WARMTENET MUIDERBERG

Overall project description

17th of march

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Prepared for:

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Abbreviation	Description
ATES/WKO	Seasonal Thermal Energy Storage
NDT	Non-Destructive-Test
SCADA	Supervisory Control and Data Acquisition
TEO	Aquathermal Energy Extraction / Thermal Energy extraction from Surface Water
TTES	Tank Thermal Energy Storage

1 General information

This document describes the overall project framework for the Muiderberg District Heating Project and defines the division of works into separate contracts, including scope boundaries, interfaces, and responsibilities between the involved parties.

The project concerns the establishment of a new district heating production facility in Muiderberg, the Netherlands. The installation is designed to supply approximately 1,200 consumers and will be based on large-scale heat pump technology combined with aquathermal energy extraction and seasonal thermal energy storage by means of an ATES/WKO.

The works are structured into separate procurement lots as described in the Tender Conditions (Document 0.3). This document provides the overarching technical and contractual context within which those lots are executed.

Warmtebedrijf Muiderberg B.V. is the Client and future owner of the district heating system. Upon completion and handover, the Client will assume operational responsibility for the installation.

Detailed technical requirements, performance specifications, and contractual conditions are provided in the Special Requirement Specifications and associated tender documents of which some will only be uploaded for Phase 2 of the tendering.

1.1 Executive Summary

The Muiderberg District Heating Project comprises the design and construction of a new heating production facility (Lots A, B & C) and its integration with the district heating network serving the town of Muiderberg.

The primary heat source is aquathermal energy extracted from the lake IJmeer. The system includes heat pumps, auxiliary peak and backup capacity, and thermal energy storage. The production facility must be capable of covering an estimated annual heat demand of approximately 16–17 GWh, including distribution losses.

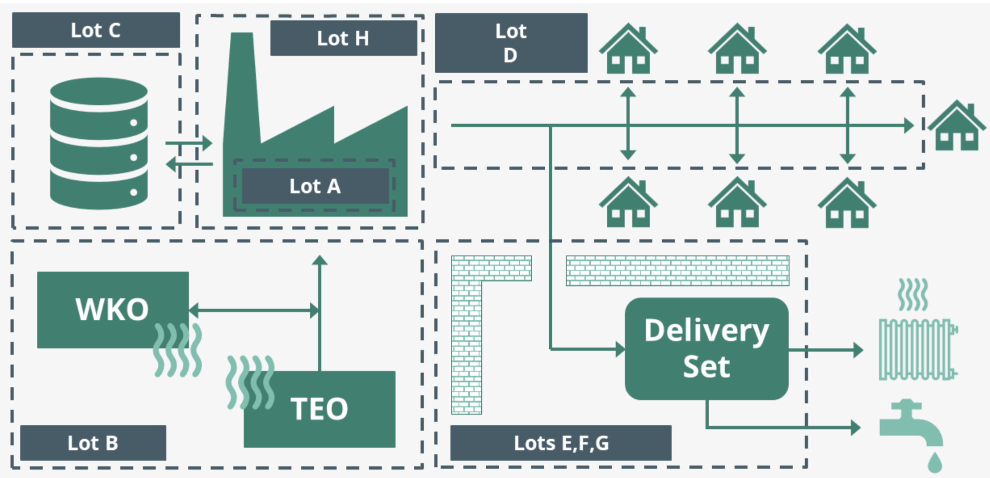

Figure 1Demarcation between the Lots

The installation shall be designed for reliable year-round operation under varying seasonal conditions. Particular attention must be given to system integration between the Heating Central, WKO/TEO systems, and Tank Thermal Energy Storage (TTES) installation, as these are procured under separate contracts.

Clear interface management, defined demarcations, and coordinated commissioning procedures are essential to ensure overall system performance. Each contractor remains responsible for its own scope, including compliance with applicable regulations, performance guarantees, and integration obligations as defined in the tender documentation.

1.2 Project Timeline and Milestones

Phase Descriptions

Contract Award (Q3 2026): Contract execution, mobilization activities, and preliminary coordination meetings between contractors, the Client, and regulatory authorities.

Permits & Approvals (2026-2027): Submission and processing of building permits, environmental approvals, and utility connection authorisations. This phase runs concurrently with detailed design.

Detailed Design (2027): Development of complete construction documentation, finalisation of equipment selections, and regulatory submissions. Design must be completed and approved before major procurement activities commence.

Construction & Installation (2028-2029): Site preparation, equipment delivery, mechanical and electrical installation, and system integration. This represents the most resource-intensive phase of the project.

Commissioning & Handover (Late 2029/Early 2030): System testing, performance verification, operator training, and final documentation delivery culminating in project handover to the client.

Service & Maintenance Period (2030–2035, with optional extension to 2040): Following commissioning and handover, the contractor shall provide scheduled service and preventive maintenance of the installed systems for a period of five (5) years. The scope includes periodic inspections, component servicing, warranty-related corrective actions, and system performance monitoring as required under the contract. This phase *does not include daily operational activities*, which remain the responsibility of the Client. The Client reserves the right to extend the service and maintenance agreement for an additional period of up to five (5) years under the same contractual framework.

1.3 Project Context and Strategic Importance

The Muiderberg District Heating Project supports the transition from individual natural gas-based heating systems to a collective, predominantly renewable heat supply. Upon completion, approximately 1,200 consumers will be connected to a centralised heating system designed to deliver reliable and long-term heat supply with a high share of renewable energy.

The technical concept combines aquathermal energy extraction from the IJmeer, seasonal aquifer thermal energy storage (WKO), and short-term TTES. This integrated configuration is designed to maximise renewable heat utilisation while ensuring operational stability across seasonal variations. The target renewable energy fraction is approximately 96%, reducing dependence on fossil fuels and associated emissions.

The heating production facility is designed not only as technical infrastructure but also as a visible part of the community. The architectural concept includes transparent elements and designated space for public information, providing insight into the functioning of the district heating system and the technologies applied.

From an economic perspective, a collective heating system offers long-term cost predictability compared to individual gas-based heating systems, particularly in the context of fluctuating fuel prices and evolving carbon regulation. Municipal ownership of the system supports alignment with local long-term interests.

PROJECT BENEFITS

- *HIGH SUPPLY SECURITY AND PROTECTION FROM MARKET VOLATILITY*
- *RESIDENT INVOLVEMENT IN DEVELOPMENT AND POLICY*
- *POSITIVE, TRANSPARENT, AND AFFORDABLE BUSINESS CASE*
- *FLEXIBLE SOLUTION IN BOTH DESIGN AND IMPLEMENTATION*
- *CO_2-NEUTRAL, SUSTAINABLE, AND SAFE ENERGY SUPPLY*

The project structure, divided into specialised lots, enables participation of experienced contractors within the Dutch heating and energy sector while ensuring allocation of responsibility according to technical expertise.

Operational performance will be monitored systematically to verify design assumptions, optimise operation, and support knowledge transfer to future district heating developments.

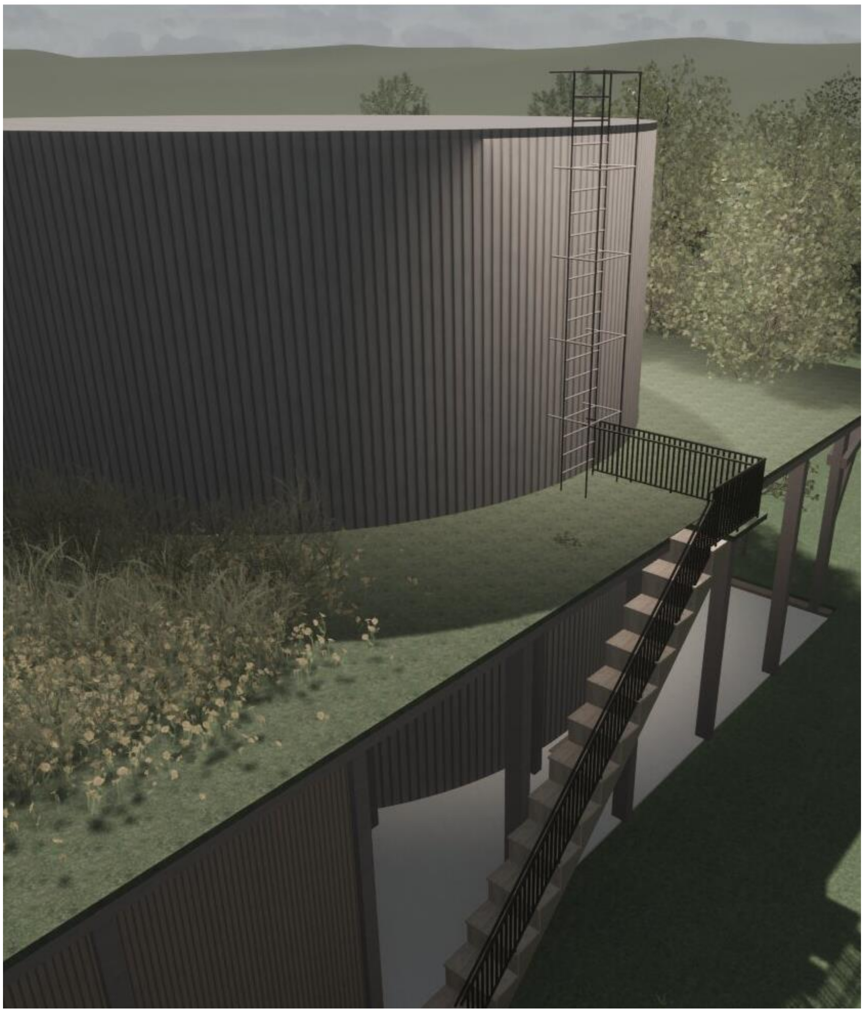

Figure 2 Design concept

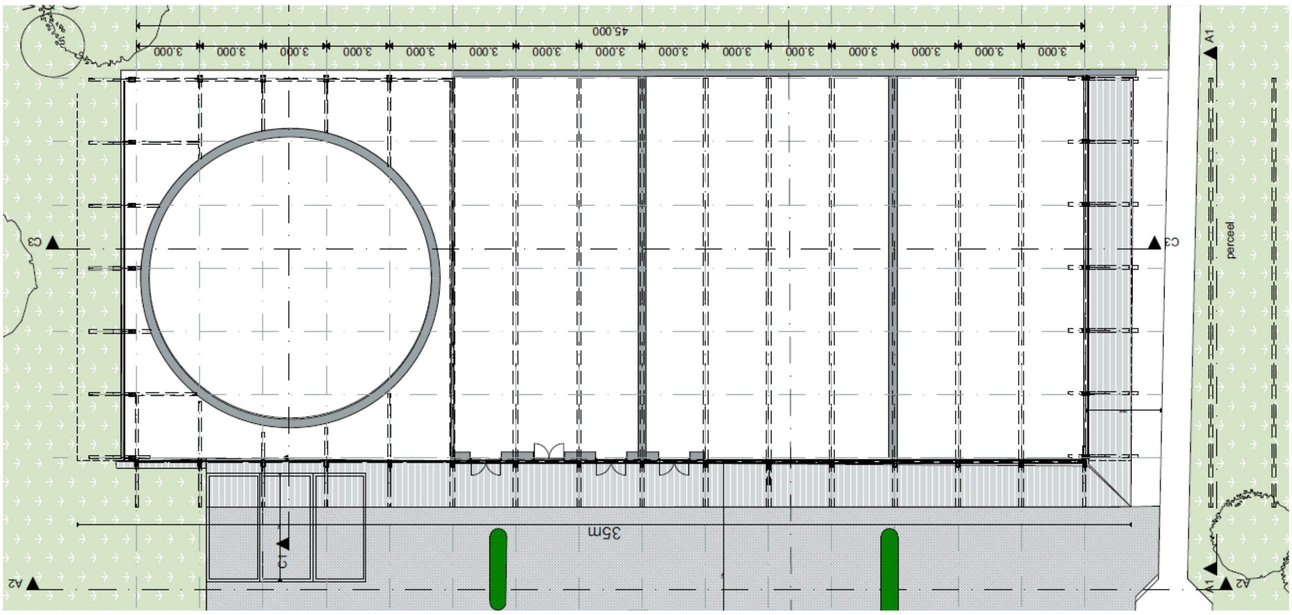

Figure 3 preliminary siteplan

1.4 Sustainability and Efficiency Objectives

1.4.1 Renewable Energy Integration

The system's design prioritizes renewable energy, with the 4 MW heat pump expected to supply approximately 92-96% of annual heat demand. By utilizing the IJmeer lake as a renewable heat source and incorporating seasonal thermal storage through ATES, the Muiderberg system will reduce carbon emissions compared to individual gas boilers.

The remaining 4-8% of heat demand is met by the gas-fired backup boiler (8 MW approx.), primarily during winter peak periods. As the Dutch energy transition progresses and renewable gas options (biogas, hydrogen) become available, this residual fossil fuel dependency can be further reduced or eliminated.

1.4.2 Efficiency Measures

Multiple design elements optimize system efficiency: pre-insulated distribution pipes minimize thermal losses; the approx. 1500 m^3 TTES enables heat pump operation at optimal efficiency points; ATES seasonal storage improves average heat pump performance; and smart control systems continuously optimize equipment dispatch and operating parameters.

The estimated 16–17 GWh heat demand figure includes realistic distribution losses, ensuring that pipe sizing, insulation specifications, and system design properly account for real-world thermal performance rather than idealised conditions.

1.5 Organization

Warmtenet Muiderberg B.V. is the developer and contracting entity for the Muiderberg District Heating Project.

Warmtenet Muiderberg B.V. is responsible for fulfilling all contractual obligations towards the contractors under the respective agreements.

Client	Technical Advisor to the Client
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1.6 Project Lot Structure and Procurement

The Muiderberg District Heating Project comprises multiple technical work packages. Only part of these are included in the present procurement procedure.

The interface and delivery responsibilities between Lots A–C and the parallel works lot D and H are defined in the Demarcation Document.

1.6.1 Procurement Lots (subject of this tender)

The following contracts are included in this procurement:

A. Heating Central (Main Lot)

Aprroximately 4 MW heat pump installation, 8 MW gas boiler, internal hydraulics, water treatment, SCADA system, and all associated mechanical and electrical installations within the heating central.

B. WKO/ATES and Surface Extraction (TEO)

Aquifer thermal energy storage system, well drilling, surface water extraction infrastructure from the IJmeer, pumping systems, heat exchangers, and control integration with the heating central.

C. Approx. 1,500 m³ Tank Thermal Energy Storage (TTES)

- Design, fabrication, delivery, and installation of the 1,500 m³ TTES system, including insulation, structural integration, and hydraulic connection to the heating central.

1.6.2 Parallel Works (Not included in this tender)

The following works are executed under separate contracts and are not part of Lot A–C:

Heat Grid Distribution Network (Lot D)

Heating Central Building (Lot H)

Consumer Connections and Heat Interface Units (Lot E, F,G)

D: Heat Grid Distribution Network

11.2 km of pre-insulated primary distribution pipework throughout Muiderberg, including installation, pressure testing, and commissioning. This lot falls under municipal responsibility.

H: Heating Central Building

Architectural design and construction of the exhibition building with glass facade, structural accommodation for TTES, mechanical system housing, and public exhibition spaces. Under separate architect responsibility.

E,F,G :Consumer Connections and Heat Interface Units

Individual consumer connections and in-home heat interface units enabling metering and heat delivery to approximately 1,200 consumers. To be procured and installed in later project phase.

2 Project Demarcations

The Muiderberg District Heating Project involves the construction of a new heating central, the development of an ATES/WKO system, the installation of a TEO lake water extraction and return system, and the construction of a 1,500 m^3 TTES. Each delivered under separate procurement lots. Successful delivery requires clear leadership and structured coordination to ensure that all systems integrate seamlessly into a fully functional district heating production system. **The Heating Central (Lot A)** constitutes the primary integration hub and is assigned the overall coordination responsibility across all lots. Lot A is specifically responsible for the complete internal system integration within the heating central building, ensuring that all subsystems from Lots B and C connect and operate coherently.

The Contractor for Lot A has the overall coordination responsibility and shall lead and coordinate all physical and functional interface points with the WKO/TEO Contractor (Lot B) and the TTES Contractor (Lot C). This includes coordinating interfaces with third-party suppliers responsible for district heating distribution connections, electrical supply, natural gas service, water supply, drainage systems, and communication networks. **Lot A shall ensure compatible system designs, correct technical interfaces, aligned installation schedules, and full functional integration of all equipment and control systems inside the new heating central building.**

Interface management shall include both physical and operational interfaces. Physical interfaces comprise structural accommodations for the TTES connections within the new heating central, building penetrations for pipework that maintain airtightness and moisture protection, integration of ATES wells and TEO pipework into the internal hydraulic system, and connection of the district heating network to the main headers, including all required metering, isolation, and safety components. Operational interfaces include SCADA communication pathways, data structures, cybersecurity requirements, and coordinated control logic. **Lot A is responsible for integrating all subsystem data, ATES well monitoring, TEO intake/return sensors, TTES stratification instrumentation, distribution network temperature and pressure inputs, into the central SCADA/SRO platform.**

To ensure long-term operational stability, all contractors shall support hydraulic modelling and system simulations covering all components across the three lots. These simulations shall verify that required flow, pressure, and temperature conditions can be achieved under all expected operating scenarios. Early identification of imbalances, constraints, or control conflicts is essential and shall be resolved before construction begins; **Lot A shall lead this process and coordinate resolution with Lots B and C.**

Regular interface coordination meetings shall be conducted throughout the design, construction, and commissioning phases, led by the Lot A Contractor. Factory acceptance tests, on-site integration tests, and staged commissioning activities shall validate that all interface points perform in accordance with the technical specifications and applicable regulations.

Effective, Lot A–led interface management across the Heating Central, WKO/TEO, and TTES lots is a critical success factor for the Muiderberg project. Only through coordinated design leadership, aligned communication standards, and robust cross-system integration testing can the installation achieve the required performance, reliability, and regulatory compliance.

3 Scope of Works

3.1 Contractor Responsibilities

The Muiderberg District Heating Project is divided into three execution areas corresponding to three procurement lots:

- **Lot A – Heating Central (incl. SCADA/SRO and Water Treatment)**
- **Lot B – WKO / TEO Systems**
- **Lot C – 1,500m³ Tank Thermal Energy Storage (TTES)**

Each Contractor is responsible for the complete design, supply, installation, commissioning, and performance verification of its respective lot.

In addition to these obligations, the Contractor for Lot A holds the overall project management and coordination responsibility. This includes leading the project's execution across all lots and ensuring the technical and functional integration of Lot B and Lot C into one fully unified system.

The works shall result in a fully functional and integrated district heating production system in accordance with the tender documentation and applicable Dutch regulations. The Contractor's scope includes, but is not limited to, the following elements:

3.2 A. Heating Central Including SCADA and Water Treatment

3.2.1 Heat Pump System Requirements

The heat pump system shall provide approx thermal output of 4 MW under the specified design conditions. The system shall utilise water-to-water heat pump technology, extracting renewable thermal energy from the IJmeer lake water (TEO system) and the ATES/WKO aquifer storage. The heat pump must deliver heat to the district heating circuit at the required supply temperature while maintaining high seasonal performance across varying lake-water and aquifer temperature conditions.

The installation may consist of multiple compressor units or stages to ensure operational flexibility, enabling capacity modulation and secure redundancy. Part-load performance shall be optimised through advanced control strategies, sequencing of compressors, and full integration with the central SCADA/SRO platform, including weather-forecast-based optimisation and thermal storage interaction (TTES and ATES).

All refrigerant circuits must comply with applicable EU F-gas regulations, Dutch Arbeidsomstandighedenwet (health & safety requirements), and environmental protection standards.

The contractor shall specify refrigerant type, charge quantities, leak detection systems, and containment measures. **Only natural refrigerants are accepted**, and the system design must ensure safe operation, monitoring, and maintenance in accordance with Dutch regulatory guidelines.

3.2.2 Gas Boiler Specifications

A natural gas-fired boiler shall provide backup heating capacity during heat pump maintenance periods, extreme cold weather events when heat pump capacity is insufficient, and system peak demand periods. The boiler must be equipped with low-NOx burner technology to minimise nitrogen oxide emissions in compliance with Dutch air quality standards with a maximum of 70 mg/nm^3.

The gas boiler system shall be capable of rapid response to load demands, with automatic controls enabling seamless integration with the heat pump system. When both systems operate simultaneously, the control system must optimise load distribution to maximise overall efficiency whilst maintaining supply temperature and system pressure within specified parameters.

Safety and Control Systems

The gas boiler installation must incorporate comprehensive safety interlocks, including flame supervision systems, pressure relief devices, combustion air proving switches, and emergency shutdown controls. All safety systems shall comply with EN standards for commercial gas-fired appliances.

3.2.3 Electrical Infrastructure

Electrical supply arrangements are in the negotiation phase with the local electricity distribution company, planning to secure 1,7 MW of available capacity for the heating plant. This substantial electrical allocation enables the heat pump system to operate at full capacity whilst accommodating all auxiliary equipment, including circulation pumps, control systems, and building services.

Primary Supply

Primary Supply

The main electrical service must be configured to handle the combined demand of heat pump compressors (largest load component), cooling yard fan arrays, district heating circulation pumps, control panels, and building lighting and ventilation systems. Power factor correction equipment shall be provided to maintain supply quality.

Distribution Systems

Internal electrical distribution must be segregated into appropriate circuits with protective devices sized according to load characteristics. Motor circuits require appropriate starting current accommodation and thermal protection. Control circuits shall be isolated from power circuits to prevent electrical noise interference.

3.2.4 Control and Monitoring Systems

A fully integrated **SCADA/SRO system** following the NIS2 demands shall provide centralised supervision, control, and optimisation of all systems within the Muiderberg heating central. The control system shall unify the operation of the **water-source heat pump, the gas-fired backup boiler, the 1,500 m^3 TTES, the ATES/WKO doublet system, the TEO lake-water extraction system, distribution pumps, and all associated safety and monitoring equipment** into a single operator interface.

The SCADA/SRO architecture shall enable autonomous operation of all major subsystems while maintaining high-level coordination across the entire heating plant. Heat pump operation shall be controlled based on supply temperature requirements, available thermal sources (TEO and ATES), system demand patterns, and optimisation strategies such as weather-forecast-based control and electrical load management. The gas boiler shall be automatically dispatched when the heat pump and thermal storage cannot meet demand or when the heat pump is unavailable due to maintenance.

The TTES shall be operated through SCADA-controlled charging and discharging strategies, maintaining stratification and ensuring that stored thermal energy is utilised effectively during peak loads or transient conditions. The ATES/WKO subsystem shall be monitored and controlled to manage warm and cold well operation, maintain seasonal balance, and comply with Dutch WKO regulatory requirements. The TEO system shall be supervised to ensure extraction and return flows remain within permitted environmental limits.

Remote access functionality shall allow authorised personnel to monitor system status, respond to alarms, modify control parameters, and analyse performance trends from off-site locations. All communication networks, data exchanges, and remote connections shall be protected by appropriate cybersecurity measures to prevent unauthorised access and ensure the integrity of operational data and system control.

3.2.5 Hydraulic System Design

The hydraulic system in house shall be designed by the Lot A contractor as an integrated arrangement that connects the water-source heat pump, the gas-fired boiler, the TTES, and the ATES/TEO heat-source systems into a coherent and flexible primary circuit. The primary circuit must ensure stable and efficient hydraulic performance under all operational scenarios, including full-load operation, partial-load conditions, and transitions between different thermal sources. Pipework dimensions shall be based on design flow rates that accommodate the maximum combined output of the heat pump and the boiler while ensuring permissible velocities, acceptable pressure losses, and sufficient capacity for charging and discharging the TTES.

Primary circuit pumps shall be selected and sized to overcome all hydraulic resistances in the system, including heat exchanger pressure drops, pipe friction, valves, filtration components, and ATES/TEO interfaces where applicable. Variable-speed pump control shall form an integral part of the hydraulic design, allowing the system to modulate pump performance based on differential pressure control and real-time system demand, thereby minimising electrical consumption and ensuring stable flow conditions for all connected equipment.

The secondary hydraulic circuit shall supply heat to the district heating network and must be designed to maintain reliable service to all consumers, including those at the most hydraulically remote points. (not part of these tender lots)

Distribution pumps shall be sized to provide the required differential pressure under peak flow conditions, and differential-pressure control strategies shall be implemented to reduce pumping energy during periods of lower demand. The contractor shall incorporate expansion vessels, pressure relief valves, and other protective devices sized to accommodate thermal expansion, system volume changes, and transient pressure events within both the primary and secondary circuits in house. All hydraulic components, including valves, strainers, safety devices, and instrumentation, shall be specified to ensure long-term reliability, ease of maintenance, and compatibility with the SCADA/SRO control system.

3.2.6 Water Treatment and Quality

The contractor shall design, supply, and install a complete water treatment system that ensures the district heating water quality remains within all specified chemical and physical parameters required to prevent corrosion, scaling, fouling, and biological growth throughout both the primary and secondary circuits. The system must continuously maintain optimal water chemistry to protect the heat pump, TTES, ATES/WKO interfaces, distribution network components, and all associated hydraulic equipment.

The water treatment installation shall condition all make-up water entering the system and maintain stable inhibitor concentrations under varying operating conditions. Filtration components shall be provided to remove suspended solids and particulate matter that could impair hydraulic performance or damage sensitive equipment. The contractor shall include dosing systems for corrosion inhibitors, oxygen scavengers, and pH correction chemicals, ensuring that the treated water remains within the permissible values defined for district heating installations.

Automatic dosing and control functions shall be integrated into the system to maintain consistent inhibitor levels without manual intervention. Monitoring and testing shall be easily obtained during operation to verify key water quality parameters, including conductivity, pH, oxygen concentration, inhibitor residuals, turbidity, and temperature. The monitoring system must interface with the SCADA/SRO platform to allow operators to view real-time water chemistry, receive alarms, and track long-term trends. All supplied equipment shall comply with applicable Dutch standards for water treatment in district heating systems and shall be compatible with the materials used in the Muiderberg plant.

Initial Fill and Commissioning	Monitoring	Make-up Water Management
During commissioning, the system must be thoroughly flushed to remove installation debris, then filled with treated water meeting specified quality standards. Initial chemical treatment shall establish protective films on metal surfaces.	Regular water sampling and analysis shall verify continued compliance with water quality standards. Monitoring parameters include pH, dissolved oxygen, iron content, and inhibitor concentration. Corrective actions must be taken if parameters drift outside acceptable ranges.	System make-up water requirements should be minimal in a properly designed and maintained installation. However, provision must be made for automatic make-up to compensate for minor losses. Make-up water must receive appropriate treatment before introduction to the system.

3.2.7 Detailed Engineering & Design

The Contractor shall carry out full detailed engineering for all technical systems within the heating central, limited to the internal fit-out of the building. This engineering scope includes:

- **Mechanical, electrical, and control (SCADA/SRO) disciplines**, as well as internal civil/structural works required for the installation and support of process equipment.
- **Integration engineering** covering the approx. 4 MW water-source heat pump, the 8 MW gas-fired boiler, internal hydraulic circuits, electrical distribution, and all interfaces required for **pumping heat to the external district heating network**.
- **Functional and technical design of the SCADA/SRO system** in compliance with Dutch standards, including:
    - Control logic for the heat pump, boiler, ATES/WKO interface, TEO lake-water system, TTES, and district heating supply/return pumping.
    - Definition and implementation of **multiple operating and load-shift scenarios**, including peak-shaving, TTES charging/discharging, partial-load operation, redundancy modes, and fallback operation.
    - Data acquisition, alarm management, cybersecurity, and secure remote access.
- **Interface coordination with relevant Dutch regulatory frameworks**, including adherence to environmental permit requirements, water quality monitoring obligations, and other statutory compliance needs.

Applicable EU and Dutch Standards

European Directives and Harmonised Standards

Mechanical and Thermal Systems

- Pressure Equipment Directive (PED) 2014/68/EU
  Applies to heat exchangers, boilers, pressure vessels, expansion systems, safety valves and all pressurised components.
- Machinery Directive 2006/42/EC
  Covers the heat pump system, boiler plant, pumping systems, and any mechanical assemblies considered machinery.
- Ecodesign and Energy Efficiency Regulations (ErP)
  Applies to heat pumps, circulators/pumps, and heat-producing equipment.

Electrical and Control Systems

- Low Voltage Directive (LVD) 2014/35/EU
  All electrical distribution equipment, MCCs and connected devices.
- EMC Directive 2014/30/EU
  Applies to all control, automation and power systems to ensure electromagnetic compatibility.
- EN/IEC 60204-1
  Safety of machinery – electrical equipment requirements.
- EN/IEC 61439
  Low-voltage switchgear and controlgear assemblies (including MCC panels).

Automation, SCADA/SRO & Communication

- EN ISO 13849 & EN 62061
  Functional safety for control systems and safety-related parts.

- EN IEC 62443
  Cybersecurity for industrial automation and control systems.
- EN ISO 50001
  Energy-management integration where required.

Dutch Legislation and National Standards

Building and Safety Regulations

- Bouwbesluit / Besluit bouwwerken leefomgeving (BBL)
  Requirements for structural safety, fire safety, accessibility, ventilation and technical building installations.

Environmental and Energy Regulations

- Omgevingswet
  Technical and environmental compliance, including integration with WKO/ATES, water discharge, and thermal emissions.
- Activiteitenbesluit / Bal (Besluit activiteiten leefomgeving)
  Rules for environmental activities inside the heating central (noise, emissions, water discharge).
- Bkl (Besluit kwaliteit leefomgeving)
  Assessment framework for installations affecting local environment or water systems.

National Technical Standards (NEN)

- NEN 1010 – Electrical installations
  Dutch implementation of low-voltage installation rules.
- NEN 3140 – Safety for operation of electrical systems
  Requirements for inspection, maintenance and safe working procedures.
- NEN-EN-ISO standards for water quality and sampling, applicable to water-treatment systems.
- NEN-EN standards for HVAC systems, applicable to heat production and pumping.

Testing, Inspection and Commissioning Standards

- EN ISO 9712
  Personnel qualification for NDT used during commissioning.
- EN ISO 5817 / EN ISO 3834
  Welding quality and fabrication requirements for pressure-bearing components.
- EN 12828
  Heating systems in buildings – design of water-based heating systems.
- EN 13445
  Unfired pressure vessels (where applicable to system components).
  EN 16798
  Energy performance and indoor environmental requirements relevant for plant rooms.

3.2.8 Procurement & Delivery

The Contractor shall procure and deliver all equipment and materials required for the complete execution of the heating central. This includes, but is not limited to, the following main supply categories:

- **Heat production and process equipment**, including heat pump units, the gas boiler system with chimney and flue gas components, process heat exchangers, circulation pumps, control valves, safety valves, and all required process instrumentation.

- **Electrical power distribution systems**, including:
    - Main electrical switchgear and protection panels
    - **Motor Control Centers (MCCs)** comprising, as relevant:
        - Motor starters (DOL, soft starters)
        - Variable Frequency Drives (VFDs) for pump and fan motors
        - Circuit breakers, fuses, disconnect switches, and protection relays
        - Power busbars and internal distribution assemblies
        - Control power transformers and auxiliary power supplies
        - Terminal blocks, internal cabling, marking systems, and interfaces to PLC/SCADA
    - All power and control cabling, trays, and cable management systems
    - Emergency power supply systems, including UPS units.
- **SCADA/SRO and automation systems**, including hardware for PLC units, operator stations, industrial network infrastructure, communication modules, and all required interfaces for control, monitoring, and data acquisition.
- **Water treatment systems**, dimensioned and configured for Dutch water chemistry conditions and in full compliance with national environmental requirements.
- **Auxiliary materials and installation components** necessary for proper and complete integration of the heating central systems, including fittings, supports, small mechanical items, gaskets, consumables, and other construction materials.

All equipment shall comply with the applicable EU legislation, harmonised standards, Dutch national regulations (main regulations mentioned above), and the technical specifications of the tender documentation.

3.2.9 Mechanical & Electrical Installation

The contractor shall install all systems inside the heating central, including:

- Heat pump installation with complete hydraulic integration
- Gas boiler installation including connecting to the gas supply, flues, condensate systems, and safety interlocks
- Primary circuits, pumping groups, expansion and pressure safety equipment
- Full electrical installation including distribution panels, motor drives, control wiring and grounding
- SCADA/SRO integration with all field equipment, meaning all sensors, transmitters, actuators, motor-operated valves, pumps, remote I/O units, safety devices, and other physical process components installed in the heating central. This includes establishing all required communication links and ensuring full visibility and control within the SCADA/SRO system.
- Balanced emergency ventilation

3.2.10 Water Treatment Systems

Installation and commissioning of water treatment systems for:

- District heating primary circuit (filtration, chemical dosing, degassing)

- Measurement systems to comply with Dutch water authority requirements (e.g. Hoogheemraadschap).

3.2.11 Commissioning & Handover

Commissioning, Performance Verification and Post-Completion Obligations

The Contractor shall perform full commissioning of all systems within the heating central. Commissioning activities shall include, as a minimum:

- **Functional testing** of the heat pump installation, gas boiler system, hydraulic circuits, pumping groups, electrical distribution panels, and all relevant safety and interlock systems.
- **SCADA/SRO verification**, including validation of control strategies, optimization algorithms, weather-forecast integration, alarm management, data acquisition, and inter-system communication.
- **End-to-end system testing** under varying thermal and hydraulic load conditions to demonstrate stable, reliable, and coordinated system performance across all subsystems.
- **Operator training** and handover of all required documentation, including as-built drawings, test records, commissioning protocols, system descriptions, and complete O&M manuals.

Performance verification shall be conducted in accordance with the warranty, performance guarantees, and acceptance procedures defined in the tender documentation.

Verification Based on Test Matrix VP01 (Efficiency and Operating Scenarios)

As part of commissioning, the Contractor shall conduct system testing in accordance with the test matrix defined in **Excel sheet VP01**.

- Prior to contract award, as part of the tender submission, the Contractor shall **complete VP01** with the **expected system efficiency (COP, seasonal performance values, boiler efficiency curves, pumping efficiency, etc.)** for all required operating scenarios listed in the sheet.
- During commissioning, the Contractor shall **verify measured system efficiency values** against the values submitted in the tender.
- Tests shall cover **multiple operating scenarios**, including but not limited to:
  - Part-load operation
  - Peak-load operation
  - Minimum-load and fallback modes
- Any deviation from the tendered performance shall be documented, justified, and corrected by the Contractor at no additional cost to the Contracting Authority, unless otherwise stated in the contract.

The verified results shall be included in the final commissioning dossier.

Post-Completion Requirements: 1-, 2- and 5-Year Inspections

To ensure long-term reliability, safety, and contractual performance, the Contractor shall conduct mandatory post-completion inspections at **1 year**, **2 years**, and **5 years** after Final Acceptance.

1-Year Inspection (12-Month Review)

- Verification of system performance against the guaranteed performance values submitted in VP01 and confirmed during commissioning.
- Review of operational data, SCADA logs, alarms and optimization behaviour.
- Inspection of mechanical, electrical and automation components for early-life defects.

- Implementation of corrective actions for all identified defects.

2-Year Inspection (Interim Warranty Review)

- Follow-up assessment of corrective actions identified at the 1-year review.
- Assessment of wear-related or performance-critical components.
- Review of system efficiency trends from VP01-related data and SCADA history.
- Verification of control network stability, cybersecurity integrity and communication robustness.

5-Year Inspection (Extended Warranty / Structural Review)

- Full inspection of all principal technical components, including compressors, heat exchangers, boiler assemblies, pumps, valves, MCC sections and SCADA hardware.
- Review of structural components, insulation, cable infrastructure, and mounting systems.
- Long-term performance evaluation comparing VP01 values with actual historic performance.
- Implementation of all necessary corrective measures to ensure continued system functionality and compliance with lifetime expectations.

Reporting and Acceptance

For all commissioning activities and for each of the 1-, 2- and 5-year inspections, the Contractor shall:

- Submit a **Post-Completion Inspection and Performance Report** summarizing findings, measurements, deviations, and recommended corrective actions.
- Provide updated VP01 performance comparisons where applicable.
- Propose corrective actions with clear timelines, subject to approval by the Contracting Authority.

Implement all approved corrective actions at no additional cost when covered by the defects liability obligations.

3.3 B. WKO/TEO – Aquifer Thermal Energy Storage & Lake-Water Extraction

3.3.1 Integrated TEO (Lake Water) and ATES/WKO Thermal Energy System

The Muiderberg district heating Project shall utilise a combined **TEO (Thermal Energy from Surface Water)** and **ATES/WKO (Aquifer Thermal Energy Storage)** installation to provide a stable, renewable heat source for the 4 MW water-source heat pump. Together, these systems ensure high operational efficiency throughout the year and compliance with Dutch environmental and water-management regulations.

Preliminary Assessment of WKO and TEO Feasibility

Initial studies indicate that the following operating assumptions for the WKO and TEO systems are technically achievable and align well with the preliminary integrated system design. For the WKO system, a configuration with two doublets providing a total flow of 390 m^3/h appears feasible, with summer design temperatures of 15.5 / 9.5 °C (ΔT 6 K) and an expected winter range of 13.5 / 7.5 °C. These conditions, based on an LMDT of 1 K for WKO, an LMTD of 1.5 K for TEO, and negligible heat losses, correspond well with the thermal requirements of the overall concept.

For the TEO system, a design flow of 500 m^3/h, a minimum discharge temperature of 7 °C, and a ΔT of 6 K is considered both realistic and compatible with the hydraulic and thermal performance expected for the combined WKO–TEO–heat-pump configuration.

IJmeer Lake Water (TEO) Heat Source

The IJmeer lake provides a highly stable and renewable thermal energy resource. Due to its large thermal mass, the lake maintains relatively constant temperatures across seasons, enabling efficient heat extraction even during winter conditions when demand is highest.

Lake water will be drawn through a purpose-engineered intake structure designed to operate reliably under all weather conditions. Screening and filtration systems should remove debris and biological material, protecting downstream equipment and ensuring continuous flow within permitted extraction limits. After passing through the heat exchangers, the cooled water must be returned to the lake at a controlled temperature. Return placement and flow direction must be engineered to avoid recirculation and to ensure compliance with Dutch ecological protection standards and environmental permits.

ATES/WKO Seasonal Thermal Energy Storage

The ATES/WKO system shall provide seasonal thermal balancing by storing warm and cold water in subsurface aquifers located at suitable depths beneath the site. During summer operation, warm water will be injected into the warm well while cooled water is abstracted from the cold well. In winter, this operation reverses: warm groundwater will be extracted from the warm well to supply the heat pump, and cooled water is injected into the cold well.

This bidirectional cycle must maintain long-term thermal balance and reduces reliance on lake-water extraction during the coldest periods. The geological conditions in the Netherlands offer excellent suitability for ATES systems, allowing efficient long-term storage with minimal thermal losses. The wells must be designed, constructed, and operated in accordance with Dutch WKO guidelines, Waterwet requirements, and local water authority conditions.

Integrated System Requirements

The TEO and ATES/WKO systems together provide the full range of thermal input conditions required for year-round heat pump operation. Contractors shall deliver a complete installation including pumps, filtration systems, wellhead equipment, heat exchangers, valves, instrumentation, and all associated pipelines. All components must meet Dutch regulatory requirements and environmental permit conditions, including limits on extraction volumes, temperature differentials, and monitoring obligations.

The entire system must be fully integrated into the central **SCADA/SRO platform which is part of lot A**, enabling automated mode switching between TEO and ATES depending on seasonal conditions, water temperatures, and system load. Continuous monitoring of flow, temperature, water quality, and system pressures is required to satisfy long-term environmental reporting and WKO permit obligations. Intelligent controls shall optimise performance across varying weather patterns and demand profiles, ensuring maximum renewable energy utilisation.

3.3.2 Definitions and Technical Scope (TEO Station & WKO/ATES System)

Definition of a TEO Station (Thermal Energy from Surface Water)

A TEO station is an installation that extracts thermal energy from surface water and typically includes:

- (Lake)-water intake and outlet (channels, pipes, suction lines)
- Screening, filtration and anti-fouling systems
- Open-loop heat exchangers
- Pumping, monitoring and control systems integrated with WKO/ATES and heat-pump systems

This definition aligns with Dutch aquathermal energy guidance (aquathermie), describing TEO as thermal energy extraction from surface waters with ecological and water-quality considerations.

Definition of WKO / ATES (Aquifer Thermal Energy Storage)

A WKO system (Warmte-Koudeopslag)—internationally known as ATES (Aquifer Thermal Energy Storage)—is a subsurface energy storage technology that uses groundwater in aquifers to store heat and cold seasonally. It consists of:

- Warm well(s) and cold well(s) forming an extraction–injection doublet
- Pumping systems for groundwater circulation
- Thermal exchange via heat exchanger with surface water and to the heat pump system
- Control systems to switch between summer mode (charge warm well, discharge cold well) and winter mode (discharge warm well, charge cold well)

In the Netherlands, WKO/ATES is regulated as an open-loop groundwater energy system under:
Omgevingswet (environmental and permitting framework for water and subsurface activities)
Bal – Besluit activiteiten leefomgeving, §3.2.6 and §4.112, which define permit requirements, monitoring obligations, interference checks, and environmental constraints for open WKO systems
WKO is recognised as a sustainable and regulated subsurface energy technology requiring environmental assessment, monitoring and certified execution under Dutch law.

3.3.3 Engineering & Permitting Compliance

The Contractor shall design, coordinate and document the complete WKO/ATES and TEO systems, including all engineering activities and compliance with Dutch laws and permitting requirements.

WKO/ATES Engineering

Engineering of warm and cold wells (doublet system) in accordance with the regulatory rules for open groundwater energy systems (open bodemenergiesystemen) under:
Omgevingswet (in force 1 January 2024) – overarching framework for water, environment, nature and spatial planning. In Besluit activiteiten leefomgeving (Bal), specifically §3.2.6 and §4.112 contains rules and regulations for open WKO systems, including permit requirements, monitoring, and start-notification obligations.

Hydraulic and Process Design

Dimensioning and documentation of brine and water pipelines, pumps, heat exchangers and control systems.

Compliance with procedural rules for water-activities and environmental activities processed through the Omgevingsloket.

TEO Intake and Return System (IJmeer)

Engineering of lake-water intake, filtration, screening, anti-fouling measures and return diffuser.
Design shall follow Dutch ecological guidance on aquathermal systems, including thermal impacts, fish protection, and screening requirements.

Dutch Legal and Permitting Requirements

The Contractor shall ensure compliance with the following legal framework:

- Omgevingswet – replaces the previous Waterwet; integrated legislation for surface water, groundwater, environment and permitting.
- Bal – Besluit activiteiten leefomgeving – national environmental rules governing water abstraction, thermal discharge, and environmental activities including WKO.
- Bkl – Besluit kwaliteit leefomgeving – assessment criteria for water activities, requiring compatibility with ecological, chemical and hydraulic water-system interests.
- Waterschapsverordening – regional by-laws regulating surface-water abstraction, discharge and related requirements (including "bruidsschat" provisions).
- Rijkswaterstaat (Rijk) – applicable for rijkswateren such as IJmeer; covers permits and conditions for works in state-managed waters.

Environmental Compliance & EIA (m.e.r.)

Open-loop WKO systems shall undergo a project-m.e.r. screening (EIA screening) under the Omgevingswet framework, including submission of an environmental notification (aanmeldingsnotitie).
The environmental dossier shall address thermal impacts, water-quality effects, hydraulic interactions and mitigation measures for IJmeer.

3.3.4 Procurement & Delivery

The Contractor shall procure and deliver all required components for the WKO/TEO systems.

WKO/ATES Components as following but not limited to:

- Wellhead assemblies,
- submersible pumps,
- valves
- flow/pressure/temperature instrumentation

all meeting monitoring requirements under Bal §4.112.

TEO Components as following but not limited to:

- Intake structures for lake-water,
- including coarse/fine screens,
- filtration
- anti-fouling systems.
- Heat-exchanger skids (open or closed loop configurations).
- Return-diffuser assemblies

All meeting Bal and regional requirements under the Waterschapsverordening.

Piping and Control Systems

All required pipelines, supports, actuators and SCADA-interfaces compatible with monitoring and reporting obligations under the Bal.

3.3.5 Installation

The contractor shall install:

- The complete ATES/WKO doublet system, including drilling and well construction.
- Underground and above-ground pipelines between ATES wells, TEO installation and central plant
- The complete lake-water extraction and discharge system in accordance with Dutch environmental and maritime requirements mentioned above
- All pumps, filters, sensors, actuators, and protective systems.

Drilling, well construction, well development, pumping tests and as-built documentation performed by certified operators in accordance with BRL SIKB 11000

All underground and above-ground pipelines between wells, the TEO installation and the heating central. Installation works shall comply with water-activity and environmental-activity rules under the Omgevingswet and must be submitted/approved via the Omgevingsloket.

Lake-Water Intake and Discharge System. Installation of intake structures, pumps, filters, return pipelines and diffusers in compliance with:

- Bal environmental rules for discharge and abstraction
- Bkl assessment rules for water interests
- Rijkswaterstaat requirements for works in IJmeer and other rijkswateren

3.3.6 Commissioning

Commissioning responsibilities include:

- Seasonal mode switching tests (summer/winter) for ATES warm and cold wells
    - Flow tests and Thermal Response Tests (TRT)
    - Verification of compliance with temperature limits, flow limits and environmental conditions as required under Bal/Bkl
- Flow tests, thermal response tests (TRT), and environmental compliance verification
- Performance testing and integration with SCADA/SRO
    - Performance testing with full data logging in accordance with monitoring obligations for open WKO systems under Bal §4.112
- Submission of monitoring data and compliance documentation to Dutch regulatory authorities.

The Contractor shall demonstrate compliance with the following Dutch certification schemes:

- BRL SIKB 11000 (incl. Protocol 11001) – underground part of WKO/ATES systems (design, construction, management).
- BRL SIKB 2100 – mechanical drilling and well construction for groundwater energy systems.
- BRL 6000-21/00 (InstallQ) – design and installation of the above-ground energy centre of WKO systems; latest designated version applies.

The Contractor shall:

- Demonstrate compliance with all permit conditions under Bal, Bkl, Waterschapsverordening and (where applicable) Rijkswaterstaat.
- Submit all monitoring data and compliance documentation to the competent authority through the Omgevingsloket.

WKO/TEO Post-Commissioning Performance Reviews (1-, 2- and 5-Year Delivery)

To ensure stable, compliant and verifiable long-term operation of the WKO/TEO system, the Contractor shall perform structured follow-up reviews at 1, 2 and 5 years after handover. These obligations are part of the commissioning and performance-guarantee framework.

1-Year Operational Review

Within 12 months after handover, the Contractor shall perform a full system review, including:

Thermal & Hydraulic Performance

- Verification of extraction and injection temperatures vs. design expectations.
- Validation of seasonal recharge and discharge balance for the ATES aquifers.
- Review of TEO system performance across seasonal water-temperature variations.
- Analysis of filter system operation, screen pressure drop, and sediment accumulation.

Environmental & Regulatory Compliance

- Confirmation of compliance with WKO permit conditions under the *Omgevingswet*, including:
  - maximum flow rates,
  - allowable temperature differentials,
  - groundwater-quality monitoring obligations.
- Confirmation of compliance with TEO surface-water rules under Bal/Bkl and water-authority conditions.

Reporting

- Delivery of a 1-year WKO/TEO Performance Review Report summarising system results, deviations, optimisations performed and recommended corrective actions.

2-Year System Performance Review

Within 24 months after handover, the Contractor shall assess medium-term performance trends and technical integrity, including:

Medium-Term Thermal Behaviour

- Review of aquifer temperature development and risk of thermal breakthrough.
- Validation of thermal recharge/discharge patterns over two full operational cycles.
- Evaluation of TEO efficiency trends, including bio-fouling or siltation effects in heat exchangers.

Operational Integrity

- Review of well performance including pump curves, drawdown behaviour and reinjection pressure.
- Inspection of sensors, flowmeters, temperature probes and communication systems.
- Examination of lake-water intake structures for fouling, debris or flow obstruction.

Regulatory Confirmation

- Summary of compliance with regional water-authority requirements and national environmental reporting obligations.

Reporting

- Delivery of a 2-year WKO/TEO Condition & Compliance Report, including optimisation recommendations.

5-Year Structural & Environmental Integrity Review

Within 5 years after handover, the Contractor shall conduct an in-depth assessment of the long-term structural and environmental integrity of the WKO/TEO system. This shall include:

Deep-Level Technical Integrity Assessment

- Evaluation of aquifer thermal drift and long-term recharge equilibrium.

- Pump, screen and well-casing inspections.
- Full performance analysis of TEO heat-exchangers, filters, and intake systems.
- Verification of long-term sedimentation, corrosion or biofilm impacts.

Environmental & Legal Compliance Assessment

- Review of multiyear compliance with:
  - Omgevingswet,
  - Bal/Bkl,
  - Waterschapsverordening,
  - and any Rijkswaterstaat conditions relevant to TEO operations.
- Analysis of impact on groundwater and surface water quality, including any deviations from permit thresholds.

Long-Term Performance Trends

- Evaluation of energy-efficiency development over five years.
- Assessment of operational stability under extreme seasonal conditions.
- Verification of long-term SCADA/SRO monitoring accuracy.

Reporting

- Delivery of a 5-Year WKO/TEO Long-Term Integrity & Performance Assessment, including strategic recommendations for system optimisation, refurbishment, or regulatory adjustments.

3.4 C. 1,500 m³ Tank Thermal Energy Storage (TTES)

3.4.1 Thermal Energy Storage Tank (TTES) Requirements

The TTES shall be designed, supplied, and installed by the contractor as an integrated part of the Muiderberg heating central **in accordance with standard EN 14015**. The tank shall have a usable storage capacity of approximately 1,500 m^3 and a structural height of maximum 11 metres. It must be designed to provide short-term thermal buffering that stabilises the operation of the heating system and allows the water-source heat pump to operate at optimal efficiency under both steady and fluctuating load conditions. To achieve this, the contractor shall ensure that the TTES supports effective thermal stratification and maintains minimal thermal losses through the application of high-performance insulation and an appropriate internal flow and diffuser design.

The TTES must be fully integrated into the hydraulic architecture of the heating central and shall be connected to the heat pump, the gas boiler, and the district heating distribution circuit through all required mechanical interfaces. The contractor shall deliver a complete installation including asphalt layer, insulation, metal cladding, service platform, ladder, all pipes, diffusers, valves, nozzles, instrumentation (level, pressure & temperature sensors), inerting station[1], safety valves, and any ancillary equipment required for safe and reliable operation. The tank foundations are not part of the tank contractor's scope[2]. All components shall be fully compatible with the overall system design, operational strategy, and Dutch technical requirements.

[1] Nitrogen or steam cushion system

[2] Foundations are part of the building lot

The tank shall be structurally integrated into the new heating central building, and the contractor shall design and deliver all structural support elements, and anchoring systems required to safely accommodate the tank's weight, thermal expansion, internal pressures, and dynamic effects. The tank must remain fully accessible for operation, inspection, and maintenance, and the contractor shall ensure compliance with all relevant Dutch building regulations, including those related to structural safety, seismic resilience, working-at-height, and confined-space access.

Through its design and integration, the TTES shall provide thermal supply capacity, ensuring operational resilience during short-term demand peaks, minor production interruptions, or maintenance activities. The contractor must verify that the delivered system meets all specified performance and safety criteria and must provide the full set of documentation required for commissioning, regulatory compliance, and long-term operation.

3.4.2 Engineering & Structural Integration

The contractor shall carry out the detailed engineering for the TTES, including:

- Structural integration of the tank into the purpose-built heating central. *(Foundation design is part of Lot H.)*
- Calculation of static loads, wind loads, and seismic resistance, including anchoring requirements, in accordance with applicable **EU structural standards (Eurocodes)** and relevant **Dutch building and safety regulations (Bouwbesluit)**.
- Mechanical design of internal and external connections.
- Design of thermal stratification, insulation, pressure equipment, and safety systems.
- Compliance with **EN 14015** for above-ground welded steel tanks.
- Preparation of detailed tank drawings and installation documentation.
- Preparation of a detailed engineering and execution schedule.

Applicable EU and Dutch Standards

The Contractor shall ensure that all commissioning activities for the TTES system comply with the relevant European and Dutch standards, regulations and technical frameworks, including but not limited to:

EU Standards and Directives

- EN 14015 – Specification for the design and manufacture of site-built, vertical, cylindrical, flat-bottomed, above-ground welded steel tanks.
- This standard sets requirements for materials, design, fabrication, erection, testing and inspection of steel storage tanks at ambient temperatures.
- EN 1993-4-2 (Eurocode 3 – Design of steel structures, Part 4-2: Tanks)
  Used in conjunction with EN 14015 for structural design verification.
- Pressure Equipment Directive (PED) 2014/68/EU
  Applies to instrumentation, pressure-safety devices and tank safety equipment.
- Machinery Directive 2006/42/EC
  Applies when moving mechanical components or powered equipment are part of commissioning.

Dutch Standards and National Regulations

- Bouwbesluit / Building Decree
  Dutch regulatory framework governing structural safety and stability requirements for built structures, including vertical steel tanks.
- NEN-EN 14015 (Dutch implementation of EN 14015)
  Dutch national standard corresponding to EN 14015 for welded steel tanks.
- NEN-EN 1993 (Eurocode implementation in the Netherlands)
  Structural integrity requirements for steel structures, including tanks and supports.

Inspection, Testing and Verification Requirements

- EN ISO 9712 – Non-Destructive Testing (NDT) qualification and certification of personnel
  Required for weld testing during commissioning.
- EN ISO 5817 – Welding quality levels
  Specifies acceptance criteria for welded joints.

Interface and Safety Requirements

Requirements for electrical and instrumentation components must comply with:

- Low Voltage Directive (LVD) 2014/35/EU
- EMC Directive 2014/30/EU
- Dutch national electrical safety requirements (NEN standards where applicable)

3.4.3 Procurement & Delivery

Procurement of all TTES components including:

- Anchors (if necessary) and layer of asphalt powder
- Above-ground welded tank (approx. volume of 1,500 m^3 & maximum height of 11m), designed and manufactured according to **EN 14015**
- "Non-Destructive Testing" (NDT) of tank welds and the treatment of certain tank surfaces against corrosion
- Insulation of the sides and the top of the tank, metal cladding, service platform, access hatches/manholes, diffusers, piping
- Valves, nozzles, inerting station[3], instrumentation (level gauge, temperature sensors & pressure sensors)
- Safety systems (relief valves, overflow protection, drainpipe, monitoring).

3.4.4 Installation

The contractor shall install:

- The asphalt powder layer.
- The complete tank structure, including insulation and protective cladding.
- The diffusers pipes, ending right outside the tank. The pipes should be equipped with ball valves and blind flanges, positioned downward close to the bottom of the tank[4].

[3] Can be either a steam or nitrogen cushion system, including all necessary equipment (e.g. for the nitrogen system: buffer tank, nitrogen generator, compressed air system etc.)
[4] Lot A is responsible for supplying and installing the piping between the tank and the remainder of the heating system

- Measurement and safety equipment in accordance with EU and Dutch requirements[5].
- Sensor cabling system:
  - The tank supplier shall gather all cables from the various sensors in an electrical cabinet included in the supplier's scope.
  - The cabinet shall be positioned either adjacent to the tank outside the cladding or integrated within the insulation layer.
  - Sensor cables shall be routed together in a vertical cable tray running through the insulation.
  - The tank supplier is *not* responsible for connecting cables from the cabinet to the existing Control System

3.4.5 Commissioning

Commissioning includes:

- Verification of tank performance, including thermal stratification, charging/discharging, and heat-loss performance.
- Execution of required inspections, Non-Destructive Examinations (NDE), functional tests, and related documentation, in accordance with applicable EU/Dutch standards[6]
- Final approval and handover.

Post-Commissioning Performance Reviews (1-, 2- and 5-Year Delivery)

To ensure long-term, stable and compliant operation of the TTES installation, the Contractor shall perform structured follow-up reviews after handover. These obligations are part of the overall commissioning and warranty framework and shall include:

1-Year Performance Review

Within 12 months after initial handover, the Contractor shall perform a comprehensive system assessment including:

- Verification of thermal stratification stability over seasonal cycles.
- Review of charging/discharging performance against design values.
- Inspection of insulation condition and external cladding.
- Verification of instrumentation accuracy (temperature, level, pressure).
- Review of NDE-related findings and confirmation that no degradation or early-life defects are present.
- Delivery of a **1-year performance report** summarising findings, recommended actions and any corrective work executed.

2-Year Performance Review

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[5] According to the construction standard EN 14015, and also the tender document 6.1 "Special requirements specification Lot C - 1,500 m³ Tank Thermal Energy Storage (TTES)"

[6] Leak testing, pressure testing, hydrostatic testing, settlement monitoring etc. all described in the construction standard EN 14015

Within 24 months after handover, the Contractor shall perform a second operational review focusing on medium-term tank integrity and performance trends:

- Evaluation of operational data to confirm stable long-term stratification, limited convection losses and expected thermal efficiency.
- Visual inspection of tank surfaces, weld seams, penetrations and structural anchoring.
- Verification of sensor performance and cable routed elements installed through the insulation.
- Review of any operational incidents or irregularities reported by the Owner.
- Delivery of a **2-year TTES condition report**, including any recommendations for optimisation or preventive maintenance.

5-Year Structural & Performance Assessment

Within 5 years after handover, the Contractor shall perform a deep-level integrity and performance assessment, which shall include:

- Internal or external NDE inspection scope (depending on tank configuration and operational constraints).
- Verification of tank structural integrity, weld condition, corrosion protection systems, safety devices and anchoring.
- Full review of thermal storage performance over multiple heating seasons, including charge/discharge efficiency curves.
- Assessment of insulation integrity and long-term heat-loss performance.
- Comprehensive documentation in a **5-year TTES Integrity & Performance Assessment Report** summarising findings, trends, recommendations and any required refurbishment actions.

3.5 Heating Central Building Design (for informational purposes)

The heating central building transcends conventional industrial architecture, designed to function as both operational infrastructure and public exhibition space showcasing modern heating technologies. Located in a green area of Muiderberg, the building must harmonize with its natural surroundings whilst maintaining clear identity as a significant community asset.

The glass facade design fulfills multiple purposes beyond aesthetics. Transparency allows public visibility into the sophisticated heating technologies, fostering community understanding and acceptance of district heating infrastructure. Natural light penetration reduces operational energy consumption, whilst carefully specified glazing systems maintain appropriate thermal performance and acoustic isolation.

The architectural brief requires a "natural expression" that respects the green setting whilst celebrating the innovative technologies housed within. This balance might be achieved through organic forms, natural materials, integrated landscaping, and green roof systems that blur the boundary between building and environment. The 11-metre TTES presents a distinctive architectural element that can be celebrated rather than concealed, potentially forming a landmark feature visible throughout Muiderberg.

Exhibition space planning must accommodate both casual public visitors and technical professionals, with interpretive displays explaining district heating principles, renewable energy technologies, and the specific Muiderberg system characteristics. Interactive elements might include real-time performance data displays, thermal imaging demonstrations, and educational materials about sustainable heating.

Operational requirements remain paramount despite the exhibition function. Equipment access for maintenance, acoustic isolation of mechanical systems, appropriate ventilation and climate control, safety systems, and security measures must all be seamlessly integrated within the architectural design. The building scope falls under separate architectural responsibility, requiring close coordination with mechanical systems designers to ensure optimal integration.

4 Expected Operating Conditions (network)

Temperature Set Points

The district heating system is designed to operate at the following temperature parameters:

- Supply temperature: 75°C
- Return temperature: 40°C

These temperature set points have been selected to optimise energy efficiency whilst ensuring adequate heat delivery to all connected consumers. The temperature differential of 35°C allows for efficient heat transfer and minimises pumping energy requirements throughout the distribution network.

The heat pump system must be capable of achieving these supply temperatures under standard operating conditions. During extreme cold periods or peak demand scenarios, the gas boiler will supplement heat pump output to maintain supply temperature and system pressure.

It must be expected that the return temperature can be as high as **50°C** during the initial start-up fase.

5 Final approval and Handover Documentation Requirements

The contractors shall prepare and deliver complete technical documentation covering all elements of their respective lot of the Muiderberg heating central, including the design, installation, testing, commissioning, and operational configuration of the heat pump system, the gas boiler, the TTES, the ATES/WKO installation, the TEO lake-water system, and all associated hydraulic, electrical, and SCADA/SRO systems. The documentation must be of a level suitable for submission to Dutch regulatory authorities, including agencies responsible for environmental permits, WKO monitoring obligations, and water quality compliance.

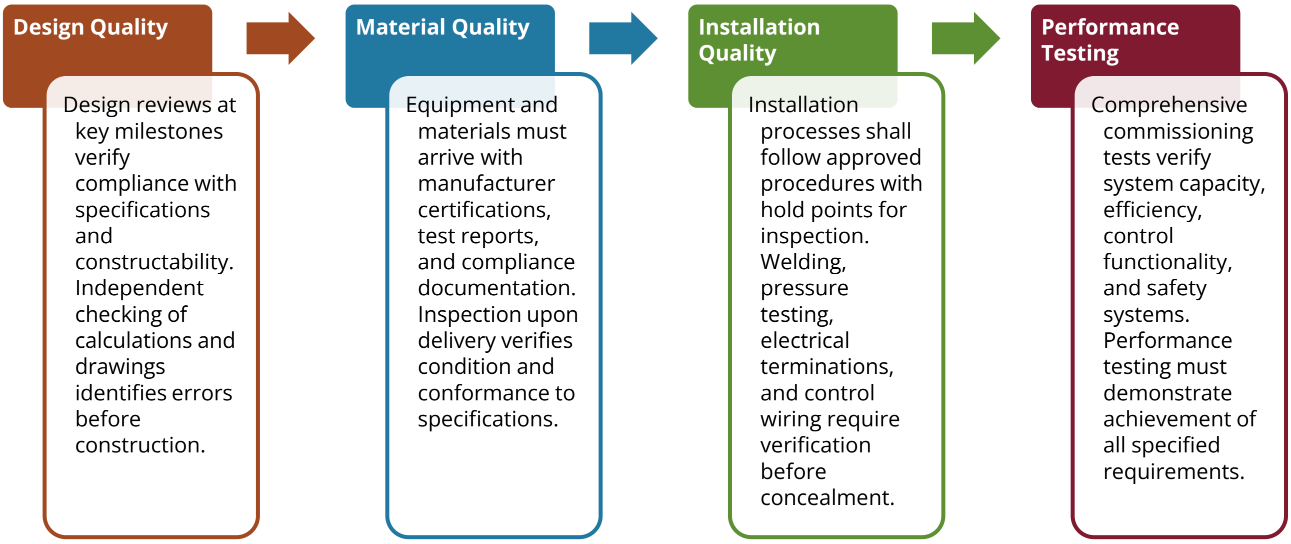
All documentation shall be structured and detailed to support the long-term operation and maintenance of the Muiderberg installation. It must provide operations personnel with a clear understanding of system functionality, safety requirements, control logic, and normal and abnormal operating conditions. The contractor shall also ensure that sufficient technical detail is included to support future modifications, expansions, or system optimisation work undertaken by third parties.

The documentation package shall include as-built drawings, hydraulic and electrical schematics, P&IDs, equipment datasheets, control philosophy descriptions, SCADA/SRO configurations, commissioning reports, test protocols, O&M manuals, and all manufacturer documentation. All documents must be delivered in both digital and editable formats and shall meet the quality and completeness requirements defined by the client for the Muiderberg project.

Design Drawings	Equipment Manuals	Commissioning Records
Complete as-built drawings showing all mechanical, electrical, and control systems, including pipework schematics, equipment layouts, electrical single-line diagrams, control system architecture, and site arrangements. Drawings must be provided in both PDF and native CAD formats.	Manufacturer's operating and maintenance instructions for all major equipment components, including heat pumps, gas boiler, pumps, control systems, and ancillary equipment. Manuals must be provided in English/Nederlands and include spare parts listings.	Documentation of all commissioning activities, test results, performance verification measurements, and acceptance certificates. Commissioning documentation must demonstrate compliance with all specified performance criteria and regulatory requirements.

5.1 Quality Assurance and Testing

A comprehensive quality assurance programme must be implemented throughout all project phases to ensure delivered systems meet specified performance criteria and regulatory requirements. The contractor shall establish quality control procedures covering design reviews, material inspections, installation verification, and performance testing.



5.2 Training and Knowledge Transfer

Operations Training Programme

Upon completion of commissioning, the contractor shall deliver a comprehensive training programme for the client's operations personnel, covering all systems and subsystems included in the Muiderberg heating central. The training shall ensure that operators are fully capable of managing the water-source heat pump, the gas-fired boiler, the TTES, the ATES/WKO installation, the TEO lake-water extraction system, and the associated hydraulic, electrical, and SCADA/SRO control systems during normal and abnormal operating conditions.

The training programme shall include detailed instruction on routine operational procedures, SCADA/SRO interface navigation, alarm handling, and system optimisation strategies such as TTES charging/discharging, ATES seasonal mode switching, and TEO flow management within environmental permit limits. Operators must also be trained in routine inspection tasks, scheduled maintenance requirements, and compliance-related monitoring activities, particularly those linked to WKO and water quality obligations. Emergency procedures—such as response to equipment failures, sensor faults, abnormal temperature or pressure conditions, and loss-of-source scenarios—shall be clearly explained and practiced.

Training shall be delivered through a combination of classroom-based sessions and practical, hands-on instruction at the completed Muiderberg facility. All training materials shall be provided in **English and/or Dutch**, and must include detailed operating procedures, troubleshooting guides, maintenance checklists, and system description documents tailored to the final installed configuration. The contractor shall organise the training schedule to allow multiple sessions, ensuring that all operational staff are able to attend and receive complete instruction prior to handover and commencement of live operation.

5.3 Warranty and Support

The contractor shall provide comprehensive warranty coverage for all equipment, materials, and installation workmanship. Warranty terms must align with industry standards for district heating installations and provide the client with appropriate protection against defects and premature failures.

Equipment Warranties

Major equipment including heat pumps, gas boiler, pumps, and control systems must be covered by manufacturer warranties for a minimum period specified in equipment schedules. Extended warranty options shall be identified in the tender submission.

Installation Warranty

The contractor shall warrant all installation workmanship for a minimum of 60 months from final acceptance. This warranty covers defects in pipework, electrical installations, structural modifications, and system integration work.

Performance Guarantee

The contractor shall guarantee that installed systems achieve specified performance criteria, including thermal output capacity, efficiency metrics, and acoustic emissions. Performance testing during the warranty period shall verify continued compliance.

Support Services

During the initial operating period, the contractor shall provide technical support services including response to operational questions, assistance with control system optimisation, and advice on maintenance scheduling and procedures.

6 Service and Plant-Specific Maintenance Scope

As part of Lot A and Lot B, the Contractor shall provide service and plant-specific maintenance for all systems delivered under these Lots during the first five (5) years of operation.

Daily operational tasks are explicitly excluded from this scope.

Service and maintenance activities shall include all preventive and corrective interventions necessary to ensure safe, reliable and efficient performance of the installed systems throughout this five-year period.

6.1 Mandatory Service and Maintenance Contract (5 + 5 Years)

The Contractor's five-year maintenance obligations shall include, but are not limited to:

- Preventive service at manufacturer-recommended intervals for all major equipment (e.g. heat pumps, boilers, pumps, valves, electrical systems and SCADA/SRO components).
- Corrective maintenance for equipment faults, component failures or performance deviations.

- Functional inspections, adjustments, lubrication, recalibration and other interventions needed to maintain approved performance.

- Replacement of wear parts (e.g. seals, filters, belts, gaskets, actuators, sensors) as defined by manufacturer requirements.

- System performance checks to verify hydraulic, thermal, mechanical and electrical functionality.

Any equipment replacement outside normal wear parts (e.g. compressor, pump motor, boiler burner assembly) shall be executed by the Contractor, with cost arrangements according to the contract's warranty and maintenance provisions.

6.2 Maintenance Accessibility Requirements

All systems shall be designed and installed to ensure safe and efficient maintenance access including:

- Clearances for service access to compressors, burners, pumps, valves, sensors, and electrical panels.
- Safe access to control cabinets, SCADA/SRO panels, instrumentation and diagnostic ports.
- Removal paths for equipment components requiring replacement within the five-year maintenance period.
- Compliance with applicable electrical safety access clearances.

6.3 Documentation and Maintenance Planning

The Contractor shall provide all documentation necessary for the execution of the service programme, including:

- Preventive maintenance schedules for all equipment.
- Step-by-step procedures for service tasks and corrective interventions.
- Spare-parts lists with manufacturer references and supplier details.
- Safety procedures and lock-out/tag-out instructions for all equipment.
- Service logs and reporting templates to document all maintenance activities.

At the end of the five-year period, the Contractor shall provide a Final Maintenance Summary Report documenting the condition of all systems, major service actions performed, and recommendations for long-term maintenance.

6.4 End of Five-Year Obligation

At the expiry of the five-year service period:

- All maintenance responsibilities transfer to the Client, unless otherwise agreed.
- The Contractor shall participate in a handover review meeting and deliver the final maintenance summary.
- The installations shall be left in fully operational condition, with all service work up to date.

7 Environmental and Regulatory Framework

The project site is located in a forested area near the IJmeer, where construction activities are subject to strict Dutch regulations governing development in and around sensitive natural landscapes and coastal ecological zones. As the project involves the construction of a new purpose-built heating central, the Contractor shall ensure that all building works comply with municipal planning requirements, environmental protection rules, and any conditions attached to development in forested or semi-protected natural areas. Special attention must be given to minimising visual and ecological impact, protecting existing vegetation where possible, and maintaining safe working practices adjacent to the IJmeer shoreline.

All required permits and approvals associated with the construction and operation of the new heating central will be obtained by the Client. This includes, but is not limited to, building permits, environmental permits, occupancy certificates, water discharge approvals, and any additional permissions related to construction within forest zones or near protected waterways. The Contractor shall review and familiarise itself with all permit conditions and is fully responsible for ensuring that all work is carried out in strict compliance with these conditions. The Client will provide all relevant permit documentation and coordinate with local authorities as necessary.

7.1 Environmental Considerations

The Contractor shall ensure that all construction and operational activities comply with applicable Dutch environmental regulations, including those related to noise emissions, construction impacts in forested areas, water extraction and discharge near IJmeer, refrigerant handling for the heat pump installation, and combustion emissions related to the gas boiler. The Contractor must implement all mitigation measures required to avoid adverse impacts on the surrounding natural environment and must maintain full documentation demonstrating compliance with environmental regulations and permit conditions throughout the construction and commissioning phases.

7.2 Acoustic Requirements

Given the heating plant's proximity to protected natural areas and residential properties, stringent noise control measures are essential. The combined sound emissions from all production equipment must not exceed 40 dB(A) when measured at a distance of 20 metres from the facility perimeter.

Heatpump noise management	Gas Boiler and Flue Systems
Fan systems (ventilation), refrigerant flow, and structural vibrations must be attenuated through acoustic enclosures, vibration isolation, and sound-absorbing materials. The contractor shall specify all noise and reduction measures in the detailed design submission.	Combustion air intake and flue gas discharge systems must be designed with appropriate silencers. Flue gas velocity shall be controlled to minimise flow noise. Boiler room mechanical systems require vibration isolation and acoustic treatment.

7.3 Health, Safety and Environmental Management

Safety Requirements

All construction and installation activities must comply with Dutch health and safety legislation, including the Working Conditions Act (Arbeidsomstandighedenwet) and associated regulations. The contractor shall prepare and implement a comprehensive health and safety plan addressing all identified hazards associated with design, construction, and commissioning activities.

Specific safety considerations for this project include: working at heights during equipment installation and structural modifications; confined space entry for tank and vessel installations; hot work activities including welding, cutting, and brazing; electrical safety during installation and testing of high-voltage systems; refrigerant handling requiring qualified personnel and appropriate safety equipment; lifting operations for heavy equipment requiring certified lifting equipment and trained operators; and noise exposure during equipment testing and commissioning.

Environmental Protection

Construction activities must implement appropriate environmental protection measures to prevent pollution of soil, groundwater, or surface water. Fuel storage, chemical handling, and waste management must follow approved procedures. Any spills or releases must be reported immediately and remediated appropriately.