

Development of a new radiation monitoring tool for the oil and gas industry

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1 Purpose

The oil and gas industry has been involved with naturally occurring radiological materials (NORM) for a couple of years, especially at the so-called low-specific activity (LSA) locations. At these locations a wide variety of contamination-monitoring equipment is used. Regularly exceedings of the legislation levels are found in scale that accumulates in certain parts of the equipment. At this moment the current action level of initiating additional research to possible contaminated equipment is regularly set at two or three times the normal background count rate.

With the introduction of new radiation protection legislation in the Netherlands in 2001 this additional research is focused on determining the radionuclides causing the increased radiation level, and summing the risk-weighted contribution of these different radionuclides. Current legislation levels are based on as well the risk-weighted activity concentration and the total (estimated) massic risk-weighted activity of the scale [TK01].

After experiences of almost two years with this new legislation it has to be stated that by continuing the postulated and easily practicable current method of keeping primary action levels at two or three times the normal background radiation levels no good correlation can be found between "alarm messages" and - according to this new legislation - contaminated materials.

2 Methods and Materials

Since the current types of monitoring equipment show as a result of the intensive use during the year lots of technical and operational failures, NRG has started to develop a more sensitive and durable inner surface monitoring tool for tubing's with which the surface contamination can be measured more accurately and more reliable.

Thereby special attention was given to immunity to ambient conditions such as temperature and magnetism. With this new tool the alpha- and beta-activity can be determined much more easily and accurately than with the current monitoring tools.

2.1 Development concept

Starting the development of a new monitoring tool the current and to be expected legislation principles were studied. In the near future the detected contamination will be averaged on a surface of several hundreds of cm². On the other hand the internal diameters of the currently used tubings in the oil and gas industry led to design constraints. The first prototype, with a detector of 4 cm diameter (2 7/8 inch) and 25 cm length showed an intolerable dependency on magnetism. By adapting the internal shielding of the detector this problem was solved. The prototype and first generation detector were calibrated with NORM-scale plate sources of different radionuclide composition.

The response of the monitoring tool was determined with NORM-scale plate sources of different nuclide composition. During the calibration these plate sources are rotated around the monitoring tool determine the 360° response of the detector, thereby simulating a tubing. To determine the influence of larger tubing diameters the response of the detector was also measured with larger distances between rotating plate sources and the detector. It was concluded that the characteristics of this measuring instrument are valid for tubing diameters up to 12 cm. To ensure proper working in more difficult weather situations the response was also determined at -18 ° and + 37° Celsius.

Finally, regarding the experimentally determined correction for the scale thickness of the inner surface contamination, a general response factor in Bq/m² per cps can be given for the NRG-COMET. With this response factor the estimated contamination level can be derived easily [Tu93]. When new legislation levels for the contamination should be determined in the near future, the NRG-COMET can be a very helpful tool to determine the level of surface contamination in an accurate and reliable way.

3 Results

When using measuring equipment in the working area some uncertainties are introduced. NRG determined for several types of equipment the dependency of the resulting signal output on scale thickness. In general, the response decreases a factor 4 from very thin scale thickness to large-scale thickness, mainly as a result of

self-absorption of the nuclides in the scale. Also the nuclide composition of the scale contributes to an extra uncertainty: if the scale consists mainly of Ra^{226} also alpha-emitters are detected, but when only Pb^{210} is involved only beta-emitters will contribute to the measuring data. This means when no information is available of nuclide composition a conservative approach has to be taken account, possibly resulting in overestimating the activity concentration of the contamination. For the scale thickness in general an average will be assumed. Only in the situations where nearly no scale or just a thick layer can be observed there should be corrected with a factor 2 [NR03].

4 Discussion and conclusion

A wide variety of radiation monitoring equipment is currently used in the oil and gas industry. Regarding the geometry's of this equipment nearly no adequate instrument is available to fit well to the future legislation on surface contaminations. Especially for tubing's NRG developed the NRG-Comet, consisting of standard available components. Not only the durability of this new monitoring tool is impressive, also the response characteristics of the NRG-Comet are. With this tool the workers in the oil and gas industry should be able to perform surface contamination measurements easily, reliable and quickly, and also in agreement with the new legislation's of the Dutch government.

References

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