br>• Temperature sensors<br>• Pressure sensors |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| | | • Control valve positions<br>• Alarms<br>• Equipment enable signals<br>• Thermal energy meter readings, including:<br>  ○ Flow temperature<br>  ○ Return temperature<br>  ○ Power<br>  ○ Flow rate<br>  ○ Utility meter consumption<br>Data shall be provided in both its raw format as minimum. This shall be provided electronically in a useable file type (e.g. .csv, .xlsx). |
| SS-S6-E15 | *As necessary:*<br>Written justification as to whether an additional Acceptance Test is required, or whether previous test certificate is sufficient | Evidence of written justification outlining if an additional Substation Acceptance Test is required shall be provided.<br>This justification is required when the expected peak demand for a Substation is increased due to a network expansion. |
| SS-S6-E16 | Condition Log | To include all basic asset data and condition data for all Heat Network equipment within the Substation, including:<br>• asset name;<br>• asset ID;<br>• asset classification code;<br>• asset classification description;<br>• asset criticality;<br>• asset maintainer;<br>• asset location;<br>• asset install date;<br>• asset condition grade;<br>• asset priority grade;<br>• whether asset is beyond economic repair;<br>• asset operational status;<br>• date of last condition survey; and<br>• remaining life expectancy (years). |

| Evidence Item | | Detailed description and requirements |
|---|---|---|
| SS-S6-E17 | Photographic evidence of labelled Monitoring Points | Photographic evidence shall be provided for each labelled Monitoring Point within the Substation.<br>The photograph shall clearly show the on-site labelling which corresponds to the as-built Substation schematics and layout drawings. |
| SS-S6-E18 | Monitoring Points Commissioning Record Sheet | Commissioning record evidencing check of each Monitoring Point. |
| SS-S6-E19 | Evidence demonstrating Operator handover sign-off | Written sign-off from the organisation responsible for carrying out operation and maintenance activities that they accept that all handover procedures meet HNTAS requirements and that they accept responsibility for the operation and maintenance of the Substation going forward. |

*Table 12: Evidence Requirements for the Substation at Stage 6: Commissioning*