WI58 ARC FLASH HAZARD ASSESSMENT & PPE SELECTION

PURPOSE	SCOPE	RESPONSIBILITIES
The purpose of this work instruction is to provide detailed direction to workers approaching and accessing all LV and HV electrical equipment for either operational or maintenance activities to ensure adequate steps for personal protection from possible electrical arc flash and touch voltages are taken into account.	This work instruction applies to all employees and contractors of QUU undertaking activities on or near live LV or HV electrical equipment. This document excludes work on ELV equipment as ELV is not considered a hazardous voltage level to personal safety.	It is the responsibility of the person/s coordinating and performing the tasks to ensure the directions outlined in this work instruction are followed, all pre start checks are carried out prior to commencing works.
TRAINING/COMPETENCY	**DEFINITIONS/ ACRONYMS**	**DEFINITIONS**
QUU authorised staff with training and competencies for task being completed and as identified in the WRAP process.	AC – Alternating Current cal – Calorie cm – centimetre CB- Circuit Breaker DC – Direct Current ESR – Electrical Safety Regulations mA – milliamp mm – millimetre O&M – Operations and Maintenance PSA – Power System Analysis RCD – Residual Current Device SWMS – Safe Work Method Statement	ELV – Extra Low Voltage: Not exceeding 50 volts AC or 120 volts ripple free DC LV – Exceeding ELV but not exceeding 1,000 volts AC or 1,500 volts DC. HV – Exceeding low voltage Switchboard – An electrical enclosure containing circuit breakers, and other switchgear components and an example is a distribution board. Control Panel – electrical enclosure with a single phase 240 volt AC, 30mA RCD protected main incoming supply rated at 32A or less. Electrical Equipment: Generally includes switchboards, control panels,

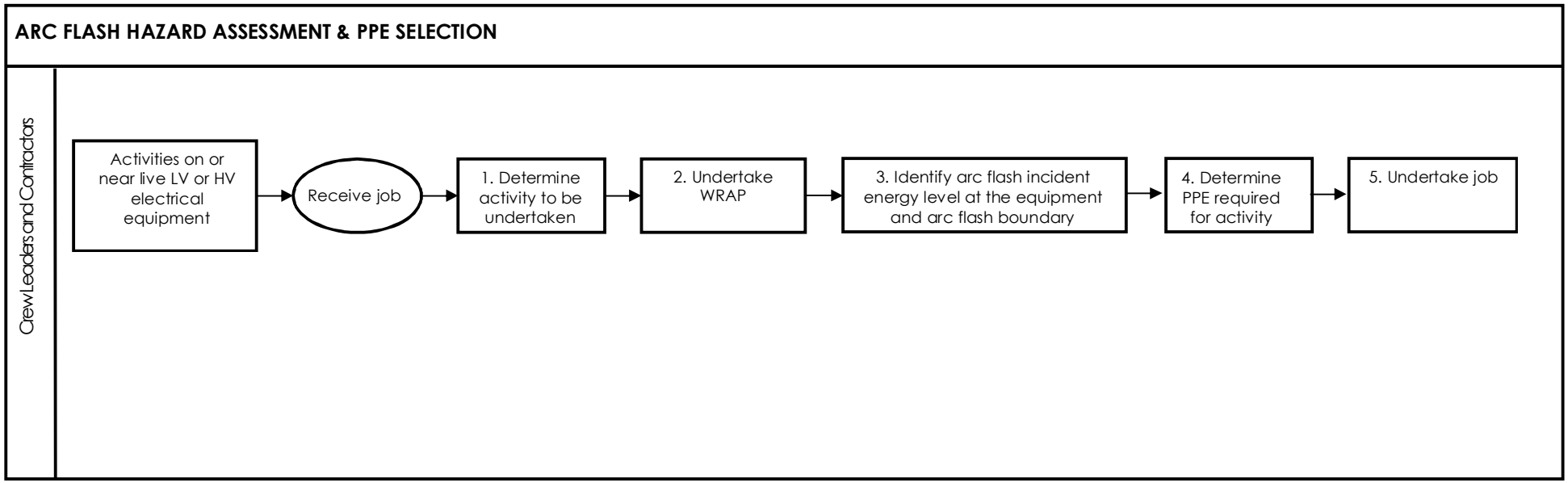
		transformers, generators, local isolators, junction boxes that have Arc Flash labels installed. It excludes all other electrical items that do not have Arc flash labels applied. WRAP – QUU workplace risk assessment.
RELATED DOCUMENTS		
NFPA 70E 2015 IEEE 1584 Electrical Safety Regulations 2013 MP71 - Electrical Safety Management System SWMS 27 - Electrical Testing SWMS PR0379 – Energy Lock Out Tag Out PRO363 – WH&S Hazard and Risk Management Procedure PRO4 – QUU Event Escalation Guidelines PRO424 - Personal Protective Standard Operating Procedure WI55 Mobile Generator Connection and Disconnection RE025800-RPT-001 – Arc Flash Risk Assessment Workshop Report		

1. PERSONAL PROTECTIVE EQUIPMENT

As identified in this work instruction and the QUU WRAP process

2. FLOWCHART

Figure 1 ARC FLASH HAZARD ASSESSMENT & PPE SELECTION



If an issue occurs during the course of this work please refer to QUU PRO4 – Escalation Guidelines for details on how to escalate events.

3. INSTRUCTION

Table 1 Arc Flash Hazard Assessment and PPE Selection

STEP	INSTRUCTION	SAFETY/ENVIRONMENT/KEY MESSAGES
Step 1 Determine activity to be undertaken	• From the job planning process determine the type of activities that need to be undertaken to complete the tasks • Select the activities to be undertaken, the highest risk consequence and applicable PPE from Appendix A.	**Incident Energy**: The amount of (arc) energy at the working distance from a potential arc flash. It is calculated using a set of formulae from IEEE 1584. The incident energy is expressed as cal/cm^2. **Working Distance**: The distance between the arc source and the workers body (face and torso). The arc flash incident energy is calculated at the specified Working Distance and for an LV switchboard is typically 455mm. **Arc Flash Boundary**:- The distance from the exposed live parts greater than Extra Low Voltage at which a person could receive a curable burn (2nd degree burn).
Step 2 Undertake WRAP	• Complete WRAP process	• Identify risks, controls and standard operating procedures.

STEP	INSTRUCTION	SAFETY/ENVIRONMENT/KEY MESSAGES
Step 3 Identify arc flash incident energy level at the equipment	• Upon arrival at site locate any Arc Flash labels. Refer to Appendix B for arc flash labels and locations at the equipment.	• Arc Flash labels are being introduced across QUU sites. Not all sites may have been evaluated. • Reconfirm WRAP and update as required • Ensure all switchboard and local control panel access door locks and latches on escutcheons are in the closed and locked positions if not required to be open for the work task.

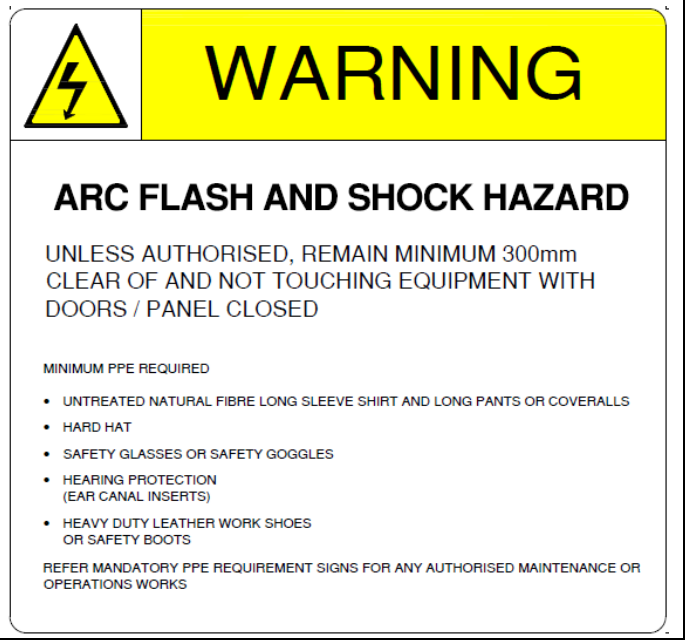
STEP	INSTRUCTION	SAFETY/ENVIRONMENT/KEY MESSAGES
Step 4. Determine PPE required from site labels and WRAP process	• The arc flash label at the equipment nominates the arc flash PPE categories required for specific tasks. • The arc flash label nominates the minimum PPE items required for each PPE Category 0, 2 and 4 • Should there be no arc flash labels installed at the equipment, then use minimum level Category 2 PPE for all tasks that require access to the inside of the equipment while energised. This is applicable with escutcheon panel open or other access doors open and when within 1.5m of the enclosure. Standard QUU PPE is accepted for undertaking tasks with all equipment doors locked closed and all removable covers fixed in place while energised. • When an emergency generator is connected to a switchboard and is running the PPE Category required to access the switchboard may be different to when the switchboard is fed from Energex normal supply. In this case refer to the arc flash label at the switchboard's generator plug connection compartment for PPE required for each task at the switchboard. Note there is also PPE required to access any parts of the energised generator as per the site specific PSA Report.	• Record PPE decision on WRAP • The safety observer must wear an equivalent level of PPE should a rescue need to be carried out in proximity to the equipment being accessed • From Appendix A select the QUU approved PPE. • For LV switchboards that are properly installed and maintained by qualified persons there is minimal risk to persons external to the switchboard during operation of the enclosed electrical equipment i.e. with the escutcheon panel securely closed (escutcheon front access door open) and all other switchboard doors locked closed and removable covers secured in place. • To operate pushbuttons or access meters on an LV switchboard with escutcheon panel securely closed and all other doors closed and locked a person may wear standard QUU PPE. This will be indicated on the Type 3 arc flash label with doors closed for control/monitoring task. • A person need only wear standard QUU PPE to enter a switchroom containing only LV switchboards that have the energised switchboards with all access doors locked closed and all removable covers fixed in place. • To operate equipment such as pushbuttons or other equipment on a HV switchboard arc rated PPE shall be worn as per the Category specified for the task on the arc flash label fixed to the HV switchboard.

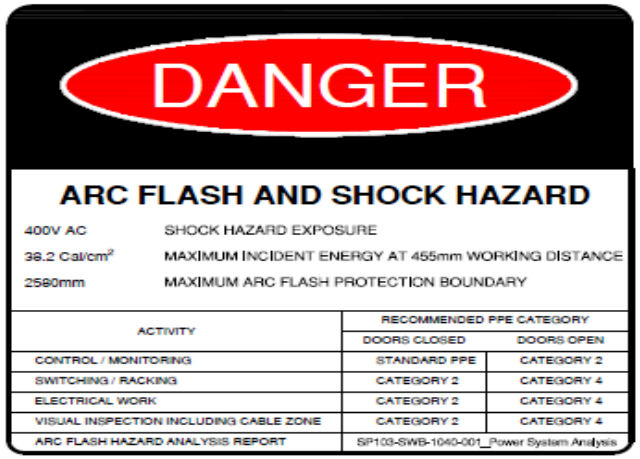
STEP	INSTRUCTION	SAFETY/ENVIRONMENT/KEY MESSAGES
Step.5 Undertake job	• This completes the Arc Fault Hazard Assessment and PPE Selection, continue with standard work instructions and procedures to complete the job safely.	• Monitor activities. Should the activities increase or be modified, review WRAP and modify risks accordingly. • Consider if the new risk profile changes existing risk profile from the activities change the hazard category. • Report any hazards or incidents following QUU hazard and reporting process. • Ensure all equipment access doors are locked closed and all removable covers are fixed in position on completion of the works. • This completes the assessment

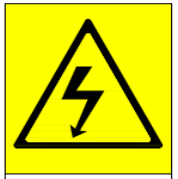
Appendix A – PPE for Arc Flash Hazard Category

Hazard Category	Rating	PPE
0	=<1.2 cal/cm2	• Untreated natural fibre long sleeve shirt and long pants or coveralls • Hard Hat • Arc rated face shield with chin cup • Safety glasses or safety goggles • Hearing protection(ear canal inserts) • Work wear gloves heavy duty leather* • Heavy duty leather work shoes or safety boots *Rated to the voltages in proximity to worker
2	=< 8 cal / cm^2	• Arc rated long sleeve shirt and pants or arc rated coveralls with minimum arc rating of 8 cal/cm2 OR overcoat with a minimum arc flash rating of 8 cal/cm2 • Hard hat • Safety glasses or safety goggles • Hearing protection (ear canal inserts) • Rubber insulated work wear gloves* with leather protectors • Arc rated face shield with chin cup • Arc rated balaclava • Heavy duty leather work shoes or safety boots *Rated to the voltages in proximity to worker
4	=< 40 cal / cm^2	• Arc flash suit with minimum arc rating of 40 cal/cm2 consisting of: • Arc flash suit, hood/face shield • Arc flash shirt/coat • Arc flash pants/coveralls • Hard hat • Safety glasses or safety goggles • Hearing protection (ear canal inserts) • Rubber insulated work wear gloves* with leather protectors • Heavy duty leather work shoes or safety boots *Rated to the voltages in proximity to worker

Appendix B Arc Flash Signage Labels

Label	Location	Image
Arc Flash Label - Type 1	The Arc flash Label Type 1 shall be fixed to the switchroom building access doors at QUU facilities where the equipment contained in the switchroom has high incident energy levels and an arc flash hazard may exist. A Type 1 label shall be installed on access gates of security fences around outdoor electrical equipment with high incident energy levels and where an arc flash hazard may exist. A Type 1 label will not be displayed where the switchroom or fenced area only contains LV switchboards and/or control panels.	

Arc Flash Label - Type 2	A Type 2 label shall be fixed to the exterior of the front access door of the common control compartment on indoor switchboards. On outdoor switchboards the Type 2 label shall be fixed to the escutcheon panel at the Common control compartment. Note the label will not be visible without opening the front door to the escutcheon panel.	
Arc Flash Label - Type 3	On indoor switchboards a Type 3 label shall be fixed to the exterior of the front access door of the common control compartment On outdoor switchboards the Type 3 label shall be fixed to the escutcheon panel at the common control compartment. Note the label is not visible without opening the front door to the escutcheon panel. A Type 3 label shall generally be fixed to electrical equipment including switchboards, distribution boards, transformer terminal boxes and generator CB compartments and local isolators.	

Arc Flash Label - Type 4	All accessible compartments including cable zones on switchboards containing LV and HV power devices shall have a label referring O&M persons to the common control panel Arc Flash Label as per labels Type 2 and 3.	
Arc Flash Label - Type 5	LV Switchboards and control panels with an RCD protected 240 volt AC single phase main supply rated at 32A or less are considered to have negligible risk to arc flash hazard. These enclosures have a Type 5 label fixed to the exterior surface of the front access door. Persons can access the energised enclosure with standard PPE and safety glasses and must follow SWMS27 for testing works. A face shield is accepted in lieu of wearing safety glasses.	

Appendix C – Arc Flash PPE Risk Assessment

For work activities on LV electrical equipment which stipulate PPE Category 0 it is accepted to undertake a risk assessment to relax the requirement for some items of PPE. The following items can only be omitted from PPE Category 0 where supported by risk assessment and where it is considered not practical to perform the tasks effectively while wearing the items:-

- Arc rated face shield with chin cup
- Hearing protection(ear canal inserts)
- Work wear gloves heavy duty leather can be substituted with rubber arc rated gloves for specific tasks

For work activities on LV switchboards and equipment classified as PPE Category 2 or 4 as well as all HV switchboards and HV equipment a risk assessment is NOT accepted to relax the PPE requirements stated on the arc flash labels for the specific equipment.

Appendix D Examples

Example 1 An electrician approaches an LV switchboard located outdoors at a pump station to attend to a fault. The electrician has a task to perform fault finding on the switchboard panel. A Type 1 label is not displayed on the site access front gate and the electrician enters the site only wearing standard QUU PPE. The electrician opens the front door to the main control panel and identifies the Type 2 and 3 arc flash labels fixed to the escutcheon. The Type 3 label indicates Category 2 PPE is required for opening doors and performing electrical works. The electrician wears Cat 2 PPE for the duration of the work while accessing the switchboard while it is live with doors open. Note the electrician can avoid wearing arc rated PPE and only required to use standard QUU PPE if isolation of the switchboard can be done by removing the Energex fuses feeding the switchboard.

Example 2 An operator approaches an LV switchboard located indoors at a pump station to reset a fault. There is no Type 1 label on the pump station access door so operator can enter the building with only standard QUU PPE. The operator approaches the switchboard and identifies the arc flash labels Type 2 and 3 on the exterior of the front door of the main control compartment. The Type 3 label indicates the switchboard requires PPE Category 0 for all tasks with doors open and for the control/monitor tasks with doors closed the Type 3 label indicates standard QUU PPE. The operator is only wearing standard PPE and so can reset the fault using the pushbutton on front of the switchboard. The operator can perform any control/monitoring task while wearing standard PPE as long as the energised switchboard doors are all locked closed.

Example 3 A control systems engineer requires access to an LV enclosure containing PLC processor, I/O cards and other control equipment. The enclosure is outdoors and the site is not fenced to restrict access by the public. The engineer identifies a Type 5 arc flash label on the external front door of the enclosure. The Type 5 label allows access to the energised enclosure by opening the front doors and requires the engineer to wear QUU standard PPE and safety glasses. Enclosures fed from an RCD protected single phase 240VAC supply rated at 32Amps and less will be provide with an Arc Flash Type 5 labels and this is applicable at all QUU facilities.

Example 4 An electrician approaches an LV switchboard located outdoors at a sewerage pump station that is being fed from an emergency portable generator. The Electrician has a task to perform fault finding on the switchboard panel and/or generator. A Type 1 label is displayed on the site access front gate and the electrician follows the direction to wear the PPE as required to enter the site and approach the switchboard and generator. The electrician opens the front door to the main control panel and identifies the Type 2 and 3 arc flash labels fixed to the escutcheon. The Type 3 label indicates Category 0 PPE is required for opening doors and performing electrical works. The switchboard is temporarily

fed from a generator and the electrician must check the Type 3 label at the switchboard's generator plug compartment. This label calls for Category 2 PPE for all tasks with switchboard doors open while energised by generator. This label has precedence over the other Type 3 label at the switchboard main control compartment only when switchboard is fed from a generator. The electrician wears Cat 2 PPE for the duration of the work while accessing the switchboard while it is energised by the generator with switchboard doors open. Note the electrician can avoid wearing arc rated PPE items and only required to wear standard PPE if isolation of the switchboard can be done by removing the Energex fuses and isolating at the generator on board CB. If the electrician requires to access the generator while energised then he must refer to the Arc Flash Type 3 label at the generator for Category of PPE required for each task required to perform at the generator.
If all doors are locked and closed on the generator and switchboard the electrician is only required to wear standard PPE to perform control/monitoring tasks on the equipment.

Example 5 An electrician approaches a HV switchboard located in a switchroom to check status of the HV switchgear and read the digital displays on the power meter and the protection relays. There is a Type 1 label on the switchroom access door so electrician must comply with the PPE stated on the label to enter the switchroom. The electrician approaches the energised switchboard and identifies the arc flash labels Type 2 and 3 on the front door of the main control compartment. The Type 3 label indicates the switchboard requires PPE Category 0 for all tasks for the control/monitor tasks with doors closed. The electrician strictly complies with all PPE items required for touching and inspecting the switchgear, protection relay and power meter.

Example 6 A control systems engineer requires access to an indoor LV switchboard containing PLC processor, I/O cards and other control equipment for fault finding. The switchboard is located in a switchroom with a Type 1 label on the switchroom access door. The engineer complies with the Type 1 PPE and enters the switchroom and then identifies a Type 2 and 3 arc flash labels on the external front door of the switchboard. The Type 3 label calls for PPE Category 2 for all activities with doors open and this includes access to the PLC control compartment. The engineer must wear Category 2 PPE items for all tasks while the switchboard is energised and doors are open. If all doors and escutcheon panels are locked closed the Type 3 arc flash label will indicate that the engineer can control/monitor the switchboard pushbuttons and displays with standard PPE.