

# Performance at Pernis

A new loading facility gives Shell throughput and energy efficiency gains

Shell Pernis in the Netherlands, one of Europe's largest and most modern refinery and chemical complexes, has replaced one of its aging truck-loading facilities with a state-of-the-art loading gantry. The new facility, which is owned and operated by Vopak, is helping Shell meet its own stringent environmental and safety goals. Terminal efficiency has risen by around 20 percent, and the new facility also improves energy efficiency by generating its own power.



Figure 1: Aerial view of the new loading terminal

The new loading facility at Shell Pernis was constructed by the logistics services arm of independent tank terminal provider Royal Vopak, which also operates the facility on behalf of Shell. It has virtually eliminated the release of hydrocarbon solvent vapor into the environment and has reduced energy costs. Efficiency improvements have been made in truck loading by shortening turn-around times, and operational costs have decreased by approximately 20 percent. These gains have arisen from new loading equipment, easier access for the trucks, and new working practices. Compared with the old loading facility, trucks take less time to load because they no longer have to negotiate the main gates and travel to the centre of the plant. Vopak has also introduced new and more flexible working practices. These allow the same volume of solvent to be shipped during an extended day shift of 16 hours compared with the previous 24 hour operation. While the old loading system required up to ten operators, the new loading gantry with the Emerson automation solution requires only six.

Vopak selected Emerson Process Management to provide the advanced automation and controls for the new facility, a critical aspect of the design, and also for on-going maintenance of the automation of the plant. Emerson provided expertise, work

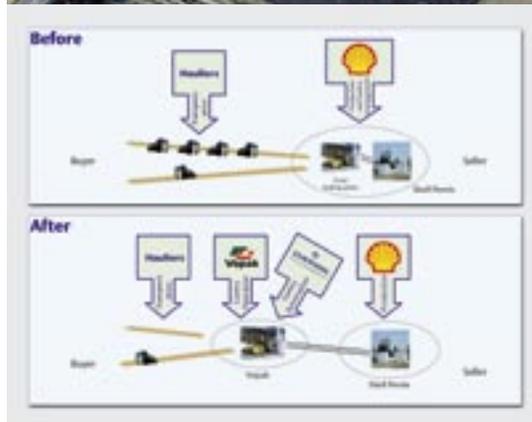


Figure 2: Business model with the old and new loading gantries

## Contractor and sub-contractors

Vopak won the contract to build, operate and maintain the new terminal, with the freedom to reengineer all aspects of the loading process to minimize waiting times and ensure reliability. In return, the company agreed to pay a demurrage fee for each truck that cannot be loaded within a two-hour window as a result of a control failure. A serious

loading problem in the morning could cause delays all day and generate charges of hundreds of Euros for dozens of trucks. Vopak managed the project by making individual subcontractors responsible for clearly defined areas of work. "We gave ownership to vendors, all of whom were selected with regard to their recognized leadership in particular fields," commented Gert Jan Krispijn, Site Manager for Vopak Logistic Services at Shell Pernis. "We're convinced it's better to make a single provider responsible for automation and controls; we have only one point of contact and only one platform to deal with. No finger pointing between different suppliers can occur. Emerson was chosen

processes and technology including PlantWeb digital plant architecture, a Smart-Process Terminal Management Solution (TMS) and PlantWeb Services, including preventive maintenance. The contract carries penalties if availability of Emerson equipment falls below 99.7 percent. The drivers behind the project were both environmental and economic. Shell sets its own standards for environmental performance and needed to be sure that its loading facilities meet these standards by recovering any displaced vapor. There was also a need to improve access for the 10,000 trucks that are being loaded every year.

because it specialises in process automation, is well regarded worldwide, and offers in-depth local knowledge of gantry loading systems,” Krispijn continues. “We expect Emerson to view the Vopak facility as if it were their own. We don’t have a maintenance crew on site as it’s more cost-effective to assign Emerson responsibility for all maintenance and support.”

The new loading system is a complex environment that is challenging in terms of both process control and tanker scheduling. To make sure that all operations are conducted safely, before a truck can be loaded plant operators and truck drivers follow an automated sequence of interlocked safety steps controlled by Emerson’s PlantWeb Digital Plant Architecture. Vapor captured by the new vapor return system is burned to generate electricity, ensuring that the new facility has zero net electrical demand. The predictive and on-line diagnostics capabilities of Emerson’s PlantWeb architecture also played a big part in cutting truck turnaround times from the original average of three hours to a guaranteed two hours. Emerson developed a “slot planning” system to space truck arrivals evenly, using an open, flexible, and internet-capable software.

**Emerson in control**

This allows transport companies to book time slots that best fit their schedules. Trucks that arrive within their slots are admitted first, whereas in the past drivers might have to queue for several hours or even a day. Emerson’s SmartProcess TMS (Terminal Management Solution) with its Autoload application was chosen to manage terminal operations. Sales orders, product quality and availability information are imported from Shell’s SAP R/3 system and the tank farm’s distributed control system. Hauliers receive transport requests from the ERP system automatically via electronic data interchange (EDI) or fax. The haulier then uses a web browser to book a time slot at the gantry and to keep information on drivers and materials up-to-date. With all the paperwork processed before the truck arrives, all the driver has to do is acknowledge the final load plan.

**Guaranteed availability**

The system allows routine maintenance work to be carried out with minimal effect on tanker loading, by marking the relevant products as unavailable during certain time slots. To minimize unexpected maintenance work, which could jeopardize the two-hour turnaround, Emerson needed a control system that is able to detect problems before a failure occurs. The Emerson PlantWeb digital plant architecture has just such predictive intelligence, plus remote diagnostic tools that make it easy for engineers to put the problem right. The PlantWeb system includes more than 100 FOUNDATION fieldbus instruments from Emerson, including Rosemount differential pressure and temperature transmitters, Micro

Motion mass flowmeters, Fisher digital control valves and EL-O-Matic on-off valves. An Emerson DeltaV digital automation system controls the gantry operations. The DeltaV system offers multi-layered redundancy for in-depth protection against system failures. Control is further distributed through the functionality of the Emerson FOUNDATION fieldbus instruments.

**Predictive availability**

The DeltaV system can notify maintenance personnel when human intervention is required to correct problems before they cause unexpected downtime. This capability, called PlantWeb Alerts, relies on software in Emerson field devices and the AMS Suite software application embedded in DeltaV. It immediately analyses incoming information, categorizes it according to severity, urgency and who needs to be told, and then alerts the recipients, along with advice about what to do.

Emerson’s goal is to move the plant from scheduled maintenance to predictive maintenance within three years. The first step in achieving this was to perform a failure mode effect and criticality analysis (FMECA) on each device to determine the likelihood of failure

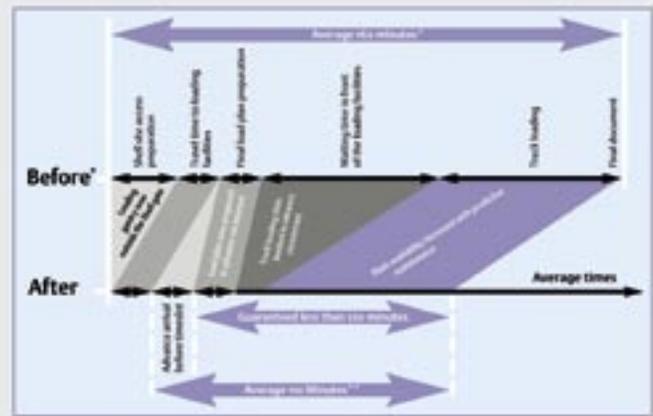


Figure 3: Improved turnaround times

and the safety, environmental and economic consequences. This information was used to define the maintenance plan, which includes:

- The optimum mix of reactive, preventive and predictive maintenance tasks, based on the criticality of the instruments. This allows technicians to focus on doing the right things at the right time.
- Spare parts requirements, based on the criticality of the device and the availability of the parts; and
- the transition time for moving from mainly reactive and preventive maintenance tasks to mainly predictive maintenance tasks.

With the preventive approach, valves are overhauled in rotation, once every three years. If a device fails in service, Emerson staff receive an automatic alert and take appropriate action. Under the predictive regime, the maintenance team visits the site and checks valves three times

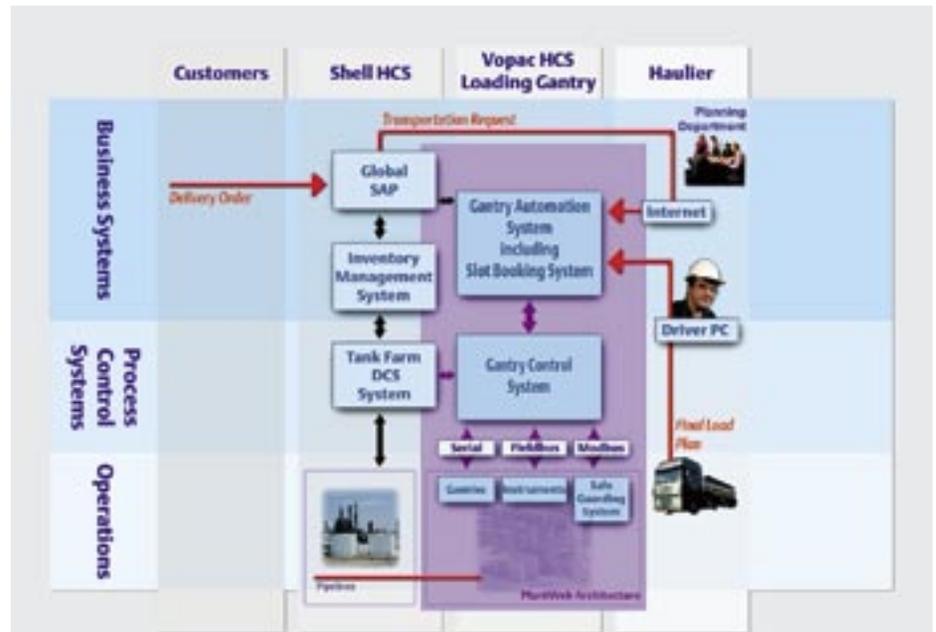


Figure 4: System flowchart

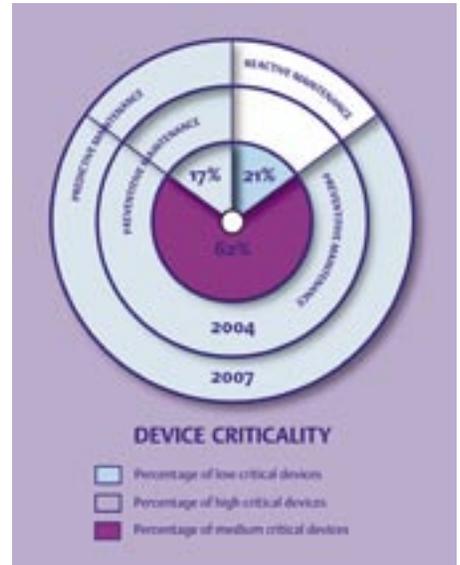
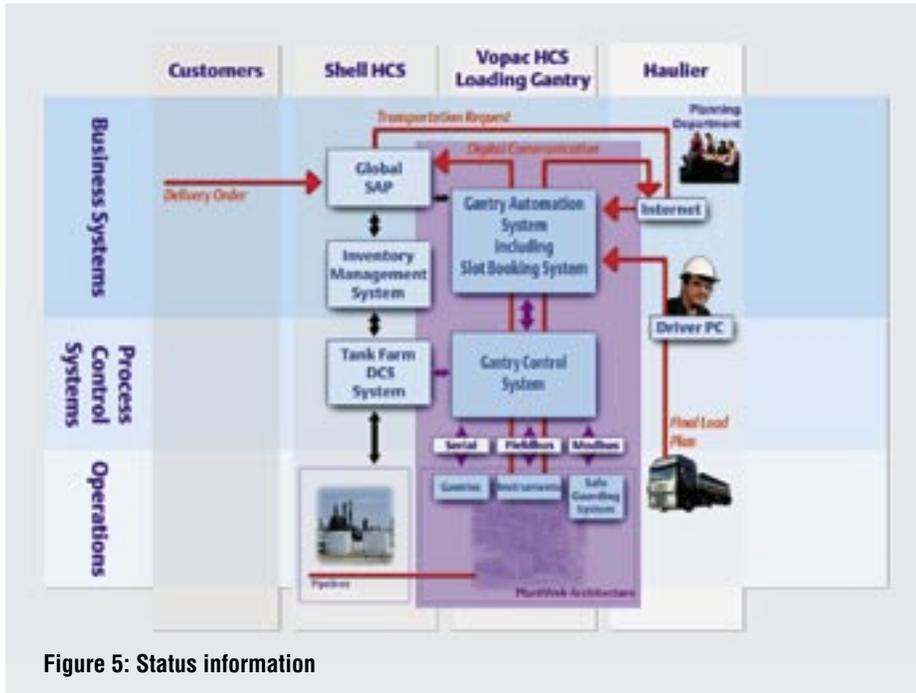


Figure 6: Criticality diagram for the control and instrumentation system. By 2007 predictive maintenance will be used for all devices of medium or high criticality.

a year. The valves are checked both off-line, by monitoring actuator feedback as valves are opened and closed remotely, and on-line, by looking for leaks and worn parts. In combination with PlantWeb Alerts, this will eliminate the need for routine overhauls and reduce maintenance costs by 10–20 percent. “We would have liked to implement predictive maintenance straight away,” said Nico Duyx, Service Manager for Emerson in Holland. “But in order to meet our availability commitments, we realized that we needed to build up a suitable knowledge bank on device performance, on this plant, before we could do that.”

**Fine-tuning predictions**

To gather the data needed to move towards predictive maintenance, Emerson offices in Holland developed an on-line device scanning tool to analyze instruments and detect potential failures in their early stages. This information enabled PlantWeb Alerts to be tuned. Following the initial tuning, the alerts are regularly readjusted as experience grows. Information monitored by the Emerson maintenance team includes the number of valve on-off cycles, and the open and close times. The resulting calculation of average valve travel times allows a PlantWeb Alert to be generated if a valve takes longer than average to open or close. If necessary, additional checks or diagnostic tests can be run using AMS Suite: Intelligent Device Manager and AMS ValveLink software. Next year, by which time the Alerts settings will have been fine-tuned, additional Alerts will be sent to the operators to provide them with instructions. “The on-line diagnostics of PlantWeb help

resolve problems faster,” says Jerry Benjert, Emerson’s lead engineer for the project. “If a failure occurs, Emerson maintenance personnel don’t automatically have to visit the site. Instead, they can first access the control system or even the attached field devices. Most times, this leads to a quick resolution.” Vopak’s Krispijn agrees: “When we have a problem, we call Emerson and a member of their maintenance team is online within two minutes. A few minutes later, the problem is usually resolved. It often takes other suppliers’ maintenance technicians or engineers an hour to reach us, plus another half-hour to resolve problems.”

**Counting the benefits**

So far, the automation portion of the new facility is on track to maintain a projected annual maintenance cost of less than 3 percent RAV (replacement asset value). This figure approaches best-in-class, and is well below the industry average of 6.7 percent; it is exceptional for an automation system guaranteeing 99.7 percent availability, says Emerson. This performance translates to no more than three outages a year of four hours each, including gantry automation, gantry electrical controls, slot planning, and communications between the tank farm and SAP systems.

What’s more, constant monitoring and quick response by service personnel means that field assets are kept in top shape and are less likely to wear excessively or be damaged. The maintenance budget is spent efficiently—less for overhauling or replacing worn or damaged devices, more for maintaining or improving plant performance. “With the help of PlantWeb

architecture and the other improvements, the actual loading time is averaging 110 minutes, including waiting for early arrivals. This is significantly less than the two-hour guaranteed turnaround time, which does not include early arrival,” says Krispijn. “We’ve had practically no demurrage claims from the hauliers since start-up.”

Shell also notes indirect benefits from the new automation, especially in terms of data capture, data processing, and communications. According to Raimond Sanders, Assistant Manager for Filling & Dispatch, Shell Nederland Chemie, there is also less paperwork required. “About 20 percent fewer Shell administrative man-hours are required compared to the old truck loading facility. The savings are being applied to more important value-added work,” says Sanders. “We bought a solution that optimizes the supply chain between Shell Pernis and our customers, while virtually eliminating volatile hydrocarbons exhaust, and strongly increasing safety and energy efficiency. We are very satisfied with the automation solution.” ■

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