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Reference

Wind energy is more reliable than ever with a new Ethernet network from Siemens

Alflex Technologies turns to Siemens to build an Ethernet network for a Dutch wind farm with 43 turbines

People all over the world are increasingly relying on clean energy, including wind energy. More and more wind farms are being built at sea just a few kilometers from the land.

The advantage of a sea site is the presence of (constant) wind and sufficient space to create big wind farms, which can provide enough energy for a large city. This wind farm is approximately 25 km from land, has 43 turbines and delivers 129 MW of energy.

The steel construction of the turbine needs to be protected against seawater to obtain a long, profitable service life. Corrosion is one of the biggest threats to wind turbines at sea, and there are different methods to protect wind turbines from this phenomenon. Cathodic protection (corrosion protection using a sacrificial anode) is realized by adding a metal as counter potential – zinc or aluminum are frequently used. However, these materials can end up in the sea during this process, which certainly does not help the environment. This is the reason that a more reliable and environmentally friendly technique was chosen for this project – the Impressed Current Cathodic Protection (ICCP). This process involves automatically controlling the potential difference, for which Alflex Technologies has developed an advanced control system.

Founded in 1991 in Zoetermeer, Netherlands, Alflex Technologies specializes in providing electronic solutions, thermodynamic systems, process management, measuring techniques and control engineering for various industries, including offshore and medical. Alflex Technologies manages the entire value-added chain for the design, development and production of their products.

The challenge

The turbines are located approximately 25 kilometers from the coast. Continuous monitoring, management and data logging from the land are very important for wind turbines, because actually visiting a wind turbine at sea can be costly and dependent on the weather. A cheaper, more efficient and reliable solution was needed for managing the data for this wind farm.

The solution

A communication network was established on the seabed based on fiber optic connections between the turbines. To guarantee that all wind turbines can be reached, an Ethernet network with redundant connections was implemented to increase the reliability. This ensures that a malfunctioning fiber optic cable or a malfunctioning wind turbine does not have a negative impact on the information from the remaining turbines.

The network was built using the RUGGEDCOM RS900 switches from Siemens with the eRSTP redundancy protocol. When a network is interrupted, or when a switch turns off, the network restores itself within just one second. eRSTP is an extension of the standard RSTP (IEEE 802.1W) protocol developed by Siemens. This enhanced protocol facilitates quick reconfiguration and recovery of the network, which means that the equipment can be reached faster and the network re-accessed after 5ms per hop (switch). With standard RSTP, this could take up to ten seconds. Not only this, RUGGEDCOM switches have a high MTBF (Mean Time Between Failure) value, which keeps the number of very expensive maintenance visits to minimum.

When creating the network topology considerable emphasis was placed on maintaining a high degree of availability and reducing implementation and maintenance costs to an absolute minimum. Because of the limited availability of fiber optics, it was a challenge to find a reliable topology with the highest form of redundancy. For every connection between the turbines, a cable would have to be pulled over the bottom of the sea. This is a complex and expensive task.

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RUGGEDCOM product

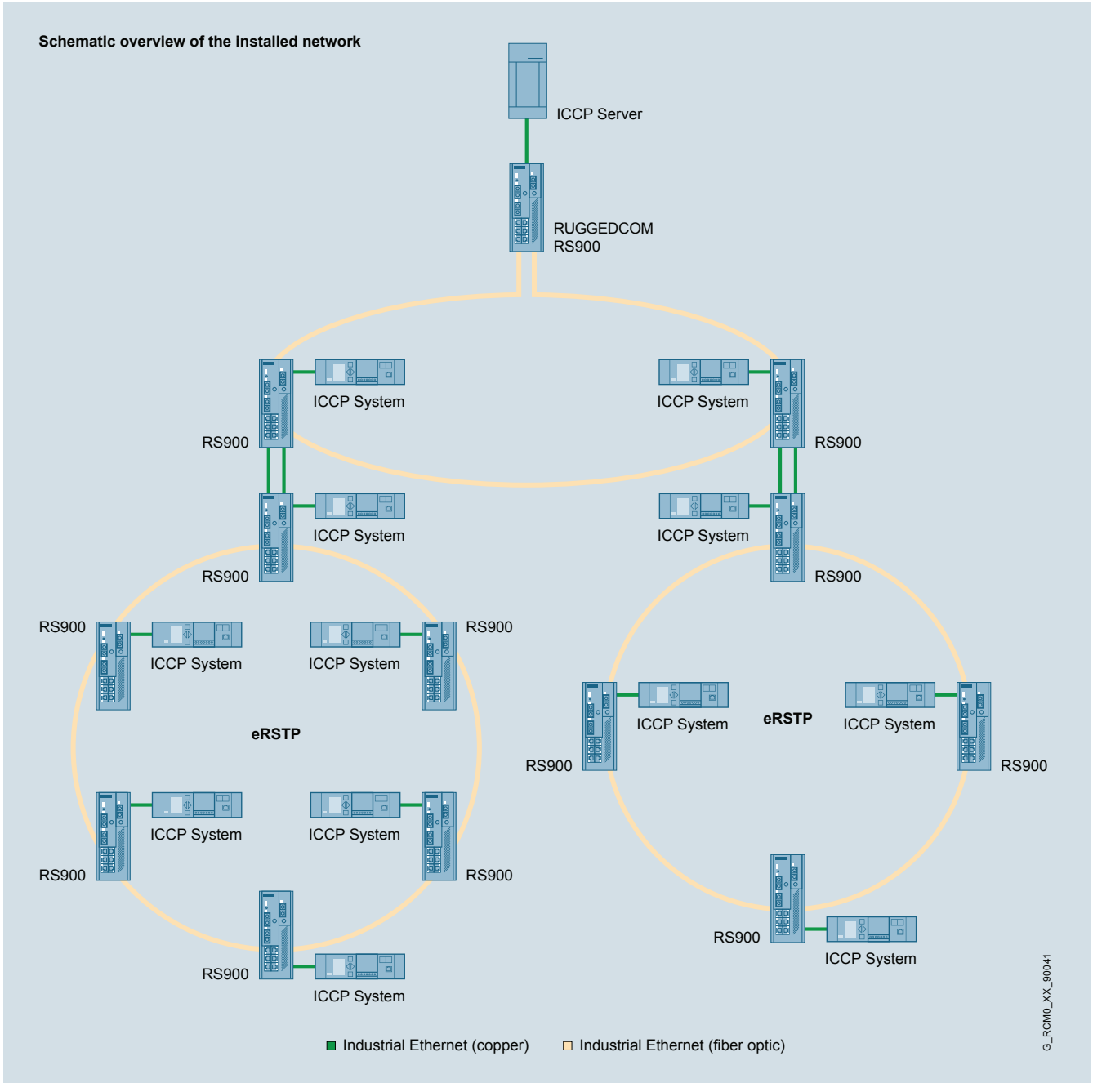
RUGGEDCOM RS900 – The RUGGEDCOM RS900 is a 9-port utility grade, fully managed Ethernet switch, specifically designed to operate reliably in electrically harsh and climatically demanding environments. The RS900 provides a high level of immunity to electromagnetic interference and heavy electrical surges typical of industrial environments such as those found in the power generation, transmission and distribution industry. An operating temperature range of –40 to +85°C (–40 to +185°F), together with hazardous location certification (Class 1 Division 2), allows the RS900 to be installed in almost any location.

As a result, a topology with maximum availability was chosen, which also includes fewer cables on the seabed.

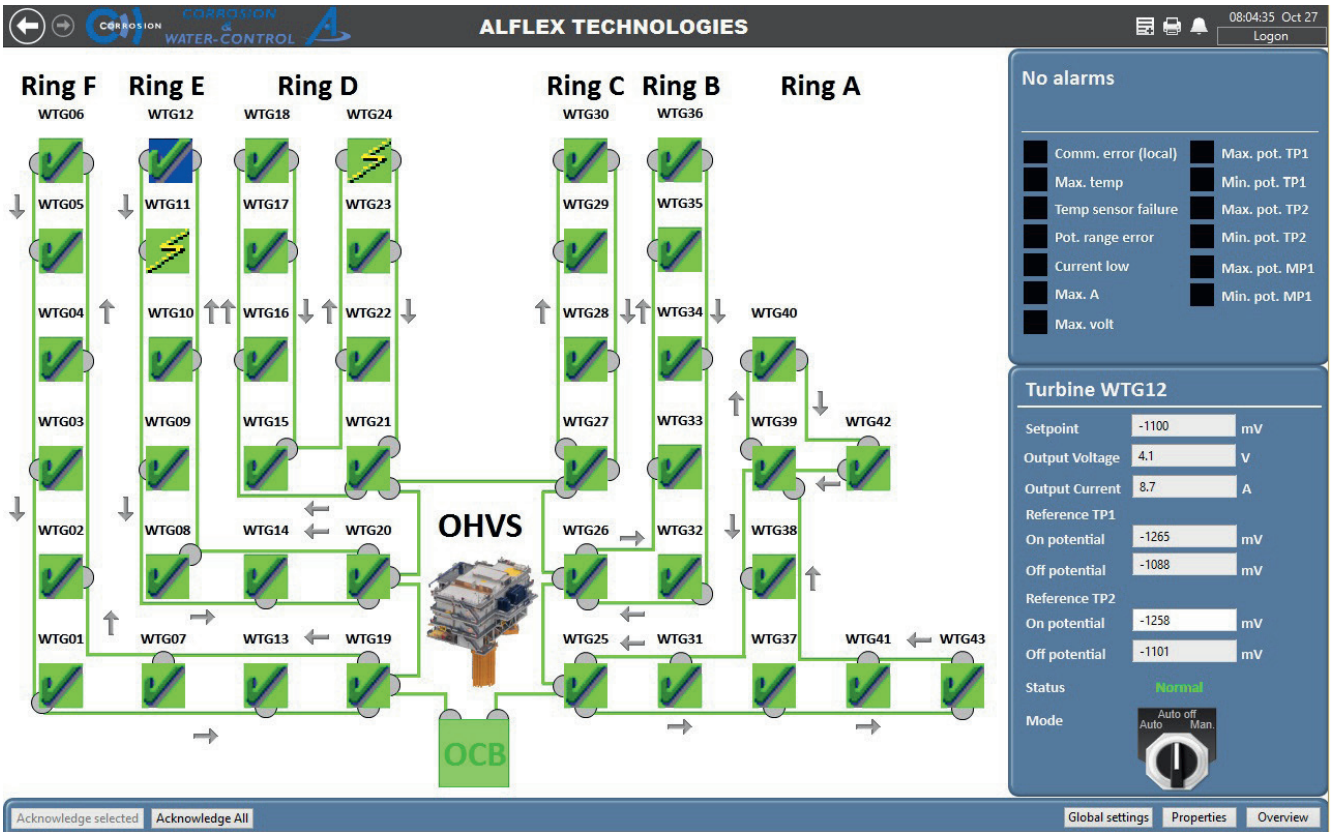
The turbines are divided into 6 sub-rings, so that a loss of connectivity or a malfunction in one of the sections would not have any functional impact on turbines in remaining sections. If two turbines were to malfunction this would have dire consequences if there was just one large ring. A connection to all turbines located between these two turbines would not be possible, which would mean that they would not be able to be monitored or redirected. Since directly connecting one turbine to the next would eventually require a very long fiber cable running between the first and last turbine, a topology that skips one turbine on the way to

Single-mode fiber optics have been implemented overall, which also enables the use of a general switch with the same built-to-order configuration. This is why the number of spare parts can be kept to a minimum and costs maintained at a manageable level.

According to Rob Vogel, General Manager of Alflex, *"We chose RUGGEDCOM products from Siemens because we had been looking for a rugged, stable and reliable network supplier. We deal with the offshore environment where it is absolutely necessary to have a reliable solution. We are very satisfied with the quality and the performance of the RUGGEDCOM solution, as well as with the support from the local Siemens service team."*



Alflex network design



SCADA system for the installation

The data link to land has also been evaluated in order to obtain an effective solution. A redundant configuration has been created, where two pairs of fiber optic cables run from the land to the central part of the turbines. At this point, the 6 ring networks meet.

Siemens provided strong support during the design phase, more specifically providing consulting services for the network structure. Various scenarios were tabled, and the pros and cons analyzed. Siemens also played a vital role when it came to choosing the switch type. The RUGGEDCOM RS900 with all of the required functions was finally selected.

The end customer has decided that networks need to be physically segregated, so that responsibility, management and maintenance are clear and any interference or contradictions relating to security are entirely preventive. The data captured from the anti-corrosion process cannot interfere with the other data retrieved from the turbines. This also functions the other way around: malfunctions or data from other parts of the turbine cannot influence of the anti-corrosion system.

Network security was another important issue.
By segregating the networks, an extra line of defence was created in order to transition from one network to the other. This also prevents mistakes. For example, if a service engineer changes the settings of the turbine, but inadvertently selects a wrong device – this would have no consequences for the other network. If a direct attack were to take place, the damage would also be limited to one of the two networks.

Given the fact that this was the first project where Alflex used RUGGEDCOM network equipment, a number of tests were first performed in an office environment. RUGGEDCOM switches have been used in a similar wind turbine project off the coast of England. The reliability and durability of these switches was remarkable, which was one of the factors that resulted in Alflex making their final decision.

The results

Despite no previous experience with the interface, the test phase was very successful thanks to its simplicity.

The possibilities and functionality of the switches was able to be thoroughly evaluated, and the switches received high scores. The time required to actually obtain the equipment was in line with Alflex's requirements, and its installation on the turbines ran smoothly.

"We are absolutely satisfied with the RUGGEDCOM solution and support from Siemens. We have made a strategic choice to use Siemens as a partner for future projects and we will offer the RUGGEDCOM components as standard in our network solutions for offshore projects in the future", says Rob Vogel.

Case study at-a-glance

Customer: Alflex Technologies, founded in 1991 in Zoetermeer, specializes in providing electronic solutions, thermodynamic systems, process management, measuring techniques and control engineering. Their portfolio spans various sectors – such as offshore and medical. Alflex Technologies manages an entire value-added chain for the design, development and production of their products.

Challenge: 43 turbines are located approximately 25 kilometers from the coast. Continuous monitoring, managing and data logging from land are very important, because physically visiting a wind turbine at sea can be costly and depends very much on the weather. A cheaper, more efficient and reliable solution was needed for managing this wind farm data.

Solution: an Ethernet network was built using the RUGGEDCOM RS900 switches from Siemens with the eRSTP redundancy protocol. Siemens worked closely with Alflex when designing the network and deploying the solution.

Results: Siemens network design addressed customer requirements and challenges when working in an offshore environment. RUGGEDCOM RS900 switches from Siemens delivered secure and reliable performance, cut costs, reduced project execution time and damage to the environment.

Security information

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions only form one element of such a concept. For more information about industrial security, please visit **www.siemens.com/industrialsecurity**

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