

**Reasons Not To Use Radiation ( in no particular order )**

Please see outlined below fourteen ( 14 ) reasons that can be used to justify not using radiation, or which can assist in the move away from radiological solutions. These items are in no specific order, indeed in some instances they are linked.

**ALARP** ( As Low As Reasonably Practicable ). All of the radiological legislation imposes a "duty of care" onto employers to protect and safeguard the well being of their employees. The Ionising Radiations Regulations 1999 ( IRR'99 ) come complete with an Approved Code Of Practice And Guidance ( ACOP ) which clearly state their main aim is to establish a framework for ensuring that exposure to ionising radiation arising from work activities, whether from man-made or natural radiation, is kept as low as reasonably practicable.

In the case of fill level inspectors it is practical to provide functionality with no exposure to ionising radiation.

**JUSTIFICATION.** All work involving Ionising Radiation may not begin until a risk assessment has been carried out. This risk assessment should be the subject of monitoring and review ( <http://www.hse.gov.uk/radiation/ionising/legalbase.htm> ). The ACOP lists some 28 factors which should be given consideration. Paragraph 62 of the ACOP states ..

" This general duty to restrict exposure covers both the decision to work with ionising radiation and the selection of any source of ionising radiation for the work. One of the first considerations may be whether the risk can be avoided by choosing an alternative technique which does not involve radiation ...."

**FOOTPRINT.** All radiological installations in the UK use "engineering control" to reduce exposure to ionising radiation. One aspect of this engineering control is safety interlocked guarding which extends 900mm to either side of a fill level inspector in the direction of container travel. On most bottling lines the 2 metre guards are a hindrance to access to the bottling line.

Laser based, non-radiological, inspection has no health & safety implication and does not require any guards.

**COSTS.** There are many 1 off and on-going cost implications associated with radiation. These costs do not apply to laser based fill level inspection solutions. For example,

- **Licence** : only licenced premises/employers can legally use radioactive sources. The licence costs £600 for the initial application ( and again for any variation ) plus an ongoing annual subsistence charge of £103

- **Training** : all employers have a stated duty under IRR'99 to provide appropriate training to their employees. An RPS course ( see below ) may cost £500

- **RPS/RPA** : All radiation users must appoint a responsible member of staff as Radiation Protection Supervisor ( RPS ) and it is usual to make an external expert appointment as Radiation Protection Advisor. An expert RPA such as the NRPB ( National Radiation Protection Board ) will charge according to the number of sites, sources etc, but a minimum appointment is approx £1,000. There is coverage of this subject by referring to a Health & Safety Executive free pamphlet available from their website ( [www.hse.gov.uk/pubns/irp6.pdf](http://www.hse.gov.uk/pubns/irp6.pdf) )



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- **Geiger Counter / Calibration** : All radiological users must have a calibrated suitable Geiger counter as part of their safety equipment. This is normally held by the trained RPS. A Geiger counter is approx £400 and annual calibration is approx £100. A recent court case saw a user fined for having a Geiger counter out of calibration. There is coverage of this subject by referring to a Health & Safety Executive free pamphlet available from their website ( [www.hse.gov.uk/pubns/irp7.pdf](http://www.hse.gov.uk/pubns/irp7.pdf) )

- **Engineering Control** : Guards, Interlocks, Indicator Lamps & Warning Signs must be maintained to satisfy legislation. On a new installation these items might add £2,000 to the base machine price.

- **Wipe Tests**. Legislation requires that all radiological devices are periodically leak tested and certified. Generally leak tests are conducted annually ( it used to be every 26 months maximum ) at a cost of approx £40 per machine.

- **Records**. The radiation user must keep all records/ documentation ( including wipe test certificates ) for a minimum of 2 years. This documentation involves a management role and must be available for inspection at any time. (see Attention below )

**UNDERFILL / OVERFILL**. It is very complex to provide both underfill and overfill within a radiological inspection head. Generally this can only be done by using two inspection heads; or by using a linear or pixelated detector. Linear or pixelated radiation detectors are limited in size which greatly reduces the scope for underfill and overfill.

The maximum range on a pixelated radiological detector is probably 8mm; or 5mm on a linear detector. The laser uses independently adjustable arrays and has a maximum range of 30mm between underfill and overfill. This is especially useful on long necked bottles.

**RETURNABLES**. When bottling lines run returnable glass it is common to see some bottles that "trip" lots of times whilst others go around very few times. The bottles that trip most often are the heavy ones. A radiological fill level inspector is a density gauge. The theory behind the radiological level inspector is that the bottle is of greater density when it is full than when it is empty. It is possible for an empty heavy multi-trip returnable to be of greater density than a full, light low tripping bottle - a radiological detector will not work in this instance.

The laser based fill level inspection system will work well in this scenario. The laser will work on bottles ranging from a PET water bottle to a dark amber Bailey's bottle without adjustment.

**MINIATURES**. On a miniature bottle the neck is very small. A radiological fill level inspector is a density gauge. The theory behind the radiological level inspector is that the bottle is of greater density when it is full than when it is empty; but there must be a significant difference if it is to be reliably detected. On miniatures ( particularly glass ) there is insufficient difference for a radiological detector to work.

The laser based fill level inspection system will work well in this scenario.



**SLEEVED.** Bottles are often sleeved to show full body artwork, this means that the glass bottle within the sleeve is not seen. Many sleeved bottles are, therefore, the cheapest glass possible. These bottles often have all sorts of variations, swings etc. A radiological fill level inspector is a density gauge. The theory behind the radiological level inspector is that the bottle is of greater density when it is full than when it is empty. We have seen bottles with such bad glass deformation that as an empty bottle is rotated in the inspection beam it changes between pass/fail according to orientation.

The laser based fill level inspection system will work well in this scenario. The laser will work on bottles ranging from a PET water bottle to a dark amber Bailey's bottle without adjustment.

**TRANSPORT :** Radiation classes as hazardous goods. If the source satisfies a series of tests designed to mimic a serious transport accident then it will be covered by an Internationally recognised Special Form Certificate ( SFC ). Shipment of a source with a valid SFC is relatively straightforward, although it can be expensive internationally. Shipment of a source without SFC is highly complex; requires special housings and is very expensive. ( see RWL )

There are no transport restrictions on X ray or laser based fill level inspectors.

**RWL.** The Recommended Working Life of an isotope is clearly stated on the Source Test Report ( in effect the birth certificate ) of every source manufactured. This is not to be confused with "half-life". Most gamma fill level inspectors use an Americium 241 isotope which has a half life of approx 450 years; but most of the sources have a RWL of 15 years. The RWL is the source manufacturer's recommendation of the period within which the source should be replaced. It is also recognised that at the end of the RWL that a source loses Special Form Certificate coverage ( see transport & disposal )

RWL has no impact upon X ray or laser based fill level inspectors.

**DISPOSAL :** Radioactive material must be correctly disposed of as it is hazardous material. In the UK there are only 2 organisations licenced for the disposal of Americium 241 which is the isotope used in most fill level inspectors. Disposal is expensive at approx £3,000 per source but becomes even more expensive for isotopes which do not have SFC or are beyond RWL ( see transport & RWL )

Disposal has no impact upon X ray or laser based fill level inspectors

**WOMEN OF REPRODUCTIVE CAPACITY.** IRR'99 and the ACOP lists some 28 factors which should be given consideration in radiological risk assessment. ACOP paragraph 45e states the need to consider " the need to alter the working conditions of any female employee who declares she is pregnant or breastfeeding". There is excellent unbiased coverage of this subject by referring to a Health & Safety Executive free pamphlet available from their website ( [www.hse.gov.uk](http://www.hse.gov.uk) select "Free Leaflets" select "Radiation" select " Working Safely With Radiation ; guidelines for expectant or breastfeeding mothers" alternatively, this document can be accessed directly at [www.hse.gov.uk/pubns/indg334.pdf](http://www.hse.gov.uk/pubns/indg334.pdf) ).

IRR'99 states that the legal dose limit is 20 mSv per year for employees over 18. The recommendation is that the dose rate must not exceed 1 mSv in the term of the pregnancy. The employer should consult and inform employees via the Health & Safety policy and female employees should be encouraged to inform the employer in writing if they suspect that they may have become pregnant. Any female employee can ask to see evidence of the employers prior risk assessment.



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**Radiactivity**

We have experienced employers opting to discontinue working with radiation rather than address "possible issues" with staff.

Particular attention should be addressed to X ray devices where the dose rate can be varied; and because of the nature of X rays rather than gamma rays.

There are no Health & Safety issues with laser based fill level inspection solutions.

**NaCTSO.** The National Counter Terrorism Security Office was established in 1998, but since the terrorist attacks in New York on September 11, 2001 attention has focused on the security of radioactive sources. All licenced sites have been contacted and site specific security issues have been raised and a framework agreed for emergency procedures.

NaCTSO has no impact upon X ray or laser based fill level inspectors

**ATTENTION.** Anything to do with using radiation will attract the attention of the authorities. HSE are interested in ensuring compliance with legislation. The Environment Agency are involved in licencing. The Fire Brigade should be involved in establishing emergency procedures etc and notification under of particular hazards as part of the risk assessment. The Police are interested due to the NaCTSO involvement.

Any event concerning an incident at any other plant will focus the attention of any of these agencies upon all users.

Any event at, or visit to your plant invites the attention of these authorities to all other aspects of your operation.

There is an excellent newsletter which can be used to keep the reader up to date on radiological developments, changes in legislation, prosecutions etc. These newsletters can be accessed at <http://www.hse.gov.uk/radiation/ionising/rpa/index.htm>. Issue 13, dated April 1998, includes news of a prosecution at a major UK Brewery which was disposing of gamma fill level gauges. In the immediate aftermath of this event all licenced radiological fill level users had HSE visits

**...but, you need to use radiation on cans !**