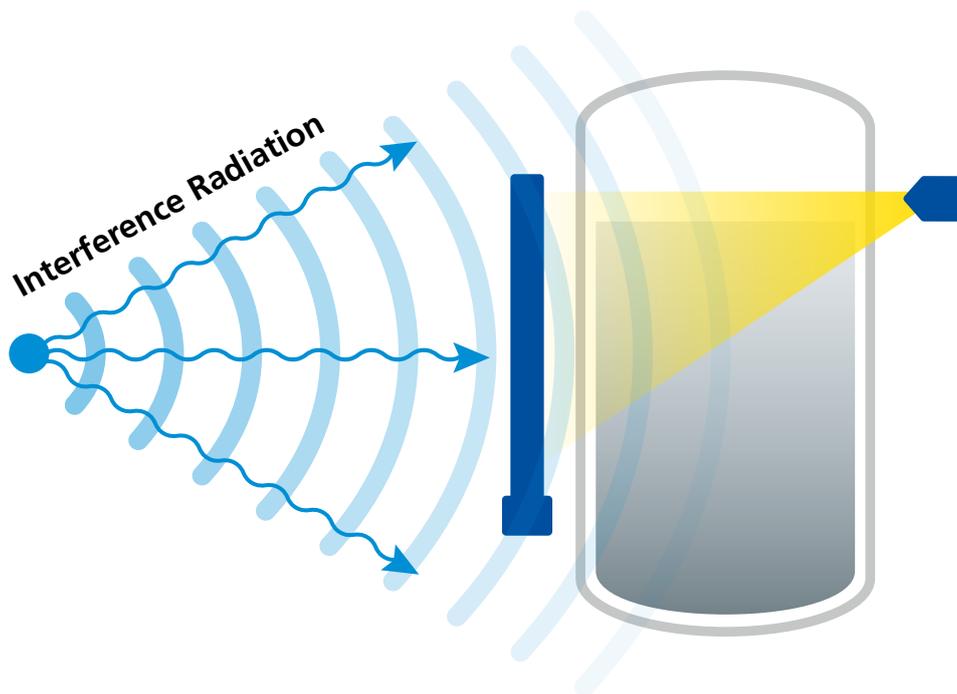


DEALING WITH RADIATION INTERFERENCE IN RADIOMETRIC LEVEL MEASUREMENTS



Radiometric measurements for industrial processes are a mainstay in performing the most difficult level, density and bulk flow measurements and have been around for many years. Nuclear gauges work when other technologies fail and provide excellent results under hostile and rugged conditions. Extreme temperatures, pressures and other difficult industrial process conditions pose no problem for a radiometric measurement.

What is a radiometric measurement?

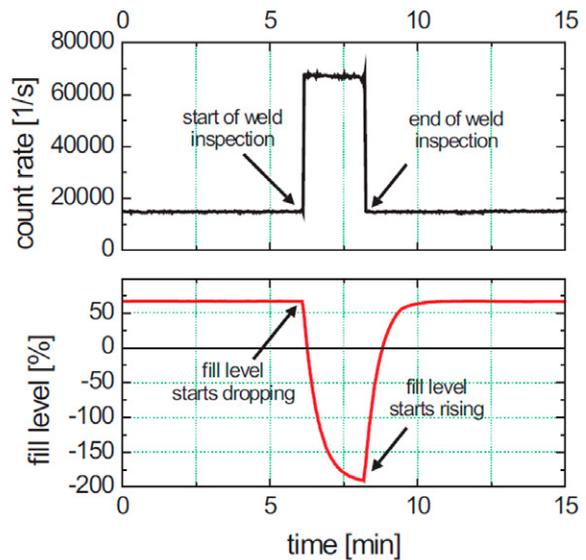
Nuclear measurement gauges operate on a simple yet sophisticated concept – the principle of attenuation. A typical radiometric measurement consists of

- a source which contains a tightly enclosed radioisotope and emits only gamma-radiation
- a detector capable of detecting gamma-radiation and determining its intensity.

After penetrating the vessel with process material under investigation, the radiation is measured with a detector. If there is no or little material in the pathway of the radiation beam, the radiation intensity will remain strong. If there is any material in the pathway of the beam, its strength will be attenuated. The amount of radiation detected by the detector can be used to calculate the desired process value. This principle applies to virtually any radiometric measurement.

NDT, X-Ray and the consequential interference radiation

Interference radiation is a common issue for any radiation-based measurement, as in industrial complexes non-destructive testings (NDT) are performed basically on a daily schedule. These are typically weld or vessel integrity inspections. Most probably a low energy radiation source, like Iridium-192 will be used. Such interferences could cause a significant increase of count rate and therefore a misinterpretation of the level.



Development stages to deal with such unpredictable events

In the following, the handling of interference radiation in relation to radiometric measurements and their further development will be explained in more detail.

A) Informing the Control Room

In the past, when there were no systems for the detection of interference radiation, it was necessary for the control centre to be informed in good time about upcoming weld inspections. The weld inspection had to be carried out in close coordination with the control centre and the control was carried out manually, blindly so to speak, during this period. This gave rise to the following difficulties:

- 1 It was not always ensured that the control room was informed about weld inspections.
- 2 It was not uncommon for weld inspections to affect measurements that were thought to be out of their reach. The corresponding control centres were therefore not informed.
- 3 Since the times could not be precisely coordinated, there was often a very long period in which the measurement had to be controlled manually.
- 4 Some manufacturers, with outdated detector technology, even had to reckon with damage to their detector in the case of strong interference radiation if the weld inspection took place in the immediate vicinity.

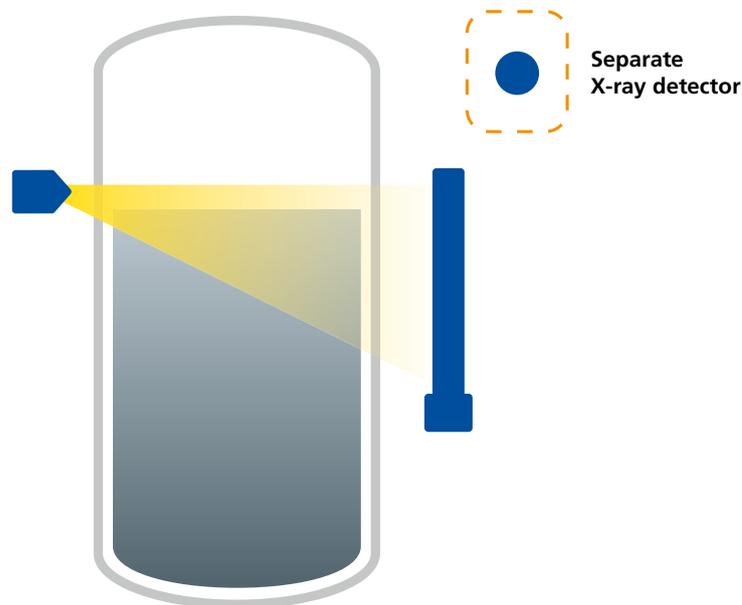
As a consequence of cases 1 and 2, there were often uncontrolled process changes or sometimes the process had to be stopped by the control room.

B) Separate X-ray detector

As weld inspections, particularly in chemical and petrochemical sector, became more and more common, the detection of interference radiation became more and more significant. The increased use of rod detectors, whose gamma-sensitive volume is significantly larger than that of point detectors and is therefore more easily influenced by interference radiation, increased the need for an automatic detection. For this purpose, X-ray detectors were used, which had the task of detecting an increase in radiation in the vicinity of the measurement and, in addition to the actual measurement, were placed in the vicinity of the measuring point. The idea was that the control room would be informed of an increased radiation level and detectors with a possibly outdated

and fragile technology would be switched off. As a consequence, switching off the detectors meant that the measurement had to output a residual current. This method involved the following difficulties:

- 1 For the X-Ray detector to measure the same interference radiation as the measurement detector itself, installation in close proximity to the measurement detector is necessary and at the same time, the X-Ray detector must be placed far enough away from the measuring detector that it is not influenced by the changing radiation intensity of the used level source. If interference radiation occurs, it is possible that the X-Ray detector is shaded by buildings, vessels or other machine and system parts, but the measuring detector itself is indeed influenced and its measured value is falsified. It is equally possible that a false alarm is triggered.
- 2 In the case of an X-Ray alarm, the personnel in the control room must act immediately, nevertheless valuable time still passes. During this time, control can easily get out of hand, because the measured value is falsified or merely a residual current is issued. The control room may have problems getting the process under control, if it does not even result in a discontinuation.
- 3 An additional detector ultimately increases the costs for each individual measuring point.



C) XIP (X-ray Interference Protection)

As already explained, the greatest difficulty for the control room was that in the case of interference radiation, the measured value was displayed incorrectly or a residual current was signalled. Freezing the measured value in these cases would be of great help to the control room, since the level in the vessels only changes very slowly. The XIP function implemented by Berthold freezes the measured value when interference radiation occurs and signals this frozen state. In most cases, it is sufficient to continue with the frozen value and intervention by the control room is more than often not necessary at all. However, if intervention in the control system is necessary, the major advantage is that the control room can take over the manual switchover in the event of interference radiation, without the risk of the process running out of control. The XIP method used by Berthold recognizes interference radiation in two different ways:

- The external influence is so great that a value is exceeded that would usually not occur during the measurement.
- The count rate suddenly changes in a way that wouldn't occur in normal operation.

This results in reliable detection of interference radiation, even if the interference radiation only causes the indicated value to drift slightly. However, a prerequisite for this, is a well-designed measurement that has a linear sensitivity as possible.

Nevertheless, in some cases a wish remains open, namely that even with interference radiation one does not want to control the process blindly, but the measurement can be continued. The LB 470 RID system makes this possible.

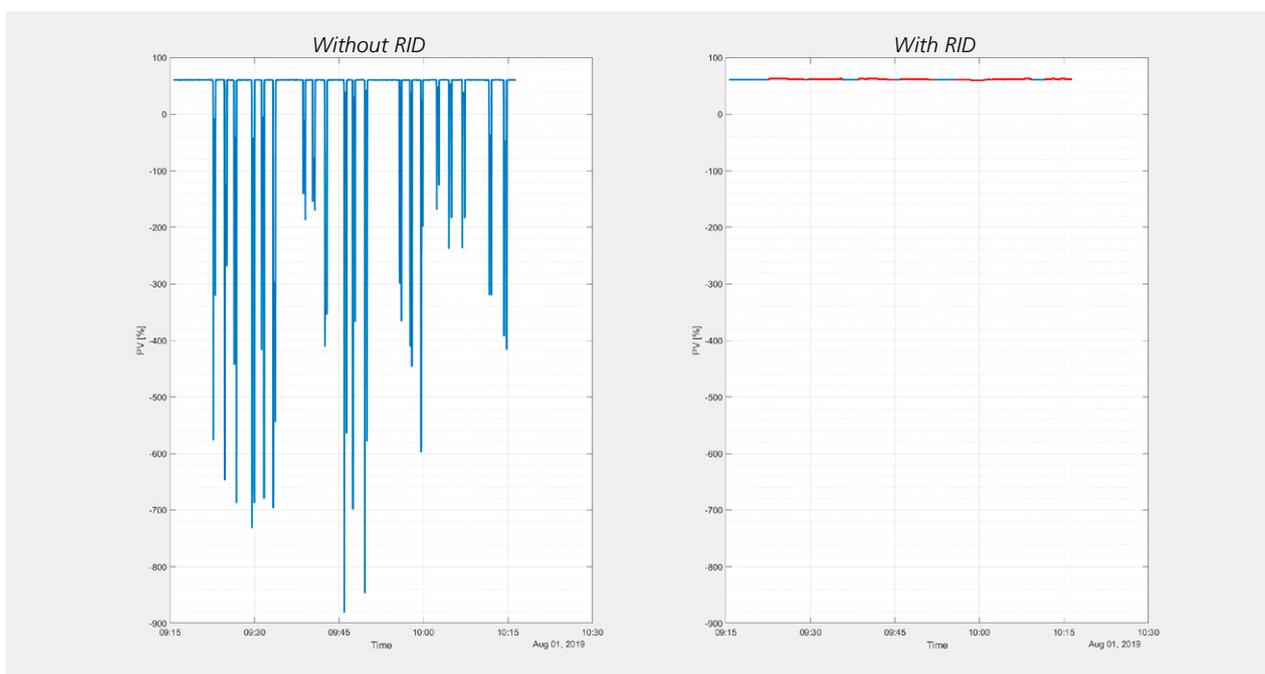
D) RID (Radiation Interference Discrimination)

The LB 470 RID takes advantage of the fact that the radioactive isotopes used for weld inspection tests, such as iridium, selenium and X-rays, have a different radiation energy than the sources used by Berthold for the measurement itself. Berthold detectors use this energy difference to detect the interference radiation and to suppress it. This means that measurements can continue even under the influence of interference radiation. In order to do so, neither an additional detector nor additional mechanics is required. The user is informed via digital outputs whether the measurement has detected interference radiation. The LB 470 RID is based on the experience of its predecessor, the LB 440 RID. While the LB 440 RID required many additional settings, just a tick in a box is required in the LB 470 to activate the RID function. This means that the measurement can be calibrated and set-up just as easily as a system without RID function

RID feature in use

The RID feature is proven in use at many customer sites since many years and Berthold has many customers who appreciate using RID.

The figure below shows the effect of RID in a process. The left side shows the level reading if no RID feature would have been used, with any peak reflecting a NDT event. The right side shows the provided signal of the RID device to the process control system. As you can see, the Berthold device was not interrupted at all, by any of the interference radiation events.



Summary:

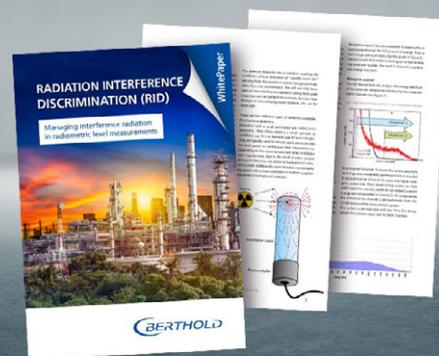
The effects of interference radiation on radiometric measurements can be considerable and must therefore be controlled. As it is neither predictable when interference radiation will be present, nor how much the impact of a distant NDT testing on a nucleonic measurement is, customers need a reliable system that is automatically dealing with such events. Over time, the technology and philosophy for dealing with interference radiation has evolved and become more sophisticated. Initially, manual notification to the control room of the execution of a weld inspection was still necessary, but this was replaced by automatic signalling by a separate detector that detects the interference radiation. Nowadays, sophisticated algorithms are used in the detectors themselves, making both manual notification to the control centre and additional detectors unnecessary. The detection of the interference radiation leads to a freezing of the measured value or, even more smart, to the discrimination of the interference radiation.

Berthold offers sophisticated products that manage interference radiation and provide the customer with a stable and reliable measurement that ensures a continuous process, avoids unscheduled shutdowns and therefore generate a real benefit for the customer. The features XIP (X-Ray Interference Protection) or RID (Radiation Interference Discrimination) are used for this. We help plant operators to get “RID” of problems caused by interference radiation and in doing so, we make sure they are always in control.

Date 03.2020

An example of a more advanced technology is explained in detail in the **whitepaper** **“Managing interference radiation in radiometric level measurements”** provided by Berthold Technologies.

Get your copy at www.berthold.com/rid



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