ADVANCE EMERGENCY MANAGEMENT IN GAS PIPELINES INCIDENTS

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Abstract

Advance Emergency Management applies well-established technologies in communications, control, electronics, and computer hardware and software. Advance Emergency Management in gas pipelines is intended to reduce notification and response time and mitigate the environmental impacts of gas pipelines incidents. The research reported in this paper attempts to reduce emergency projecting response times by usage of several modern technologies such as ILI, GIS, ATLAS, AVL/GPS and etc. [1]

Introduction

Natural gas is a nontoxic, colorless fuel, about one third lighter than air and has no smell in its natural state. Natural gas has a limited flammability range and a high ignition point. When mixed with air in the right proportion and ignited by a spark or flame, natural gas will burn or explode.
Natural gas is usually distributed in both coated steel and plastic pipelines. Steel natural gas lines may have pressures from 35 pounds per square inch to over 500 pounds per square inch and can be up to 24 inches in diameter. Plastic natural gas lines may have pressures up to 60 pounds per square inch (Intermediate High-Pressure) and can be up to 8 inches in diameter. Plastic natural gas lines will have a coated copper wire running parallel to the natural gas line. This wire is for locating purposes. [2]

Most distribution natural gas lines are not marked, except for temporary markings after someone contacts the one-call system. Pipeline markers indicate the approximate location of the high pressure pipelines and some larger Intermediate High-Pressure lines in rural locations. Pipeline markers bear the company name and emergency telephone number.

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Distribution natural gas mains are buried underground with service laterals installed for industrial, commercial and residential customers.
Natural gas has an excellent safety record and gas emergencies are not common. However, we believe people should know how to recognize and respond to a natural gas emergency if one should occur. [2]

A gas emergency is any gas-related event that: threatens the safety of any person or property; that causes damage to any part of the gas supply chain; that threatens the ability of the gas delivery system to meet customer demand; or that has the potential to do any of these. In many emergencies several of these events may be combined.
Most jurisdictions currently have a classification of gas incidents and emergencies, which provides for different levels of incident/emergency severity. The levels escalate from minor incidents such as a gas service pipe rupture affecting a small number of customers, to loss of gas supply jeopardizing the integrity of the gas supply network. [5]

Major Causes of Gas Pipelines Incidents

Damage to gas pipelines in Iran occurs most often because of these major causes:

- Earthquake
- Flood and river bank situations
- Mountainous regions
- Old age pipelines
- High populated regions close to pipelines
- Land sliding

Possible Signs of a Gas Pipeline Leak

Pipelines can be accidentally hit, dented, scraped or gouged. Sometimes, there may not be any apparent damage to the pipeline. When a pipeline is damaged, the supply of natural gas to homes and businesses could be interrupted. A damaged pipeline can leak natural gas – possibly causing fires, explosions or asphyxiation. Possible signs of a gas pipeline leak are usually: [6]

1. A blowing or hissing sound
2. Dust blowing from a hole in the ground
3. Continuous bubbling in wet or flooded areas
4. An odor similar to the smell of rotten eggs
5. Dead or discolored vegetation in an otherwise green area
6. Abnormally dry or hardened soil
7. Flames, if a leak has ignited

Prevention Management

Pipeline Safety
According to Federal Program and Reauthorization Issues, DOT statistics indicate that excavation damage, by such third parties as construction companies and highway crews, is the major cause of pipeline accidents for natural gas transmission and distribution pipelines. Excavation damage is the second leading cause of accidents for hazardous liquid pipelines, after corrosion, according to DOT. Other major causes of pipeline releases include material defects and pipeline operator errors. Significant releases from pipelines happen infrequently; however, when they occur, they attract much attention. [8]

In order to reach high preparedness during gas pipelines incidents, four emergency exercises and four leak inspection emissions are being held annually in Iran.

Pipeline Integrity Management

Pipeline management requires a delicate balance of many factors, including technical and managerial skills, financial resources, and environmental compliance. As pipeline infrastructures age, inspection and maintenance programs are needed to maintain integrity, promote longevity and incidents reduction. However, the selection of appropriate, yet cost-effective, methods is still widely considered to be more of an art than science. There are numerous factors to consider in pipeline management: design, construction, operation, protection, inspection, maintenance, repair and rehabilitation.

A key management tool involves qualitative and quantitative or probabilistic risk assessment (including both hazard identification and evaluation), as well as risk control and reduction. Performance monitoring and evaluation through periodic reviews of the management system also are important. The goal of such programs is to use inspection, monitoring and maintenance to prevent structural integrity problems, especially those that jeopardize public safety or the environment.

There are three aspects to consider in dealing with pipeline integrity: prevention of loss, detection of loss, and response in the event of loss. To prevent loss of integrity, pipeline inspections are a fist-line defense.
Furthermore a GIS map with several important layers such as populations, earthquake zones, flood vulnerable regions and etc can be a valuable help. [7]

In-line Inspection Technology to Detecting Mechanical Damage

Mechanical damage is the most common cause of pipeline incidents for both gas and hazardous liquid pipelines. Many of the incidents are in areas previously located in sparsely populated regions, but as construction and populations have expanded, are now located within and adjacent to significant population centers. Pipeline operators, in addition to everyday operations, must now take into account the activities on and near pipeline right-of-ways that occur as municipalities and industrial centers expand.

Accurately determining areas that have been subjected to mechanical damage has become one of the priorities facing pipeline operators today. As in-line inspection (ILI) tools become more sophisticated, the expectations of accuracy in identifying certain features are considerably higher than was the case as few as ten years ago. Operators are being encouraged to make greater utilization of the inspection technology and tools available; and with the additional information provided from these tools and other methods, maintain or improve upon an already exemplary safety record.

The need for a safe, reliable, and efficient pipeline system becomes more crucial as energy consumption continues to increase. To that end, helping to provide a safer and more efficient delivery system may be one of the benefits of the second quadrant magnetic flux leakage (MFL) technique.

Advance Emergency Management

Applications and Technologies

Several applications and technologies can be deployed and integrated to support gas emergency response work: [1]

- ATLAS – Automated mapping (AM), Facilities Management (FM) and geographic information system (GIS). The automated mapping component captures gas and electric distribution maps, and detail plates along with other graphical layers used to design new gas and electric facilities. The FM component interfaces to existing

corporate gas and electric business databases that store "facility" information (such as service pedigree and location) to the graphical images to provide intelligence to the network model. A landbase, which includes aerial photography (in the background) , includes vector features, road centerlines and edges and other features used to develop a spatially accurate depiction of gas and electric facilities. ATLAS interfaces with the Mobile Dispatch System to provide the geographical location of all gas work orders, and provides the landbase information and the vector information. It is also the basis for the Mobile Maps application.

- A geographic grid system, which was traditionally used to key gas and electric distribution maps and records and locate equipment into some grids.
- The Mobile Dispatch System provides real-time work order dispatching from the office to field crews. It runs on desktop computers and "hardened" laptops mounted in service vehicles. It allows any field personnel to obtain job information on their in-vehicle computers and to provide job status and completion information using the same device. Communication is done over public and private wireless networks.
- The SkyView application uses the ATLAS landbase and in-vehicle Automated Vehicle Location (AVL/GPS) to provide job location and a view of the crew's location relative to the service territory for the crew, dispatchers and supervisors.
- Mobile Maps provide crews with gas and electric drawings for the service territory. It is updated electronically when someone enters one of the wireless network access points (typically at a service center).

Figure1. Advance emergency management integrates the technologies in the left hand and results the benefits in the right.

Integrating technologies has led to numerous benefits: [1]

1. Team well being – field employees are able to locate and complete work more efficiently.
2. System updating directly – gas emergency information is updated more quickly and is immediately available to the dispatcher.
3. Safety – dispatchers use SkyView to pinpoint crew's location if there is a problem.
4. Effectiveness – wireless communication allows faster dispatch, a quieter control/dispatch room, and reduced dispatcher/field crew radio time. MDS coupled with AVL through SkyView provides a graphical representation of the work and the resources available, which help the dispatcher more readily identify the closest resource to reduce drive time.
5. Emergency response – because the dispatcher has the SkyView application, he is able to see his position relative the assigned job to determine the best route.
6. Cost savings – as a result of more efficient scheduling, the number of full-time employees has been reduced and over time reductions have occurred.

Mobile Mesh Networking Technology

New wireless technologies being developed may dramatically improve communications for defense among federal, state and local officials. Staying in touch by wireless e-mail has become essential during a national disaster such as a gas pipeline huge incident, just as it is during routine operations. E-mail has become the most used communications technology in organizations, even more than the phone.[4] But mobile communications can go down during a disaster. One way to keep the networks online being pushed by some technology developers is mobile mesh networking technology, which is based on a combination of mobile technologies and can be deployed very quickly when conventional mobile lines go down. One of these emergency-response new technologies is Iridium-based mobile telephones, which can help government and business set up emergency "command centers" after a disaster.

Response to Pipeline Incidents

In the event of a suspected natural gas emergency: [4]

1. Isolate the area and restrict entry to trained emergency response personnel.
2. Establish isolation zones based upon measurements from combustible gas indicator instruments. Gas odor or lack of gas odor is not sufficient to establish safe zones.
3. Avoid creating sparks. Potential ignition sources for natural gas include electrical motors, firearms, static electricity, non-explosion-proof flashlights or tools, and any open flame or spark. Do not light a match, start an engine, use a telephone, switch lights on or off, or do anything that may create a spark.
4. Immediately make the operator aware of the situation. Check the posted right of way or station signs to find out what company operates the pipeline and how to contact the operator.
5. Let the escaping gas burn if it is on fire. Attempting to extinguish a natural gas fire may result in a secondary explosion. If necessary, provide cooling for nearby exposures that are threatened by the fire.
6. Avoid forced ventilation of structures and excavations. Forced ventilation can actually increase the possibility of a flammable atmosphere.

If gas escaping from broken/leaking line: [2]

1. Turn off machinery and prevent other sources of ignition such as open flames, vehicle engines and the operation of electrical switches or cellular phones.
2. Evacuate everyone from the endangered area and prevent vehicles and bystanders from entering the area.
3. Do not attempt to make any repairs or operate natural gas valves unless instructed to do so by professional personnel.

If escaping gas catches fire: [2]

1. Evacuate the area and prevent others from entering.
2. Do not attempt to put out flames. Putting out a gas fire without stopping the supply of gas could cause a more serious danger.

If a fine is pulled, jarred, or if coating or locating wire is damaged: [2]

1. Stop all work and check for the sound and other signs of escaping gas in the area.
2. Do not attempt repairs or backfill until the related Gas Company has repaired any damage. Unrepaired damage to a gas line or coating will eventually cause a failure to occur. Unrepaired damage to a locating wire will cause difficulty in properly locating a plastic gas line in the future.

[4] Marty Hollander, vice president for marketing at Cemaphore Systems Inc.

Results and Conclusions

Since implementing the Advance Emergency Management, the number of emergency and potential emergency calls responded to in 60 minutes or less by four percent has been increased. The average response time for all jobs has also been reduced by more than five minutes – an improvement greater than twenty percent. Deploying AVL technology with the MDS rollout can be very suspicious. Emergency employees and dispatcher who use the system see first-hand the convenience of being able to immediately view where they are with respect to the job and view the best route to get to the job. Employees no longer need to waste time looking for directions on paper maps. They also appreciate the added measure of safety they feel because the dispatcher can see them, knows where they are, and is able to provide assistance should they need it. [1]

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