World’s Largest LNG Facility Poses Unique Challenges for Public Address/General Alarm System

Integrated PA/GA system sets new benchmarks for reliable performance, customized features, operator friendliness and streamlined maintenance.

Escalating demand for natural gas around the globe continues to bring the benefits of liquified natural gas (LNG) to center stage. Unprecedented growth within this segment of the energy marketplace coupled with ongoing technological advancements in gas drilling, processing, shipping and distribution are unleashing substantial investment across the LNG industry. And now, with construction well underway on the Qatargas 3 and Qatargas 4 projects—two of the world’s largest LNG developments—Qatar Petroleum and partners ConocoPhillips, Mitsui, and Royal Dutch Shell have taken an impressive step towards meeting the rapidly growing demand for LNG while reinforcing their positions of market leadership.

When combined with Qatargas 1, which has been in operation since the mid-1990s, and the soon-to-be-completed Qatargas 2, Qatargas 3 and Qatargas 4 will bring total annual production of Qatargas Operating Company Ltd. up to 42 million tons. Commenting on the aggressive pace of expansion, Mr. Faisal M. Al Suwaidi, CEO and Vice Chairman of Qatargas Operating Company Ltd., notes that Qatargas has been supplying markets in Asia since 1996, and will reach Europe in 2008 and North America by 2009. “By the end of the decade we anticipate to be shipping 42 million metric tons per year, with our marketing efforts reaching every corner of the world,” states Al Suwaidi.

Today Qatargas is viewed as one of the industry’s dominant players as much for its world-class facilities as the breathtaking volume of production it brings to the ever expanding LNG marketplace. From its state-of-the-art drilling, refining, processing and storage operations, to its impressive fleet of ocean tankers, Qatargas is clearly committed to being the best at what it does. Perhaps nowhere is this commitment to excellence more visible than in the advanced technology the company deploys to safeguard its employees as well as the environment.

With a keen awareness of the potential hazards posed by LNG as well as the other products (untreated field and plant condensate, helium and sulfur) processed at the company’s facility in Ras Laffan Industrial City, Qatargas has a reputation for being meticulous when it comes to critical plant and employee communication and warning systems. Most recently this predisposition for detail made itself evident in the specification of a Federal Signal PAGASYS public address and general alarm system to link all of Qatargas’ primary onshore production, storage and loading/off-loading facilities.

The PAGASYS public address/general alarm system is designed to achieve total integration with the facility’s security, fire and gas warning systems. In addition to offering the advantages of fiber-optics to provide a redundant and completely “self-healing” system, the network-managed PA/GA system incorporates a number of features, such as addressable speakers, user-friendly touch screen control panels and automated testing and diagnostics that will simplify both operation and maintenance while assuring the highest degree of reliability.

Qatargas is located in the Ras Laffan Industrial city in Qatar.
Fully Integrated PA/GA System Emphasizes Reliability through Redundancy, “Self-Healing” Features

As is the case with any major petrochemical facility, safeguarding personnel, the environment and the surrounding community are key issues that touch on all facets of specification and construction for Qatargas’ current expansion projects. The unique configuration of the PA/GA system that will ultimately link all of Qatargas’ production operations, administrative offices, tank farms, port facilities and jetties can be traced to Mr. Taha Ganadi, Head of Telecom, Qatargas Operating Company Ltd., and his team. With chief responsibility for overseeing system specification, Ganadi has worked closely with Federal Signal in customizing the PAGASYS public address/general alarm system to meet an exhaustive list of stringent operational parameters.

In terms of the scope of the project, Ganadi reports that the system, which covers facilities spread out across an area of 3.7 square kilometers, and incorporates approximately 3,000 individual loudspeakers, will rank as one of the world’s largest PA/GA systems.

Just how important is the PA/GA system to Qatargas? “Without the ability to communicate a hazardous situation to all of our workers, we would immediately shut down all production,” declares Ganadi without a hint of hesitation. In terms of lost production, the cost of such an event is difficult to fathom. Nevertheless, and as drastic as a total production shut-down may sound, it accurately reflects the importance Qatargas places on safeguarding its employees. It also demonstrates the critical role of the Federal Signal PA/GA system that Ganadi says is nothing less than the final warning employees receive in the event of an emergency.

Addressing key features of Qatargas’ ATEX-certified PA/GA system, Ganadi points to the use of fiber-optic transmission to link the facilities in, “… a redundant, completely ‘self-healing’ communications ring that not only assures reliability, but also speeds and simplifies maintenance.” Network management stands out as another key advantage of the system, as well as such features as “intelligent” addressable speakers, operator friendly touch screen control panels, and automated testing and diagnostics.

In detailing the system integration aspects of the project, Ray White, Director of Federal Signal’s Integrated Systems Group, explains that the PA/GA system is on line and integrates seamlessly with other facility’ systems, most notably the fire and gas detection systems. In the event of a fire or gas leak the general alarm system immediately activates audible signals as well as visual signals, which Federal Signal also supplies as part of the fully integrated PA/GA system.

The software-based distributed system controls both inputs and outputs. Illustrating another important benefit of the system, Qatargas is able to define their own custom reactions for inputs received from the various fire and gas detection sensors located throughout the facility.

According to White: “The ISMT [Intelligent Speaker Monitoring and Tapping] and self healing fiber optic ring network provide the highest possible level of system integrity. Each rack is equipped with hot standby amps that assume the load in the event an individual amp fails, and failed amps can be quickly replaced on a powered system. User controls and fault reporting can be accessed on either the local LCD display or remotely via the Federal Signal GUI (graphical user interface)-based application.”

The PAGASYS system, which facilitates both central and decentralized system monitoring, also has the ability to automatically generate email notifications if a failure does occur.

Discussing the fiber-optic ring, Ganadi notes that it simply would not be cost effective or practical to run standard network cabling because of the distances involved for a facility of this size. In this case, the nodes of the system are tied together via fiber-optic cable. “The system is designed in such a way that if the fiber is broken it will re-route communication to the rack through a self-healing ring,” says Ganadi.

“Think of a circle with all the nodes placed on the circumference,” explains White. “The data is being routed around the circumference and stops at the appropriate location. If the circumference
of the ring is broken then the signal can still get to where it needs to go by reversing or re-routing itself back to the designated controller.” White contends that Federal Signal is the only company that is capable of deploying this type of networked audio system without syncing or latency issues.

“If a component in the system does fail [i.e. DSP card or audio input from an access panel] the redundancy in the system automatically re-routes audio inputs via other control frames to ensure full system operation at all times,” adds Ganadi. “Even if the control frame fails completely, direct audio analog input is still available at the rack.”

Confirming that every aspect of the system is monitored, Ganadi emphasizes that the initial specifications demanded that there is no single point of failure, either by re-routing or duplication of system components. The supplied system meets these exact requirements.

Network Management Offers a Productive Tandem of Flexibility and Cost Effectiveness

Describing the features and benefits of network management as being similar to what the internet offers as opposed to the postal service, White says that the PAGASYS PA/GA system represents a huge advance over previously available technology. Perhaps the most noticeable benefit is the reduction of infrastructure, which represents a substantial cost savings.

“A system that enables users to distribute data and information over a network is a lot quicker and much more efficient than one that depends on discrete wires and relays,” adds Ganadi. “A network-managed system also accommodates a broader range of media, such as audio and video. By eliminating the use of relays, it also allows the user to pass ‘smart’ information rather than just discrete [i.e. “ON” and “OFF”] data.”

Network management is a proven methodology that is now standard throughout the MIS community. Standard Network Management Protocol (SNMP) gives Qatargas the capability to monitor all wires, networks and fiber optics in the system. “Not only does this make maintenance much easier, it also assures a higher degree of system reliability,” says White. Summarizing, he muses on what it must have been like in offices 20 years ago before the advent of email.

When Is One Alarm Tone Better than Two? or Three? or Four?

Though the PAGASYS system is capable of providing hundreds of different alert tones, the Qatargas system employs just a single alarm tone, thereby eliminating the need for people to memorize a multitude of tones and their associated meanings.

Elaborating further Ganadi says, “…with only one tone there is no confusion—action needs “to be taken.” Once the tone sounds it is immediately followed up with more detailed voice instruction over the PA system. Pointing out that there are more than 38 different nationalities working at Qatargas facilities, Ganadi stated that an automated weekly test routine was introduced that uses plain, accent-free announcements to familiarize all personnel on site with the ALARM/ALL CLEAR signals.
Automated Testing and Diagnostics Streamline Maintenance Requirements While Preventing Costly Production Disruptions

As expansion continues, the trains for each facility have grown progressively larger. While the first production trains had capacities of 2.3 million tons-per-annum, the newer trains have three times that capacity. “With the larger trains there’s a significant increase in the number of speakers and visual signaling devices that are necessary. That means a corresponding increase in maintenance requirements,” says Ganadi. “However, due to all of the automation and information being provided, diagnosing a problem or identifying a failed piece of equipment can be accomplished rather quickly.”

“Maintenance on a big system like this is a major task,” concurs Gordon Riddiough, Business Development Manager for Federal Signal’s Integrated Systems Group. “After system reliability, maintenance is undoubtedly the single biggest concern.”

“Detailed reporting of maintenance requirements is instantaneous, with all data being recorded in logs that can be reviewed after the fact,” says Riddiough, who goes on to stress that the system’s self-diagnostics enable Qatargas to maintain their system with a limited staff. Ultimately, the equation is quite simple: less people, less time, less cost.”

While SNMP goes a long way towards simplifying maintenance requirements, it is not the only maintenance-related advantage of Qatargas’ fully integrated PA/GA system. Ganadi takes particular note of Federal Signal’s “intelligent” addressable speaker units, which eliminate the need to shut down production for routine maintenance issues by providing digital monitoring of speakers and remote volume adjustment.

One of the PAGASYS options being employed in the Qatargas PA/GA system is the Intelligent Speaker Monitoring and Tapping (ISMT) module, which both simplifies installation and increases whole-life system integrity. Just as importantly, the ISMT module provides the capability to periodically and automatically check each loudspeaker for faults. Considering that the Qatargas system has approximately 3,000 speakers this translates to a significant advantage, especially when the only other alternative would be to conduct periodic walkthroughs to find a bad device. In addition to the time savings, the automated testing available through ISMT ensures that the Qatargas PA/GA system is continually maintained at the highest possible level of readiness.

The Qatargas facility at Ras Laffan Industrial City is a huge operation, at one point approximately 12 kilometers across. Consequently, tracking down a faulty speaker, or even performing routine volume adjustments can be very time consuming. Beyond the sheer size of the facility, numerous security checkpoints further add to the time it takes a technician to reach a faulty speaker. For this reason, it’s no wonder Ganadi cites the ability to recognize and diagnose a problem from a remote location as an extremely important, time-saving benefit.

As already mentioned, if a situation occurs when it is determined that communication with employees at any location within the facility might be at risk Qatargas shuts down production—regardless of the cost that would be incurred by such a disruption. By constantly monitoring loudspeakers for failure, ISMT promotes a dramatic reduction in maintenance hours. Pulse-width modulated, Class D amplifiers are designed to operate with greater than 84% efficiency in order to minimize heat generation and prevent power surges at start up. In the event of an amplifier failure, the system automatically re-routes the signal through a standby amplifier. Because amplifier reliability is so critical, testing required powering up each and every unit for a half-hour without cooling fans. This testing process is particularly relevant to the Qatargas project where an air conditioning failure would quickly result in extreme temperatures that could lead to device failure.

Ganadi contends that the reduced weight and footprint of Federal Signal’s digital amplifiers is another welcome benefit, especially in light of the fact that space in technical rooms is very limited. In fact, due to the Class D design, the amp is one-quarter the size and weight of a
traditional amplifier. To those who think that this is not a particularly noteworthy advantage, Ganadi might just suggest that they pick up a conventional amp and try carrying it for a couple of miles in 130-degree F temperatures.

If a Picture is Worth a Thousand Words, Qatargas’ PA/GA System Has Plenty to Say When it Comes to Operator Friendliness

The PAGASYS system is equipped with GUI (graphical user interface)-based system control and configuration software. The field-configurable system does not require custom factory software to make changes, which not only promotes faster, easier installation, but also simplified modifications in the field. With just a “point and click,” users are able to program settings into the non-volatile system memory. For obvious reasons, there are a number of built-in protections against modifications by unauthorized users.

“The easy to understand touch screen graphical user interface (GUI) control panels allow technicians to modify the system configuration on site without requiring the support of a software engineer,” says Ganadi. Additionally, the GUI provides an access point for status and data collection. In addition to Local Access Panels (LAPs), Global Access Panels (GAP) are located throughout the facility.

Qatargas 3 and Qatargas 4…the Most Recent Stage of an On-going Relationship with Federal Signal

Qatargas’ association with Federal Signal began with the Qatargas 1 operation. Though not assigned the original contract, Federal Signal was called in shortly after Qatargas 1 began production.

“There were many shortcomings to the general alarm system, which were due in large part to the absence of network management,” says Ganadi. He goes on to explain that while the original system was able to detect faults it was unable to pinpoint the location of those faults. “Instead of trying to improve the existing system the decision was made to completely replace it.”

This prompted Ganadi to completely re-write the Qatargas 1 system’s specifications in 2000. After evaluating bids for a replacement system it was determined that Federal Signal was best equipped to meet their requirements for a fully integrated, network-managed PA/GA system.

“Probably the biggest reason we have such a strong relationship with Federal Signal is due to the fact that not only were they able to meet our specifications, but that they clearly understood what we were trying to accomplish,” says Ganadi. Federal Signal’s amplifiers are highly efficient and one-quarter the size and weight of a traditional amplifier.
Signal ultimately responded to all of Qatargas’ goals by developing a fully redundant, network-managed PA/GA system that could interface seamlessly with the facility’s other systems. In the wake of the success of the replacement system for Qatargas 1, Federal Signal’s product line has remained well positioned to meet Qatargas’ needs in subsequent phases of expansion, including the Qatargas 2 project.

Ganadi believes firmly that there is a culture of safety. And for organizations that share that belief, safety comes through as a predominant feature of just about everything they do, even the little things. To illustrate why he believes Federal Signal is solidly in that category Ganadi relates a recent visit to Federal Signal’s technology center in University Park, IL for a Factory Acceptance Test (FAT).

“For the FAT, Federal Signal took added steps to simulate real-life working conditions. Everything was neat and clean … the documentation was thorough and easy to follow. I confess I was even impressed with the care Federal Signal’s integration team took to protect interconnect cables. It’s clearly evident that they take safety very seriously.”

Ganadi concludes by stating: “Though I’ve been involved with numerous FATs down through the years, I’ve never seen this kind of simulation.”

Ganadi notes that you often hear people citing the adage, ‘Build it like somebody’s life depends on it’. As construction on the Qatargas 3 and Qatargas 4 projects moves ahead on schedule, these words accurately reflect the company’s efforts to strengthen cooperative relationships with suppliers such as Federal Signal that share Qatargas’ commitment to safety in everything they do. <
Custom configurations and suites are also available as part of a Federal Signal Total Solution.