



# Fortum Relies on *MySQL* to Monitor Power Plant in Real Time

The Högdalen power plant near Stockholm, Sweden is one of Europe's most modern facilities for waste incineration. It produces electricity and heat from municipal waste and processed industrial waste. The plant, which is jointly owned by the City of Stockholm and the Fortum company, converts waste into 1.300 GWh of energy on a yearly basis. This amounts to half the electricity and a fifth of the heat consumed by all homes in Stockholm. European environmental legislation requires that this sensitive industrial process is strictly monitored.



As management prepared to add a new waste fuel boiler to the plant in late 2004, they found that the current system for monitoring the waste incineration process would become insufficient. Furthermore,

both legal regulations and future business opportunities forced the need to move from collecting data every minute to collecting data every second. Fortum decided to create a standard system that could be used in other plants for similar purposes. Competing with major companies like ABB, the consulting company UPSYS was chosen to develop and supply the new system. UPSYS selected MySQL for its performance, reliability, and flexibility to build their data warehouse solution.



**Fortum**

*"It wouldn't be possible to reach the same performance in any conventional database handler. By building directly on top of the MySQL code, we were able to seamlessly integrate our solution to meet our requirements."*

**Staffan Flink**  
Senior Developer  
UPSYS



## High Performance

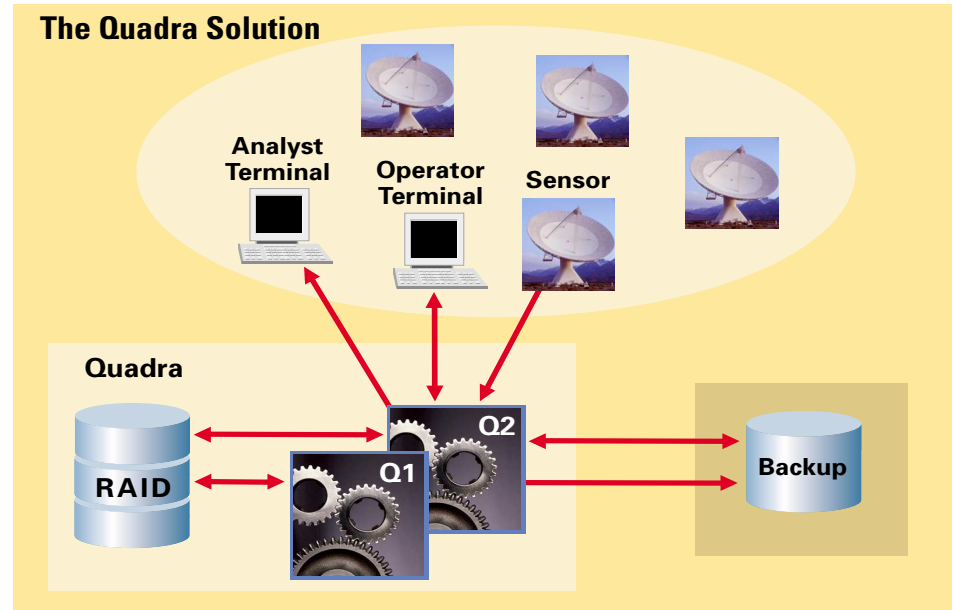
### Real-time Measurement

With new regulatory requirements the specifications for the monitoring system demanded an upgrade from currently measuring 6,000 values per minute to an astounding 15,000 values per second. In addition to this, 5,000 values are calculated and stored every second. The values have to be kept for 18 months and need to be available for verification and analysis during this period.

The system must also handle incorrect or missing values due to malfunctioning equipment.

### Flexible Storage Engine Architecture

UPSYS calculated that the amount of data simultaneously stored would eventually grow to 30 Terabytes of data. Very expensive hardware would have been required to meet performance demands if this amount of data was stored in a conventional storage engine. Using the flexibility of the MySQL pluggable storage engine architecture, the decision was made to create a new, more compact table handler, specifically tailored to the needs of the project. It was clear from the



**Figure 1** Sensors capture and feed data to the processing system. The system is accessed from terminals through a standard SQL interface in MySQL. The Collection – Calculation Database receives raw values from sensors and continuously creates the desired calculated and aggregated values. Collected and created values are then stored in the database. An SQL standard interface provides connectivity to external applications.

amount of data being stored every second, the file structure had to be extremely efficient. Since MySQL is open source, UPSYS programmers were able to seamlessly integrate a custom made table handler consisting of an optimized flat file structure with the database engine. MySQL AB consultants were used as advisors to avoid pitfalls and optimize performance. If a proprietary database had been chosen, the work would have required extensive consulting time, costing €100,000 or more.

*“It’s really easy to integrate customized code with MySQL and provide a clean visualization of the data using the C-API and Perl. We considered another open source database for the project but rejected it due to lack of flexibility”*

**Staffan Flink**  
Senior Developer  
UPSYS

## Reliability and Flexibility

### High Performance

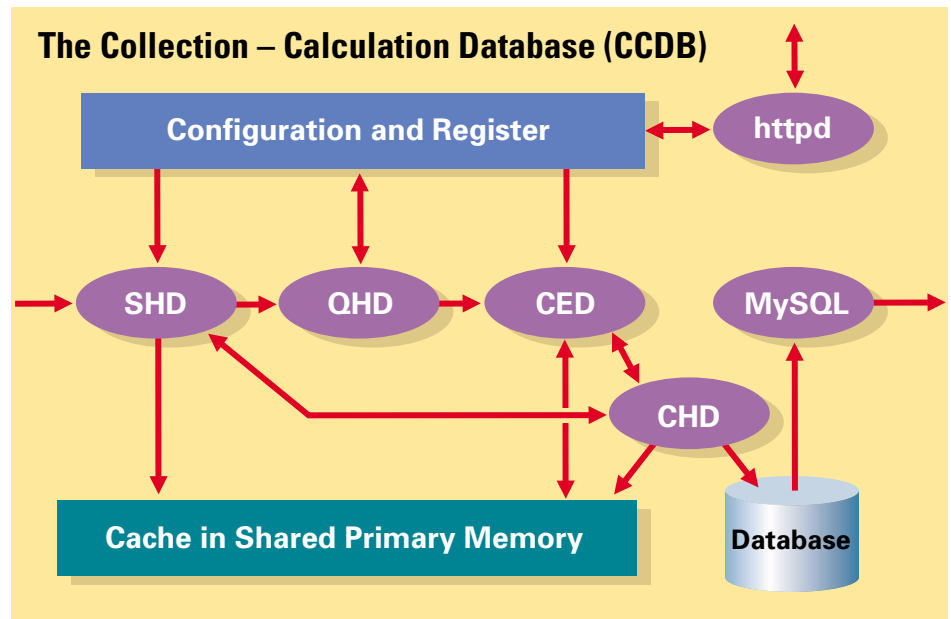
In order to increase performance, indexes were omitted in the data files. Instead UPSYS created an algorithm that only needed access to disk once to find values. Time count and data series identities are used as keys to find specific values in the files. The customized table handler is optimized to handle data from a range of defined sources arriving at fixed time intervals. The total amount of data stored for 20,000 series is approximately 10 GB per day. The resulting table handler decreased the total amount of data stored to 6 Terabytes, 80% less space than using an unmodified database.

In designing the solution, Fortum wanted to have the opportunity to solve similar scenarios using the same basic system at other power plants. Therefore, any type of sensor can be used to deliver values from the industrial process to the scanner database. Only the format of the value is specified, making the system truly generic.

### A System for Business Growth

Fortum considered several formal proposals before choosing the UPSYS system based on MySQL. From the start it was clear that no existing solution could meet the demands out of the box. "Reliability and flexibility were the most important aspects", said Julia Sundberg, technical manager at Fortum. "European legislation is strict about quality and redundancy in monitoring a waste incinera-

tion plant but the business advantages are just as important to us. The MySQL based system from UPSYS has been tailored to let us modify the production process with high precision. It's easy to insert new equations, analyze data by specific time periods, and aggregate data as needed". Fortum has also implemented the system in Hammarbyverket, a second power plant near Stockholm, and is investigating additional implementations of the system.



**Figure 2** The five modules of the CCDB are executed as separate processes. The Scanner Handler Daemon (SHD) receives data from scanners, stores them in the database. The Queue Handler Daemon (QHD) decides what calculations need to be performed. The Calculation Engine Daemon (CED) performs and reports calculations, while the Cache Handler Daemon (CHD) reads and writes data in the database. A MySQL database handler (mysqld), acts as the read-only SQL interface towards external systems.

## Technical Environment

<i>Hardware:</i>	HP Proliant DL 380 (2)
<i>OS:</i>	Suse 8 Enterprise Server
<i>CPU:</i>	Intel Xeon 3.06GHz (2) (two CPUs in each)
<i>RAM:</i>	2Gb
<i>Database:</i>	MySQL Server
<i>Storage:</i>	Eon Store, 16 x 250Gb RAID5 (2) (two RAID-cabinets).
<i>Database Size:</i>	6Tb

For more information, please go to [www.upsys.se](http://www.upsys.se) and [www.fortum.com](http://www.fortum.com).

## About MySQL

MySQL AB develops, markets, and supports the MySQL database server, the world's most popular open source database. With over five million active installations, MySQL has quickly become the core of many high-volume, business-critical applications.

Major corporations such as Yahoo!, Sony Pictures Lucent Technologies, Digital Entertainment, HP, Motorola, NASA, Xerox and Cisco rely on the ultra-fast, highly-reliable MySQL database. MySQL is available under the free software/ Open Source GNU general public license (GPL) or a non-GPL commercial license.

For more information about MySQL, please go to [www.mysql.com](http://www.mysql.com).



The World's Most Popular Open Source Database

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