Standard Operating Procedure

Energy and environmental impacts under normal, abnormal and emergency conditions

When carrying out any procedure, it is important to consider energy and environmental impacts under normal, abnormal and emergency conditions. All members of the group are encouraged to identify ways to improve any SOP in all aspects, including energy use and environmental impacts; if you have an idea how to improve things please contact the PI or LO so that they can add it to the SOP and this SOP dedicated to the general consideration of energy and environmental impacts under normal, abnormal and emergency conditions. Most if not all of the information given below is covered in the training session given by the PI and summarised in the 'LEAF training notes.ppt' which is **on the Mills group web site, https://www.profandrewmills.com/leaf-documents/.** All SOPs and RAs, as well as the latter training notes require the research to first read this general SOP on energy and environmental impacts under normal, abnormal and emergency conditions. All SOPs and RAs, as well as the latter training notes, are revised at least annually, but more frequently when ideas for improvement are identified.

Normal conditions: Most of the equipment used in the laboratory requires a warm-up time – typically 30 min, to ensure lamps/ovens/detectors/light sources are at the optimum temperature. As this warm-up time is quite energy intensive, instruments that are to be used during the day are best switched on first thing in the morning and switched off last thing at night. All instruments/equipment have stickers on them reminding the users to switch of when finished. The FT-IR is THE exception in that it should not be switched off as the ceramic IR source is meant to be kept on al all times. In UV/Vis spectrophotometry and fluorimetry the use of plastic cuvettes should be minimised and rare; glass, and quartz cells are available. Re-usable, and readily recyclable glass sample bottles are sued for the GC and HPLC. The fume hoods should usually be switched off after use and certainly by the end of the day. The LO is responsible for ensuring all equipment, taps, fume hoods etc are switched off at the end of the day unless overnight working has been agreed and a form completed. Most laboratories have appropriate as sensors installed, O_2, CO_2 and/or H_2, detectors installed, so any unusual conditions which may become environmentally impactful can be monitored. To reduce the group's use of single-use plastic goods, all spectrophotometry and fluorimetry must be conducted using glass/quartz cuvettes and all non-biological work must use glassware, including glass pipettes. Wherever possible reusable glassware must be used in place of single use plasticware.

All researchers should aim to conduct their research in a way that minimises energy and resource use. When conducting research, the research should ask: how does the method minimises energy and resource use and how may the SOP be improved with this regard? Please notify the LO and PI with your ideas/suggestions and share them with the other group members through the Mills group WhatsApp. Before revising an accepted procedure, you MUST clearance by the PI and LO.

Abnormal conditions: As most of our experiments are carried out in aqueous conditions with very low concentrations of mild reagents, there is generally no need for extra energy intensive measures in the case of spills. However, what to do in the event of abnormal/emergency conditions, such as the advent of a large chemical spill, power cut, flood, or major accident is covered in the training session given by the PI and summarised in the 'LEAF training notes.ppt' which is on the Mills group web site, https://www.profandrewmills.com/leaf-documents/. Obviously, initially, the focus will

be on resolving the immediate problem. For example, in the case of a major chemical spill, the LO, PI and School's safety officers (SOs)must be consulted and an action plan devised and effected. In the case of a major accident, the University's emergency response team must be contacted (x2222) immediately. However, as soon as the emergency is under control, then energy and environment impacts need to be considered and addressed – usually by the LO. In all cases which render the laboratory temporarily unusable – all electrical equipment must be switched off, when and where possible and appropriate. If a fume hood is being used to vent off volatiles due to a major spill, the LO is responsible for ensuring it is switched off after this has been completed. The LO and SO will help with the clear up, advise what can be put down the sink and find and put away the cleaning equipment. The LO is responsible for maintaining the chemical spill kit. The LO or PI will advise what to do if a sample gets stuck in an instrument and ALWAYS notify IMMEDIATELY the PI and LO if any instrument is not working, so they can arrange for it to be fixed AND arrange an alternative.

Emergency conditions: If it is not obvious, the LO/PI – in consultation with the SO if available - will usually decide at what point a spill moves from a "contain, neutralise and mop up" to "evacuate the building and call the fire brigade", status. The most likely situation this might occur is if there was a major gas leak, or fire, which could not be readily contained. In such a case, the alarm would need to be rung and the room and building evacuated.

All suggestions with regards to improving energy and environmental impacts under normal, abnormal and emergency conditions, should be sent to the LO and PI so they can put them into effect.