ESC engineering

project brief

Responding to High Tank Alarms in a Natural Gas Field Using **Integrated GIS**

British Petroleum approached ESC engineering with a need for a more efficient way to monitor and respond to high tank alarms. This was a necessity since a full tank can cause a shut-down in production at the well pad, and may result in a spill requiring extensive cleanup. Due to the remoteness of well locations, tanker trucks must drive to these tanks, empty the contents and drive to a disposal area.

Safety, spill prevention and production are the three most important factors to BP's operations, and implementing GIS technology to allow an earlier interpretation of SCADA information will improve all three.

SUMMARY:

GOALS:

- Bridge the gap between GIS map data and SCADA data
- Visually locate high tank levels on the GIS mapping system before spill occurs
- Track nearest water truck using an Automated Vehicle Location System
- Dispatch nearest truck to the alarm location
- Improve vehicle safety and efficiency by navigating to the well pad location

SYSTEM COMPONENTS:

- Access to real time SCADA data from field radio signal to office database
- Map display of high levels using symbols for quick visual recognition
- AVL hardware to track nearby assets
- Turn-by-turn directions generated by custom Garmin GPS application in each truck

HIGHLIGHTS:

- Fuel and time savings in the field
- Lessened environmental hazards of a spill
- Enhanced driver safety and response to well pads
- Improved overall operations and maintenance for the entire field

APPLICATION:

BP currently employs a response method in which the control operator examines a SCADA output table for high tank levels. When the operator finds a tank that needs to be emptied, calls are made to locate a water tank driver nearby who is available to go empty the tank. By contacting the list of drivers throughout the day, the operator has a vague idea about the status of each driver but lacks concrete information.

The current system offers several disadvantages:

- The control operator has to scroll through tables to find the tank high level alarms.
- The operator has to blindly call a list of water truck drivers to get their status, location and availability. Not only do drivers have to pull over and stop their trucks to answer the phone, but calling drivers in the wrong order also wastes time. If the operator cannot verify every driver's distance from the location, they could be sending a truck unnecessarily far, which takes time, uses fuel, and creates a higher potential of a driving accident.
- The drivers must rely on their knowledge of the field and on paper mapbooks to find the particular tank at well pad site that needs to be emptied. Not all new drivers are familiar with local roads—including unmarked turns and variable conditions—or the location of each tank, and the paper mapbooks can be slow way to search for directions. The mapbooks do not show all minor roads so it is common to miss a turn or turn too early, to get lost, or have to make unnecessary turnarounds.

REQUIREMENTS:

To link the current SCADA system to GIS maps, ESC engineering designed a solution that involved:

- adding "ID tags" to each location that would match the SCADA information
- joining the SCADA and GIS systems in ArcMap
- building a map to symbolize all the potential alarms in a simple and easily viewable way
- writing queries to parse out old or dated info that would count as false alarms

CHALLENGE:

The field is a remote area with poor cell phone coverage, so ESC engineering's approach uses Automated Vehicle Location (AVL) units that have a satellite option, enabling information from trucks out of cell range to be automatically transferred to the satellite-based GPS mode. Many of the roads are private roads that are not on general maps, so ESC engineering planned to utilize the road data layer previously generated for the GIS maps and converted it into a custom Garmin data format.

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SOLUTION:

ESC engineering's approach was to link the current GIS mapping system to the client's SCADA system. Using a GIS map in the control room, operators are able to respond to high tank alarms by AVL marker proximity on the map, dispatching water trucks using up-to-the-minute vehicle location data. Each truck was also equipped with an off-the-shelf Garmin GPS unit loaded with a custom data set. Because of Garmin's large investment in creating a reliable vehicle navigation product for the mass-market, this solution proved to be easy to use and relatively inexpensive.

The new system presents several advantages:

- As the SCADA values reach certain levels, symbols on a map of the entire field change to depict symbols of tanks that are approaching a high level. This map, like all GIS maps, allows the operator to zoom in and out, and it offers clickable high value symbols that display more specific data, including the level value and the date and time the level was reported.

- Water truck values are displayed on the same GIS map as the high tank levels, using an Automated Vehicle Locator (AVL) installed on each truck. With this integration, the operator can see where the trucks are in relation to each site, and where they are driving, without the need to make individual phone calls. The operator can also use the map to monitor drivers' progress, whether they are emptying at the disposal site and how often.

- Each truck's Garmin GPS unit features a custom dataset pre-programmed with all the well locations and minor roads, so that the driver can search by location name to get accurate, audible, custom directions.

RESULTS:

Because of its mapping component, the new system presents less chance that a tank alarm will be overlooked. Time, resources, and trip miles are saved by using AVL units to eliminate phone calls and ensure that the nearest available truck is always used to do the job. Individual navigation units reduce the potential for accidents by taking the best route and giving audible directions so the driver does not have to take his eyes off the road.

The execution went well, other than the time lost in unforeseen pitfalls encountered during implementation, which included:

- reconciling two SCADA systems and their two different ID tags. (The company headquarters in Houston was able to consolidate the systems and unify the IDs.)

- procuring the AVL data from the service providers' server. (We initiated custom programming to retrieve the data from the server and then populate a geodatabase.)

The link of the GIS to the SCADA system works smoothly and is a dramatic improvement over the former system. It is an impressive achievement to integrate multiple systems to work together. The operators in the control are pleased by tools they now have to do their jobs more effectively and the trucking company is experiencing increased efficiency in their operations. As more people use the GIS system, they learn about its potential uses in streamlining other aspects of company business.

The best part of the solution, however, is preventing tanks from overflowing and causing spills and production shut-downs.

FOLLOW-UP:

In addition to high tank alarms, ESC engineering is now linking and displaying other alarms that the SCADA monitors, such as high pressure in the pipelines and high temperatures at the well sites. The AVL is used for the night shift trucks as a safety tool to monitor their location in the field. The client is also considering installing AVLs on all vehicles for safety purposes.

The GIS, Garmin data, and AVL units are continuously maintained, therefore the life expectancy will match that of the SCADA system and the client's system of using trucks to empty tanks (as opposed to initiating the huge task to install pipelines). ESC engineering is partnering on additional GIS projects with this client.

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