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Updated government regulations created a need for a major international oil and gas company to install a direct, real-time communications link at a platform located off the coast of Louisiana in the Gulf of Mexico. A new data concentrator system allowed the control room and drill ships to communicate at a distance of more than 100 km, providing security in case of an incident while avoiding costly shutdowns.

Figure 1. Rising more than one mile above the ocean floor, the Devil's Tower oil platform is one of the largest in the Gulf Coast.



Background

ENI Petroleum is an Italian multinational oil and gas company with around 78,400 employees at sites in 77 countries. ENI operates in the oil and gas, electricity generation and sales, petrochemicals, oilfield services construction and engineering industries. It has oil and natural gas production of almost two million barrels per day, with exploration and production efforts at sites throughout North American, Africa and Asia. One of these production locations is an oil well platform called the "Devil's Tower" that is located just off the coast

of Louisiana in the Mississippi Canyon region of the Gulf of Mexico. The platform rises 5,610 feet above the sea bed. Until 2010, it was the deepest production truss spar in the world. Drill ships perform periodic operations within close proximity to subsea pipelines that transport oil and gas to and from the production platform.

Problem

Platform operators were informed by the Mineral Management Service (a division of the Department of the Interior's Bureau of Ocean Energy Management, Regulation and Enforcement) that a direct, real-time communications link needed to be installed to increase safety if any wells are affected by a possible event such as a "dropped object" near a submerged pipeline.

If a potential hazard is recognized or communications are lost, the wells and pipes will be shut down and production stopped – a shutdown that costs \$100,000 a day in lost production. Therefore, this communications method must be proven reliable with an independent verification process in order to assure that unnecessary shutdowns are avoided.

ENI's original solution involved short range radio links in their control room and drill ships in communication with each other. However, new pipeline work done by ENI expanded the scope of operations to a distance greater than 100 km from the platform – farther than the operating scope of normal radios for this type of "over the horizon" communications link.

Considerations

- The communications solution must accommodate transmission distances greater than 100 km.
- The system must be reliable with built-in security and verification tools.
- Two-way voice radios are not appropriate to meet MMS requirements.
- A solution needs to be suitable for use on platforms as well as on drill ships.
- A simple, portable and automatic HMI was needed that was easy to install with little to no learning curve to the end user.

Solution

ENI uses an Ethernet network for most of the communications on its oil platform. This included the initial VOIP telephone conversation regarding their need to upgrade their existing system. The technology compresses voice messages and other data into small packets which can be pushed through an Ethernet network.

Remote Emergency Shutdown Device Improves Safety and Performance at Oil Production Platform

Figure 2. The Net Concentrator System (NCS) from Moore Industries has a Discrete Input Module and a Relay Output Module.



This network handles telephone, emails, weather updates, Internet and communications between the oil platform and the mainland. The Ethernet cabling is readily available in the control room and critical areas of the platform. Drill ships are large enough use the Ethernet satellite communications for the same important tasks.

ENI chose to implement a solution from Moore Industries consisting of a simple NET Concentrator System® (NCS) mounted on DIN rails. The data concentrator system has two Ethernet Interface Modules: one is coupled to a Discrete Input Module mounted in the drill ship's control room; the second EIM is coupled with a Relay Output Module and mounted in the oil platform's control room. Control programs run on the kernel level within the data concentrator; communications between the two assembled data concentrator systems are done via a standard Ethernet data communications layer that includes satellite communication. Addressing is done via IP.

The system uses an IEC 61131-compliant software configuration program, which sets up the data concentrators to collect contact switch input signals, timers and communicate with each other. The system has five standard languages: ladder, function blocks, structured text, sequential function charts and instruction lists.

ENI developed its own compatible application software to scan the input switch contacts and combine them into digital memory locations. These contact closures are packaged for transfer from one data concentrator to another via Ethernet by the EIM module. The receiving data concentrator disassembles the Ethernet data and places it into variables and memory locations to activate relay contact closures as needed. One-way communication is established when a contact closure at one data concentrator activates a relay on the other one.

Each data concentrator has its own unique IP address, allowing the EIM internal Ethernet communications to address and direct all levels of the OSI stack. Through this, the programmer only needs to provide correct addressing, while the EIM handles all communications protocols, retries, collisions, dropouts and other communications issues.

The drill ship data concentrator has a mechanically latching push button switch, while the oil platform data concentrator has a klaxon horn plus a set of contact closures connected to the control panel wired in failsafe mode. During normal operations, the data concentrator provides the operator with visual indicators, audible alarms (through the klaxon) and electrical signal connections to the control room panel.

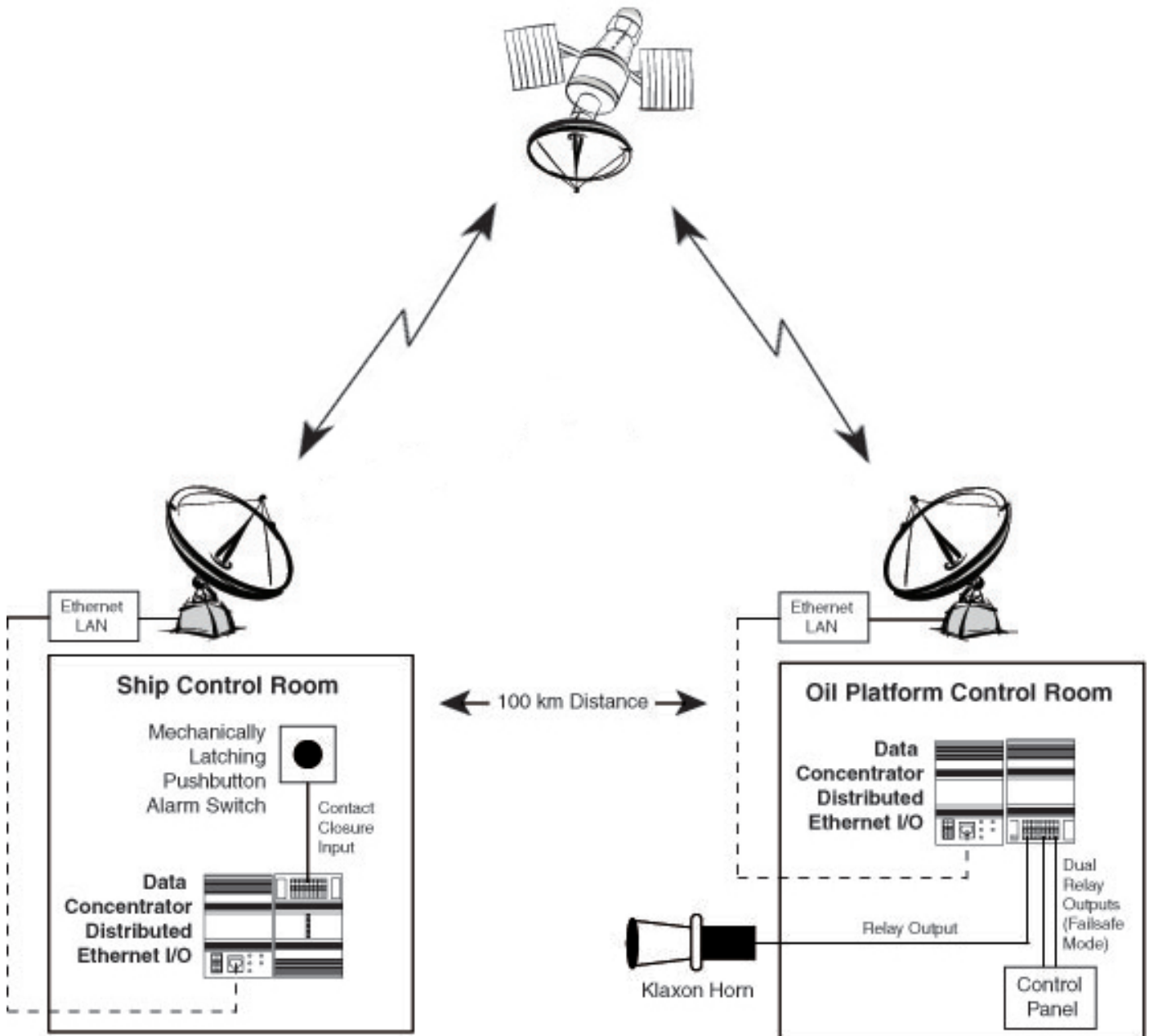
ENI needed to verify a continuous line of communications between the two data concentrators in order to satisfy the MMS directive on reliable communications. If the link is lost, the system automatically sounds an alarm. Normal communications include a bi-directional update of all data within each data concentrator every second along with a "watchdog" subroutine which monitors communications

Figure 3. The local node of the communications system developed for the Devil's Tower platform interfaces with a remote node to provide an integrated system for communicating potential problems between the control rooms of a control ship and the oil platform. The local node communicates with a network mode through the use of an Ethernet network and the NET Concentrator System (NCS) Distributed I/O data concentrator solution; local and remote consoles allow operators to take action should a problem be detected.



Remote Emergency Shutdown Device Improves Safety and Performance at Oil Production Platform

Figure 4. The control rooms of the Devil's Tower oil platform and its drill ship are able to communicate with each other through an Ethernet satellite connection at distances of 100 km or more by utilizing the NET Concentrator System (NCS) Distributed I/O data concentrator solution. A push button alarm switch on the ship alerts the oil platform control room of potential problems, and a relay output signals and klaxon horn.



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between data concentrators.

When the watchdog timer doesn't recognize valid communications between data concentrators, it times out and a "communications status" lamp changes from green to a warning color and sends a separate set of closed contacts to the control panel. Additional watchdog time delays trigger a second level of closed contacts and signals the end of the grace period for down communications to automatically initiate shutdown should human operators not be readily available to respond.

Testing

Initial testing on the bench confirmed the value of the system. After the data concentrators were secured via password protection, Ethernet port assignments were activated to allow data to flow through the Ethernet cables and be forwarded to the satellite link Internet providers. The reserved Ethernet ports were opened for the bi-directional access between the data concentrators along with for the laptop used by the service technicians to monitor activity between data concentrators and tap into the Ethernet at select points on the oil platform or drill ship.

Within one minute of the two data concentrators powering up, both communications lamps lit up green. One second after a technician pressed an alarm button as a test, the klaxon was heard from the oil platform control room over the telephone. The alarm was immediately silenced when the switch was cleared. Technicians also simulated a communications fault by removing an Ethernet cable from one of the data connectors. Communications alarms sounded on both the oil platform and the drill ship within seconds of the loss of the connection, while communications were restored about one second after the cable was reconnected.

Results

The data concentrator system was installed on schedule and remains in service. It has been proven to meet the requirements of the MMS directive for reliable communications for safety tasks along with expectations for performance. When severe weather briefly obstructs the satellite communications link, the data concentrator briefly goes offline with its appropriate signaling lamps. Upon restoration of the satellite link, the data connector's remote ESD recovers immediately.

ENI engineers have also considered adding bi-directional telemetry capabilities to each data concentrator, made possible by the reliability and simplicity of the system. Simply adding a DB25 cable to each data concentrator allows ENI to add up to 14 I/O data concentrator plug-in modules for transferring analog and discrete signals (including temperature, pressure and flow) and even feedback control signals. There is plenty of extra time for added telemetry on a non-interference basis because the Ethernet packet is burst in just a few hundredths of a microsecond for each data concentrator.

The Bottom Line

Implementing the NET Concentrator System has given ENI a reliable and durable communications platform, allowing it to operate its oil platforms safely from any range of distance. The low-cost solution helps ENI avoid costly shutdowns and maintain a regular production

Richard Conway is a private consultant in the field of industrial process control and safety systems. He is a certified functional safety expert and holds a degree in Mechanical Engineering. His background includes more than 13 years providing application expertise in the pulp and paper, chemical and mining industries with a major North American automation supplier and nine years of first-hand operational experience in the offshore oil & gas industry, focusing on regulatory compliance, safety shutdown systems and process optimization.



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