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Bulletin 275 Health & Safety

Working with radioactive sources - risk assessment

The task of risk assessment can often be viewed in a negative light, however here at SSERC we prefer to think of it as a positive process that leads to making exciting and interesting practical work possible and safe.

Radioactivity is an area of the curriculum that particularly benefits from practical work. On a recent SSERC course we had a teacher comment that they find radioactivity difficult to teach because you cannot see it. Practical work in this area really helps to make it more engaging, tangible and accessible. You might not be able to see the actual radioactive decay however you can see and hear the effects of it. There is nothing more mesmerising than watching tracks appear in a cloud chamber (Figure 1) and the spark counter (Figure 2) is impressively visual.

Not to mention that hearing one click on the GM tube counter represents a single atom event, there are very few other times a learner will experience that! When a topic is seemingly abstract, it is all the more important to convince learners of the science you are teaching them with actual experimentation rather than just telling them or using a simulation which is unlikely to make it seem anymore real. We are keen that no school is put off from doing practical work in a particular area because of the requirement to risk assess it and recognise that radiation

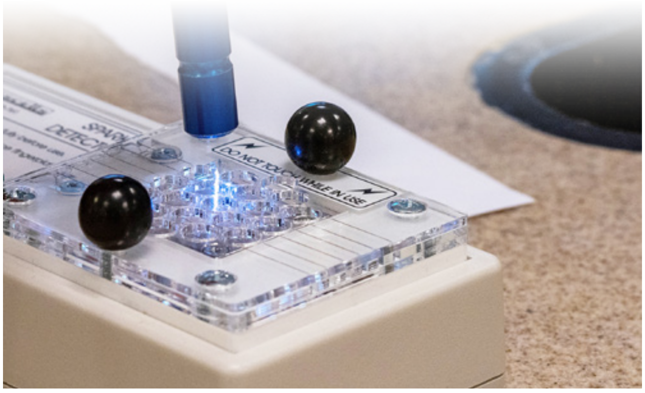


Figure 2 - The spark counter in action.

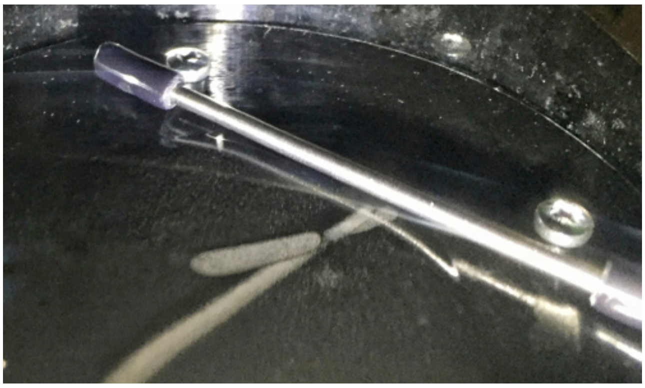


Figure 1 - Tracks in a cloud chamber.

risk assessment can be seen as particularly daunting. This is why, as part of providing RPA services for Scottish schools, we aim to provide as much assistance with it as possible.

Before any radioactive source is approved for use in schools it goes through what is known as a prior risk assessment. This looks at its safety and suitability for use in schools. A prior risk assessment evaluates a variety of factors about the source, for example its construction, and it considers the dose received by those in its vicinity not only during standard operation of the source but also in situations where there is an accident or improper use, in some cases it even goes as far as considering the environmental impact. These prior risk assessments are of course necessary and useful. However, they do contain a lot of highly detailed information which isn't needed for normal school use of radioactive sources. >>

Other topics

Until recently we provided these prior risk assessments on the SSERC website to aid schools with writing their own risk assessments for working with radioactive sources. After a recent review we decided that we could take this a step further and create example operational radiation risk assessments which focus on the information and control measures that need to be considered by the user when performing standard demonstrations with radioactive sources.

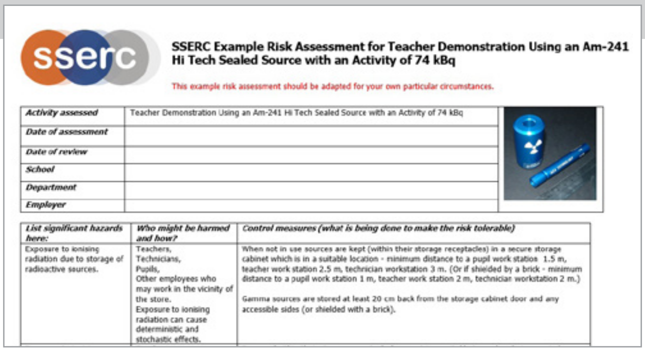
When producing these risk assessments, the relevant sections of the code of practice associated with the ionising radiation regulations have been consulted to ensure they cover what is legally required of a radiation risk assessment (RRA). The most important outcome of an RRA (and also a legal requirement) is to limit radiation exposure as far as is practical to all those in the vicinity of a radioactive source. This will be achieved by following the control measures set out in our user risk assessments.

These user risk assessments have been created using what HSE used to refer to as the ‘five steps’ approach. Therefore, they should be in a format which is familiar to you (Figure 3) and this also ensures that not only do they satisfy the requirements for a RRA but they also form a complete risk assessment.

Part of this five-step process is to implement the findings from a risk assessment. Performing a risk assessment is only useful if the control measures identified in it are communicated clearly to the users. As such we have also produced some example ‘operating procedures’ documents to provide you with an idea of how you might want to disseminate the information within the risk assessments.

Both these new user risk assessments and example operating procedures can be found by logging in to our website and visiting the ionising radiation pages (Figure 4) of our health and safety section [1].

We are in the process of providing risk assessments for all the main radioactive sources permitted for use in Scottish schools and the standard demonstrations involving them. If you wish to perform an experiment out with this scope, please first ensure you are using a permitted source and the activity you wish to carry out is justified. If in doubt, contact us [2]. You will then need to create a risk assessment specific to this experiment, however the user risk assessments provided by us should still help and further advice can be provided by us if required. Likewise, these user risk assessments produced by us only cover teacher demonstrations. Students under 16 must not work with radioactive sources. Students aged 16 and over may work with sources so long as there are no under 16s in the same room, they are supervised, they have received appropriate training and a separate risk assessment specific to this has been carried out.


SSERC Example Risk Assessment for Teacher Demonstration Using an Am-241 Hi Tech Sealed Source with an Activity of 74 kBq

This example risk assessment should be adapted for your own particular circumstances.

Activity assessed	Teacher Demonstration Using an Am-241 Hi Tech Sealed Source with an Activity of 74 kBq
Date of assessment	
Date of review	
School	
Department	
Employer	

List significant hazards here:	*Who might be harmed and how?*	*Control measures (what is being done to make the risk tolerable)*
Exposure to ionising radiation due to storage of radioactive sources.	Teachers, Technicians, Pupils, Other employees who may work in the vicinity of the store. Exposure to ionising radiation can cause deterministic and stochastic effects.	When not in use sources are kept (within their storage receptacles) in a secure storage cabinet which is in a suitable location - minimum distance to a pupil work station 1.5 m, teacher work station 2.5 m, technician workstation 3 m. (Or if shielded by a brick - minimum distance to a pupil work station 1 m, teacher work station 2 m, technician workstation 2 m.) Gamma sources are stored at least 20 cm back from the storage cabinet door and any accessible sides (or shielded with a brick).

Figure 3 - Example risk assessment.

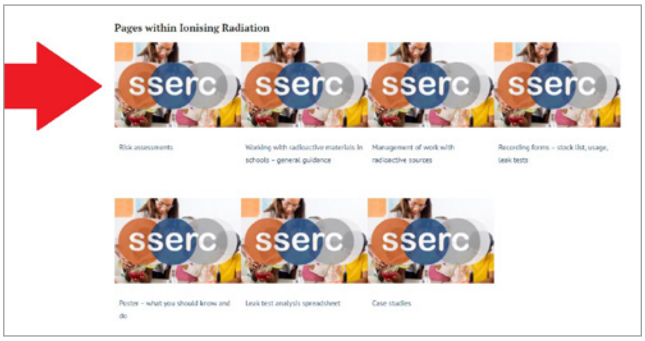


Figure 4 - Ionising Radiation web page.

Again, we can provide support with producing this type of risk assessment if required.

Finally, it must be stressed that although we have tried to provide as much assistance with this process as possible, the user risk assessments and operating procedures produced by us are generic as circumstances will vary from school to school. Therefore, it is vitally important that schools read through these and adapt them for their own situation. It is also essential that all users of radioactive sources within a school are aware of the corresponding risk assessments and the control measures within them that they must put into action – this should be covered in the training provided to them prior to using the sources and the information on control measures made easily accessible, for example in operating procedure documents. These risk assessments, as with all risk assessments, should also be reviewed at appropriate intervals to ensure that they are still fit for purpose.

Next time your risk assessments are up for review please consult this updated area of our website to ensure your own risk assessments contain all the information required. Or if you are new to owning radioactive sources or considering purchasing them, please be assured that there is plenty of support available for putting your risk assessments in place along with full guidance on all areas of working with radioactive sources in schools. So- there is nothing to stop you and your classes enjoying the wonder and enhanced learning of practical work with radioactive sources in a safe way. «

References

[1] https://www.sserc.org.uk/health-safety/physics-health-safety/ionising-radiation

[2] Email: rpa@sserc.scot

SSERC RPA Service

At the turn of the century, the Ionising Radiation Regulations 1999 stipulated that an employer who had employees who worked with certain types of radioactive materials had to consult with a Radiation Protection Adviser (RPA). The materials held by schools to teach the properties of ionising radiation fell into this category. RPAs had to hold a qualification recognised by the Health and Safety Executive. To gain such a qualification, the would-be RPA had to demonstrate good theoretical knowledge and a track record of giving advice on radiation protection over a period of time. With great foresight, the SSERC physics specialist at that time, having had extensive experience in offering advice, applied for and gained RPA accreditation. This meant that local authorities and member independent schools had automatic access to an RPA as part of their SSERC membership, a significant benefit in terms of cost and convenience.

People retire and move on, but the SSERC RPA service continues. Working with other members of the physics team, the RPA answers queries, develops guidance, runs courses and, where necessary, makes visits to ensure that work with ionising radiation is carried out safely and in compliance with the law, in a way that is not unnecessarily onerous. The current RPA is Gregor Steele.


Evelyn Lee

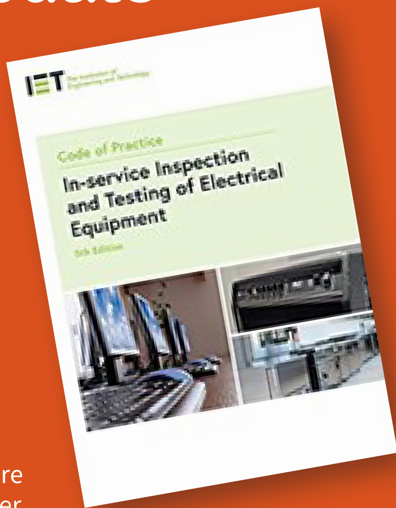
We would like you to meet the latest member of the Radiation Protection team – Evelyn Lee. Evelyn has a degree in physics and has been a technician at SSERC for a number of years. She has supported radioactivity courses and has had a role in in-house radiation protection. She is now training to be a Radiation Protection Adviser. You will see her at courses and she will be answering many of your queries going forward. She also wrote the risk assessments mentioned elsewhere in this bulletin, and the bulletin article itself.

You can contact SSERC for radiation protection advice using rpa@sserc.scot

Electrical Safety and PAT update

New equipment Class II (FE)

The article is taken from the first issue of The Stem Technician, published three times a year, it's a technician specific bulletin you can find here.



The IET 5th edition In-service Inspection and Testing of Electrical Equipment code of practice has introduced a new equipment classification. Class II (Functional Earth). This new classification is to distinguish items that are considered for electrical safety to fulfil the requirements for Class II, but for functional reasons require a connection to earth.

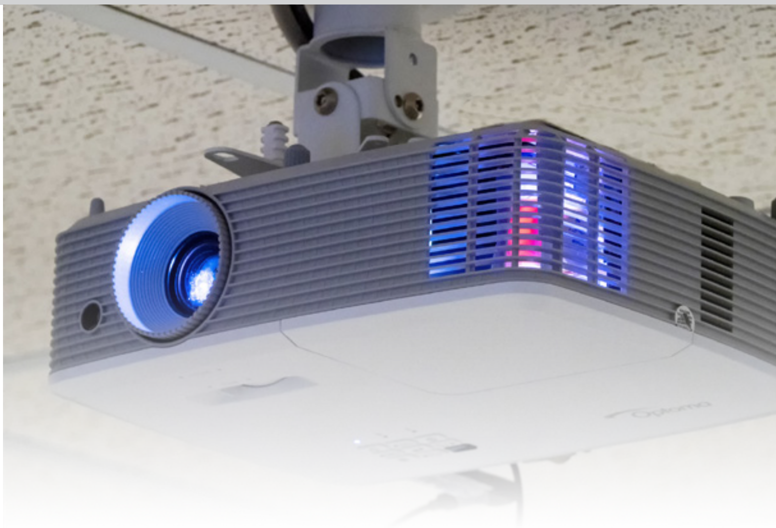
This means the item will be double insulated but will have a connection to earth on the mains side. In the past such items may have been referred to as Class I Hybrid.

The most common examples of these are switch mode power supplies which are used in a variety of applications especially in IT equipment such as laptop power supplies/chargers.

The symbol for Class II (FE) is shown on the right. Some older equipment with this type of supply arrangement may be marked as ITE (Information Technology Equipment).

When testing and inspecting such equipment, for electrical safety, they should be treated as any other Class II item.

Mercury in projector bulbs



Data projectors are ubiquitous in classrooms and many other places around schools and colleges.

There are three main types: LED, Laser and Lamp. The oldest type, and the most likely to be found in schools are the lamp type. The bulbs in these contain mercury vapour at high temperature (when operating) and very high pressure.

While in general these are perfectly safe, as the mercury is contained within the glass, we have heard reports of the bulbs exploding and consequently releasing their contents into the room.

Before we consider any health effects, it is a good idea to look at ways in which you can reduce the likelihood of this sort of bulb failure.

There are various factors that can extend a bulb's life: avoiding overheating, keeping the fan etc dust free, not switching on and off rapidly but as far as avoiding breakage or explosion, there is one thing that is particularly important.

Make sure not to touch the bulbs with bare hands when inserting or changing them: wear gloves instead. The bulb has an internal pressure of up to 250 atm at about 1300° Celsius and the greasy spots can lead to uneven temperature across the glass surface, internal tension, and eventual cracking or explosion.

Image cropped from original by Otis Blank on Flickr – used under CC BY-NC-SA 2.0 license.

So, whether you did this or not, if your bulb explodes, what is the danger?

There is not much mercury in a bulb – around 30mg – but this is still a significant amount.

Inhalation

The main hazard comes from inhalation of mercury vapour. The workplace exposure level (WEL) for mercury vapour is extremely low (0.02 mg/m³ over 8h). Assuming all the 30 mg is vapourised and spread evenly over the lab even a large lab would produce a concentration of around 0.1 mg/m³ (though this is without allowing for ventilation).

Without measurement it is impossible to get accurate figures but some factors affecting the level could be.

Positives

- Not all the mercury vapour will escape into the room: some (maybe most) will be deposited on the glass shards and the surfaces of the projector.
- Ventilation will remove the contaminated air fairly rapidly.
- At the time of writing, face coverings are widespread in laboratories and provide some slight extra protection. It is to be hoped, though, that this situation will not last for long so the risk will be slightly higher.

Negatives

- Vapour will not be dispersed evenly so near the projector the concentration will be higher.
- It could be that the fan in the projector disperses it more or blows it in a particular direction.

Depending on the nature of the bulb, the lamp housing and the projector design, differing amounts of mercury vapour will be ejected.

In any case, in case of such an explosion the room should be evacuated to allow the ventilation to clear the vapour from the air – an hour should be plenty of time in a normal laboratory with its 5 air changes per hour. >>

Skin contact

Not all the mercury vapour in the room will be removed by ventilation. A significant amount will condense onto the surfaces.

Here, if no action is taken, it can be picked up by hands and clothing.

The amount of mercury will be small so there is no need for a complete deep-clean of the room but any bench/table tops within a few metres of the projector along with stools/chairs should be wiped down with damp paper towels or tissues. These should be “double bagged” and kept for disposal as possible mercury containing waste.

It would be prudent to arrange for a good cleaning of floors and any other surfaces near the projector as well. But the highest amount of mercury condensate will be on the projector itself. The projector should be cleaned as thoroughly as possible (it will probably need to be demounted for this) and any tissues etc bagged for disposal as above.

It should be noted that this has happened and perhaps a sticker put on the outside of the projector to make sure that whenever it is being handled, people wear gloves to do so.

Some perspective

While the above might sound alarming, any level of exposure is going to be very low. It is worth remembering that we are all constantly exposed to mercury in the environment, albeit at low levels: the CDC in America suggests about 3.5 micrograms (μg) of mercury per day for an adult of average weight.

If for any reason there is reason to suspect anyone has had a larger exposure – perhaps the vapour is vented directly at an individual, symptoms of mercury poisoning include the following:

- Breathlessness
- Coughing
- A tightening or burning sensation in the chest
- Shaking tremors
- Feeling nervous and irritable

This is extremely unlikely to be an issue but if there is concern about exposure, the levels of mercury in the body can be diagnosed by a blood or urine test via the medical services. So anyone concerned should be encouraged to contact their GP.

SSERC Health & Safety poster

Whatever your job, your employer must tell you how to work safely. In turn, you must follow your employer’s guidance. When it comes to safety in practical work in STEM subjects, your employer will expect you to follow SSERC guidance. There are a few exceptions when an employer adds additional measures over and above those specified by SSERC, but this is rare. If you are a regular Bulletin reader or have ever been on a SSERC health and safety course, you will know this.

To help get the message across to all employees working in this area, you can now download a poster from SSERC [1].

The poster reminds readers that employers expect them to follow SSERC advice and highlights how this advice can be accessed. The advice is free, save for some courses which, though they must be paid for, are subsidised. The poster could be downloaded and printed out, for display in staff bases, prep rooms or classrooms as you see fit. We hope that you will see this as an effective way of reminding colleagues of the guidance they should be following and of how to access that guidance.

Reference
[1] https://www.sserc.org.uk/health-safety/h_s-poster/

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