

RADIATION EDUCATION IN THE DELFT SCIENCE CENTRE

K.R. HUITEMA, J.DE BEER-KOUWENBERG

Delft University of Technology

Faculty of Applied Science

Reactor Institute Delft

National Centre for Radiation Protection

Mekelweg 15, 2629 JB, Delft,-The Netherlands

E-mail:k.r.huitema@tudelft.nl

ABSTRACT

The Reactor Institute Delft, the Netherlands, has developed a special exhibit in close collaboration with the Science Centre Delft. This exhibit explains the basics of radiation and radiation detection to children and their parents or teachers. Science Centre Delft turns Delft University of Technology inside out and allows you to see the role technology and science play in society. As a visitor, you are invited to participate in and contribute to its development. Inspiration, creativity, timeliness and true interactivity are the principles behind the Science Centre, putting humanity, designs and buildings first. Within this context it was essential that the exhibit should be constructed with real live sources and radiation measuring equipment and at the same time the exhibit had to be safe to use for children. Furthermore, the Science Centre organises a yearly open day for all members of the public, on which scientist and teachers explain what their research is about. These days mostly attract young children with their families. During these days the teachers of the Reactor Institute Delft have used cloud chambers to visualize the ever present and mysterious background radiation.

1. Introduction

The Reactor Institute Delft (RID) is part of the Delft University of Technology (TU Delft) and operates a pool type reactor for education and research purposes. Also it houses several research departments as well as the National Centre for Radiation Protection, which is the largest provider in radiation protection training in The Netherlands. The RID considers outreach activities and informing the public as one of its important tasks. Information is given to the public via various channels. Guided tours are given and we host a website on ionising radiation for the public. A collaboration with the Science Centre Delft resulted in an exhibit about radiation. During the Delft science days we inform children and their parents in a playful way about radiation. Teenagers in secondary schools and sixth form college with questions about reactors and radiation are provided with information and help.

2. Exhibit

For the public at large it is often a mystery what happens at a technical university. The Science Centre Delft gives the public a look behind the scenes of the university at large. It houses several exhibits that represent recent research and student projects. The exhibits are mostly replicas of real research set-ups because the Science Centre wants to show the reality. As a visitor, you are invited to participate in and contribute to its development. The Science Centre first approached the RID in 2011 with the request to come up with a topic that would fit their aims. At first, all thoughts were focussed on current research that is done at the scientific department of the RID, Radiation Science and Technology (RST). Although most research is done with neutron and positron radiation, this was not feasible for an exhibit. Other bits of research have to do with new and improved detector materials, again something which is difficult to visualise.

Eventually the basics of radiation detection became the focus for the exhibit. The idea was to make use of real live sources and real detectors. At this point a commercial bureau, Tinker, was contacted by the Science Centre. Tinker specialises in making constructions or spaces that stimulate people to interact with.

2.1 Set-ups and sources used in the exhibit

The first part of the exhibit deals with measuring and shielding radiation. In this part of the exhibit the differences between alpha, beta and gamma radiation are shown. Am-241 was selected as an alpha source, Sr-90/Y-90 as a beta and Cs-137 as a gamma source. All these sources have a relatively long half-life, 28 years and up and if they also emit another type of radiation this does not interfere with the measurements, due to a relatively low yield and/or energy. The chosen shielding materials were paper, Perspex and lead. The second part of the exhibit shows that sources may be identified by their radiation spectrum (gamma spectrometry), Na-22, Cs-137 and Eu-152 were chosen as sources of photon radiation. These radionuclides have very different spectra and the use of Na-22 allowed the introduction of beta plus radiation for the more advanced groups of pupils. The third and last part shows that also some everyday objects such as tiles, watches and pieces of rock might be radioactive. A tile and watch were purchased online and the pieces of rock (one radioactive and one phosphorescent) came from the collection of the mineral museum in Delft. Because this makes people wonder about their own watches and other objects also a position was reserved for personal objects.

2.2 Permit

The aim was to use real radioactive sources in the exhibit. However, the application of ionising radiation sources for education purposes in the Netherlands requires a license unless the activity of the source(s) is below exemption values. The activities of the sources that were selected due to their type of radiation and half-life were above the exemption values. The Science Centre is part of the TU Delft, which has a licence that allows a system of internal permits. So for the use of the sources an internal permit had to be obtained at the radiation protection unit of the TU Delft, this is still a formal application procedure, but in general the handling time is much faster. In the permit, information on the type of sources as well as information about expected dose and dose rates needed to be included. Because none of the set-ups, not individually and not combined, resulted in a significant dose to the public (the equivalent dose was estimated to be less than 0,1 μSv) a permit was given.

2.3 Construction

The colours for the exhibit were based on the warning signs for ionising radiation. The sources had to be difficult to remove, so sources mounted on a brass screw were purchased. Furthermore the sources were encased in a Perspex housing, the shielding material was placed in a rotating disk, both can be moved by pressing a button. The objects that were used for radiation measurements were separated by lead screens, to prevent radiation from one source interfering with the measurements of the other objects.

RADIOACTIEVE LAB TAFEL
300x90 cm

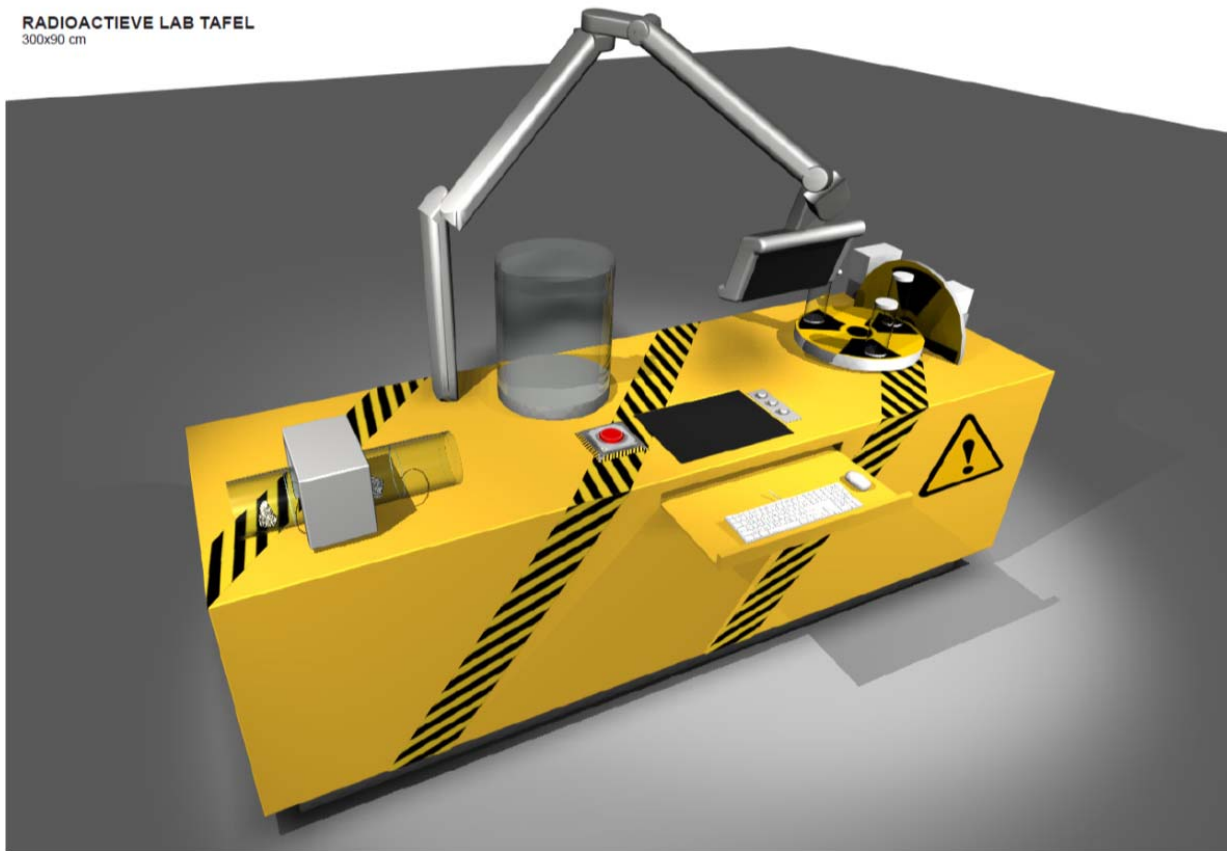


Figure 1. Original drawing by Tinker for the exhibit.

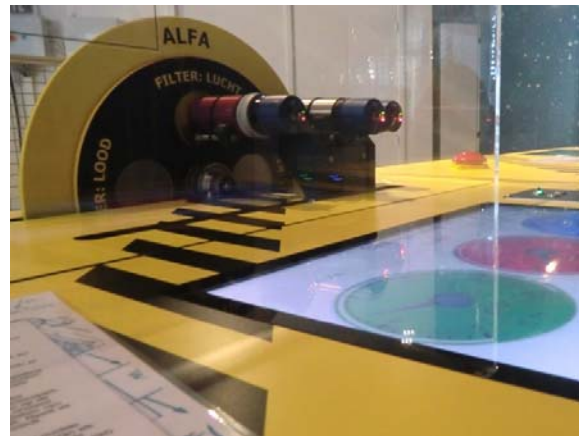
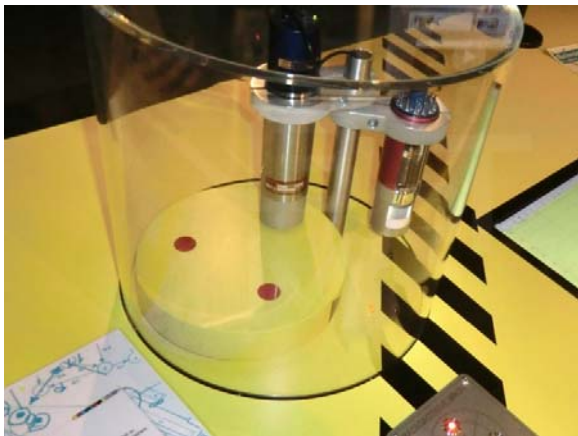


Figure 2. Details of the actual exhibit

3. Delft Science Day

The exhibit was launched during the Delft Science days. These Delft science days on the one hand are an opportunity for Delft companies to show their expertise and knowledge to the public. On the other hand it allows members of the public to get some insight in the organisations.

During the Delft Science Day the Science Centre acts as a host to several Delft companies and institutes, together they show the public all sorts of recent and ongoing research. Combined with the free admission on this special day, it ensures a big crowd, which was perfect for the launch. The Reactor Institute hosted several sessions during this day. Guided tours were given in the reactor hall. For those who could not participate in the tours, we hosted special skype sessions during which one of the employees of the reactor institute used a tablet to show the inside of the reactor to people in the science centre. Another employee was present in the science centre to facilitate the conversation between the two parties. During another activity the children and their (grand)parents could build a cloud chamber. This does not always give satisfactory results and that is why also a larger cloud chamber was brought along to show the visitors that radiation is always present. In later years also a radiation quiz was added in which children could measure everyday objects and in which they could guess if an object was radioactive or not. For the quiz all sources were placed on separate plastic plates to facilitate handling and also to identify them as special objects. Objects used were: KCl (salt substitute or nu salt), brazil nuts, a banana, an old watch with radium dials, a thorium gas mantle and a phosphorescent (non-radioactive) toy.



Figure 3: Skype guided tour (left panel) and radiation quiz (right panel). For the quiz all sources were placed on separate plastic plates to facilitate handling and also to identify them as special objects.

4. Guided Tours

The domed reactor hall of the Reactor Institute inspires a lot of curiosity. Many people living in Delft know that the building houses a reactor, but in general they don't know what happens on the inside. The RID regularly hosts tours for interested groups such as student associations, companies and government officials on a regular basis. In 2013, the 50 year anniversary of the reactor was celebrated. These celebrations were seen as a good opportunity for outreach activities. Since the RID, as part of TU Delft, has limited resources it was necessary to identify the target audience. Two main groups were identified; future students and citizens of Delft.

The future students were addressed by writing to the sixth form colleges that supply most students to TU Delft and informing them about the possibility to sign up for a guided tour in the reactor hall. We reserved space for 50 classes, with a maximum of 30 pupils per class. It was the goal to let these sixth formers share their experience during the tour. The problem was that cameras and mobile phones are not allowed in the reactor hall due to security restrictions. This drawback was solved by giving the sixth formers a camera during their tour and allowing them to

film everything that they found interesting. Additionally the students could provide their three favourite pieces of music that could function as background music throughout the film. The camera was handed back and a professional editor made a clip, without any security sensitive details, that was made available to the pupils within five days. Not all pupils filmed their visit, many teachers thought that filming would distract their pupils, but 24 classes did film their tour and the resulting film clips have been watched for just over 10,000 times in total on YouTube.

For the people from Delft another approach was taken. They were invited for a visit on a Saturday during the Delft Science Day that was dedicated to visitors of the Delft municipality. On this day, tours in the reactor hall were planned for a maximum of 150 people and several interactive stands explaining the current research were displayed throughout the building. This day was announced in a local newspaper on a Wednesday morning. The same evening all tours were fully booked.

5. Acknowledgements

Many useful discussions between the people from the Science Centre Delft, Tinker and the RID have led to the realisation of the exhibit.

6. References

Primary website addresses:

www.watiradioactievestraling.tudelft.nl

www.whatisnuclearradiation.tudelft.nl

<http://sciencecentre.tudelft.nl/>