Quick Reference Guide
Energy Based Safety (EBS)

This guide will help you identify, assess, and control the energy hazards present during critical risk activities - **before** the work begins, **during** the work, and if **conditions change**.

Principles of Energy Based Safety (EBS)

The principles of EBS are:

- Exposure to energy causes harm,
- More energy causes more harm,
- Safety is the extent to which we can control high-energy hazards.

The aim is to sharpen the focus and integrate EBS thinking where it will have greatest impact - during upfront planning workshops, pre-start/toolbox meetings and when observing high-risk work in practice. Ultimately, the goal is to identify high-energy hazards and implement controls that prevent serious injuries and fatalities.

Backed by evidence-based research, EBS introduces 3 key concepts:

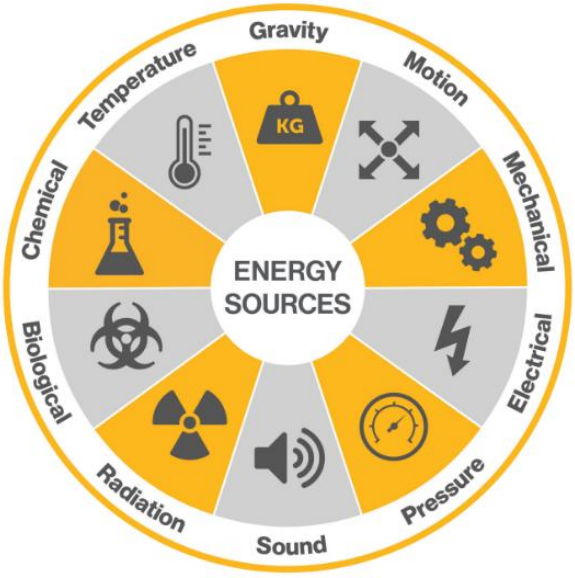
- The Energy Wheel – to identify all energy sources, including those often missed,
- STKY (Shit That Kills You) – prioritise the hazards that could lead to serious harm or fatality if uncontrolled,
- Hierarchy of Energy Control – to apply the most effective controls at the source.

Key Concepts of EBS

The Energy Wheel

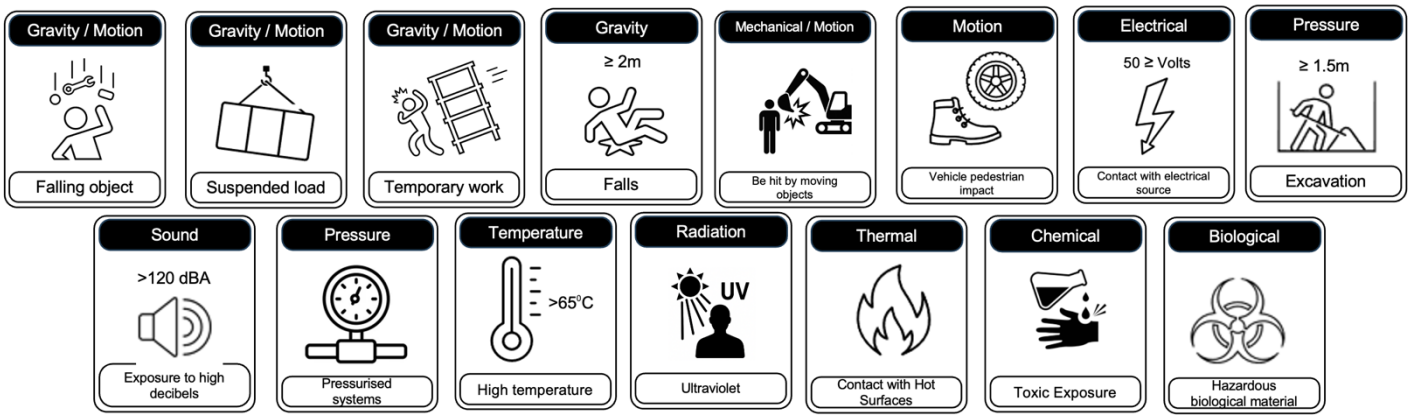
The Energy Wheel is a tool designed to help detect less obvious hazards that are often missed due to cognitive blind spots. While common hazards like working at heights (gravity) and mobile plant (motion) are usually identified, other energy types (thermal, electrical, chemical, pressure) are less obvious and may be missed.

The Energy Wheel acts as both a ‘blind spot’ detector and a visual prompt to systematically guide a project team through ten common categories of energy associated with construction work. Studies show that using the Energy Wheel can significantly improve hazard identification by about 30%. For further background, refer to research conducted by the Construction Safety Research Alliance (CSRA). The Energy Wheel complements existing safety practices and can be used at any stage, planning, execution, or review to expand hazard identification.



STKY (Shit That Kills You)

The hazards that hurt people are not the same as the hazards that cause life changing or life-threatening harm. EBS focuses on those hazards that could lead to serious injuries or fatalities, the STKY's. High energy hazards or STKYs are characterised icons representing typical examples of high-energy hazards designed to be tailored for your company/ industry. Focusing our attention and resources on the STKY's, objectively helps to communicate and quantify the risk to everyone involved.



Icons to be tailored to suit industry sector & nature of work of Company

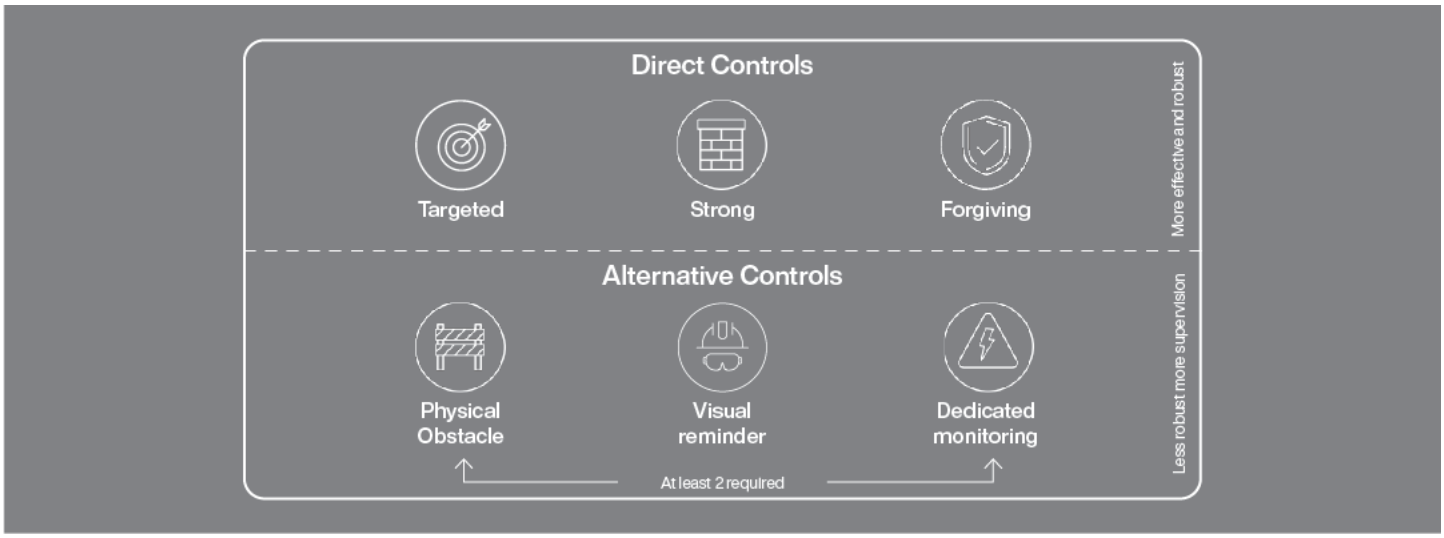
Hierarchy of Energy Control

The hierarchy of energy control introduces two tiers of controls – these are 'Direct Controls' and 'Alternative' controls.

Direct controls are the most robust, they target the source of energy and remain effective even if someone makes a mistake.

When direct controls are not reasonably practicable, 'Alternative Controls' such as physical obstacles, visual reminders, and monitoring can be used; these controls are less robust, so at least two (2) different alternative controls from distinct categories must be used to effectively manage the risk.

**Note: This hierarchy complements, but does not replace the obligations on PCBU's to apply the traditional hierarchy of control as per relevant WHS legislation*



Applying Energy Based Safety Theory to **High-Risk Workshops (HRW)**

A HRW is a planning meeting, or series of meetings, held prior to undertaking defined high-risk work. EBS principles are embedded into high-risk work planning, assisting us to identify high-energy (STKY) hazards, prioritise, establish and agree the controls before work begins.

HRW's are facilitated by the Principal Contractor and aim to bring together key stakeholders involved in the high risk work and includes managers with the authority to make decisions, other site staff (Supervisors, Engineers, Project Coordinators, HSE Advisor/Coordinator), Health and Safety Representatives (HSRs), the subcontractor managers / supervisors and key workers who will perform the work, and (where applicable) relevant consultants. Together, this group aims to:

- Develop and review detailed, site-specific safe work methodologies, accounting for logistics, site conditions, and work interfaces including temporary and permanent conditions
- Systematically identify energy hazards associated with the work, using traditional hazard identification methods and the Energy Wheel to identify less obvious risks
- Prioritise STKY hazards, focusing control efforts on those with the highest potential for serious harm or fatality
- Incorporate lessons learned from past incidents or similar projects to inform better hazard identification and control strategies
- Assess risks collaboratively and agree on controls, document the agreed scope of work, sequence of tasks, hold points, inspection/test requirements, responsibilities, and control measures.

HRW Process Steps	
1. Identify High-Risk Work	Prior to high-risk work commencing, identify the activities that qualify as high-risk work and therefore require a HRW, referencing the WHS legislation's list of high-risk construction work and, where applicable, the Principal Contractors internal criteria.
2. Engage Stakeholders Early	The Principal Contractor (and/or subcontractor performing the work) notifies all key stakeholders of the HRW well in advance to allow sufficient time for potential adjustments to the work methodology or sequencing if needed.
3. Complete Pre-Planning Meeting/s	Subcontractors in consultation with the Principal Contractor conduct pre-planning meeting/s to prepare for the HRW, involving: • Developing a site-specific work methodology for how the high-risk work will be executed, considering site logistics, equipment and site conditions • Preparing site-specific materials such as drawings, digital models, sequence diagrams, and other visual aids to support clear understanding of scope and methodology for all stakeholders • Performing an initial hazard identification for the planned work and applying the Energy Wheel and STKY icons as a checklist to capture less obvious energy hazards and proposing appropriate control measures • Reviewing previous lessons learned (i.e. incident reports, data) if available to inform hazard identification and control strategies
4. Conduct the High-Risk Workshop	The Principal Contractor and subcontractor representatives work together to collaboratively: • Walk through the planned methodology and sequence, presenting how the work will be done, step by step, using the visual aids prepared • Present and review the hazards identified during pre-planning and collaboratively work to identify additional hazards by encouraging input from all stakeholders and using the Energy Wheel as a prompt to revisit and uncover any high-energy hazards that may have been missed during initial review/planning • Verify and agree for each high-energy hazard, appropriate controls (direct and alternative) are planned, understood, documented, and accountability assigned. Where it is necessary schedule follow-up workshops to revisit the methodology, reassess hazards, and refine controls.

Applying Energy Based Safety Theory to **Pre-start/Toolbox Meetings**

Pre-start (toolbox) meetings are short meetings held on-site with the work crew before starting high-risk work. These meetings connect the planning from the HRW with the workers actually doing the work on the day. Led by the responsible front-line supervisor (e.g. site supervisor, foreman or leading hand), the purpose of a pre-start meeting is to verify all workers involved:

- Are informed of the plans and agreed work methodology
- Are aware of the high-energy hazards and the agreed controls
- Understand what to do if things aren't going to plan – specifically, that they have the authority to stop work and re-plan if an unexpected hazard emerges or if the job deviates from the agreed method.

Pre-start/Toolbox Meetings Process Steps	
1. Preparation before the Meeting	Before gathering the crew, the supervisor should do some preparation to make the briefing effective: • Review the planned high-risk work scope, site conditions, and anticipate changes such as weather, deliveries, or equipment issues throughout the day. Think ahead about what might be different today versus what was assumed during the planning. • Hold the meeting close to where the work is being carried out so that the potential hazards can be recognised and controls explained.
2. During the Meeting	• Walk through key tasks, sequencing, including interfaces with deliveries, use of specific equipment, designated exclusion or restricted zones, and any other simultaneous activities by other trades. • Reinforce the agreed work methodology and plan developed during the HRW, varifying workers understand how the work will be carried out. • Confirm hazards identified in HRW and probe for any new or unforeseen energy sources or risks that might have emerged since initial planning. • Review and discuss the STKY (high-energy) hazards identifed during the HRW and verify all workers are aware of the associated risks and clearly understand the agreed controls (direct / alternative) in place to manage them.
3. Concluding the Meeting	• Have all team members confirm they understand the discussed controls and their individual responsibilities. • Remind everyone they have the ability to STOP WORK immediately if things aren't going to plan or unsafe conditions prevail or changes arise, so that the situation can be reassessed and the work plans (e.g. SWMS) amended, before work resumes.

CASE STUDY

Managing Gravity and Mechanical Energy Hazards using Energy-Based Safety

Tower Crane Installation — Multi-Storey Construction Project

This case study describes the application of Energy-Based Safety (EBS) principles during the installation of a tower crane on a multi-storey construction project. It demonstrates how the High-Risk Workshop (HRW) and Pre-Start Meeting processes from the EBS Guide were used to systematically identify high-energy hazards or the STKYs (Shit That Kills You) associated with gravity and mechanical energy hazards, including falls from height, dropped objects, uncontrolled tension in luffing ropes, and the release of stored energy during anchor stressing.

Tower crane installation presents a unique safety challenge and involves high-energy hazards including gravity and mechanical hazards through the sequence of activities — from foundation anchor stressing well in advance of the installation, through to the erection of the crane structure. Different brands and models of tower cranes present different assembly processes, requiring careful planning and coordination to confirm all high-energy risks are controlled to an acceptable level.

Identify High-Risk Work

The task was to erect a 42-metre free-standing tower crane with a 50-metre jib in a busy urban area. The installation required a public road closure and involved workers operating at heights equivalent to a 14-storey building.

Complete Pre-Planning Meeting

In consultation with the Principal Contractor, the tower crane subcontractor held pre-planning sessions to:

- Develop the site-specific crane erection methodology, accounting for site access and logistics, equipment, and site conditions
- Prepare site-specific materials including drawings, sequence diagrams, and visual aids to support clear understanding of the scope and methodology for all stakeholders
- Perform an initial hazard identification applying the Energy Wheel as a checklist to capture less obvious high-energy hazards and propose appropriate control measures
- Review lessons learned /incidents from previous tower crane installations and operations, including the following:

On a previous project, lifting operations were underway when a camera and battery box attached to a tower crane hook block dislodged during high winds. The equipment had been secured using magnetic mounts but had not been independently tethered to the hook block. The camera and battery box fell from height into the exclusion zone below. While no personnel were in the immediate area at the time and no injuries occurred, the incident demonstrated the risk of relying on a single control.

Applying the Energy Wheel in the pre-planning meeting identified several energy sources. For the purposes of this case study, we focus on two primary energy categories:

- **Gravity:** Falls from height during at-height assembly tasks; dropped objects including tools, components, and equipment attached to the hook block.
- **Mechanical:** Uncontrolled tension in the luff rope during reeving; uncontrolled release of stored energy during stressing and destressing of the tower crane base anchors.

Control Measures (Hierarchy of Energy Control)

For each high-energy or STKY hazard, the team applied the Hierarchy of Energy Control, prioritising and searching for Direct Controls. Direct controls are controls that specifically target the energy source and remain effective even if someone makes a mistake. Where Direct Controls were not reasonably practicable, multiple Alternative Controls were identified to further mitigate / manage / reduce the risks.

Gravity		
Hazard	**Falls from Height**	**Dropped Objects**
Direct Controls	• Eliminate exposure to height by conducting ground-level pre-assembly in a designated laydown area • Perform pre-installation maintenance on crane components to prevent emergency repairs at height • Install guardrails and working platforms for any unavoidable work at height • Use fall arrest systems with harnesses	• Secure tools and components using lanyards or containment systems • Require independent tethering of all equipment attached to the hook block, in addition to any primary magnetic or mechanical mounting • Install hard physical barriers and establish exclusion zones beneath suspended loads
Alternative Controls	• • Visual barriers and signage to delineate work zones • Provide continuous supervision and assign dedicated spotters during at-height activities • Establishment of rescue plans and maintain readily available rescue equipment	• Deploy visual barriers and signage delineating exclusion zones • Assign dedicated spotters to monitor ground-level areas • Conduct regular inspections of tools and equipment prior to lifting

Mechanical		
Hazard	**Uncontrolled tension in the luff rope during reeving**	**Uncontrolled release of stored energy during stressing and destressing of tower crane base anchors**
Direct Controls	• Use an eyelet at the end of the luff rope instead of a cable sock (friction sling) to prevent unintentional rope movement during threading	• Use engineered torque-controlled, NATA-calibrated equipment to verify anchor stressing is applied within the manufacturer's specified limits, reducing the risk of over-tensioning and sudden energy release • Install mechanical locking systems (e.g. locking nuts, wedges, pins, or certified anchor-holding plates) that secure the anchor in place during and after tensioning, preventing uncontrolled movement or back-drive during destressing
Alternative Controls	• Establish exclusion zones around the winch, boom foot, and sheave areas during reeving to keep personnel clear of potential snap-back paths if the rope becomes loaded unexpectedly • Implement communication protocols (e.g. radio or visual signals) are in place so all workers can immediately stop the task if rope movement or tensioning is detected	• Establish exclusion zones around the base during all stressing and destressing activities to keep personnel clear of potential release or snap-back paths • Use controlled stressing procedures, including staged tensioning, incremental load checks, and supervisor verification before progressing to higher loads

Conduct the High-Risk Workshop (HRW)

The HRW brought the Principal Contractor and the tower crane subcontractor together to review the planned methodology and confirm that the hazards and controls identified in the pre-planning meeting were appropriate, understood, and agreed before work commenced.

Documentation

All agreed controls were documented in the site-specific Safe Work Method Statement (SWMS) with responsibilities assigned.

Key Learnings

- The Energy Wheel’s structured approach improved hazard identification by highlighting high-energy or STKY hazards that may not have been identified through traditional methods particularly the mechanical energy hazards associated with luff rope tension and anchor stressing.
- The hierarchy of energy control applied to the high-energy hazards including uncontrolled rope tension, stored energy release during anchor stressing, and gravity-driven dropped-object events were prioritised and managed using the more robust direct controls rather than relying on administrative controls alone.
- Conducting ground-level pre-assembly as a direct control demonstrated the effectiveness of eliminating exposure for STKY gravity hazards.
- The HRW process helped the team understand the high-energy hazards present across all stages of tower crane installation, from foundation anchor stressing to final erection.

Pre-Start (Toolbox) Meeting

On the morning of the tower crane installation, the Subcontractor Site Supervisor led a Pre-Start Meeting with the work crew at the actual work location to enable direct reference to the tower crane erection sequence, exclusion zones, and anchor points. The meeting followed the process outlined in the EBS Guide.

1. Preparation Before the Meeting

Before gathering the crew, the Site Supervisor took time to prepare by:

- Reviewing the HRW outcomes and SWMS
- Checking weather forecasts and wind speed predictions, noting the forecast for increasing winds in the afternoon and identifying this as a potential trigger for a work stoppage
- Confirming the crane erection sequence and identifying any changes from the planned methodology
- Confirming that all workers held the required licences, tickets, and competencies and relevant experience for their assigned roles, including crane operators, riggers, and dogmen
- Confirming road closures and exclusion zones were established prior to the commencement of any activities.

2. During the Meeting

During the meeting, the Subcontractor Site Supervisor:

- Provided a detailed description the day's crane erection sequence, referencing the physical locations, equipment including the laydown areas, and exclusion zones
- Reinforced the direct and alternate controls agreed for high-energy/STKY hazards
- Highlighted the afternoon wind forecast as a potential trigger for a work stoppage and confirmed the wind speed threshold at which work would cease

3. Concluding the Meeting

All participants confirmed their understanding of the planned crane erection sequence, and the agreed controls for the high-energy-STKY hazards. The site supervisor reinforced the direct and alternative controls in place and reminded the team they could STOP WORK if conditions changed or any unsafe situation emerged.

Key Learnings

- The Pre-Start Meeting provided an opportunity to consult with workers, confirming their understanding of the STKYs and inviting input on any conditions that had changed since the HRW.
- Holding the meeting at the work location, with direct reference to physical locations, equipment, laydown, and exclusion zones assisted in closing the gap between planning and practice, and improved workers' understanding of the high-energy-STKYs by connecting hazards to the real work environment.
- Reinforcing STOP WORK authority, particularly around changing wind conditions, empowered workers to act without hesitation if conditions differed from those anticipated during planning.

CASE STUDY

Managing Electrical Safety using Energy-Based Safety

Lock-Out Tag-Out (LOTO) and Electrical Isolation — New Data Centre Fit-Out and Commissioning

This case study demonstrates the application of Energy-Based Safety (EBS) principles during the fit-out and commissioning of a new data centre. It shows how the High-Risk Workshop (HRW) and Pre-Start Meeting processes from the EBS Guide were used to systematically identify high-energy electrical hazards or the STKYs (Shit That Kills You) associated with multiple and overlapping sources of electrical energy, including mains supply, Rotary Uninterruptible Power Supplies (RUPS) or static Uninterrupted Power Supply (UPS) battery systems, and generators.

Data centres present a unique electrical safety challenge. Unlike most construction environments, where a single mains supply can be isolated, data centres are designed with multiple redundant power paths to ensure continuous operation once commissioned. During commissioning, these systems are progressively energised, tested, and handed over, creating periods during which the boundary between “live” and “isolated” equipment is dynamic and can be misunderstood by the workforce.

Identify High-Risk Work

The project involved the fit-out and commissioning of a new multi-hall data centre facility. The electrical infrastructure included high, medium, and low-voltage switchgear; multiple low-voltage distribution boards; Rotary UPS (RUPS) units; emergency diesel generators; and an extensive busbar and cable reticulation network.

Complete Pre-Planning Meeting

In consultation with the Principal Contractor, the commissioning team and electrical subcontractors held pre-planning sessions to:

- Develop a site-specific work methodology of electrical isolation and LOTO (Lock Out Tag Out) plan identifying every energy source feeding each distribution board and circuit
- Map all power paths, including mains, RUPS or static UPS, and generator back-feed routes
- Perform an initial hazard identification applying the Energy Wheel as a checklist to capture less obvious energy hazards and propose appropriate control measures
- Review lessons learned from previous data centre projects, including specific incidents involving unexpected energisation, including the following:

On a previous project, electrical workers were performing testing and verification work on the downstream distribution board of a RUPS unit. The mains supply to the board had been isolated and locked out. However, the RUPS unit had not fully powered down and continued to generate power exposing workers to the electrical hazard.

As designed for a power outage, the LOTO was undertaken, and the mains were isolated to the plantroom. The commissioning team initiated a test sequence while the RUPS flywheel continued spinning and generating electricity. The distribution board from which the electrical workers were testing and verifying cables remained energised following the LOTO process. Workers were in direct contact with conductors at the time, resulting in an electrical burn to the injured person’s hand.

Applying the Energy Wheel in the pre-planning meeting expanded team’s hazard identification by drawing attention to several energy sources that were not initially obvious:

- **Electrical:** Unexpected Energisation from multiple power sources such as the 11kV high-voltage supply; 415V three-phase mains distribution; RUPS output (415V); generator back-feed (415V) and residual voltage held in capacitors and power factor correction equipment
- **Stored Electrical Energy:** Residual energy from RUPS flywheel and capacitor banks within switchgear and power distribution units

Control Measures (Hierarchy of Energy Control)

For each high-energy or STKY hazard, the team applied the Hierarchy of Energy Control, prioritising and searching for Direct Controls. Direct Controls are controls that specifically target the energy source and remain effective even if someone makes a mistake. Where Direct Controls were not reasonably practicable, multiple Alternative Controls were identified to further mitigate / manage reduce the risks.

Electrical		
Hazard	**Unexpected Energisation from Multiple Sources**	**Residual Electrical Energy from RUPS Flywheel and Capacitor Banks**
Direct Controls	• Implement a multi-source isolation procedure requiring physical lock out (LO) of all energy sources feeding a circuit — mains, RUPS, UPS/battery, and generator — before any work commences	• Implement a multi-source lock out (LO) procedure requiring isolation of RUPS, UPS, and battery systems in addition to mains before any work commences, ensuring residual electrical generation from the flywheel is fully dissipated before work proceeds
Alternative Controls	• Where physical lock out (LO) is not practicable, apply tag out (TO) process. • Mandatory prove-de-energised testing at the point of work using a calibrated voltage tester immediately before commencing any electrical task • Appoint a 3rd party energy warden to sign and approve work permits as part of the LOTO process • Use danger tags and physical barriers on all panels and switchboards with adjacent live and isolated circuits	• Where physical lock out is not practicable, apply a tag out (TO) process. • Mandatory prove-de-energised testing at the point of work using a calibrated voltage tester immediately before commencing any electrical task • Appoint a 3rd party energy warden to sign and approve work permits as part of the LOTO process

Conduct the High-Risk Workshop (HRW)

The HRW brought the Principal Contractor, commissioning team, and subcontractors together to review the planned methodology and confirm that the hazards and controls identified during the pre-planning meeting were appropriate, understood, and agreed before work commenced.

Documentation

All agreed controls were documented in the site-specific Safe Work Method Statement (SWMS) and a dedicated Electrical Isolation and LOTO Management Plan and permit system.

Key Learnings

- The Energy Wheel's structured approach improved hazard identification by revealing electrical energy paths and stored energy sources that may not have been identified through traditional processes alone.
- The hierarchy of energy control approach demonstrated that high-energy hazards particularly unexpected energisation from multiple sources and residual electrical energy from RUPS flywheels and capacitor banks were prioritised and treated as the most critical risks requiring the more robust Direct controls.
- Presenting real incident investigation findings during the HRW helped the team better understand the potential STKY consequences associated with electrical and stored-energy hazards, reinforcing the value of Direct controls
- The application of EBS principles reinforced those direct controls, such as multi-source LOTO and mandatory prove-de-energised testing, are far more effective for STKY hazards than administrative measures alone, ensuring energy is controlled at the source.

Pre-Start (Toolbox) Meeting

On the morning of the first commissioning phase, the subcontractor Commissioning Manager led a Pre-Start Meeting with the full work crew at the main electrical switch room to allow direct reference to equipment, isolation points, and the Commissioning Status Board. The meeting followed the process outlined in the EBS Guide.

1. Preparation Before the Meeting

Before gathering the crew, the subcontractor Commissioning Manager took time to prepare by:

- Reviewing the HRW outcomes, SWMS, and Permit
- Verifying all LOTO controls were in place and current
- Confirming the RUPS / UPS subcontractor's testing schedule for the day and identifying any potential interface conflicts
- Identifying any changes from the planned commissioning sequence

2. During the Meeting

During the meeting, the subcontractor Commissioning Manager:

- Walked through the day's commissioning sequence using the single-line diagrams, pointing to the specific switchboards and panels involved
- Reinforced the LOTO procedure for the multiple electrical energy sources, emphasising that isolating mains alone is not sufficient in a data centre environment
- Confirmed the controls for the STKY hazards and invited input on any new hazards or changes to conditions
- Confirmed the boundary between live and isolated equipment and reinforced all personnel understood which areas required a permit to access

3. Concluding the Meeting

All participants confirmed understanding of and acceptance of the controls. The subcontractor Commissioning Manager reminded the team they could STOP WORK if conditions changed, if they were uncertain about the energisation status of any equipment, or if any unsafe situation emerged. The team was reminded that no work was to proceed on any circuit without first confirming de-energisation even if a permit was in place.

Key Learnings

- The Pre-Start Meeting provided an opportunity to consult with workers, confirming their understanding of the controls for the high-energy/STKYs and inviting input on any conditions that had changed since the HRW.
- Reinforcing STOP WORK authority was critical, particularly empowering workers to refuse to proceed if they could not personally verify de-energisation
- Holding the meeting at the switch room with the Commissioning Status Board visible improved hazard comprehension and engagement significantly compared to a site office briefing.