DESIGN, DEVELOPMENT AND EVALUATION OF A NOVEL SYSTEM FOR LOCALISED, REAL-TIME RADIOMETRIC GROUNDWATER MONITORING AT CIVIL NUCLEAR SITES: A UK CASE STUDY

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The regular monitoring of groundwater samples in and around civil nuclear sites is of key importance, both in terms of ensuring that any possible contamination resulting from leaks or spills is detected in a timely fashion and to satisfy the regulatory and environmental demands of government bodies such as the UK Environment Agency (EA) and Office for Nuclear Regulation (ONR). Currently, the periodic manual sampling, analysis and reporting process is resource heavy in terms of both the cost and time (sometime weeks) required to obtain, analyse and collate the data arising from measurements of groundwater samples.

Here, we present the design, development and evaluation of an innovative radioactivity monitoring system, based on LabLogic's 'WILMA', a liquid-scintillation-based analytical instrument, developed in conjunction originally with the US EPA [1]. This work focuses on the system development for field-based groundwater analysis that is being funded via an Innovate UK feasibility study R&D grant and undertaken in conjuction with the Land Quality team at Sellafield Ltd. in the UK. This extension of the WILMA programme is seeking to develop a system that aims to increase the throughput of groundwater sampling and analysis to provide full radiometric characterisation in real-time, as well as temporal trend analysis. The novel development described in this work focuses on the addition of features to satisfy the rigorous demands required for groundwater monitoring, including: direct sample acquisition from boreholes with sampling depths up to 50 m; sample pre-treatment and filtration; improvements to the lower limit of detection to enable more accurate quantification of key environmental radionuclides and a specific software package to automate the data acquisition and analysis processes. In addition, the requirements for remote operation, requiring high reliability, low power consumption and secure wireless data transfer, as well as resistance to fluctuations in the ambient environment over several weeks' continuous operation, have been factored into the design. The prototype system has now been developed and a comprehensive evaluation programme will begin at key borehole locations on the Sellafield site during the early Autumn of 2015, the preliminary results of which will be presented here.

Also described are additional future developments of the system, focusing on optimising the system for continuous ^{3}H measurement of sea water samples in the vicinity of the Fukushima Daiichi nuclear power plant and integration with a bubbler system to permit analysis of gaseous ^{3}H and ^{14}C in nuclear waste repositories, as well as providing capability for additional on-line analytical measurements at civil nuclear sites in support of decommissioning and other activities.

[1] US EPA Report EPA/600/R-13/228, published May 2014