RADIATION PROTECTION SERVICE

DEPARTMENT OF WELLBEING, SAFETY AND HEALTH

UNIVERSITY OF LEEDS

‘RADIATION EMPLOYERS’ GENERIC PRIOR RISK ASSESSMENT FOR PRACTICES UTILISING LOW ACTIVITY LOW-RISK SEALED SOURCES (I.E. SOURCES USED FOR TEACHING, LIQUID SCINTILLATION COUNTING AND IN LABORATORY INSTRUMENTS)

INTRODUCTION

This prior risk assessment relates to the use of low risk, mostly exempt, sealed sources used in teaching and / or for the making of scientific measurements. The assessment has been prepared in accordance with the guidance given in paragraph 44 of the ACoP to the IRR99.

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Nature of the sources and maximum radiation dose rates.	**Teaching sources** Typically, radioactive sources comprising of activity sealed in plastic disks or in steel cups (Philip Harris type). Sources are usually 37 kBq (1 µCi) in strength and include radioisotopes such as ^{22}Na, ^{54}Mn, $^{57/60}$Co, ^{90}Sr, ^{109}Cd, ^{133}Ba, ^{137}Cs, ^{139}Pu, ^{241}Am. The highest dose rates emanate from ^{90}Sr sources, with contact dose rates being <10 µSv h^{-1} to the hand, and body doses being <0.5 µSv h^{-1}. **Liquid scintillation counters** Common 'calibration' sources are ^{133}Ba, ^{137}Cs and ^{226}Ra that are fully contained in sealed systems within the instrument. Sources are moved into position for background checks typically using pneumatic systems. Activities are usually 370 kBq (10 µCi) to 740 kBq (20 µCi). Accessible dose rates are less than <0.5 µSv h^{-1}. *nb. If the sources are removed, as must happen prior to disposal of counting equipment, dose rates will be high and there is potential for contamination. This activity must only be carried out by the Radiation Protection Service, and is subject to separate risk assessment.* **Instrument sources** Sealed sources are used in instruments such as gas chromatographs, SMPS (atomisers & particle classifiers), and may include the radioisotopes ^{63}Ni (EC detectors), ^{85}Kr and ^{241}Am (SMPS). Activities in ECDs are usually 370 MBq (10 mCi) and in . Accessible dose rates from sources installed in instruments are <0.5 µSv h^{-1}, but may be slightly higher <20 µSv h^{-1} to the hands for ^{85}Kr SMPS sources outwith instruments. *nb This risk assessment does not apply to high activity SMPS sources, by which is meant sources not exempt from the EPR10: separate risk assessments apply.*

Likelihood of contamination arising and being spread	**Teaching sources** Only cup sources are capable of being damaged by a person performing an unsafe act such as pushing a narrow sharp object through the protective mesh and into the source capsule. Should this occur the contents would leak, although the activities involved are insufficient to cause biological detriment (harm). Sources are inspected before and after use by the responsible person, and checked for damage. Additionally, sources are wipe tested and checked annually by the Radiation Protection Service to ensure they are intact and in good condition. **Liquid scintillation counters** The likelihood of LSC calibration sources failing and leaking their contents is low, and the further risk of contamination being spread is remote because the containment vessels and delivery tubes are fully enclosed and have welded seams. Staff monitor calibration curves on a regular basis, and the Radiation Protection Service inspects equipment on an annual basis to check efficiencies and the condition of equipment. **Instrument sources** SMPS sources are held within steel cylinders, and are not expected to leak or rupture. Should this happen staff would observe indicative trends in measurement results. Most radioisotopes would remain contained within the source canister, although krypton (gas) would be evacuated and dispersed into the environment. *If a person worker for a day in a very small laboratory (30 m^{-3}) that had 10 air changes per hour, then using a DPUI of 2.2 10^{-11} (Sv/d)/(Bq/m^{-3}) and assuming a 370 MBq ^{85}Kr had leaked into the room, then the maximum dose received would be <5 µSv. There would be no residual contamination as krypton is an inert gas.* Gas chromatograph source do leak slightly on occasions as the hot gas

	mixtures cause the removal of the surface deposited ^{63}Ni. The outlets are protected from hand access and so, contamination would not be expected to spread to the hand. Any great loss of the source would be observed by the operator who would observe unusual instrument responses. sources are wipe tested and checked annually by the Radiation Protection Service to ensure they are intact and in good condition.
Personal and area monitoring results	**Radiation dosimetry** The use of dosimetry is not appropriate for these activities as levels of radiation would not be picked up by dosemeters. **Area monitoring** The historical record of monitoring and annual checks indicates the risk of exposure remains negligible.
Manufacturers recommended instructions	**Teaching sources** In general manufacturers do not provide operational instructions. However, sources are used in accordance with CLEAPSS guidance (for school related activities) and undergraduate experiments are conducted in accordance with scientific protocols. **Liquid scintillation counters** Manufacturers provide comprehensive operational instructions, which are followed, and also provide clear recommendations on servicing arrangements. Users are advised not to remove the protective covers of equipment. Instructions are followed. **Instrument sources** Sources are purchased from known suppliers and comprehensive information on source usage is supplied or made available on supplier's websites. Clear recommendations are given on servicing arrangements,

	and users are advised not to attempt to interfere with devices. Instructions are followed.
Engineering controls	**Liquid scintillation counters** LSCs are fully enclosed and there is no access to calibration sources or associated containment and delivery vessels. To access these users would be deliberately performing an unsafe act. **Instrument sources** Sources are protected from sources by the encapsulation of the source within the device, i.e. by physical barriers.
Systems of work or local rules	**Standard Operating Procedures** Users follow the instructions contained in SOPs.
Estimated levels of airborne and surface contamination likely to be encountered	**Normal operational use** Airborne or surface contamination is highly unlikely.
The effectiveness and suitability of PPE	**PPE** Very low risk of contamination arising, no external radiation dose rates, and so no requirement to wear PPE.
The extent of unrestricted access to areas where there are dose rates	**Teaching sources** Access to source storage locations is restricted on the grounds of security and the safe keeping of radioactive materials. Teaching laboratories are appropriately secure environments and are locked when unoccupied or out of normal teaching hours. Sources are removed from storage only for the purposes of teaching. Access to the sources in a teaching environment is not restricted. Sources may be used and handled by any person under the supervision of a responsible person, and in accordance with SOPs.

	Liquid scintillation counters Access is not restricted. **Instrument sources** Access to source storage locations is restricted on the grounds of security and the safe keeping of radioactive materials. Access for operational reasons (normal use) is not restricted to sources affixed to equipment or instruments.
Possible accident situations, likelihood and severity. **Steps to prevent identified accident situations.**	**Loss or theft** A source may become lost through negligent keeping. A source may be stolen because of improper use / keeping or through poor security. ***Collateral risk – high*** Infraction – Likely enforcement action by the Environment Agency and possible action by the HSE. ***Health risk - low*** Levels of radioactivity in low risk sources are not sufficiently high to cause detriment, or sources are constructed in such a manner as to prevent the leakage of contents. ***Risk reduction measures*** When not in use, sources not installed in equipment should be stored in a locked 'source store' (e.g. a lockable metal container that bolted to a wall / floor, or a lockable filing cabinet drawer). The room in which the source is stored must also be lockable. Only remove the source for the duration of its use, no longer. Do not leave unattended.

	Fire damage Sources become damaged when in storage or installed in instruments through the effects of fire in the room. ***Collateral risk - low*** ***Health risk - low*** Sources are inherently low risk and with accidental fire there is no direct negligence or intent to misuse radioactivity, and appropriate precautions have been taken regarding fire prevention and storage. ***Risk reduction measures*** Although fire damaged sources may not be intact, radioactivity will most likely be retained in the damaged or molten containment or store. The fire brigade should fight fires in areas where sealed sources are held. Remediation may only be carried out under the direct supervision of the Radiation Protection Service.
The consequences of possible failures of physical control measures	**Liquid scintillation counters** Equipment failure would cause the LSC to fail to operate. Physical containment means sources would not be released. Sources stuck in the 'open' position could be detected using a monitor, but would not present dose rates in excess of the dose constraint (>0.5 μSv h^{-1}). **Instrument sources** Sources are embedded in instruments and protected by physical containment. No other safety systems are used.