RADIATION PROTECTION GUIDANCE NOTE FOR WORKING WITH RADIATION WHEN PREGNANT OR BREASTFEEDING

PURPOSE

The purpose of this Guidance Note is to explain the risk to expectant and breastfeeding mothers from working with ionising radiation; it applies to any type of radiation, and from any source, whether sealed, unsealed or electrically generated. It also explains what arrangements have been made by Technological University Dublin (TU Dublin) to identify the essential precautions that are needed to ensure the protection of the foetus.

SCOPE:

All staff, students, campus users

OBJECTIVES

Identifies the risk to the foetus and outlines the control measures which have been implemented for the protection of the foetus.

GUIDELINE DETAILS

1.1 Risk

The foetus is known to be particularly sensitive to damage by radiation. Therefore, it is important that its radiation exposure is kept **as low as reasonably achievable**. Due to the stringent control measures in place at TU Dublin and the type of work done, the estimated annual exposure of staff members is less than 0.2 milliSieverts (mSv). This is less than both the dose limit of a member of the public and the special dose limit of 1mSv/pregnancy for pregnant women. To ensure that any additional control measures can be activated promptly, it is imperative that the University, usually through the line manager, is informed as soon as possible, when a staff member or contract worker/campus user is pregnant. The specific measures are described in section 1.3 below.

There is no special dose limit for breastfeeding mothers. The only extra risk is where there is the possibility of the uptake and subsequent transfer of radioactive material to a child through the mother's milk. When a mother returns to work, it will be assumed, unless she informs her line manager otherwise, that she is breastfeeding for six months after birth.

1.2 Legal Requirements

Once a pregnancy is confirmed the dose to the foetus must not exceed 1mSv for the rest of the pregnancy. This is regardless of whether the worker is monitored with radiation dosimeters or not. It is however difficult to determine the actual dose to a foetus, therefore the approach of monitoring the exposure of the worker to radiation will ensure that the foetal dose is measured using the radiation dosimeters for the

duration of the pregnancy and that it does not exceed 1mSv. The annual dose to an infant must be limited to not more than 1mSv per year. In most cases there should be no need to restrict work with radioactive materials as the doses received are unlikely to approach the permitted limit, but occasionally it may be considered prudent for a pregnant worker to curtail a particular aspect of their work e.g., radioiodinations.
It is the employer's (i.e., the University's) responsibility to manage the control of radiation exposure of its employees and other persons. The law is however quite clear that if a pregnant worker does not tell her employer that she is pregnant, the employer is not required to introduce any special measures.

1.3 Controls

The following control measures should be applied when the University has been informed that a worker is pregnant. To ensure that the risk to the expectant mother or the foetus is minimised, pregnant workers must inform their line manager, in writing, that they are pregnant as soon as possible.
- Once the line manager has been informed, they will then arrange a review of the relevant radiation risk assessment. This should be done in conjunction with the Technological University's Radiation Protection Adviser. As part of the review, any relevant dose records for the pregnant worker will be checked.
- The review of the risk assessment should identify and record any changes or restrictions to work practices that are required to meet the special dose limit. These will be communicated back to the expectant mother within two weeks of the RPAC being informed of the pregnancy. It is important that she co-operates with her line manager in complying with any of these changes or restrictions and seeks further advice from the Radiation Protection Supervisor for the area or if appropriate from the Radiological Protection Officer of TU Dublin if unsure about anything.

A review of the risk assessment will be undertaken for all relevant workers. However, the following guidelines give some indication of what might be required.

1.4 Exposure to external radiation only

This applies to exposure arising from radiation sources such as sealed sources, undergraduate experimental x-ray systems and analytical x-ray sources. The following guidelines apply to such exposure:
- If the worker is working in an area designated as Supervised due to the external radiation risk, then work may continue and (if not already the case) she should wear a whole-body personal dosimeter (four-weekly wearing period) for the rest of the work with radiation whilst pregnant.
- Currently any work involving sources of ionising radiation with TU Dublin City Campus produces a total exposure of less than the 1mSv limit and so no additional controls of restrictions should be necessary for pregnant workers and breastfeeding mothers.

Section 2

2.1 Minimising external radiation exposures.

The fundamental ways of reducing external radiation exposure are:

(i) **Limiting the activity** of the source (or energy of the X-rays) used.
(ii) Placing **shielding** around the source.
(iii) Maintaining **sufficient distance** from the source. Operate the inverse square law concept in which the intensity of the dose is inversely proportional to the square of the distance.
(iv) Reducing the **time of exposure** if (i) to (iii) are not feasible.

This latter option, in particular, necessitates the use of a dose-rate meter and an understanding of the units of dose and dose limitation.

Section 3

3.1 Dose Calculations for One year for Staff and Students within the School of Physics, Clinical and Optometric Sciences in TU Dublin City Campus working with sources of Ionising Radiation.

1st Year Physics Laboratories

Staff Dose

The staff would be handling the following sources, 0.0033mSv (8 x Co-60) = 0.0033mSv - for less than 10 minutes for thirty laboratory sessions per year. The estimated maximum achievable dose that they would receive would be 0.0033mSv. This is 1/303th of the annual dose limit of 1mSv per annum for members of the public.

Students

The students will carry out one 2-hour experiment involving a source of ionising radiation, the maximum achievable dose that they would receive would be from Co-60 with a maximum dose of 0.00134mSv, and this is 746 times less than the annual dose limit of 1mSv per annum for members of the public.

2nd Year Physics Laboratories

Staff Dose

The staff would be handling the following sources, 0.0022mSv (Co-60) + 0.156mSv (2X Sr-90) = 0.158mSv, for less than 10 minutes for twenty laboratory sessions per year, the maximum achievable dose that they would receive would be 0.158mSv, and this is 1/6th of the annual dose limit of 1mSv per annum for members of the public.

Students Dose

The students will carry out one 3-hour experiment involving a source of ionising radiation, the maximum dose that they would receive would be from, Co-60 or Sr-90 with a maximum dose of 0.002mSv and 0.141mSv, respectively, and this is less than the annual dose limit of 1mSv per annum for members of the public.

3rd Year Physics Laboratories

Staff Dose

The staff would be handling the following sources, 0.000733mSv (Ba-133) + 0.00027mSv (Cd-109) + 0.00027mSv (Co-57) + 0.0027mSv (Co-60) + 0.000137mSv (Cs-137) + 0.00171mSv (Mn-54) + 0.00263mSv (Na-22) + 0.0023mSv (Zn-65) + 0.067mSv (Sr-90(metal)) = 0.07775mSv, for less than 10 minutes for twenty four laboratory sessions per year, the maximum achievable dose that they would receive would be 0.07775mSv, and this is 13 times less than the annual dose limit of 1mSv per annum for members of the public.

Students Dose

The students will carry out one 12 hour experiment involving the following sources of ionising radiation 0.0022mSv (Ba-133) + 0.000137mSv (Cd-109) + 0.000827mSv (Co-57) + 0.00808mSv (Co-60) + 0.000412mSv (Cs-137) + 0.00516mSv (Mn-54) + 0.00792mSv (Na-22) + 0.006936mSv (Zn-65) + 0.1008mSv (Sr-90), the maximum dose that they would receive from this experiment would be 0.1325mSv, and this is 7.5 times less than the annual dose limit of 1mSv per annum for members of the public.

4th Year Physics Laboratories

Staff Dose

The staff would be handling the following sources, 0.000733mSv (Ba-133) + 0.00027mSv (Cd-109) + 0.00027mSv (Co-57) + 0.0027mSv (Co-60) + 0.000137mSv (Cs-137) + 0.00171mSv (Mn-54) + 0.00263mSv (Na-22) + 0.0023mSv (Zn-65) + 0.0669mSv (Sr-90) + 0.03832mSv (C-14)= 0.11597mSv, for less than 10 minutes for twenty four laboratory sessions per year, the maximum achievable dose that they would receive would be 0.11597mSv, and this is 8 times less than the annual dose limit of 1mSv per annum for members of the public.

Students Dose

The students will carry out one 20 hour experiment involving the following sources of ionising radiation 0.00368mSv (Ba-133) + 0.000228mSv (Cd-109) + 0.001378mSv (Co-57) + 0.01347mSv (Co-60) + 0.000686mSv (Cs-137) + 0.0086mSv (Mn-54) + 0.0132mSv (Na-22) + 0.01156mSv (Zn-65) + 0.336mSv (Sr-90) + 0.1924mSv (C-14), the combined maximum dose that they would receive from these experiments would be 0.5812mSv, and this is less than the annual dose limit of 1mSv per annum for members of the public.

Staff

The staff would be in a room containing an X-ray physics system (Max current = 1mA and Max voltage = 35KeV). This X-ray physics system has the following engineering controls, lead shielding, door interlock – when X-rays are being produced the door is locked, if the door is forced open during the experiment the X-ray tube is shut off, both of which ensure that the x-ray leakage from the system is less than 2µSv per hour.

Therefore, if a staff member stood beside the system for the 12 hours over thirty laboratory sessions that the system was used their maximum achievable dose would be approximately 0.72mSv, and this is still less than the annual dose limit of 1mSv per annum for members of the public.

Students

The student would be in a room containing an X-ray physics system (Max current = 1mA and Max voltage = 35KeV). This X-ray physics system has the following engineering controls, lead shielding, door interlock – when X-rays are being produced the door is locked, if the door is forced open during the experiment the X-ray tube is shut off, both of which ensure that the x-ray leakage from the system is less than 2µSv per hour. Therefore, if a student stood beside the system for the 12 hours over thirty laboratory sessions that the system was used their maximum achievable dose would be approximately 0.72mSv, and this is still less than the annual dose limit of 1mSv per annum for members of the public.

Research in the FOCAS Research Institute (CREST) involving X-ray Units – Rigaku XRD and Bruker XRF

Rigaku 600 MiniFlex XRD

The staff would be in a room containing an X-ray physics system with Max current = 15mA and Max voltage = 40KeV. This X-ray physics system has a number of safety features including a RED emergency stop button on the lower front of the instrument, a HV Enable Key to lock off the X-ray generation, a safety switch that cuts power to the top cover if removed, a warning lamp on top of the XRD to show that the X-ray is on, and a door interlock – when X-rays are being produced the door is locked, if the door is forced open during the experiment the X-ray tube is shut off.

Bruker Tracer 5g XRF

The staff would be in a room containing an X-ray physics system with Maximum current = 0.195×10^{-3}mA and Max voltage = 50KeV. This X-ray physics system has a number of safety features including a radiation warning note which comes on prior to log on, a radiation warning light that must come on when the X-ray is running, a Backscatter check which shuts the X-ray tube off if the count rate falls below a threshold limit and a proximity sensor which checks that an object is within range of the examination window i.e., the X-ray tube will only operate if an object is detected.

These safety features ensure that the X-ray leakage from the XRD and XRF systems is less than 1µSv per hour. The staff who work with the X-ray units monitor them both for leakage radiation on a periodic basis. A radiation survey is carried out on a monthly basis to ensure that the leakage radiation from the XRD and the XRF systems is less than 1µSv per hour. There are currently no practices within the Technological University Dublin that are classified as Supervised due to the external radiation risk.

ROLES AND RESPONSIBILITIES

Staff and campus users to report to line manager when pregnant so that an assessment may be carried out.

Line managers to advise and facilitate.

MONITORING, EVALUATION AND REVIEW

Reviewed in line with the EPA (Environmental Protection Agency) licence.

DOCUMENTATION

The most recent version of this guidance note will be found on the Safety, Health and Welfare **Safety Hub**