BIOGRAPHICAL INFORMATION

Scott Mundy. P.E.
Director, Pipeline Integrity
CenterPoint Energy Pipeline Services

Specific Responsibilities

Joined Arkansas Louisiana Gas Company (now part of CenterPoint Energy) in 1980. Responsible for developing and implementing the pipeline integrity management program for the 8,200 mile CenterPoint Energy interstate pipeline system since 2002

Past Experience

Region Director responsible for operations, maintenance and construction activities on a 2,700 mile section of the CenterPoint Energy interstate pipeline system.

Served on task force responsible for developing the ASME B31.8S-2001 Managing System Integrity of Gas Pipelines.

Educational Information

B.S. – Industrial Engineering, University of Arkansas
M.B.A. – Louisiana Tech University

Professional Memberships

Interstate Natural Gas Association of America Pipeline Safety Subcommittee
National Society of Professional Engineers
Institute of Industrial Engineers

THE USE AND VALUE OF AERIAL IMAGERY
FOR
PIPELINE INTEGRITY MANAGEMENT

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ASTRACT

Imagery has been integrated with GIS over the past decade at varying levels of utilization. Recent technology improvements in hardware, software, and improved overall user understanding have made the integration of high-resolution imagery with GIS not only practical, but cost effective and expected in many cases. This paper will discuss the recent advances in high-resolution imagery, some of the uses, and their respective value. Topics presented include digital vs. film, LiDAR vs. traditional DEM collection, storage, retrieval, satellite vs. airborne acquisition, pixel size, among others.

CenterPoint Energy

CenterPoint Energy operates two interstate natural gas pipelines as well as a gas gathering operation pipeline services and three local distribution companies. The two interstate pipelines, CenterPoint Energy Gas Transmission Company and CenterPoint Energy-Mississippi River Transmission Corporation, together form one of the largest natural gas pipelines in the mid-continent United States. With more than 8,200 miles of pipe, its companies move approximately one trillion cubic feet of gas per year, which is five percent of the country's total natural gas volume. Its pipelines serve as a hub for the Midwestern states, serving customers in Arkansas, Illinois, Kansas, Louisiana, Mississippi, Missouri, Oklahoma, and Texas. The gas gathering company, CenterPoint Energy Field Services, Inc., operates 4,300 miles of gathering pipeline and moves more than 850 MMcf of gas per day from wellhead to market. The Pipeline Services subsidiary provides pipeline project management and facility operations to affiliates and third parties.

Challenge

About four years ago, CenterPoint began compiling, converting and collating pipeline data. These efforts were accelerated to address the anticipated new pipeline integrity rules that CenterPoint closely tracked. After considerable effort, some of this data was plotted on dated commercially available imagery. The team realized that correct geographic location of the pipeline was important to continue with efforts to address the forthcoming pipeline integrity rules, including HCA analysis and risk analysis. The challenge was to find a cost-effective method to locate the pipeline and surrounding structures geographically and still use the existing converted data. Two methods were reviewed and pilot tested: GPS locating the centerline of the pipe and all surrounding structures; and acquiring new aerial imagery for this purpose.

Process

A 185 mile pipeline was chosen for a pilot project. This pipeline was selected because it was a reasonable representation of the CenterPoint system and was large enough to test solutions that could be extended across the entire pipeline system.

In preparation for the aerial imagery project, field crews used line locators to mark the pipeline in pre-determined locations, such as road crossings and other easily accessed areas. At these points, the centerline was accurately located using traditional tools and the points were targeted with photogrammetric style targets that could be located from the resultant orthophotographs.

Figure 1. Pre-targeted pipeline

Considerations in the acquisition of the aerial imagery included: availability of existing digital elevation model (DEM), desired resultant accuracy, corridor width, sun angle, and pixel size among other parameters. Imagery was acquired at 1”=1000’ negative scale, scanned at one foot pixel resolution, the USGS DEM was used, and the photography was captured with a minimum 28 degree sun angle. The corridor width was a nominal 7000 feet.

Airborne GPS and IMU (Inertial Measurement Unit) were used to determine the precise location and orientation of each acquired image.

To perform the HCA analysis, this project required high relative accuracy of the structures as they relate to the pipeline. This was achieved by orthorectifying the imagery to the USGS DEM and using the pre-targeted pipeline points to route the pipeline on the orthophoto landbase.

Figure 2. Re-alignment of pipeline route.

After the pipeline was correctly placed on the imagery, structures were digitized as points to perform a preliminary Class and HCA analysis. This pipeline and structure information was overlaid on the imagery and plotted in a specific format to produce Field Verification Worksheets. Field crews used these worksheets to verify structures were for human occupancy, locate identified sites, and to QA/QC the office digitizing.

Field worksheets were returned to the office to use to edit the HCA and Class structure data. Final HCA and Class analysis were calculated using automated software. It was noted that using new imagery save significant field time compared to using older available commercial imagery. The existing centerline showed a wide variation of spatial accuracy dependent upon the method it was originally captured and loaded into the GIS as well as how it was maintained.

Conclusions

Some new techniques for the capture of pipeline imagery were employed along with some new techniques to automate calculations necessary to manage pipeline integrity and compliance. These new techniques provided improved efficiency and accuracy. Some important lessons learned include:

- Fresh aerial photography reduces costly field time. Freshness is determined by the growth and change rate in a given area.
- A picture is worth 1000 words (and 10,000 steps).
- We could locate and determine the extent of HCAs and Identified Sites easier with the view from above from the othos.
- Easy, good intuitive check of fit of centerline data. Not over-collecting/over-engineering accuracy of data. We didn't want to collect data at a more accurate level than we were willing to maintain.

The use of pre-targeting and pipeline routing can be effectively accomplished in conjunction with the acquisition of new, high-resolution imagery. Proper planning for the integration of the images, HCA, and updated centerline route data effectively address both internal maintenance needs and the data integration and improvement process mandated as part of the pipeline integrity rule.