

Utilising neutron backscatter technique to measure the level and interfaces of liquids.

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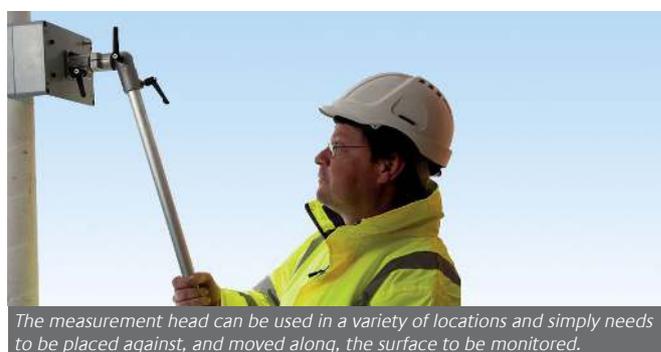
# Liquor Level Monitor

## OVERVIEW

Cavendish Nuclear's Liquor Level Monitor uses the neutron backscatter technique in a hand held instrument which measures the level and interfaces of liquids such as water and oils in vessels, tanks and pipes.

## KEY INFORMATION

- Detection of liquors in vertical pipes
- Confirmation of whether pipes are full or empty
- Measurement of fill height of tanks, vessels and pipes
- Detection of interface between different liquors
- Identification of blockages or slugs within pipes
- Simple hand-held deployment
- Real-time indication of liquor level
- Works through lagging, lead shielding and double skinned pipes
- Optimised to operate reliably in high gamma dose rate environments



## OUR PRODUCT IN DETAIL

### Applications

The Liquor Level Monitor can be used in a large number of scenarios where the position of the interface between different liquors, or between liquor and air, or between liquor and a solid needs to be known.

The Liquor Level Monitor uses neutrons to probe inside the object being measured, providing a measurement where other techniques, such as ultrasound, gamma-ray transmission or visual inspection, cannot be employed.

Other features include

- Detects liquor level in vertical pipes
- Identifies whether a pipe is full of liquor or empty
- Measures the fill height of a tank or vessel
- Detects the interface between different liquor types
- Finds solid blockages or slugs within piping
- Can detect leaks by identifying if lagging material is wet
- Identifies liquid levels in heat exchangers
- Can identify sludge levels within tanks

Access is only required along one external surface and it is not necessary for the probe to be in direct contact with the object being measured.

### Benefits

The neutron backscatter technique has several advantages over alternative means of detecting liquor levels.

- The technique is in-situ and non-destructive
- Requires access from just one side of the item
- The technique does not require the probe to be in direct contact with the object
- Simple hand-held deployment
- The measurement is fast
- Real-time indication of the presence of liquors
- Can detect levels through double skinned vessels
- Can operate in ambient gamma dose rates in excess of 8 mSv/hr
- Can operate where the liquor being monitored is active
- Works through lagging and lead shielding

The Liquor Level Monitor uses the

neutron backscatter technique in a hand held instrument to measure the level and interfaces of liquids such as water and oils in vessels, tanks and pipes.

The technique has been adapted by Cavendish Nuclear for use in the nuclear industry, allowing operation in areas that are both contaminated and have elevated ambient gamma dose rates.

### Description of the Neutron Backscatter Technique

The measurement head, deployed at the end of a hand held pole, contains a  $^{252}\text{Cf}$  sealed source, which acts as a source of fast neutrons, and a small  $^3\text{He}$  thermal neutron detector. The measurement head is simply placed close to, or preferably against, the pipe or surface which is to be monitored and then slowly moved along the surface.

Neutrons from the  $^{252}\text{Cf}$  source enter the pipe and are moderated to thermal energies if there is neutron moderating material in the pipe (such as water or any other liquor with a high hydrogen content).

Once the neutrons are thermalised a number of them will pass back out of the pipe towards the backscatter probe and its detector. As the neutron detector measures only the thermalised neutrons coming back from the pipe it will not detect the high energy neutrons coming directly from the  $^{252}\text{Cf}$  source.

The count rate being detected by the measurement head is shown remotely, at a small electronics module. The presence of liquor is indicated by a higher count rate, and the absence of liquor by a lower count rate. The interface between air and a liquid can typically be measured to within a few cm.

As the technique is based on neutron detection it is unaffected by the presence of common metals such as steel, lead and iron which have little effect on the passage of neutrons. As such the technique can successfully operate through gamma shielding, and double walled pipes or vessels. The probe can be calibrated for a variety of different liquors and pipe or vessel geometries.

The technique requires access to only one side of the item to be measured, and a measurement can be performed

in as little as a few minutes, enabling it to be successfully deployed in areas of high ambient gamma dose rate.

The calibration and configuration of the system have been optimised to minimise the system's sensitivity to gamma radiation, allowing it to operate reliably in gamma dose rates of up to 8 mSv/hr.

### Deployment and Operation

The Liquor Level Monitor's detection head is normally deployed by hand. A single cable connects the head to a small set of electronics at which the count rate is displayed.

The unit can be operated in one of two modes:

- It can be operated in a near-real time scanning mode where the head is continuously moved along the item being measured. A change in count rate indicates where there is a boundary or interface between liquors, or at a liquor-air or liquor-solid interface.
- It can be operated in a start-stop mode where the head is moved in discrete increments along the surface being measured. At each position a count is made, and this process is iterated to find any interfaces.

The near-real time scanning mode can be used to rapidly identify the approximate location of an interface. If a more precise measurement of the interface is required then the start-stop mode can be used to locate the interface to within a few cm.

### Measurement Service

The Liquor Level Monitor is available from Cavendish Nuclear as a service. The measurement head requires the use of a neutron source and so suitable procedures must be put in place for the use and, if necessary, storage of the source before and after use.

Optionally your staff can be trained to perform the deployment of the measurement head; this can be preferable if the head is to be deployed in an environment that would require additional local training for Cavendish Nuclear personnel.



### FOR MORE INFORMATION, CONTACT:

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