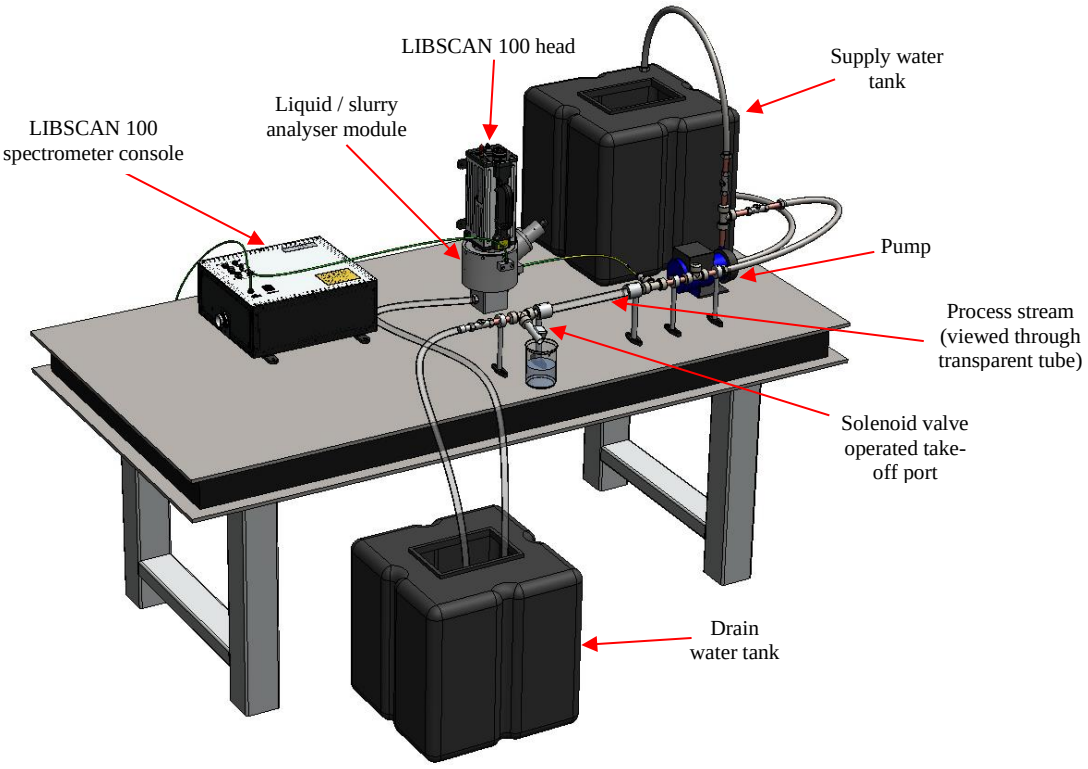
A technical demonstration of LIBS on-line analyser for liquids characterisation developed by APL

This was the third of three inactive technical demonstrations to show the applicability of LIBS technology in selected application areas of interest to nuclear decommissioning. The aim of this particular demonstration was to show the ability of APL's *LIBSCAN* technology to provide a means of performing on-line, real-time monitoring of the elemental composition of a process stream (aqueous sludge). A further aim of this inactive demonstration was to show how *LIBSCAN* may be used to detect in real-time significant changes in the elemental composition of the process stream and provide a signal to an automated sampling station so that a sample of the process stream may be acquired at the time of a significant change in elemental composition.

The demonstration rig is illustrated in the following schematic diagram and images.



To demonstrate the capability of the LIBS analyser, two simulated process liquid streams were used: i) tap water, and ii) tap water containing a suspension of magnesium hydroxide. The LIBS analyser may be "trained" to recognize a particular process stream by detection and analysis of the constituent elements. When an additional chemical "spike" is introduced, the LIBS analyser detects this and displays the chemical signature (eg. sodium, magnesium) and activates a solenoid valve which allows a sample of the process stream to be taken at the time when the chemical "spike" is present. Accordingly, the LIBS analyser is capable of real-time analysis of the process stream.

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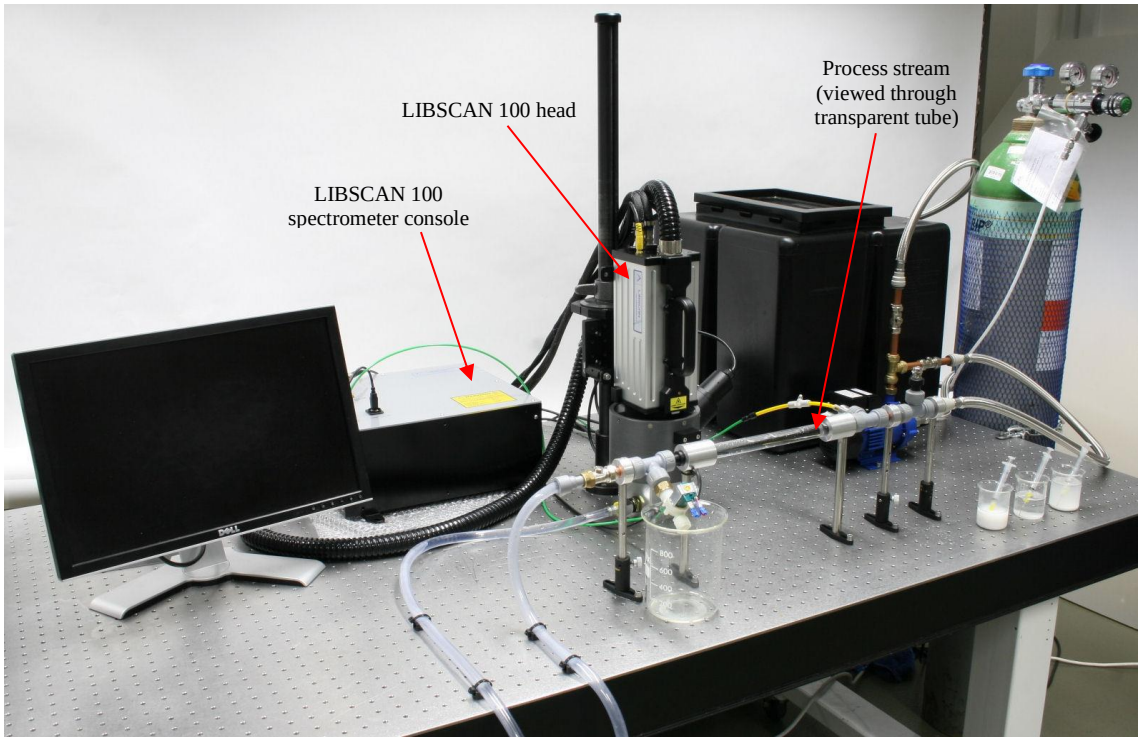
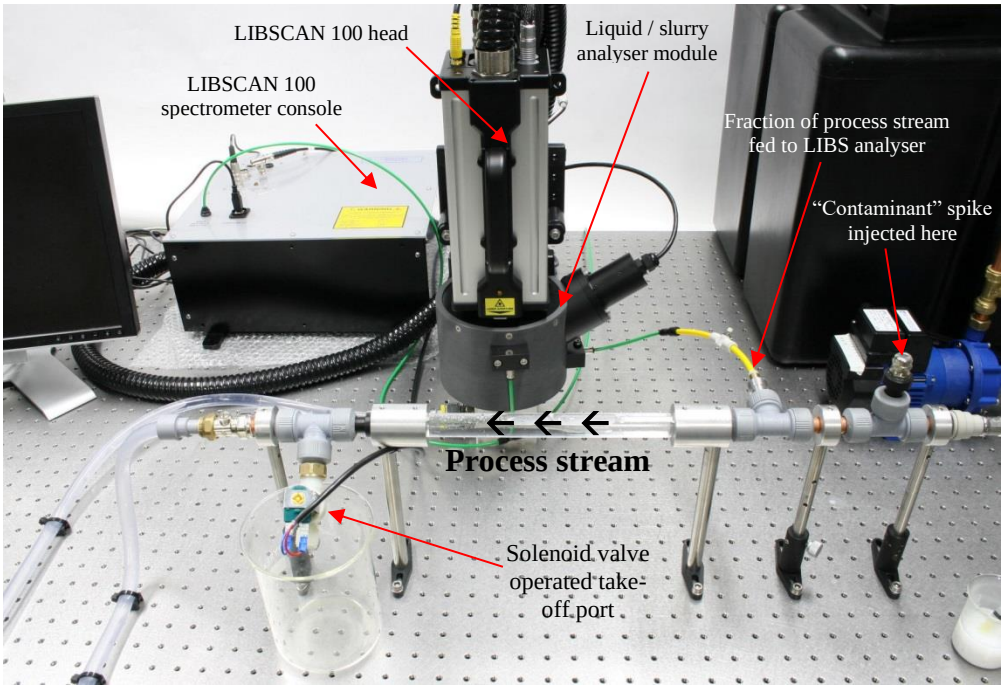


General view of the demonstration rig



Close-up view showing the simulated process stream flow and associated pipework

Process stream: Tap water

With the tap water process stream, two "contaminants" were used: i) saline solution, and ii) an aqueous suspension of magnesium hydroxide. The LIBS analyser was trained to recognize the tap water as being the normal process stream. The analyser system was set to perform an analysis every 10 seconds, although this may be programmed to be longer or shorter as required. The analyser was programmed to look for sodium (saline solution) and magnesium (magnesium hydroxide aqueous suspension) and to take a sample of the process stream whenever the concentration of either of these analytes exceeded an arbitrary amount. The system was set to run continuously and at various intervals a ~3 ml "spike" of either saline solution or magnesium hydroxide was added to the process stream by injection into a port located upstream of the LIBS analyser take-off port. On detection of the "spike", the LIBS analyser displayed the relevant chemical

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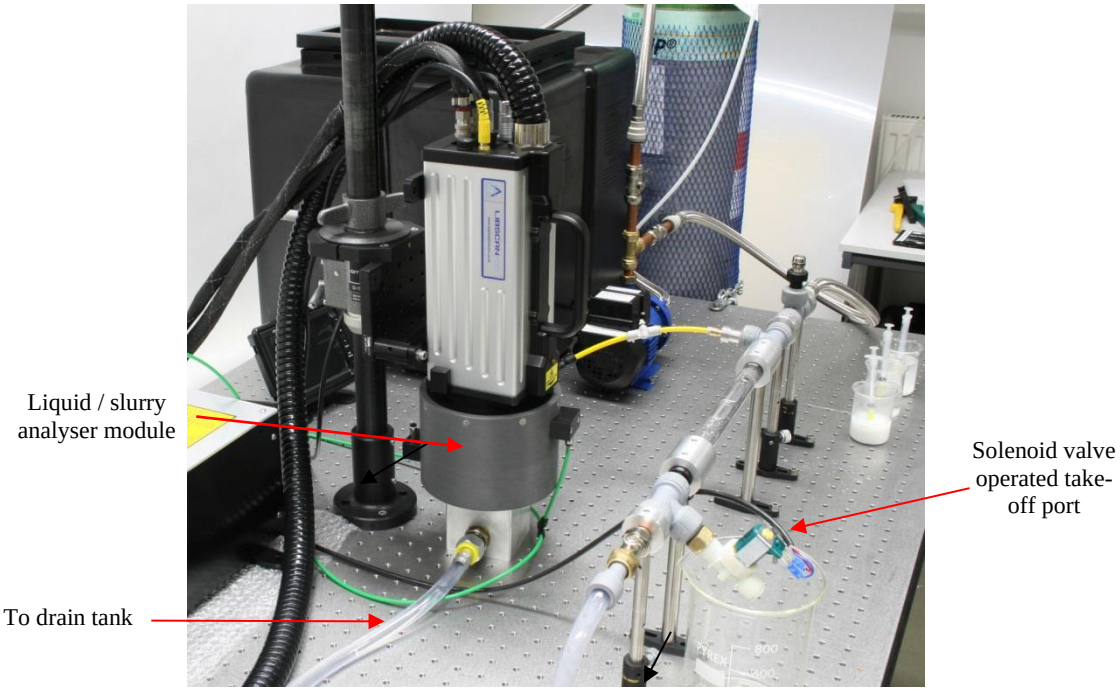
name on the computer monitor and opened the solenoid valve for 5 seconds to take a sample of the process stream. The LIBS analyser continued to analyse the process stream and, after the "spike" had been flushed through, the analyser showed that the process stream had returned to normal. This was repeated a number of times.



Close-up view of the LIBSCAN 100 head connected to the liquid / slurry analyser module

Process stream: Tap water containing a suspension of magnesium hydroxide

A further demonstration was conducted whereby the simulated process stream was tap water containing a suspension of magnesium hydroxide. The LIBS analyser was "trained" to recognize this as being the normal process stream and then a ~3 ml chemical "spike" of saline solution added to show that the LIBS analyser was capable of detecting this in a process stream of different chemical composition to that used in the first demonstration. This was repeated a number of times to demonstrate that the LIBS analyser was capable of detecting the saline solution "spike" and correctly detecting when the process stream had returned to normal.

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