Smart Water Guidance System

A Guide to Requirement Specifications

TABLE OF CONTENTS

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A Smart Water Guidance system is a system designed to manage and control the distribution of water in a water supply network. It can be designed to operate on any platform, be it cloud-based or on-premises, according to the customer's requirements.

Smart Water Guidance systems can provide many benefits, including improved energy efficiency, reduced water waste, and enhanced water quality and service reliability. Smart Water Guidance system uses a machine-learning algorithm to control the water distribution system, which can reduce leakage and improve the accuracy of consumption forecasts. This can lead to lower CO_2 emissions and more sustainable management of water resources.

Functionality requirements

It is important to see the condition of each reservoir cell to understand how much storage space there is and how long it will take for an event to affect it. The transfers of water between hydraulic systems should be assessed to see if they are the best option and if they have enough water to enhance the health of an area. Control actions should be done to use these transfers when possible.

1. Simulation and Optimization

The system should comprise a simulation section that permits offline simulation of any scenario and optimization based on certain events.

2. Real-time Algorithm

In real-time, the algorithm should detect if a cell is unavailable and will automatically calculate the water available in storage and the run time of available water based on area supply requirements. All calculations should be generated with a prediction of how long the current storage levels will last on normal operating parameters and consumption levels.

3. Understanding Demand

It is crucial to understand actual demands to ensure that operational changes meet these demands and ensure customer supply. Additionally, comprehending the predicted demand is necessary to formulate a production plan. The system should calculate predicted demand based on historical data and real-time data inputs. Actual demand should be displayed against predicted demand within the system based on historical data and real-time sensor data based on flow into each pressure zone or DMA.

4. Event Management

Comprehending when particular events are occurring and when it will not be a normal demand event is necessary to manage the system to ensure supply is maintained. The system should include a holiday calendar where days should be added to the run schedule based on extra demand. This calendar should be customized to include other events that may alter demand, such as large sporting events. The machine learning algorithm needs to also learn from historical data to account for events that happen at the same time each year, such as national holidays. The algorithm should also should be manually adjusted if there are one-off events to account for.

5. Storage Management

Comprehending the overall storage is necessary to ensure the health of the system is good and customer supply is not at risk. The target storage level at a hydraulic system level must be able to be set and adjusted. All water storage sites have an upper and lower limit set with warning levels and then alarm levels. The algorithm needs to ensure that water levels at storage sites are always maintained within these safe levels.

6. Supply Management

It is crucial to understand what is being supplied by a works and how far this deviates from the planned output so that any risk to customer supply is understood. The system should calculate predicted demand based on historical data and real-time data inputs. Actual demand needs to be displayed against predicted demand within the system based on historical data and real-time sensor data based on flow into each pressure zone or DMA. The functionality of maintaining pressures across an area could be handled within the programming layer of existing SCADA systems. The system should be configured to alert when pressure goes outside of set parameters, ensuring that pressures are not increased above healthy levels to prevent the risk of bursting the network, especially at night. Pressure should be logged within the platform, and inputs from sensors should be incorporated into failsafe programming for pumps.

7. Model Setup

With programming from Water Utility staff, the model should be set up to incorporate different water systems and pressure zones, optimizing the full operating area and not just individual zones. The platform needs to balance the entire covered network, including the dependency of different operating areas, as long as the other systems are covered by the incoming data to the platform.

8. Change Simulation

Before being issued to assets, changes should be simulated to understand their impact. The platform should be capable of implementing manually adjusted pumping strategies and optimizing around these set parameters, utilizing the most efficient pumping to minimize leakage impact.

9. Pumping Schedule Optimization

Parameters should be introduced to optimize the pumping schedule based on the needs of the network, and an optimized schedule will be submitted for approval. Sufficient time must be left between pump starts to minimize any surge, and the pumping schedule should be configured based on input data from the user. Pumps should be started at any time when uninhibited to maintain supply, and the pumping schedule should be manually overridden by users at any time with instantaneous action to assets.

10. Remote Monitoring

The tool and plan for hydraulic systems should be viewed remotely to confirm any planned outages and take action to mitigate them. A read-only user level needs to be defined for this purpose. User groups should be implemented based on the needs of the customer, and users will only be responsible for a certain number of assets, with a view of relevant information to their role.

11. Incident Management

In the case of any incidents, full system-level logins and change logs are kept, recording any changes made with the user, time, and date stamp. The relevant SCADA data must be sent to the optimizer tool in a timely manner for effective optimization of hydraulic systems, with a robust link. SCADA inputs are sent to the platform in real-time when input signals are received from SCADA-linked assets, and update signals are pushed directly from SCADA to the platform when received.

12. Data Integration

The system needs to interface with corporate datasets to incorporate contextual information that will benefit the optimization process. Integration tool needs to enable the incorporation of data from any source. The real-time prediction algorithm should utilize existing demand profile prediction data alongside historical data. Off-peak energy pricing should be integrated at the user setup level to determine the optimal or low-cost times for the majority of filling. Data from sites utilizing the SCADA System Platform is required for supply levels from large works and should be made available within the tool. Software should import all automation measurements from the SCADA platform and allows for visualization of the data sets on a single user screen. PID is implemented within the platform at an individual station level, such as a visualized view of a pumping station.

13. Data Validation and Cleaning

The software needs to validate data and identify erroneous data to prevent optimization based on false information. Data filtering and cleaning are carried out within our platform to ensure the removal of erroneous data. Users should be possible to override any data within the system based on their local understanding of the status to enable the best possible optimization. Manual adjustment of data needs to be possible to optimize for the best values for the user.

14. Reservoir Cell Turnover

The system must have a tool that ensures the top and bottom turnover levels of reservoir cells are met within a set timeframe. The user must have the ability to change the set levels and the timeframe within which a turnover must occur. This is a core function of the system. Changes should be made, and the system will optimize based on these inputs. Finite pump control should be a key function of the system.

15. Asset Refresh and Water Quality

The system must be able to refresh assets within a specific period and always have a sweetening flow to avoid the risk of water quality incidents. Assets that are not fresh should not be utilized. The user can set minimum flows and rules within the system's optimization options to prevent pumps from sitting unused for extended periods. Thresholds should also be set within the system so that pumps that need to run at minimum levels at all times should do so, and the algorithm will adapt to these inputs to ensure water stays fresh and flushing is not required. The user must be able to know when an asset has been refreshed within a certain timeframe to understand where there is a risk to water quality and where flushing is required before operation. Pump run times are tracked within the system, and water quality levels should be added to the algorithm so that these parameters should be adhered to and tracked based on water quality inputs being available and added to the calculations.

16. Energy Cost Reduction

In order to provide customers with the best service at the lowest cost, it is imperative that the system is capable of reducing energy costs where possible. This should be achieved through the creation of pumping tables, which optimize the pumping schedule based on energy costs and timings. Water utility must provide information on low-cost pumping times, which should then be factored into the algorithm to help reduce pumping costs and optimize pump timings, ensuring water availability to all customers at the lowest energy cost. However, the exact savings should not be quantified in advance due to the unavailability of detailed information on water utility's energy costs and network layout.

17. TRIAD Period Implementation

The implementation of TRIAD periods must be ensured by maintaining supply to customers while minimizing pumping through the high tariff period. TRIAD times should be added to the system and picked up by the optimization algorithm, where a pump or booster station should be blocked out for a specific time period, locking out functionality and balancing with other water supply sources. It is important to ensure minimal pumping during a period of load shedding to reduce cost to the business while maintaining customer supply. Understanding the average cost of water in a reservoir is also beneficial. The amount of water in the reservoir and the cost of pumping should be calculated to give an average cost of water for a specific area, with input from water utility on energy prices.

18. Chlorine Residual and Water Quality

The chlorine residual within reservoirs must be maintained at a healthy level so that customers receive wholesome water. The turnover rate and chlorine levels should be tracked to ensure that a healthy level is maintained. The age of water within a reservoir must be understood to drive turnovers and maintain water quality. The water supplied to customers must be within regulatory WQ parameters.

19. Reservoir Maintenance and Control

Reservoirs must be maintained within set levels to prevent overfill and the risk of structural damage to the asset, which has the potential to remove the asset from service and risk storage/supply to customers. All water storage sites should have an upper and lower limit set with warning levels and alarm levels. The algorithm needs to ensure that water levels at storage sites are always maintained within these safe levels. Control of the assets must be able to be taken by the user where circumstances require, so that the tool is not issuing controls. Both at a system and asset level, the automated functionality should be overridden to manually input specific instructions, or the system should be placed into full manual control or user-defined control.

20. System Optimization and Asset Management

The model must be capable of being run on an ad-hoc basis to optimize for specific operational changes. The system should be manually optimized whenever required, and operational changes are picked up by the system and optimized if real-time data is fed into the system or if manual optimization is inputted. It is important to ensure that assets are not run where restrictions or operating conditions prevent this. The system should detect from SCADA input whether an asset is offline or online, or if it has some operational restrictions written into SCADA programming. Users should have possible to also lock out an asset manually completely.

21. Performance Tracking and Reporting

The performance of the system relation to expected operation and the resulting benefits need to be understood. If historical data regarding energy consumption costs, pumping costs, water production, etc. is available from Water Utility, the platform should cross-reference both data sets. Reporting of datasets should be set up to report individual KPIs and savings. The software provider needs to work with users to create bespoke reports that meet their needs and are easy to use. Other benefits, such as CO_2 reduction, should also be tracked.

Technical requirements

The Water Guidance system needs to be designed with versatility in mind, allowing it to operate on any platform, be it cloud-based or on-premises, according to the customer's requirements.

22. Redundancy and Backup Options

Redundancy options are available and adhere to industry standards, including replication, docker volume backups, virtual machine snapshots, and third-party backup solutions, such as offline backups.

23. Software Updates

Updates to the software should be typically released every six months and require vendor support. The scheduling of updates and upgrades should be coordinated with the customer to ensure minimal disruption. In the event that system downtime is necessary, it will be arranged in advance and typically lasts between 30 seconds and one minute.

24. Product Roadmap

The product roadmap of software should be continuously evolving to meet the changing needs of customers. Current plans should include the integration of a waste and stormwater system to improve understanding of sewer system performance and CSO impact. Integration of AMI meter data, which will enhance the accuracy of leak detection and demand prediction features within the water supply system should be possible.

25. System Integration and Access Control

The system should be connected to a customer's active directory, with geo-restrictions typically set within the active directory, admin layered access privilege, or firewall settings of the overall customer architecture. The system should implement user groups with different access levels based on customer requirements, linking to active directory authorization levels. This is achieved through links to the active directory, which restricts remote logins for certain applications and requires a physical local network connection for high-level tasks. Full training is provided to all required staff as part of the project roll-out, with ongoing training should be possible. Integration with SCADA should be easy and secure.

26. System Design and Scalability

The software must be built to the CIS hardening guides and be scalable, with no limits on scalability for resources, users, and measuring points. The system should be designed to be user-friendly and easily adjusted. At the beginning of a project, the system should allow for the importation of existing hydraulic models. These models are fine-tuned using historical and real-time data from sensors to create a real-time model that reflects the current state of the operating network.

27. System Operation and Backup

The software should be turned off without impacting the SCADA system. This should be achieved through a built-in function that allows the system to switch to passive mode, which does not affect SCADA operability. In passive mode, the system only monitors data points and does not send instructions to other systems. Backup data should be downloaded from the database in various formats, including JSON (via API link), .bak, text file, CSV, and TAR, depending on the type of data backup requested.

28. System Requirements

To ensure its proper functioning, the Water Guidance system must meet several requirements. VPN access should be arranged. The architecture of the VPN access must be guided by Water Utility in accordance with their protocols and requirements. For on-premises installations, the system is usually installed on private networks that are closed off from the internet and external environments. The software should not require internet access, and even the AI components should be installed on-premises without the need for a connection to the cloud or the internet.

29. Proven Track Record

The software must have a proven track record. The Water Guidance System should be used in several water utilities. Pumping and water storage optimization modules should be successfully implemented and running with customers for over 3 to 5 years.

The system should be ISO 27001 accredited, GDPR compliant, and will be implement the NIS 2 cybersecurity directive.

A detailed specification of the requirements

Application Resilience	Recovery Time Object RTO and Recovery Point Objective RPO against the proposed architecure.
Data Backup	Water utility specific code should be backed up in a product agnostic way, if so what file types are supported and what standards are used.
Geographically Restricted Access Control	Control of assets or planned control of assets through the Software should only be able to be carried out from approved locations.
Conditional Execution of Control Logic	The Software should allow the addition of pump run conditions, taking into account any situation where pumps should be prevented from running. For example, when multiple pumps are running simultaneously or when the delivery pressure is high.
Corporate Information	The Software should be able to bring in data such as predicted demand (if we choose to use our current dataset) / energy cost to allow the optimiser to take the best decisions operationally
Water Reservoir Cost	The cost per m3 of water in a reservoir will enable an understanding of the expenses associated with supplying water to an entire area.
Cybersecurity Measures	The software must be developed in accordance with the hardening guidelines established by the Center for Internet Security (CIS).
Safeguarding Data	It is crucial for the software or company to ensure the privacy of our sensitive data. We recommend implementing data governance and security policies for the management and use of proprietary water utility data.
Verification of Data	The Software should be capable of identifying erroneous data and utilizing assumed or expected values to ensure the optimization is most effective. It is important to understand how the Software will accomplish this.

Data Verification Override	The Software should have the capability to temporarily override any faulty data, ensuring that the optimization is based on the most accurate information available.
Hydraulic System Demand Override	For occasions such as bank holidays or events with abnormal demand, I need the ability to input exceptional demands. The Software should be able to optimize around these inputs, as opposed to relying solely on normal demand predictions.
Efficient Water Pumping	The Software should calculate both predicted and actual demands, using a specified calculation method, and optimize the operation of assets based on this information.
Energy Expenditure	The Software should be capable of identifying the most efficient pumping options available and optimizing them. By doing so, it should minimize the impact of leakage in the area.
Energy Load Reduction	The Software is designed to optimize energy costs while ensuring that all operational requirements are met for the provision of wholesome water to customers.
Compliance with Energy TRIAD	The Software allows an operator to implement periods of load shedding and optimizes operation to minimize pumping throughout this period.
Detailed Access Control	The Software should be optimized to operate during TRIAD periods, as confirmed by the operator, and avoid any unnecessary pumping during high tariff periods.
Hardware Requirements	Controls should only be issued by trained individuals and, ideally, by a single user at any given time. The software must support granular RBAC (Role-Based Access Control) security measures.
High-Level Model Modification	Minimum hardware specifications are required to run the software across various solution scales.

SCADA Integration	Changes to the hydraulic system or network must be implemented in the Software to enable accurate management of the hydraulic systems. What is the process and timeframe for implementing these changes, and to what extent will the water utility be able to make the changes themselves?
System Maintenance	The Software must receive data from the SCADA platform to enable optimization. It is essential that the Software is resilient to ensure minimal outages and continuous optimization based on real-time data.
Network Velocity Limits	The software must be designed with ease of maintenance in mind and should include comprehensive documentation to enable engineers to understand the system's architecture and functionality. Additionally, it should feature a user-friendly interface that allows engineers to perform daily tasks efficiently changes.
Network Infrastructure Management	The Software can ensure that velocities are maintained within the set levels to minimize the risk of sedimentation or movement of sediment.
Water Pressure Management	The software should possess the ability to operate on a private network, ensuring a secure and isolated environment.
Pressure Setpoint Constraints	A minimum pressure of 1.5 bar and a maximum of 5 bar is required to ensure that the customer's pressure is sufficient without over-pressurizing the area.
Product Development Roadmap	The Software should be capable of monitoring pressures and initiating assets only when the limits are not exceeded and there is a risk of bursting.
Pump Monitoring and Refresh	The software provider should have a development roadmap of at least 5 years
Pump Operation and Refresh	The Software should provide visibility into the duration since each pump was last operated and how it compares to the refresh timeframe.
Pump Activation Scheduling	Assets that fall outside of the specified parameters should not be utilized as part of the Software optimization. The Software must ensure that assets are refreshed within a specified timeframe to

	prevent water quality issues and avoid the need for flushing, ensuring that they are always operationally available. The parameters for flushing should be configurable on a per-asset basis.
Strategic Pumping	The Software must be capable of issuing controls whenever there is a need to initiate a pump.
Remote Access with Read-Only Permissions	The Software should have the capability to process and execute pumping strategies as needed for leakage control and optimize its operations based on the availability of pumps.
Remote System Access	The Software should provide read-only access to the schedule, enabling others within the business to view and understand the current and planned state.
Remote Access Privileges	Software sahould be accessed securely via VPN, allowing all users to have remote access to our systems.
Water Age in Reservoirs	The platform should be integrated with Active Directory to provide Role-Based Access Control (RBAC), and geographic restrictions need to be applied.
Exception-Based Model Execution	It would be beneficial if the Software could determine the average age of water within a reservoir. This information could then be used as a driver for turning over the reservoir and maintaining healthy water quality.
Chlorine Residuals in Reservoirs	The Software should have the capability to be manually optimized when required by an operator.
System-Level Reservoir Storage	The Software should have the capability to take reservoir cells in and out of service, enabling us to comprehend the overall storage within the system.
Reservoir Water Level Constraints	It would be beneficial if the Software could automate the turnover of reservoirs to maintain the chlorine residual based on live data where online chlorine residuals are available.
Reservoir Water Circulation	The Software is designed to determine the overall storage of the hydraulic system and maintain it at an optimal level to ensure that the customer supply is not at

	risk. This level should be adjustable by operations personnel.
Compatibility with SCADA Systems	The Software must be designed to prevent reservoirs from being overfilled or emptied.
SCADA System Interface	To maintain healthy water quality in reservoirs, it is necessary to achieve turnovers between set levels within a specific timeframe. This process should be managed by a Software that allows water utilities to adjust the levels or timeframe as needed.
System Scalability	The software should have the capability to be disabled without affecting the functionality of our SCADA system.
Incident Simulation	The software need to have cyber-secure interfaces to integrate with multiple SCADA software systems.
System Stability	The software must be scalable.
Technical Support	The Software should have the capability to model changes in the background and comprehend their impact based on real-time data, in order to determine the most effective response during an incident.
Pump Activation Intervals	At least 3 references are required.
Software Deployment Location	The options for ongoing support and maintenance need to be clarified.
Employee Training	The Software should ensure that there is a sufficient amount of time between pump starts to prevent any surges.
System Upgrade Procedures	Several hosting platforms can be used, including SaaS, PaaS, IaaS, and On-Premise.
User Responsibility	Training should be offered for the various end users of the system.
Customizable User Interface	Professional upgrade process.
Predicted Water Transfer Needs	The system should have a logging feature.
Planned vs. Actual Supply Volume at WTW.	Control desks are responsible for managing specific hydraulic systems. Filters should be implemented at the user

	level, allowing individuals to view only the areas for which they are responsible.
Water System Transfers - Predicted Need	It would be useful if the Software could determine whether a transfer from another system is required and optimal, and then inform the user of this requirement. Additionally, it could potentially implement transfers between hydraulic areas where appropriate.
WTW - Supply Volume - Planned v Actuals	The Software should be capable of comprehending the current supply from a WTW and optimizing the pumping process based on the actual supply versus the predicted supply for that time. Additionally, the Software should be able to ingest production plan data

Guidelines for Purchasing a Water Guidance System

Research the vendor

Purchase from reputable software vendors, whose staff are often knowledgeable and can provide specific care tips tailored to your environment.

RFP

Provide a comprehensive definition of the requirements as an attachment to the request for tender.

Cybersecurity

It is recommended to choose software vendors with a strong track record in security expertise, such as those with an ISO 27001 certification.

For further information regarding the Smart Water Guidance Systems, please contact Lining at lining.info@lining.fi.

www.aquavisio.fi

AQUAVISIO is a complete water management platform that offers significant advantages to water utilities. It is a ready-to-use, easy-to-deploy solution for water and waste-water network management. It provides a full solution with strong cyber security and extensive integration options.

One of the main advantages of AQUAVISIO is its ability to lower water and energy wastage, reduce CO_2 emissions, and improve water quality and service dependability. This is done through leakage management and Water Guidance and production based on consumption forecasts. Predictive maintenance and planned investments in the water supply network decrease the leakage rate by using advanced technologies and sustainable solutions to monitor, prevent, and improve the system.

Another advantage of the AQUAVISIO system is its ability to lower energy costs. By allowing water storage levels to drop during the day and then pumping the storage tanks steadily back to high levels during the night, the system can help utilities to save money on electricity costs, as electricity is usually cheaper at night. Moreover, by using pumps with optimal running rates, the system can help to lower energy use and extend the lifespan of pipes and network components.

AQUAVISIO also uses Artificial Intelligence (AI) and Machine Learning (ML) to provide more sustainable management of water resources. These technologies automate processes that are expensive to manage manually, improving the accuracy of the outcomes and allowing utilities to make better decisions based on real-time information about what is going on in the infrastructures.

In summary, the AQUAVISIO water management platform can provide significant benefits to water utilities by helping them to optimize water use, lower costs, and enhance the efficiency and reliability of their operations.

AQUAVISIO can be integrated with existing and third-party systems directly or through the SAP Business Technology Platform (BTP).

Around this database, AQUAVISIO and FRENDS iPaaS brings a huge catalog of connectors and integration elements, from API libraries to synchronize master data and real-time events handling to integrate multiple data sources such as SCADA, Transactional systems (ERP), Geographical Information Systems (GIS), third-party application files, or smart meter data, as well as AI tools and services to work with the data.

On top of these data services, there is a possible to use third party analytics and business intelligence tools, together with development and process automation services to create or integrate the applications required to consume the data for diverse cases.

Lining, a software provider of AQUAVISIO, have obtained ISO 27001 certification. This means that Lining have implemented a framework of policies and procedures that includes all legal, physical, and technical controls involved in an organization's information risk management processes. This international standard specifies the requirements for establishing, implementing, maintaining, and continually improving an information security management system (ISMS) within an organization.

For water utility customers, this certification provides assurance that Lining is taking the necessary steps to protect our sensitive information and data. This includes measures to prevent unauthorized access, disclosure, or theft of customer data, as well as ensuring the integrity and availability of the data. This help to build trust and confidence in Lining's ability to securely manage the customer's information.

Helsinki Regional Water and their use of AQUAVISIO:

In 2015, Helsinki Regional Water entered into an ongoing agreement with a software provider to implement AQUAVISIO, a machine-learning algorithm that controls the water supply system in the entire Finnish metropolitan area. The system also includes Aveva SystemPlatform, measuring stations, and PLCs in the pressure boosting stations of the water distribution network.

The contract covers four cities with a combined population of more than 1.3 million. The package combines Aveva System Platform, SCADA, and AQUAVISIO to provide a comprehensive solution for managing the water supply system.

This partnership has allowed Helsinki Regional Water to leverage the power of machine learning and advanced technology to improve the efficiency and effectiveness of their water supply system, benefiting the residents of the Finnish metropolitan area.