Application of Navigation Systems for Real-Time, Large-Scale VOCs and Gas Detection at Remote Potential Spill Sites

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Background/Objectives. To carry out a large-scale environmental monitoring of an oil pipeline at a remote field site, to assess potential spill locations, Golder developed a dedicated system based on the use of a navigation system equipment. The system aims at real-time and fast collection of a large number of concentration measurements of VOCs and other gases on a mobile vehicle. The system also had to allow quick selection of areas needing more detailed field characterization, through localized soil gas surveys. The system thus had to support different investigation techniques and to be easily deployable in a variety of environments. The first application was on a 30 km onshore underground pipeline, including two oil pipes and one gas pipe and located partly on desert areas and partly on marshy areas. The climate is extreme, with temperatures varying from -30°C to +40°C. The second application was for the characterization of a remote and impervious site, where jet fuel was released after an air crash in a steep mountain area, requiring roped access.

Approach/Activities. To satisfy the project needs, Golder developed a system composed by equipment for real time positioning and data management and connected to a variety of environmental sensors. The navigation system includes a hydrographic data acquisition, navigation and processing software package, whose typical applications range from marine geophysical surveys to complex offshore constructions. The software package was used to manage in real time the differential global positioning system (DGPS data, average XY accuracy of 0.5 m) and compass, to store the acquired data and to visualize in real time the results on a cartographical environment. Devices for the pipeline monitoring included a portable photoionizing detector (PID, resolution of 0.1 ppm) for VOCs, an Off-Axis Integrated Cavity Output Spectroscopy (OA-ICOS) for Methane (precision of 2 ppb for sampling period of 1 s) and carbon dioxide, a meteorological station and hand drilling tools for field investigations in soil and ice. The system was vehicle mounted allowing for on-the-fly VOCs and gas concentration measurements along the pipe tracks. Where needed, hand-driven monitoring points were temporarily installed and direct field investigations quickly carried out, using the same acquisition system. For the characterization of the steep mountain Site, the system was carried on a rucksack, connected with a PID and a handheld control, allowing for automated collection of positioning and gas data.

Results/Lessons Learned. The system allowed for quick identification of potential impacted areas while travelling over the buried pipeline and on the mountain site. A large quantity of data was collected, in the order of 3000 reading per hour at the pipeline Site and 150 per day at the mountain Site. The data were collected and directly plotted in GIS with a significant saving of time and allowed understanding and modification of the sampling plan while doing the work. Navigation systems developed for marine applications has been proved to be conveniently used for environmental investigation on land. During the site works, positioning is available both in static and dynamic conditions. Its capability of real time management of digital data from sensors linked with geographical data results in avoiding time-consuming post processing operation, as the georeferencing of collected data. Future project include the use of the system for abandoned landfill characterization.