# QUICK GUIDE

SAFETY Everyone. Everywhere. Every day

## RADIATION AND LASER SAFETY

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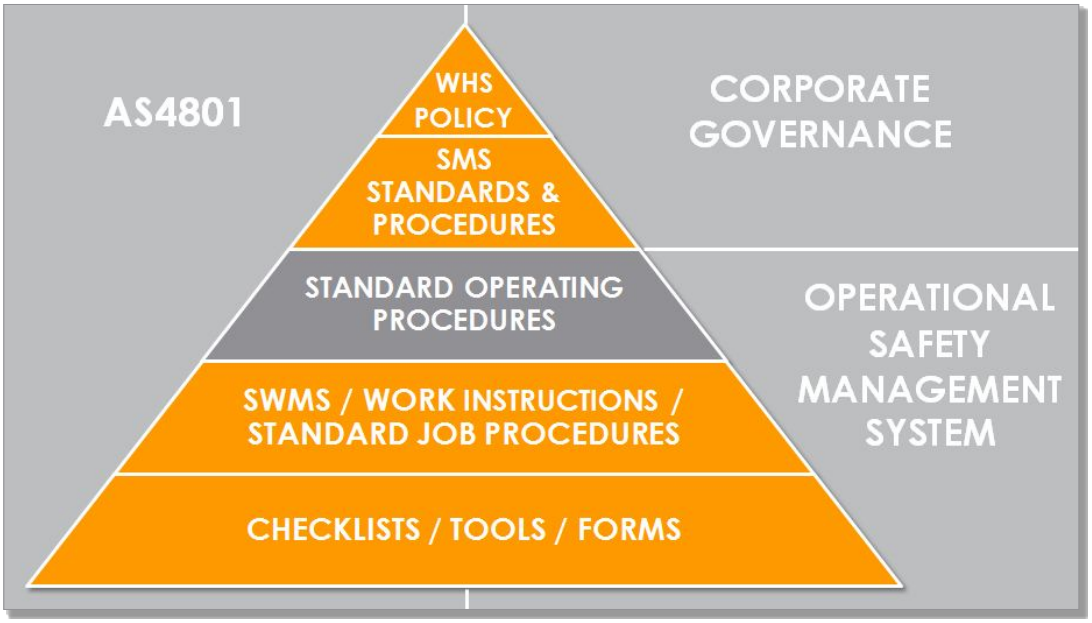
## 1. SMS DOCUMENT HIERARCHY




## 2. PURPOSE

This Quick Guide documents Queensland Urban Utilities' (QUU) approach to the safe use of ionising and non-ionising radiation and laser equipment. The aim is to ensure that risks associated with radiation and lasers are adequately managed in order to minimise the risk of injury or harm to workers.

This Quick Guide has been developed as an information and planning resource only and is not to be used as a WHS inspection or audit tool. WHS audits and inspections must be undertaken using the relevant WHS audit or inspection tool as outlined in **WHS Audit and Inspection Procedure (PRO366)**.

## 3. RELATED DOCUMENTS

- WHS Hazard and Risk Management Procedure (PRO363)
- WHS Incident Reporting, Investigation and Escalation Procedure (PRO364)
- WHS Audit and Inspections Procedure (PRO366)
- Health Management Procedure (PRO367)
- Radiation Risk Assessment Form (FOR281)

## 4. FURTHER INFORMATION

For further information, contact your Health and Safety Representative or the QUU Safety Team.

## 5. PROCESS ACTIONS TO ACHIEVE COMPLIANCE

| AT ALL TIMES | REFERENCE |
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| **1. OVERVIEW** | |
| (a) Exposure to radiation and laser light has specific risks to health and must be controlled. | Section 7.1 (PRO446) |
| (b) QUU will assist workers and contractors to identify, assess, control and review radiation sources and laser in order to prevent injuries at work. | |
| **2. IONISING RADIATION SOURCES** | |
| (a) Industrial gauges that incorporate radioactive substances are used for a variety of manufacturing process and quality control applications. The radioactive substances incorporated in industrial gauges are generally of a level of activity that would, if not adequately shielded, result in a significant health hazard. | Section 7.2 (PRO446) |
| (b) Unauthorised persons should not remove, or in any way interfere with, radioactive substances or carry out any maintenance, adjustment or modifications to radiation gauges. | |
| (c) In QUU, there is currently one work place, Oxley Creek STP, that uses instrumentation with an ionising radiation source. The units are located near the top of the three reactor tanks of the CAMBI system. | |
| **3. RADIATION SAFETY & PROTECTION PLAN** | |
| (a) QUU has developed *MP72 Radiation Safety and Protection Plan for Oxley Creek STP* (the Plan) as required under the *Radiation Safety Act 1999*. | Section 7.2.1 (PRO446) |
| (b) All workers and contractors and contractors working at Oxley Creek STP who are required to carry out the industrial gauging practice must be familiar with *the Plan*. | |
| (c) QUU's responsibilities under *the Plan* include:<br>• Holding a licence, issued under the *Radiation Safety Act 1999*, with authority to possess sealed radioactive substances incorporated in industrial gauges;<br>• Managing radiation doses arising from the radiation practice below the limits specified in the *Radiation Safety Regulation 2010* and as low as reasonably achievable;<br>• Providing personal monitoring devices to monitored persons as required, and ensuring that:<br>o Personal monitoring devices are handled properly;<br>o Monitored persons are advised of their personal monitoring assessment results; and<br>o Copies of the personal monitoring assessment results are submitted to the Chief Executive of Queensland Health;<br>• Achieving compliance with any conditions imposed on the possession licensee by the Chief Executive, Queensland Health and with those stated in *the Radiation Safety Act 1999* and the *Radiation Safety Regulation 2010*;<br>• Implementing the version of *the Radiation Safety and Protection Plan* that has been approved by the Chief Executive, Queensland Health;<br>• Appointing a Radiation Safety Officer certified under the *Radiation* | |

| AT ALL TIMES | REFERENCE |
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| *Safety Act 1999*;<br>• Providing adequate resources to implement *the Plan* (e.g. provision of appropriate training in radiation safety, radiation monitoring devices etc.);<br>• Ensuring that the industrial gauges continue to comply with radiation safety standard *NM009:2010* and obtaining certificates of compliance from an appropriately accredited person before initial use and every three years thereafter;<br>• Ensuring that, if there has been a change in the location of a gauge, an appropriately accredited person performs an assessment of the premises for compliance with Radiation Safety Standard *PR100:2010 - Ionizing Radiation Sources* before the gauge is used;<br>• Obtaining approval from the Chief Executive of Queensland Health before disposing of radioactive material greater than the amount and concentration prescribed in the *Radiation Safety Regulation 2010*; and<br>• Immediately notifying the Chief Executive of Queensland Health after an incident, either verbally or in writing. | |
| (d) Any other QUU sites that are required to obtain or install a sealed ionising radiation source instrument will develop a site-specific *Radiation Safety and Protection Plan*. | |
| **4. RADIATION SAFETY OFFICER** | |
| (a) As a possession licensee who possesses a radiation source for a radiation practice, QUU must appoint a Radiation Safety Officer (RSO) under the *Radiation Safety Act 1999*. | Section 7.2.2 (PRO446) |
| (b) Only a qualified person who holds a Radiation Safety Officer Certificate relevant to a radiation practice may be appointed as an RSO for QUU. | |
| (c) QUU-appointed RSOs will be provided with training relevant to industrial gauging ionisation sources through a Queensland Government approved training provider and will be issued with a RSO Certificate from Queensland Health. All costs associated with training and certification will be met by QUU. | |
| **5. MAINTENANCE OF INDUSTRIAL GAUGES** | |
| (d) When maintenance works are to be performed, the RSO will:<br>• Provide a site specific induction with the contractors. The contractors will have relevant qualifications to undertake maintenance work. This also includes advising contractors that whilst the CAMBI is de-energised the source remains energised;<br>• Lock out and tag out, including de-energising, the CAMBI prior to any maintenance works occurring;<br>• Undertake radiation readings. These reading will occur at contact and at 1 metre; and<br>• Remove all locks and re-energise the CAMBI at the end of the maintenance period. | Section 7.2.3 (PRO446) |
| **6. DISMANTLING OF PLANT** | |
| (a) If the CAMBI or related equipment needs to be dismantled, the following must occur:<br>• All items must be stored in the bunker and records of stored items | Section 7.2.4 (PRO446) |

| AT ALL TIMES | REFERENCE |
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| kept with the Radiation Safety Officer; and<br>• Disposal of radiation sources must be undertaken by a suitably qualified contractor. | |
| **7. RADIOFREQUENCY RADIATION (RFR)** | |
| (a) Some QUU reservoirs have RFR antennae on top. Where RFR-generating antennae are located in a workplace, the following will be implemented:<br>• A Radio-communications Site Management Book (RCSMB) will be developed by the telecommunications provider and a copy kept on site;<br>• The site will be registered with the Radio Frequency National Site Archive (RFNSA);<br>• The RCSMB will include a plan of the structure and will indicate where antennae beams are directed and where it is safe and unsafe for access of the public and maintenance workers;<br>• Antennae will be located so as to ensure full compliance with RFR exposure standards and to minimise unnecessary RFR exposure;<br>• Access to the site and antennae will be secured through the use of barricades, locks, perimeter fencing etc.; and<br>• Signage and ground markings will be installed to warn of RFR hazard zones and safe areas. | Section 7.4 (PRO446) |
| (b) When QUU staff or contractors access areas where RFR-generating antennae are located, the following must be completed prior to undertaking works:<br>• Prior to performing work in and around an RFR-generating antennae area, a Working at Heights Permit must be completed. Additionally, in accordance with PRO409 Falls SOP, a Safe Work Method Statement (SWMS3) must also be completed.<br>• Prior to accessing the upper level of a QUU reservoir that contains RFR equipment, all QUU staff and contractors must consult the RCSMB. Where access is required inside the transmitting zones (as defined in the RCSMB), the following will apply:<br>o **Red Zone** (areas above ARPANSA RPS3 Occupational Limits): no access without confirmed power reduction or transmitter shutdown;<br>o **Yellow Zone** (areas above ARPANSA RPS3 Public Limits): limited access to specially trained personnel (RF Workers); and<br>o **White Zone**: General access allowed. | |
| (c) Training must be provided to all QUU staff and contractors who are required to access areas where RFR generating equipment is located; and | |
| (d) All hazards, risks and control measures associated with RFR on site must be included in the site-specific induction/prestart. | |
| **8. UV RADIATION** | |
| (b) To avoid exposure to UV radiation workers need to be shielded from UV radiation sources, and control measures need to be put in place. | Section 7.5 (PRO446) Hot & Cold Environments<br>SOP (PRO423)<br>Welding SOP |
| (c) *Sun:* For control measures against UV exposure from the sun, refer to Hot & Cold Environments SOP (PRO423). | |

| AT ALL TIMES | REFERENCE |
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| (d) *Welding:* Refer to the Welding SOP for safe welding practices. | |
| (e) *UV Sterilisers:*<br>• To prevent exposure to QUU staff and contractors, all ultraviolet germicidal irradiation (UVGI) systems will operate in an environment that is isolated from persons, fully shields the UV source and features an interlocked power source such that opening the enclosure will shut down power to the UV lamps.<br>• Additional controls that will be implemented in QUU work places to prevent exposure to UV radiation from lamps include:<br>o Written work instructions for specific UV generating equipment;<br>o Training of all workers in the safe use of all UV generating equipment including lamps and hand-held devices used in laboratories;<br>o Labelling of all UV generating equipment warning that there is a UV radiation hazard, shielding should be in place when operating the equipment, and eye/skin protection is needed for operation; and<br>o PPE will be worn when using UV lamps and hand-held devices and will include long sleeves, gloves, and face shields designed to protect against the UV wavelength generated. All skin must be covered. | |
| **9. LASER CLASSIFICATION** | |
| (a) Lasers are classified according to the hazard associated with their emissions (refer to Australian/New Zealand Standards for further information). | Section 7.6.1 |
| (b) **Class 1 and 1M lasers** are safe under reasonably foreseeable conditions of operation.<br>Class 1M can be hazardous if the beam is viewed with magnifying optical instruments (hence the letter 'M' is added). | |
| (c) **Class 2 and 2M lasers** emit visible light at higher levels than Class 1, but eye protection is provided by aversion responses such as the human blink reflex.<br>Class 2M lasers can be hazardous if the beam is viewed directly with magnifying optical instruments. | |
| (d) **Class 3 lasers** are medium-power lasers that pose a modest potential for injury.<br>Class 3 laser users may be required to follow specific safety precautions and may require the wearing of safety equipment such as laser protective eye wear.<br>Skin hazards normally do not exist for incidental exposures. | |
| (e) A **Class 3A laser** emits higher levels of radiation and requires more stringent precautions than those necessary for Class 2 laser products.<br>Class 3A lasers differ from Class 2 laser products in that they emit more power in a beam of larger cross-section, so that when the output is viewed directly, the power of the beam entering the eye does not exceed that of a Class 2 laser product.<br>However, if the beam is viewed through larger diameter collecting optics (e.g. binoculars) then the hazard is usually increased. | |

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| For continuous wave (CW) output in the visible wavelength range, the output power from Class 3A lasers is limited to 5mW and the maximum irradiance (power density) is 25W.m-2. | |
| (f) **Class 3B (restricted) lasers** or laser systems operate at the same power levels as Class 3A but have higher levels (25 to 50W.m-2) of irradiance.<br>Class 3B (restricted) lasers may be used in daylight conditions under the same controls as for Class 3A laser products. Where used in conditions of less illuminance (generally less than 10 lux), the appropriate safety controls are those specified for Class 3B laser products. | |
| (g) **Class 3B lasers** can emit either invisible or visible radiation and direct viewing is hazardous to the eye.<br>Class 3B lasers are capable of causing eye injury either because their output is invisible and therefore aversion responses are not activated, or because the beam power is such that damage is done in a time shorter than the blink reflex (0.25s).<br>Higher power lasers in this class may also cause skin burns. However, with laser wavelengths other than those in the ultraviolet region, the pain produced by rapid heating of the skin will usually evoke an aversion response sufficient to avoid such burns. | |
| (h) **Class 4 lasers** are high power devices capable of causing both eye and skin burns.<br>Their diffuse reflections may also be hazardous and the beam may constitute a fire hazard. | |
| **10. LASER HAZARDS AND CONTROL MEASURES** | |
| (a) Radiation hazards include injury to the eyes and skin from direct exposure to the laser beam or any reflections. The factors that can contribute to tissue injury and influence the degree of damage from laser beam exposures include:<br>• Wavelength of laser radiation;<br>• Tissue spectral absorption, reflection and transmission;<br>• Strength of irradiance of incident laser beam;<br>• Size of irradiated area;<br>• Exposure duration;<br>• Pupil size;<br>• Location of retinal injury; and<br>• Laser pulse characteristics. | Section 7.6.2 |
| (b) *Eye protection:*<br>• Eye protectors are only intended to protect against accidental exposure. Eye protectors are not intended to be used for looking directly into the beam.<br>• Standard safety glasses alone do not provide protection from lasers.<br>• The following should be considered when specifying suitable protective eyewear for use with lasers:<br>o Wavelength(s) of operation;<br>o Radiant exposure or irradiance;<br>o Maximum permissible exposure (MPE); | |

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| ○ Optical density of eyewear at laser output wavelength;<br>○ Visible light transmission;<br>○ Radiant exposure or irradiance at which damage to eyewear occurs;<br>○ Need for prescription glasses;<br>○ Comfort and ventilation;<br>○ Degradation or modification of absorbing media, even if temporary or transient;<br>○ Strength of materials (resistance to shock);<br>○ Peripheral vision requirements; and<br>○ Any relevant legislation.<br>• Special attention must be given to the protection and stability against laser radiation when choosing eyewear for Class 4 laser products.<br>• Any laser eyewear, plain or prescription, must be labelled in accordance with *BS EN207* or *BS EN208* with information adequate to ensure the proper choice of eyewear with particular lasers.<br>• Laser eye protectors and laser adjustment eye protectors which have been damaged or have undergone a colour change must not be used. | |
| (c) *Skin protection:*<br>• Where employees and other persons on QUU-controlled worksites may be exposed to levels of radiation that exceed the maximum permissible exposure for the skin, suitable clothing must be worn.<br>• Class 4 laser products:<br>○ Protective clothing made from a suitable flame and heat-resisting material must be worn when working with Class 4 laser products.<br>○ Special attention must be given to resistance and long-term stability against laser radiation when choosing protective clothing for use with Class 4 laser products. | |
| (d) *Electrical hazards:*<br>• All electrical equipment associated with laser beam materials processing must be installed in conformance to AS/NZS 3000 Electrical installations.<br>• All doors and access panels must be properly secured, either electrically or mechanically, to prevent access by unauthorised personnel to electrical components.<br>• All employees and other persons on QUU worksites working on or around high-voltage components must:<br>○ be trained in the proper safety techniques for electrical systems;<br>○ be trained in the technique of removing a victim from an electrical circuit and administering cardiopulmonary resuscitation (CPR);<br>○ be aware of and adhere to any additional electrical safety requirements of the laser system installed in their facility; and<br>○ always read, understand and follow the manufacturer's recommended safety procedures. | |

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| (e) *Fumes and gases:*<br>• Welding, cutting and drilling, and surface modification with lasers may result in the generation of fumes, dust, and gases that can be hazardous to personnel. These airborne contaminants may include:<br>o Vaporised target material and reaction products in the form of metal particles and oxides;<br>o Gases from the flowing gas laser systems or from the by-products of laser reactions, such as ozone, nitrous oxide, carbon monoxide and carbon dioxide;<br>o Gases or vapours from cryogenic coolants; and<br>o Gases used to assist laser-target interactions, such as oxygen.<br>• Care must be taken to avoid the excessive build-up of laser discharge gases, shielding gases, and assist gases, especially in enclosed spaces where oxygen can be displaced.<br>• All necessary environmental engineering measures for fume and gas control (external venting, filtering, etc.) must be taken to prevent the accidental inhalation of harmful concentrations of fumes and gases by personnel working on or around laser materials processing equipment.<br>• The possible toxicity of the work-piece and consumables (wire, powder, etc.) must be determined before laser-beam material processing begins.<br>• Adequate protection to personnel must be provided.<br>• the Safety Data Sheet (SDS) must be consulted to determine what hazards exist for all materials. | |
| (f) *Fire hazard:*<br>• Flammables must be kept away from the welding or cutting area.<br>• All flammable items in the area must be covered and protected, as reflected radiation could start fires in unexpected areas. | |
| (g) *Secondary radiation hazards:*<br>• Viewing of the visible radiation emitted during laser materials processing can also be harmful to eyesight.<br>• During welding, adequate filtering, such as welding shades, must be employed for eye protection.<br>• All persons involved with laser beam materials processing must:<br>o Wear proper optical filtering as part of their PPE; and<br>o Be instructed in the use of proper optical filtering. | |
| **11. LASER USE AT QUU** | |
| (a) Use of lasers at QUU is typically:<br>• Profiling levelling and measurement applications (e.g. surveying);<br>• Laser scanners used in office and stores applications;<br>• Laser pointers used in meetings, lectures and seminars; and<br>• Construction lasers. | Section 7.6.3 |
| (b) Laser pointers are normal **Class 1 or 2 lasers**, emitting a maximum power output of less than 1 milliwatt, and do not represent a significant risk to health. | |
| (c) Workers using measurement, levelling or surveying lasers outdoors must | |

| AT ALL TIMES | REFERENCE |
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| wear standard UV protective safety glasses. | |
| (d) Construction lasers range between **Class 1 and 3** (A and B Restricted), and may have an invisible beam or a coloured beam (typically red). | |
| (e) Precautions must be followed when construction lasers are being used. These include:<br>• All operators must be trained in accordance with Australian Standard *Australian Standard AS2397: 1993 Safe Use Of Lasers in the Building and Construction Industry*;<br>• A Laser Safety Officer (LSO) must be appointed at the worksite (only for **Class 3** [A,B Restricted and B] and **Class 4**).<br>• A copy of *AS2397 - 1993* must be kept on work sites operating lasers at all times;<br>• They must not be used in dimly lit environments; and<br>• The level of natural illumination must be above 100 lux or not low enough to cause the pupil to dilate in excess of 5 mm in diameter (this is to limit the amount of energy that could enter the eye. | |
| (f) QUU does not currently use **Class 3 or 4 lasers**. Should the use of class 3 or 4 lasers be required, the advice provided in the Radiation & Laser Safety SOP must be followed. | |
| **12. LASER HEALTH MONITORING** | |
| (a) QUU employees and other persons using lasers on QUU-controlled worksites whose work involves a significant risk of exposure to laser radiation in excess of the Maximum Permissible Exposure (MPE) must have eye examinations and, where appropriate, skin examinations carried out before commencement and after termination of the job. | Section 7.6.4 |
| (b) For anyone at increased risk of laser damage, more frequent eye examinations may be advisable. | |
| **13. CALIBRATION OF LASER EQUIPMENT** | |
| (a) Lasers used at QUU work sites must be calibrated at intervals recommended on the laser device/ | Section 7.6.5 |
| (b) Any instruments that are outside of calibration date must be tagged 'out of service' until calibration can be verified. | |
| **14. LASER SAFETY OFFICER (LSO)** | |
| (a) Any worker or contractor operating or using a class of Laser identified as requiring an LSO as outlined in the Australian Standard must appoint an LSO. | Section 7.6.6 |
| **15. DOCUMENTATION AND RECORD KEEPING** | |
| (a) A copy of all Radiation and Laser record must be held in TRIM and must be kept in hardcopy format on site. | Section 7.7 |
| (b) Hardcopy records must be easily accessible, secure and provide confidentiality (where required). | |

## 6. REVIEW PROCESS

This document is to be reviewed every 12 months or earlier if:

- there is an identified risk to business;
- a significant safety event occurs;
- incident investigation or audit results show that application of the Quick Guide fails to deliver the required outcomes;
- there are changes in associated legislation; or
- there is evidence that the Quick Guide is not having a positive impact on safety-related KPIs.