

# TUNNELLING

## PURPOSE AND SCOPE

The intent of this document is to eliminate or minimise the risks of fatalities, injuries and incidents arising from tunnelling activities on Gamuda Australia (GA) projects / workplaces.

### CRITICAL CONTROLS

- Tunnelling works to be risk assessed and recorded against the Project Risk Assessment.
- A tunnel design and construction methodology are developed by a suitably qualified and experienced engineer.
- Temporary and permanent ground support systems must be designed by a suitably qualified and experienced engineer and certified in writing by a competent person at the time of their installation, at intervals no greater than 24 hrs and subsequent to any change in ground conditions.
- Mechanical ventilation systems must be designed and certified by a Ventilation Engineer and operational during construction, including localised extraction ventilation for dust, heat, fumes, operating plant, and maintenance activities.
- An Occupational Hygienist must develop and implement an Atmospheric Monitoring Program to ensure the atmosphere maintains a safe oxygen level free from contaminants above Workplace Exposure Standards (WES).
- A commissioning report is in place for Tunnel Boring Machine(s) (TBM) prior to operation.
- A permit to tunnel is in place prior to work commencing and at intervals no greater than 24hrs or as specified (Refer Permit to Tunnel).
- A ground support monitoring system shall be designed, installed, and certified by a competent person to monitor ground movement and the effectiveness of temporary ground support.
- A process is in place to assess and manage changes in conditions and the adequacy of the tunnel design and ground support.
- Safe access / egress is maintained to tunnels and a system is implemented to prevent access by unauthorised persons.
- Personnel performing tunnelling activities are trained and competent.
- An air quality monitoring program is in place.
- Tunnelling boards (or equivalent) are implemented to accurately determine personnel in tunnel.
- A communication system is in place to support operational requirements and to effectively manage any emergency event.
- An Emergency Response Plan is developed which details escape routes, provision, and location of self-contained self-rescuer (SCSR) device, safe place and refuge chambers, and location of fire services and emergency equipment.
- A SWMS must be in place for tunnelling activities.

**Note:** The above controls are to be read in conjunction with the Regulations, Standards and Codes listed below.

## TUNNEL DESIGN AND RISK ASSESSMENT

Safe tunnel design and construction depends on pre-construction investigation of the ground conditions. Pre-construction investigations should consider the type, extent and location of the tunnelling activity and local environmental conditions. Tunnelling designs and risk assessments should be based upon, but not limited to the following conditions and aspects, so far as is reasonably practicable.

- climatic and prevailing weather conditions
- local topography – location, condition and influence of existing structures, services, and old workings
- geophysical conditions – drilling boreholes or examining existing borehole results, laboratory assessment of soil and rock properties, rock cutting, dust production and blasting trials (if applicable)
- hydrology – ground water conditions including location, volume, and possible changes due to tunnelling and other activities
- excavation methods, type of plant and equipment to be used and associated risks and controls
- tunnel dimensions and allowable excavation tolerances
- limitations for installing ground support during excavation e.g., maximum, and minimum distances from the tunnel face
- temporary ground supports during tunnel construction
- ventilation and extraction systems
- construction phase electrical systems
- materials handling systems including spoil removal and loadings from roof mounted spoil conveyors
- places of safety including refuge chambers and emergency plan requirements, including methods of communication, first aid and rescue equipment, rescue personnel and capability.
- final ground support and lining requirements for each location within the tunnel, and other requirements for the finished tunnel.

## TUNNELLING COMPETENCY AND INSPECTION

Personnel are considered competent if they hold the minimum competency and experience in tunnelling as follows.

- Civil engineering qualification, geotechnical engineering, and previous experience in a tunnel engineering role.

Personnel in a supervisory role (for example, superintendent or supervisor) are considered competent to regularly undertake inspections to monitor the effectiveness of controls in accordance with the design/drawing/plan/permit if they hold the minimum competency requirements.

- Verification of evidence that the person has the required training, qualification, experience, knowledge, and skills to verify and confirm the state of ground support systems.

## PERMIT TO TUNNEL

Where tunnelling work is undertaken a Permit to Tunnel (PTT) must be issued by a person holding delegated authority and must be signed by all nominated signatories prior to tunnelling excavation

commencement and at intervals no greater than 24hrs as a minimum or as specified otherwise. Permit validity periods may need to be increased or extended depending on the following variables, type of tunnelling or excavation method and/or specific ground conditions and geology. The PTT delegated authority will be documented in the Project Work Health and Safety Management Plan. The PTT shall certify the structural integrity of the ground including any temporary ground support system.

A Safe Work Method Statement will be completed in consultation with workers prior to any tunnelling works being conducted such that all hazards are identified, and control measures implemented, and a **GA-HSE-FRM-134 Permit to Tunnel** is issued, approved, and recorded.

## **REGULATIONS, STANDARDS AND CODES**

- Work Health & Safety Regulation 2011 (QLD, ACT), 2012 (SA), 2017 (NSW, NT) and 2022 (WA)
  - Part 3.1 Managing Risk to health and safety (Regs 32 – 38), Part 6.3 PCBU.
  - Division 2 High Risk Construction Work – SWMS (Regs 299 – 302); Division 3 Excavation Work (Regs 304 – 306); Division 7 Managing risk from airbourne contaminants (Regs 49, 50); Division 8 Hazardous atmospheres (Regs 51, 52); Chapter 4 – Hazardous work; Chapter 5 – Plant and Structures; Chapter 7 – Hazardous Chemicals
- Occupational Safety and Health Regulations 1996 (WA)
  - Subdivision 6 - Excavations and earthworks
- Occupational Health and Safety Regulations 2017 (VIC)
  - Chapter 5, Division 4 Notification of construction excavation work
- AS 1657-1992 – Fixed platforms, walkways, stairways, and ladders – Design, construction, and installation.
- AS 4024 (Series) – 2006 Safeguarding of machinery.
- AS/NZS 1210:2010 – Pressure vessels.
- AS/NZS 1200:2000 – Pressure equipment.
- AS/NZS 3873-2001 – Pressure equipment – Operation and maintenance.
- AS/NZS 4041-2006 – Pressure piping.
- AS/NZS 1680.0:2009 – Interior lighting, Safe movement.
- AS/NZS 3000:2018 – Electrical installations (Wiring Rules).
- CIA Z5-2010 – Shotcreting in Australia.
- ACI 506.5R-09 – Guide for Specifying Underground Shotcrete.
- AS/NZS 3745-2010 – Planning for Emergencies in Facilities.
- SafeWork Australia: Guide for Tunnelling Work.
- SafeWork Australia: Model Code of Practice; Managing Electrical Risks in the workplace.
- Safe Work Australia: Workplace Exposure Standards for Airborne Contaminants.
- BS 6164:2019 – Code of Practice: Health and safety in tunnelling in the construction industry (UK).
- EN12111 – Tunnelling machines, Roadheader, continuous miners, and impact rippers - Safety requirements.
- EN12336 – Tunnelling machines, shield machines, auger boring machines, lining erection machines – safety requirements.

INTEGRATED MANAGEMENT SYSTEM  
**CRITICAL RISK STANDARD**  
**TUNNELLING**



- EN1710 – Equipment and components intended for use in potentially explosive atmospheres in underground mines.
- EN12110 – Tunnelling machines, air locks, safety requirements.

**FORMS AND CHECKLISTS**

- **GA-HSE-FRM-134** Permit to Tunnel