

P-8 Workers Health and Safety Plan

Aim and Objective				
<p>The objective of <b>P-8 Workers Health and Safety Plan</b> (WHSP) is to ensure staff, contractors and sub-contractors act in a professional and safe manner and go home safe at the end of each day. The WHSP applies to all site and office workers employed by THL, including contractors, sub-contractors, full-time, part-time, and casual staff. It also applies to all visitors (including members of the public) that enter sites controlled by THL and its contractors and sub-contractors. The WHSP will assist in meeting THL's obligations under Solomon Islands work health and safety legislation and comply with the requirements of CFPs, including adherence to the World Bank Group's Environmental Health and Safety Guidelines (EHSG).</p>				
Summary of Impacts and Risks				
<p>Construction activities pose a potential risk to all onsite personnel. Risk assessments must be performed by HEC and its sub-contractors prior to commencement of all works that require a method statement and all works that require a Permit to Work. Note that a risk assessment is sometimes referred to as a Job Hazard Analysis (JHA). Samples of both a JHA and a risk assessment are provided in <b>Annex P-8-I</b>. Refer to <b>HEC-AH-H04-H03</b>for the risk assessment procedure (see also <b>Annex P-8-II Risk Assessment Process</b>).</p> <p>HEC maintains a suite of corporate health and safety documents that provide detailed procedures and considerations for project construction. These procedures are referenced where applicable below and copies of these detailed procedures are provided in <b>Annex P-8-III</b>.</p> <p><b>Annex P-8-IV</b> contains details on HSE roles and responsibilities for the construction phase of the Tina River Hydropower Project.</p> <p>Note that health and safety risks related to local communities, including Covid-19 and sexual transmitted infections, are covered in <b>P-10 Community Health and Disease Vector Management Plan</b>.</p> <p>Other activity-specific health and safety risks are covered in <b>P-11 Traffic Management Plan, P-13 Hazardous Materials Management Plan, C-2 Unexploded Ordinance Management Plan, C-11 Drill and Blast Management Plan, C-13 Noise and Vibration Management Plan, P-9 Workers Code of Conduct, P-7 Security Management Plan</b> and <b>P-14 Spill Prevention and Emergency Response Plan</b>.</p>				
Mitigation and Management Actions				
#	Issue or Risk	Action	Timing / Frequency	Responsibility
P-8-1.	General safety (office, accommodation and workplace)	<p>The following measures will be implemented at the Workers Accommodation Camp and workplaces to provide a safe and healthy environment for workers:</p> <ul style="list-style-type: none"><li>- Passages to emergency exits are marked and clear at all times.</li><li>- Buildings equipped with fire alarms and fire-fighting equipment. Equipment maintained and readily accessible.</li><li>- Sanitary toilet and washing facilities.</li><li>- Potable drinking water.</li><li>- Workplaces to receive natural light or be supplemented with sufficient artificial light to promote workers' health and safety, and enable safe equipment operation</li><li>- Equipment to be regularly inspected, maintained and serviced.</li><li>- Installation of railings or other fall prevention measures on stairs, fixed ladders, platforms, permanent and interim floor openings, loading bays, ramps, etc.</li><li>- Measures to prevent unauthorized access to dangerous areas.</li><li>- Sufficient fresh air supplied for indoor and confined work spaces.</li></ul> <p>Refer to <b>HEC-AH-H04-H40 Office Safety</b>.</p>	Throughout construction	HEC Construction Manager, HSE Manager, Camp Manager
P-8-2.	Workers unaware of project site procedures	<ul style="list-style-type: none"><li>• Health and safety orientation training will be delivered to all new employees to ensure they are apprised of the basic site rules and of personal protection and preventing injury to fellow employees.</li><li>• Workers will be made aware of the relevant contractor procedures relating to their job description.</li><li>• Workers and contractors, prior to commencement of new assignments, will receive adequate training and information enabling them to understand work hazards and to protect their health from hazardous ambient factors that may be present.</li><li>• Training and licensing will be conducted for vehicle/machinery operators in the safe operation of specialized vehicles or machinery. Drivers and operators will undergo annual medical checks to determine their fitness for the job.</li><li>• Refer to <b>HEC-AH-H04-H05 HSE Training and Awareness Procedure</b>.</li><li>• Refer to <b>Annex P-8-V List of HSE training courses provided by HEC</b>.</li></ul>	Upon induction and throughout construction	HEC Training Supervisor, HSE Supervisor
P-8-3.	Communication	Daily health and safety meetings will be conducted to provide a platform for communication and consultation on health and safety matters with workers. Refer to <b>HEC-AH-H04-H06 HSE Coordination &amp; HSE Meetings</b> .	Throughout construction	HEC HSE Manager
P-8-4.	Incidents and accidents	<p>Incidents and accidents can be prevented by eliminating unsafe acts and mitigating unsafe conditions.</p> <p>Behavioural Base Safety (BBS) Observation will be implemented at the site by focusing all workers and management attention and actions on their own and others' safety behaviour. The BBS programme provides for both immediate feedback to the person who was observed (both safe behaviours and unsafe behaviours are discussed), and the analysis of observations (with no name identified as to who was being observed) as they are collected and gathered across the group.</p> <p>The Safety Observation Card is a fixed list of the most common hazards on construction sites. It will be reviewed daily and regularly updated across the project site.</p> <p>Refer to <b>HEC-AH-H04-H15 BBS Program</b>.</p>	Throughout construction	HEC Construction Manager, HSE Manager, HSE Supervisor, all workers
P-8-5.	Visitor Safety	A visitor orientation and control programme will be established to ensure visitors receive induction training and do not enter hazard areas unescorted.	Throughout construction	HEC Site Manager
P-8-6.	First aid and medical treatment	<p>Equipped first-aid stations will be easily accessible throughout the project area.</p> <p>A First Aid Facility will be located at the site office and will function as the main medical facility for the Project workers. There will be written emergency procedures for dealing with cases of trauma or serious illness up to the point at which patient care can be transferred to an appropriate medical facility.</p> <p>Refer to <b>Annex P-8-V</b> for a floor plan of the First Aid Facility and an Injury Management and Rehabilitation Procedure. Responsibilities, training, evacuation/emergency procedures, and required equipment are provided in <b>HEC-AH-H04-H32 Medical &amp; First Aid Facility</b> and <b>P-14 Spill Prevention and Emergency Response Plan</b>.</p>	Throughout construction	HEC HSE Manager
P-8-7.	Identification of hazardous areas	Hazardous areas (electrical rooms, compressor rooms, etc), installations, vessels, materials, safety measures, and emergency exits etc will be communicated to workers and visitors, and marked appropriately in accordance with international standards.	Throughout construction	HEC HSE Manager, HSE Supervisor

P-8-8.	Protection from hazards that cannot be avoided (Personal Protective Equipment – PPE)	<p>Workers shall be supplied with PPE in accordance with the specific needs and activities of their job, to allow for safe working.</p> <p>PPE will be properly maintained, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE will be part of the induction and refresher training programmes for employees.</p> <p>Refer to <b>HEC-AH-H04-H28 Personal Protective Equipment (PPE)</b> for information on conducting a hazard assessment of the workplace to determine the need for appropriate PPE, communicating the assessment results to employees, eliminating defective PPE, and training employees in the proper use of PPE.</p>	Prior to commencing work, throughout construction	HEC HSE Manager, Training Supervisor
P-8-9.	Approval to perform high hazard jobs	<p>A Permit to Work is required for jobs including, but not limited to the following:</p> <ul style="list-style-type: none"> <li>Construction works</li> <li>Alterations, modifications, repairing of permanent and temporary facilities</li> <li>Work inside confined space</li> <li>Working at height including work over 1.8 meters at height, scaffolding activities, grating removal</li> <li>Excavation and ground disturbance</li> <li>Critical lifting activities</li> <li>Handling of hazardous materials including radioactive source</li> <li>Systems and equipment testing and commissioning, pre-commissioning</li> <li>Vehicle/mobile equipment entry into Hazardous Areas</li> <li>Use of non-certified equipment in Hazardous Areas</li> <li>Non-routine work in workshops, warehouse</li> </ul> <p>A work permit is NOT required for the following types of works if it's not falling under particular criteria of permitted work (e.g. critical lifting operation during routine warehousing activities):</p> <ul style="list-style-type: none"> <li>Routine work carried out in established workshops and adjacent yards with fixed boundaries.</li> <li>Routine material handling work in established warehouses and adjacent lay down yards with fixed boundaries (not falling under critical lifting conditions).</li> <li>Routine office work including cleaning, servicing of office equipment, communication equipment and furniture.</li> <li>Maintenance cold work in temporary facilities buildings outside construction / commissioning areas, which does not exceed climbing of ladder or scaffold over 1.8 meters. e.g. hand tool work, re-lamping, servicing of air conditioners, manual painting.</li> <li>Routine operations in temporary facilities like catering services, housekeeping, operation of clinic etc.</li> <li>Visual inspection or checking without using any tools and without opening equipment and instrumentation enclosures (if such work involves confined space entry, confined space authorization is required).</li> <li>Any other work approved by Construction Manager and HSE Manager as permit-free upon written request from the concerned Department Manager.</li> </ul> <p>Refer to <b>HEC-AH-H04-H04 Permit to Work Procedure</b> (found in <b>Annex P-8-III</b>) for the detailed procedure of obtaining a permit to work. Attachment 2 of this procedure provides templates for all the different types of permits (e.g. cold permit, hot permit, confined space entry certificate, etc.) and the Permit to Work Log Sheet template (also found in Annex P-8-III).</p>	Throughout construction	HEC Construction Manager, Discipline Supervisor, HSE Manager
P-8-10.	Welding hazards incl. high temps, fumes, radiation, electric shock	<p>Actions to control hazards associated with the use of welding plant and fuel/oxygen cylinders are provided in <b>HEC-AH-H04-H25 Welding Safety Procedure</b>. These actions will be implemented by supervisors, workers and sub-contractors for the project construction. Training, housekeeping of work area and use of PPE will assist in reducing hazards.</p>	Throughout construction	Welding supervisor, welders
P-8-11.	Moving vehicles	<p>Vehicles with restricted rear visibility will be outfitted with audible back-up alarms.</p> <p>As detailed in <b>P11 Traffic Management Plan (TMP)</b>, the following measures will be taken to ensure driver safety:</p> <ul style="list-style-type: none"> <li>Clear signage will be installed, and the use of signs, flagmen and signals will be set up where necessary. Where temporary traffic signals are required, the details and locations of the signals will be discussed with the relevant authorities. The signs will be fixed safely and securely to ensure they do not become detached or dislocated and will be visible and comprehensible by all. HEC will also carry out maintenance checks to clean and re-secure signs if necessary.</li> <li>Appropriate supervision will be provided by HEC to control the flow of traffic when machinery needs to crossroads.</li> <li>Liaison with the Police and other authorities will occur before the movement of any abnormal loads. In particular, liaison with the Ministry of Infrastructure Development will occur prior to transportation on Kukum Highway and any other public road HEC will use.</li> <li>Access to commercial and residential properties along Lot 1 will be maintained and speed limits will be established and enforced over all construction traffic routes.</li> </ul>	Throughout construction	HEC HSE Manager HEC Maintenance Manager
P-8-12.	Working at Heights	<p>Fall prevention, protection measures and emergency rescue planning will be implemented whenever a worker is exposed to the hazard of falling:</p> <ul style="list-style-type: none"> <li>more than 1.8 meters</li> <li>Into operating machinery</li> <li>into an excavation</li> <li>into water or other liquid</li> <li>into hazardous substances</li> <li>through an opening in a work surface.</li> </ul> <p>Refer to <b>HEC-AH-H04-H18 Working at Height Safety Procedure</b> and <b>HEC-AH-H04-H19 Scaffolding Safety Procedure</b></p>	As required throughout construction	HEC HSE Manager Discipline Supervisor
P-8-13.	Operating mobile and heavy equipment	<ul style="list-style-type: none"> <li>The procedures provided in <b>HEC-AH-H04-H21 Control and Use of Plant and Equipment Procedure</b> will be implemented at the Project site. It includes requirements for managing, maintaining and controlling the use of plant and equipment during construction activities. The types of plant and equipment that may be used onsite during construction activities and covered by this procedure include earth moving plant, road making plant and equipment, drilling rigs, augers, mobile elevating work platforms, vehicle mounted platform, mast climbing work platforms, man-riding skips and cradles, crushing plant, asphalt plant, concrete batching plant, winches, water pumps, bar bending and cropping machine.</li> </ul>	Throughout construction	HEC Construction Manager HEC HSE Manager, Supervisors, Attendants

		<ul style="list-style-type: none"> <li>A register of all plant and equipment used for construction will be kept as described in <b>P11 Traffic Management Plan</b>.</li> <li>A chock will be used when vehicles/mobile plant are not parked on a flat surface.</li> <li>All vehicles/mobile plant will include Traveling First Aid, mini spill kit and a fire extinguisher.</li> <li>Safe use of mobile cranes is covered by <b>HEC-AH-H04-H20 Lifting Safety Procedure</b>.</li> <li>All vehicles and heavy equipment will be visually inspected at the beginning of each work day for any malfunctions that could affect safe operation (refer to <b>HEC-AH-H04-H10 HSE Inspection Procedure</b>).</li> </ul>		
P-8-14.	Confined spaces	<p>Workers entering, inspecting and working in confined spaces are potentially exposed to hazardous concentrations of toxic and flammable gases, vapours and oxygen enriched or oxygen deficient working environments. Refer to <b>HEC-AH-H04-H22 Confined Space Entry</b> for:</p> <ul style="list-style-type: none"> <li>the detailed procedure for working in confined spaces that will be implemented</li> <li>safeguards and precautions that will be followed</li> <li>the arrangements that will be made on site for rescue in case of emergency situations.</li> </ul> <p>Confined spaces encompass a variety of workplaces having limited access and deficient ventilation. These procedures and precautions apply to tunnelling activities that will be carried out for construction of the main works.</p>	Throughout construction	HEC Construction Manager HEC HSE Manager, Supervisors, Attendants
P-8-15.	Lifting and suspended loads (Loading/unloading rebar and form, use of crane)	<p>Refer to <b>HEC-AH-H04-H20 Lifting Safety Procedure</b> for all activities involving the use of cranes, lifting gear, hoists, forklifts and telescopic material handlers. The general requirements for this procedure apply to all lifting operations, irrespective of weight and complexity of arrangements. Foundations, stages, scaffolds, derrick masts, anchorages, guys etc that have to support lifting appliances must be strong enough for the plant under working conditions. This procedure provides detailed processes, procedures, and checklists for safe lifting actions.</p> <p>Regular inspection on a monthly basis will be conducted by a competent person to all lifting equipment, appliances, chains, ropes, lifting gears and hoist (refer to attachments to HEC-AH-H04-H20 and to <b>HEC-AH-H04-H10 HSE Inspection Procedure</b>).</p>	Throughout construction and commissioning	HEC Construction Manager, HEC HSE Manager, Lifting Supervisor, Lifting Operators, Riggers, Signalmen/Banksmen
P-8-16.	Working around and in excavations	<p>Hazards of excavating or trenching are associated with the potential for collapse and the use of heavy plant and equipment. Actions for managing the hazards include:</p> <ul style="list-style-type: none"> <li>The Daily Report will register all excavations including date of back filling and any other relevant information related to the history of the excavation. These records will be kept in the office.</li> <li>Benching, sloping and shoring (depending on soil classification/stability) will be installed to prevent cave-in.</li> <li>Excavations will be checked daily or before use by a competent person who can recognize signs of subsidence or other evidence of potential failure of the support system. The excavations will also be checked following any inclement weather or other environmental conditions that may affect the integrity of the excavation.</li> <li>Spoil, soil and heavy equipment, construction material will be kept away from excavation edge (minimum 1m away from edge, but it is dependent on weight of material)</li> <li>Equipment will be shut down when the operator exits the equipment.</li> <li>Hard barriers around the excavation, reflective signs and safety signs/posters will be erected to keep unauthorized personnel clear and traffic will be monitored at the work area.</li> <li>Trucks used for the removal of spoil will be controlled by authorized driver/operator.</li> <li>A signal man will be in place for vehicle dumping material for backfilling to prevent them over running the edge.</li> <li>Adequate lighting will be provided in and around excavated area for working in night hours as per the job requirement.</li> <li>Excavation adjacent to, or beneath powerlines, or passing under power lines is prohibited unless conditions outlined in HEC-AH-H04-H17 are met.</li> <li>A signal person (banks man) will be in place when equipment operators cannot see the bottom of the excavation.</li> <li>Dewatering equipment will be sited in locations that avoid creating a tripping hazards and will be operated only by competent persons. If any diesel/petrol generator is provided as a source of power supply near excavation, then the exhaust fumes will be ducted away in order to avoid oxygen deficiency.</li> </ul> <p>Refer to <b>HEC-AH-H04-H17 Excavations Safety Procedure</b>.</p>	Prior to and throughout construction	HEC Construction Manager, HEC HSE Manager, all workers and sub-contractors
P-8-17.	Tunnelling	<p>Tunnelling is highly complex and involves the use of a range of construction techniques, engineering, plant and equipment. The hazards of tunnelling include collapse, contaminated atmospheres, use of heavy plant or equipment (refer to <b>Annex P-8-VI</b> and <b>Annex P-8-VII</b>).</p> <ul style="list-style-type: none"> <li>The emergency response plan will specify the emergency response procedure to be implemented in the event of a major incident during tunnel construction, such as communication, locating workers within the tunnel, evacuation procedures, first aid, notifications, source of emergency respirable air, safe places/refuges, rescue equipment, drills/testing and training.</li> <li>The HEC company standard requires installation of emergency call and speaker facilities every 300m as well as CCTV.</li> <li>The mechanical ventilation design will be such that there are no dead spots, no low air speed areas, no flow reversals, no areas of dust concentration, no recirculation, and inspection points are fitted where blockages are likely to occur. The ventilation pipe will be secured to the side of the tunnel. Lighting will also be provided.</li> <li>Materials on the surface will be stored in places away from where ventilation fresh air intakes could be compromised through a surface fire or chemical spill.</li> <li>A ventilation system will be provided while the tunnel is being constructed such that it is monitored and upgraded to ensure air flows are always provided and is promptly repaired and maintained.</li> <li>To minimize the dust hazard arising from drilling operations in rock excavations, all holes shall be wet drilled. Water sprays or atomizers shall be used to prevent dust rising during mucking operations including keeping the floors of haulage ways.</li> <li>At least a weekly check shall be conducted at the tunnel face and elsewhere for concentrations of noxious or other harmful gases or dust. The maximum concentrations shall not exceed the following limits: <ul style="list-style-type: none"> <li>Carbon dioxide 1,5000 parts/million by volume.</li> <li>Carbon monoxide 100 parts/million by volume.</li> <li>Nitric oxide 35 parts/million by volume.</li> <li>Nitrogen dioxide 5 parts/million by volume.</li> <li>Hydrogen sulphide 15 parts/million by volume</li> </ul> </li> <li>The air shall not contain more than the following concentrations of total respirable airborne particles of dust (sizes from 5.0 to 0.2 microns).</li> </ul>	Prior to and throughout tunnelling activities	HEC Construction Manager, HSE Manager, Discipline Supervisor, tunnel workers

		<ul style="list-style-type: none"> <li>o quartz content &lt; 1% 8 mg/m³</li> <li>o quartz content &gt; 1% &lt; 4% 4 mg/m³</li> <li>o quartz content &gt; 4% 0,15 mg/m³</li> </ul> <ul style="list-style-type: none"> <li>• The ventilation system in each section of the Works shall ensure that the following minimum air quantity requirements are provided at all times: <ul style="list-style-type: none"> <li>o 3.0 m³/min for each person or worker</li> <li>o 6.0 m³/min for each installed kW power of diesel plant or equipment</li> <li>o The average air velocity in all excavation areas shall not be less than 0.3 m/s.</li> <li>o The minimum quantity of fresh air delivered at the advancing face shall be 7 m³/s.</li> </ul> </li> <li>• The gas detection devices shall be placed at the Power Tunnel and Surge Tank.</li> <li>• Oxygen mask &amp; cylinder harness will be kept in adequate numbers as stand -by for emergency rescue.</li> <li>• Press-in ventilation system shall be provided.</li> <li>• A fan will be installed at the entrance of the tunnel to meet the requirements of tunnel construction (diameter of 600mm, power of 45kW, air volume of 340m³/min and wind pressure of 7.84kpa (800mmAq)). The high-power and high-performance fan duct will have an effective distance of air supply of more than 3km to ensure the requirements of long-distance ventilation.</li> <li>• In general, the noise of ventilation equipment shall not exceed 75 dB, the fresh air volume for tunnel workers shall not be less than 30m³ per hour, and the relative humidity shall be between 65% and 80%. Meanwhile, the oxygen content in the air inhaled by the staff shall not be less than 20%, the concentration of H₂S, CH₄ and other toxic or harmful gases shall not exceed the concentration harmful to human health, and the concentration of flammable gas shall not exceed 10% of the minimum explosive concentration.</li> <li>• The ventilation equipment shall achieve the following maximum permissible level: <ul style="list-style-type: none"> <li>o Nitrous fumes 3ppm</li> <li>o Carbon dioxide 5000ppm</li> <li>o Carbon monoxide 25 ppm</li> </ul> </li> <li>• Air monitoring equipment shall be positioned at each working face, in bye each airlock and also within 20m of the tunnel entrance when the tunnel has advanced 250m or more.</li> <li>• The ventilation equipment shall commence its operation 30 minutes before any man-access e.g. in the morning or after lunch to ensure there is no accumulation of carbon monoxide or dioxide etc.</li> <li>• Oxygen mask &amp; cylinder harness will be kept in adequate numbers as stand -by for emergency rescue.</li> <li>• Re-entry testing procedures including re-entry times after blasting will be provided to workers. The monitoring will include air testing for: <ul style="list-style-type: none"> <li>o flammable fumes or gases</li> <li>o oxygen deficiency and the presence of asphyxiant gases</li> <li>o unsuitable temperature and humidity</li> <li>o airborne contaminants like toxic gases, fumes or respirable dusts.</li> </ul> </li> <li>• Warning signage for areas without adequate ventilation will be installed. The danger, warning, caution or information signs shall be provided, erected, maintained and removed by HEC. The signs shall be no less than 1.5m x 1.0m in size written boldly in English as well as incorporating visual images of the safety message. These signs shall be erected on existing footpaths and at points of access likely to be used by the public to warn, caution or inform them.</li> <li>• Plant cut-offs will be used in explosive atmosphere.</li> <li>• In the event that the risk assessment identifies dusts and silicas may be hazards, extraction at or close to the point of generation will be maintained by suing brattice curtains or half-curtains to reduce dust roll-back; and ventilation capacity will be increased where needed.</li> <li>• Water sprays will be used where necessary to suppress dust.</li> <li>• Workers will be provided with PPE respirators rated for the concentration and duration of dust exposure. All tunnel personnel shall wear appropriate personal protective equipment. (In addition to safety helmets and protective footwear, safety equipment such as safety glasses, rubber gloves, ear protectors, goggles or face shields, self-rescuers, dust masks, breathing apparatus etc.)</li> <li>• Sign in/sign out procedures will be implemented for entry and re-entry into the tunnel.</li> </ul>		
P-8-18.	Drowning hazard when working over or near water bodies	<ul style="list-style-type: none"> <li>• Workers will be restricted to access particular areas (e.g. hazardous areas, working on river bed/in water).</li> <li>• Warning signs at the perimeter of construction areas and barricades will be installed to notify workers of hazards at work sites adjacent to watercourse.</li> <li>• Workers will not work alone near any water body.</li> <li>• If workers are required to enter a water body deeper than knee height a Personal Flotation Device will be worn, and this must be in good condition, regularly checked/serviced (if automatically inflating) and not outside of manufacturer's expiry period.</li> <li>• A lanyard/rope will be kept within easy reach of the work area, in case rescue/assistance is required.</li> <li>• Anyone working in water will be supervised by a spotter on the bank/edge of the water body; this person must be a competent swimmer and able to perform a rescue if needed.</li> <li>• Workers will only enter a watercourse if they are a competent swimmer.</li> <li>• No person shall enter any water body during a flood.</li> </ul>	Prior to and throughout construction	HSE Manager, Discipline Supervisor, all workers
P-8-19.	Sprains and strains from manual handling and ergonomic hazards	<p>The risks involved in manual lifting or handling of a load will be assessed by a person with experience of the tasks according to factors such as nature of the task, the load, the working environment and individual capability (per HEC-AH-H04-H03). The identified risks will be reduced by implementing practical control measures such as:</p> <ul style="list-style-type: none"> <li>• providing mechanical assistance</li> <li>• making load smaller or lighter</li> <li>• training workers to identify potentially hazardous handling operations and training in good handling techniques.</li> </ul> <p>Refer to <b>HEC-AH-H04-H29 Manual Handling</b> for detailed actions for manual handling of loads.</p>	Throughout construction	HEC HSE Manager, Discipline Supervisor

P-8-20.	Live Electricity	<div>ANNEX P-8-V</div> <ul style="list-style-type: none"><li>• All energized electrical devices and lines will be marked with warning signs.</li><li>• Electrical cords, cables, and hand power tools will be checked for frayed or exposed cords. Power cords and extension cords will be protected against damage from traffic by shielding or suspending above traffic areas.</li><li>• The Electrical Work Superintendent will carry out at least monthly audits of compliance of the temporary electrical supplies on the project site.</li><li>• A register of checked and tagged electrical equipment will be kept onsite.</li><li>• Requirements contained in <b>HEC-AH-H04-H24 Temporary Electrical Safety Procedure</b> will be followed by HEC managers, supervisors workers and sub-contractors. This procedure applies to all construction works including, generating station, switchyard, 11kV site distribution system Intake controlling and monitoring station, use and maintenance of temporary electrical supplies and any other electrical equipment required for the permanent works. This procedure provides detailed actions regarding:<ul style="list-style-type: none"><li>– general electrical safety</li><li>– lock out/tagout procedures</li><li>– Insulation</li><li>– earth leakage circuit breakers</li><li>– checking/inspection of power generators/transformers, distribution and hand tools</li><li>– clearance around electrical equipment</li><li>– enclosures for circuits operating at 50V or more or storing more than 5J</li><li>– electrical equipment rooms</li><li>– overload protection</li><li>– rating of equipment</li><li>– equipment acceptability</li><li>– cable clamping</li><li>– clearance distances from energized overhead power lines</li><li>– working conditions</li><li>– management of extension cords</li><li>– electrical hazard (electric shock, fires) and their prevention.</li></ul></li><li>• Actions for the erection and installation of electrical equipment are:<ul style="list-style-type: none"><li>– When new electrical equipment or an electrical installation is installed it will be tested and examined to ensure the equipment or the installation is electrically safe before commissioning. This work will be performed by the subcontractor/workers with required level of competence and skills.</li><li>– Risk assessments on these works must be carried out and control measures used must be implemented before start of works. The following control measures are commonly used for such works:<ul style="list-style-type: none"><li>○ A. Barriers installed to prevent access by unauthorized persons</li><li>○ B. Remove any metallic jewellerys or accessories before doing any erection/installation works of electrical equipment</li><li>○ C. Remove any sources of water which makes the environment wet</li><li>○ D. Insulating mat used in close situation or when high fault currents exist</li><li>○ E. Insulating gloves used in close situation or when high fault currents exist</li><li>○ F. Live parts not involved in the installation works to be covered</li><li>○ G. Work in a buddy system (not alone)</li><li>○ H. Lock-out/Tag-out procedures to be implemented</li><li>○ I. Minimum Personal Protective Equipment (PPE) to be worn.</li></ul></li></ul></li><li>• Actions for the testing and commissioning of electrical equipment are:<ul style="list-style-type: none"><li>– Remove metallic jewellery or body piercing when conducting tests.</li><li>– Non-flammable clothing with long sleeves and long trousers worn in high fault current situations or in a close testing environment.</li><li>– Insulating mat used in a close situation or when high fault currents exist.</li><li>– Insulating gloves used in a close situation when high fault currents exist or when the ground or surrounds are wet.</li><li>– Instrument checked to ensure it is suitable for prospective fault current, is intest and the leads are in a satisfactory condition.</li><li>– Tools checked to ensure insulation is complete and in good condition RCD used on supply for equipment connected by a plug and socket.</li><li>– Barriers installed to prevent access by the unauthorized people.</li><li>– Live parts not involved in the testing activity covered for safety.</li><li>– Safety Observer is used if high fault currents exist at work site or a risk assessment identifies sufficient additional hazards.</li></ul></li></ul>	Throughout construction	HEC HSE Manager, HSE Supervisor, Electrical Work Superintendent, subcontractors, electricians,
P-8-21.	Chemical hazards	<p>Chemical hazards will be managed through implementation of <b>P-12 Waste Management and Point Source Pollution Plan</b> and <b>P-13 Hazardous Materials Management Plan</b>. Actions may include:</p> <ul style="list-style-type: none"><li>• replacement with less hazardous substitute</li><li>• engineered or administrative controls to avoid or minimise release of hazardous substances</li><li>• limiting number of employees exposed to hazardous substances</li><li>• labelling hazardous substances in accordance with international requirements</li><li>• training workers in safe work practices and use of PPE.</li></ul>	Throughout construction	HEC Construction Manager, HSE Manager, HSE Supervisor, Training Supervisor

P-8-22.	Ionising radiation	Workers conducting non-destruction testing onsite need to be protected against over exposure to ionising radiation. Refer to <b>HEC-AH-H04-H26 Site Radiography</b> for actions for the safe use of both radiographic and non-radiographic equipment.	Throughout non-destructive testing	HEC Construction Manager, HEC HSE Manager, NDT Inspector
P-8-23.	Explosives	Explosives will be stored in a purpose-built magazine, checked/monitored by security personnel. The transportation, storage, processing, packaging on site, blasting and the disposal of the blasting material will comply with Solomon Island regulations on the use of explosives. Explosive boxes will be clearly labelled with an “explosive” sign. Further actions are provided in <b>C11 Drill and Blast Management Plan</b> .	Throughout construction	HEC Construction Manager, Security Services
P-8-24.	Excessive noise	Hearing protection will be provided in the case where an employee is exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day. No unprotected ear will be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).	As required throughout construction	HSE Supervisor, HSE Officers
P-8-25.	Eye hazards	Use of machine guards or splash shields and/or face and eye protection devices, such as safety glasses with side shields, goggles, and/or a full face shield is required if eye hazards are identified.	Throughout construction	HEC HSE Manager, HSE Supervisor
P-8-26.	Remote Locations	Where workers are required to perform work under lone or isolated circumstances, PPE and safety measures will be in place including verbal contact with the worker at least once every hour, and provision for the worker to summon emergency aid.	As required throughout construction	HSE Supervisor
P-8-27.	Heat Stress	Actions related to preventing heat stress in <b>HEC-AH-H04-H35 Heat and Cold Stress</b> will be implemented at site to minimise workers developing heat stroke, heat exhaustion, heat cramps and heat rash. In the event a worker develops symptoms of heat stress, they will report to the first aid facility and treated.	Throughout construction	HSE and discipline supervisors
P-8-28.	Health and Hygiene	<ul style="list-style-type: none"> <li>Sanitation facilities, for both men and women will be provided on site and at the workers accommodation camp.</li> <li>Regular inspection of the sanitation facilities will be conducted.</li> <li>Hand hygiene stations will be provided.</li> <li>Adequate supply of drinking water will be provided to workers. Drinking water supplies will be clearly marked.</li> <li>Worker's accommodation camp kitchen/caterers will maintain high standards of hygiene.</li> <li>First aid equipment and facilities will be provided (see separate hazard/issue) and a designated vehicle will be stationed outside the first aid facility for medical evacuations to Honiara.</li> <li>Domestic rubbish will be managed in accordance with P12 Waste Management Point Source Pollution Plan.</li> <li>Indoor and outdoor spraying/thermal fogging of workers accommodation camp will be conducted for reduction of disease carrying mosquitos.</li> <li>COVID-19 protocols will be implemented (refer to <b>P10 Community Health and Disease Vector Management Plan</b>).</li> </ul> Refer to <b>HEC-AH-H04-H33 Sanitation and Food Hygiene</b> for detailed actions that will be implemented to protect the health of workers.	Throughout construction	All workers
P-8-29.	Fitness for work	<p>Health checks will be conducted for all project drivers/operators annually to assess their fitness to work and drive.</p> <p>The use of drugs, alcohol, tobacco and betel nut has the potential to affect fitness for work. Compliance of workers with the Alcohol and Drug policy attached to <b>P-9 Worker's Code of Conduct</b> will be checked and disciplinary action taken for non-compliance. Relevant health and safety actions are:</p> <ul style="list-style-type: none"> <li>All workers are prohibited from consuming illicit drugs. Any workers found to possess illicit substances, and/or consuming illicit substances will subject to disciplinary action up to and including termination.</li> <li>All workers are prohibited from consuming alcohol during working hours and working while under the influence of alcohol. Alcohol is not permitted in the workers' accommodation camp. Any workers found unfit for work due to alcohol consumption will be disciplined in accordance with P4 Human Resources and Labour Management Plan. Workers may also be requested to take a breath alcohol test at the discretion of the HEC HSE Manager, HEC Camp Manager or Security Manager (subcontractor – Midlands Security Services).</li> <li>Only medically prescribed drugs are permitted to be consumed by workers. Workers using medically prescribed drugs may be required to produce a medical certificate stating that they are fit for work or specifying any restrictions.</li> <li>Smoking will only be permitted in designated smoking areas during work breaks.</li> <li>Chewing of betel nuts is strictly prohibited during working hours and anywhere on the Project site (Direct Impact Area and Infrastructure Area, including the Workers' Camp).</li> <li>Indiscriminate littering of cigarette butts and spitting of betel nut stain are prohibited.</li> <li>Drugs and alcohol must not be consumed in the workplace, while driving vehicles, while using access roads, while staying in the workers' accommodation camp, or in local communities.</li> </ul>	Throughout construction	All workers
P-8-30.	Emergency Response to incident	Refer to the Emergency Response Plans as detailed in <b>P-14 Spill Prevention and Emergency Response Plan</b> .	Prior to and throughout construction	HEC Construction Manager, HSE Manager
P-8-31.	Incident investigation and reporting	<p>A procedure for reporting, investigating and managing occupational accidents and diseases, and dangerous occurrences and incidents will be implemented. It will enable workers to report immediately to their immediate supervisor any situation they believe presents a hazard to life or health. The overall process involves the following steps:</p> <ol style="list-style-type: none"> <li>Assessment of incident severity and initial classification (HSE Manager)</li> <li>Fill-out Notification report (HSE Manager)</li> <li>Designation of Incident Owner and approval (Construction Manager)</li> <li>Issue Notification report (HSE Manager)</li> <li>Investigation (Incident Owner)</li> <li>Action plan development (Investigation Team)</li> <li>Review and approval of action plan (Construction Manager)</li> <li>Action plan implementation (Incident Owner)</li> <li>Confirmation of implementation (HSE Manager)</li> </ol>	Prior to and throughout construction	HEC Construction Manager, HEC HSE Manager, all workers

		<p>10. Close-out (Construction Manager)</p> <p>Near Misses will be investigated for the benefit of the project. All project employees (HEC, Subcontractors) can report a Near Miss incident by submitting the Near-miss report form to HSE office at site. Since a near miss is an incident, which resulted in no injury, illness, damage to environment or harm to the reputation is has an actual severity rating of 0 (zero). However, it can have a potential severity. A level of investigation effort will be based on potential severity of the near miss event.</p> <p>Refer to <b>HEC-AH-H04-H14 Incident Investigation and Reporting</b> for the detailed procedure.</p>			
P-8-32.	Audit of P8 Workers Health and Safety Plan	The procedure outlined in <b>HEC-AH-H04-H11 HSE Audit Procedure</b> will be followed in order to conduct internal HSE audits. Compliance with this plan and effectiveness of the implementation of this plan will be verified. Audits will be conducted at least every six months.	Throughout construction	Audit Team formed for each audit	
Monitoring Requirements					
#	Title	Description	Target / Performance Indicator	Timing / Frequency	Responsibility
P-8-A.	Risk Assessments	<ul style="list-style-type: none"><li>Completion of a Risk Assessment prior to commencement of construction activities in accordance with HEC-AH-H04-H03, with a full list of all hazards and controls to be implemented on site</li></ul>	Risk Assessments stored and visible to site staff	Prior to construction. Updates reported in quarterly E&S reports.	HEC H&S Manager
P-8-B.	Training Register	<ul style="list-style-type: none"><li>Records of all health and safety training for workers and visitors maintained. This shall include but not limited to worker and visitor site inductions, hazard-specific training (e.g. confined space, hot work etc.), annual H&amp;S refresher training.</li></ul>	Training Register with details of all training including date, nature of training, location, trainer, personnel in attendance, and signatures.	Reported in quarterly E&S reports	HEC H&S Manager
P-8-C.	Incident Register	<ul style="list-style-type: none"><li>Maintain a register of all incidents (including fatalities, lost time injuries, first aid, non-injury), near misses, and hazard observations. Actively promote and reward the reporting of leading indicators such as hazards and unsafe conditions.</li><li>All incidents will be investigated as per HEC procedure <b>HEC-AH-H04-H14 Incident Investigation and Reporting</b>.</li></ul>	Number of incidents, near misses and hazard observations.  Frequency rate (injuries per million person hrs).	Reported in quarterly E&S reports	HEC H&S Manager
P-8-D.	Non-compliance Reports (FORs or NCRs)	<ul style="list-style-type: none"><li>Maintain a high standard of health and safety on site to avoid any H&amp;S related NCRs.</li></ul>	Zero NCRs issued for H&S breaches	Reported in quarterly E&S reports	HEC H&S Manager

<b>Supporting Documents</b>		
<b>Annex</b>	<b>Name</b>	<b>Description</b>
P-8-I.	HEC Risk Assessment Samples	Sample of the risk assessment undertaken for road construction and earthworks in 2020. Also included are example Job Hazard Analyses.
P-8-II.	Risk Assessment Process	Diagram representing the process outlined in the Management Standard HEC-AH-H04-H03 Risk Assessment Procedure Process flow chart; Cold Work Permit template; excavation certificate template; Job Hazard Analysis template
P-8-III.	HEC Corporate Health, Safety and Environment Management System Documents	List of the relevant HEC Health and Safety Policies and Procedures available on the HEC Project Space
P-8-IV.	HSE Roles and Responsibilities	Details on HSE Roles and Responsibilities as outlined in Attachment 4 of HEC-AH-H04
P-8-V.	First Aid Facility	Description of first aid facility (including floor plan), roles and responsibilities, operation of the facility, equipment to be available at the facility, and the content of first aid boxes to be provided at work locations.
P-8-VI.	Hazard Assessment of Tunnelling	Identification of mitigation measures to minimise hazards of tunnelling.
P-8-VII.	Tunnel Work Safety Guideline	Prepared by HEC, 15.04.2020

## ANNEX P-8-I HEC RISK ASSESSMENT SAMPLES



# RISK ASSESSMENT for Road Construction(FEB 2020)

Project : TINA RIVER HYDROPOWER PLAN DEVELOPMENT PROJECT

prepared	reviewed	confirmed

TASK	Activities	POTENTIAL HAZARD & CONSEQUENCES	RISK LEVEL			CONTROL and / or RECOVERY MEASURES	Responsible Person		Remark
			P	S	R		Subcon	HEC	
1	Excavation	Equipment Mobilization				Provide shoring / proper sloping&benching as per a soil classification	JOKIM	HGSONG	
		Collapse of excavation due to heavy equipment movement	3	3	B				
		Excavation				Physical barricades or soil dike should be places at enough distance from the excavation edge to prevent heavy equipment from parking or positioning and stacking of spoil soil			
		Collapse of excavation due to heavy equipment and stacking of spoil soil	3	3	B				
		Disconnection of excavator bucket due to removal of connecting pin	1	3	D	Prior to commence of task daily pre-inspection should be conducted			
		Collision, stuck and caught between by excavator and dump truck	3	3	B	Check reversing alarm, rear mirror and spotter must place at workpl			
2	Backfilling	Collapsing due to ground subsidence while moving equipment	1	4	D	Assignment of designated spotter	JOKIM	HGSONG	
		Collision/caught between due to entering the equipment working radius	3	3	B	Place barricade with sign and spotter to prevent unauthorized enteri			
		Electricution due to the overhead power cabel at black post junction ar	3	3	B	Provide spotter to control excavatio work when working near power			
		Hauling of spoil Soil				Establishing equipment moving route before work, confirm spotter			
		Compaction				Check reversing alarm, rear mirror and spotter must present at work			
		Fall of dump truck into excavation	3	3	B	Place a barricade or traffic cone at edge of excavation			
3	Form & Rebar work	Fall of personnel into excavation	1	3	D	Check reversing alarm, rear mirror and spotter must present at work	JOKIM	HGSONG	
		Collision / caught between by roller while compacting	3	3	B	Keep safety distance while dumping spoil soil and assignment of spo			
		Falling soil and stone while hauling of spoil soil	1	3	D	Keep safety distance while levelgn of soil, assignment of spotter			
		Collision to excavator bucket while soil leveling work	3	1	D	Spotter must be present and give a hand signal while edge of excava			
		Fall of dump truck into excavation while dumping soil	2	3	C	Provide appropriate working platform for working at heigh			
		Material Hauling,bending wor	1	3	D	Daily inspection must be carried out for working platform			
4	Rebar work	Form and rebar erection	1	3	D	Conduct daily inspection for rigging tools before commence of task	JOKIM	HGSONG	
		Dismantling work	1	2		Conduct daily inspection of material arrangemnt and stacking			
		Lifting of Form and rebar	1	3	C	Conduct daily rigging tools inpection before commence of work			
		Rebar mobilization	1	3	C	make sure that rigger and spotter should control lifting area			
		Hauling of Rebar	1	3	C	Conduct daily housekeeping to remove obstruction on accessway			
		Assembly and erection	1	2		Arrange spotter to control working area			
5	Con'c Pouring work	Fall of bunch of rebar while hauling by forklift	1	3	D	Provide lifting basket for miscellaneous materials	JOKIM	HGSONG	
		Fall of unsecured miscellaneous materials on rebar while unloading	1	4	C	Provide boards on assembled rebar for safe assess			
		Fall from assembled rebars due to unprotected side and edge of rebar	1	3	D	Conduct crane daily inspection before starting lifting work			
		Fall of bunch of rebar due to damaged or disconnected safety latch	2	2	C	Provide grounding(copper rod)			
		Electrocution while operating of rebar cutting machine	1	2		Control of workplace by supervisor to prevent unauthorized entering			
		Hauling Concrete	1	3	D	Make sure that spotter should control con'c pouring area			
6	Manhole and culvert	Con'c pouring and compaction	3	3	B	make sure full extend of outrigger and base timber, ground conditio	JOKIM	HGSONG	
		Collapsing of pump car due to unstable ground condtion	1	3	C	Prohibit moving of remicon truck's hopper			
		Curing work	1	2		Conduct inspection by competent before use(grounding, cable insula			
		Electicution from concrete vibrator	1	2		Conduct close monitoring during working hours			
		bumping and pinch point, skin burn due to non-copliance of PPE	1	2		Survey for power line should be carried out by supervisor			
		Electicution from overhead power cable	2	3	C	Provide shoring / proper sloping&benching as per a soil classification			
7	Temporary road work	cave-in while working inside trench	3	3	B	Provide physical barrier or soil dike to prevent falling into trench	JOKIM	HGSONG	
		Excavation				Provide physical barrier or soil dike to prevent falling into trench			
		Installation of Manhole, culvert				Provide spotter to prevent entering excavator's swing radius			
		collision with excavator While carrying out excavation	2	2	D	Provide fire blanket, fire extinguiser and remove combustible materi			
		Fire due to welding spark	1	2		not allow to entering excavator's working area and provide spotter			
		Run-over due to excavator operation	1	3	D	Conduct inspection of rigging tools and not allow to enter suspended			
8	Paving work	Fall of culvert due to breaking of web sling while lifting	3	3	B	Provide physical barrier or soil dike to prevent falling into trench	JOKIM	HGSONG	
		Removal of surface soil	1	2		Provide barrier away 1m from excavation edge			
		Construction of temporary lo				Area control should be carried out by spotter			
		Soil collapsing on edge of excavation	3	3	B	Provide physical barrier or soil dike to prevent falling into trench			
		Run over by roller while compaction	3	2	C	Provide spotter to prevent entering of equipment operating area			
		Fall of person into excavation	1	3	D	Provide guardrail if possiblity of fall from height			

9	Dumping of gravel, Compaction	Dumping	Collision with glader	2	3	C	Check reversing, back-up alarm and place spotter to control of work	JOKIM	HGSONG	
		Compaction	Collision with roller while reversing(Spotter and workers)	2	3	C	Establishing equipment moving route before work, place spotter			
		Grader	Fall of roller into ground due to collapsing of the edge of paved road	3	3	B	preparation of work plan(Equipment moving route, position of worker)			
			Collision between dump truck due to violation of speed limit	1	3	D	Conduct operator training, monitoring to make sure keep speed limit			
10	Workplace Condition		Collision between excavator and worker while leveling	2	3	C	Establishing equipment moving route before work, place spotter	JOKIM	HGSONG	
		Illumination	Fall into excavatio and tripping / slipping due to lack of illuminatio	1	3	D	Provide proper illumination to maintain 70 lux			
		Dust	Respiatory damage due to dust	1	2		Spreading water as regular interval			
		Heat stress	Heat stroke,Heat exhaustion, heat rash& cramps	1	2		Provide shelter and water, first aider, medical attention			
11	Temporary facilities	Open hole	Fall from heigh through open hole	2	3	C	Provide cover for openhole with warning sing	JOKIM	HGSONG	
		Working Platform	Fall from heigh due to unsecured workplatform	3	3	B	Conduct daily inspection by competent person before work			
		Scaffold	Collapsing of scaffold due to incomplete scaffold erection and modificati	3	3	B	Carry out daily inspection by competent scaffold supervisor to confir			
			Falling into ground while climbing and dscending of scaffold	3	3	B	Conduct safety training for safe use of scaffold and daily inspection			
		Temporary accessway	Fall from edge of temporary accessway due to unprotected accessway e	1	3	D	Provide guardrail and conduct daily inspection			
		Ladder	Fall from ladder due to unsecured ladder	2	3	C	make sure buddy system, safety angle, 3point contact rule, no work			
12	Power tools	Generator	Electrocution due to contact of energized part	2	3	C	Provide grounding(copper rod),Exposed energized part must be repe	JOKIM	HGSONG	
		Hand Grinder	Face and eye injury due to flying object while cutting and grinding	2	3	C	Disk cover must be affixed and RPM for disk and grinder must be ch			
		Rebar cutter and bending machine	Pinch point and caught between on finger	1	3	D	Only authorized person can operate, condut training for safe use			
			Hit by rebar while bending	1	3	D	Place barricaded around bendig machine to prevent entering bending			

#### Probability (P)-

1 = Improbable  
2 = Remote  
3 = Possible  
4 = Probable

#### Severity (S)-

1 = Negligible  
2 = Minor  
3 = Severe  
4 = Extreme

#### M Matrix P/S-

	S1-	S2-	S3-	S4-
P1-	-	-	D-	C-
P2-	-	D-	C-	B-
P3-	D-	C-	B-	A-
P4-	D-	B-	A-	A-

#### Risk level (R)-

A = Hazard MUST be avoided (or level of risk reduced significantly & reliably by controls)  
B = Hazard SHOULD be avoided (or level of risk reduced significantly & reliably by controls)  
C = Risk to be controlled as far as reasonably practicable  
D = Risk is controlled as far as reasonably practicable  
- = No control measures necessary

# RISK ASSESSMENT for Earthing work(Site office)(FEB 2020)

Project : TINA RIVER HYDROPOWER PLAN DEVELOPMENT PROJECT

prepared	reviewed	confirmed

TASK		Activities	POTENTIAL HAZARD & CONSEQUENCES	RISK LEVEL			CONTROL and / or RECOVERY MEASURES	Responsible Person		Remark
				P	S	R		Subcon	HEC	
1	Excavation	Equipment Mobilization	Collapse of excavation due to heavy equipment movement	3	3	B	Provide shoring / proper sloping&benching as per a soil classification	JOKIM	HGSONG	
		Excavation	Collapse of excavation due to heavy equipment and stacking of spoil soil	3	3	B	Physical barricades or soil dike should be places at enough distance from the excavation edge to prevent heavy equipment from parking or positioning and stacking of spoil soil			
			Disconnection of excavtor bucket due to removal of connecting pin	1	3	D	Prior to commence of task daily pre-inspection should be conducted			
			Collision, stuck and caught between by excavator and dump truck	3	3	B	Check reversing alarm, rear mirror and spotter must place at workpl			
			Collapsing due to ground subsidence while moving equipment	1	4	D	Assignment of designated spotter			
			Collision/caught between due to entering the equipment working radius	3	3	B	Place barricade with sign and spotter to prevent unauthorized enteri			
2	Backfilling	Hauling of spoil Soil	Collision/caught between by dump truck	3	3	B	Establishing equipment moving route before work, confirm spotter	JOKIM	HGSONG	
		Compaction	Fall of dump truck into excavation	3	3	B	Check reversing alarm, rear mirror and spotter must present at work			
			Fall of personnel into excavation	1	3	D	Place a barricade or traffic cone at edge of excavation			
			Collision / caught between by roller while compacting	3	3	B	Check reversing alarm, rear mirror and spotter must present at work			
			Falling soil and stone while hauling of spoil soil	1	3	D	Keep safety distance while dumping spoil soil and assignment of spo			
			Collision to excavator bucket while soil leveling work	3	1	D	Keep safety distance while levelign of soil, assignment of spotter			
			Fall of dump truck into excavation while dumping soil	2	3	C	Spotter must be present and give a hand signal while edge of excava			
3	Temporary road work	Removal of surface soil	Fall of excavator into trench	1	2		Provide physical barrier or soil dike to prevent falling into trench	JOKIM	HGSONG	
		Construction of temporary lo	Soil collapsing on edge of excavation	3	3	B	Provide barrier away 1m from excavation edge			
			Run over by roller while compaction	3	2	C	Area control should be carried out by spotter			
			Fall of person into excavation	1	3	D	Provide physical barrier or soil dike to prevent falling into trench			
			Collision with excavator bucket	1	3	D	Provide spotter to prevent entering of equipment operating area			
4	Dumping of gravel, Compaction	Dumping	Collision with glader	2	3	C	Check reversing, back-up alarm and place spotter to control of work	JOKIM	HGSONG	
		Compaction	Collision with roller while reversing(Spotter and workers)	2	3	C	Establishing equipment moving route before work, place spotter			
			Fall of roller into ground due to collapsing of the edge of paved road	3	3	B	preparation of work plan(Equipment moving route, position of worke			
			Collision between dump truck due to violation of speed limit	1	3	D	Conduct oprator training, monitoring to make sure keep speed limit			
			Collision between excavator and worker while leveling	2	3	C	Establishing equipment moving route before work, place spotter			
5	Workplace Condition	Illuminatio	Fall into excavatio and tripping / slipping due to lack of illuminatio	1	3	D	Provide proper illumination to maintain 70 lux	JOKIM	HGSONG	
		Dust	Respiratory damage due to dust	1	2		Spreading water as regular interval			
		Heat stress	Heat stroke,Heat exhaustion, heat rash& cramps	1	2		Provide shelter and water, first aider, medical attention			

Probability (P)-  
1 = Improbable  
2 = Remote  
3 = Possible  
4 = Probable

Severity (S)-  
1 = Negligible  
2 = Minor  
3 = Severe  
4 = Extreme

M Matrix P/S-

	S1	S2	S3	S4
P1	A	B	C	D
P2	B	C	D	A
P3	C	D	A	B
P4	D	A	B	C

Risk level (R)-

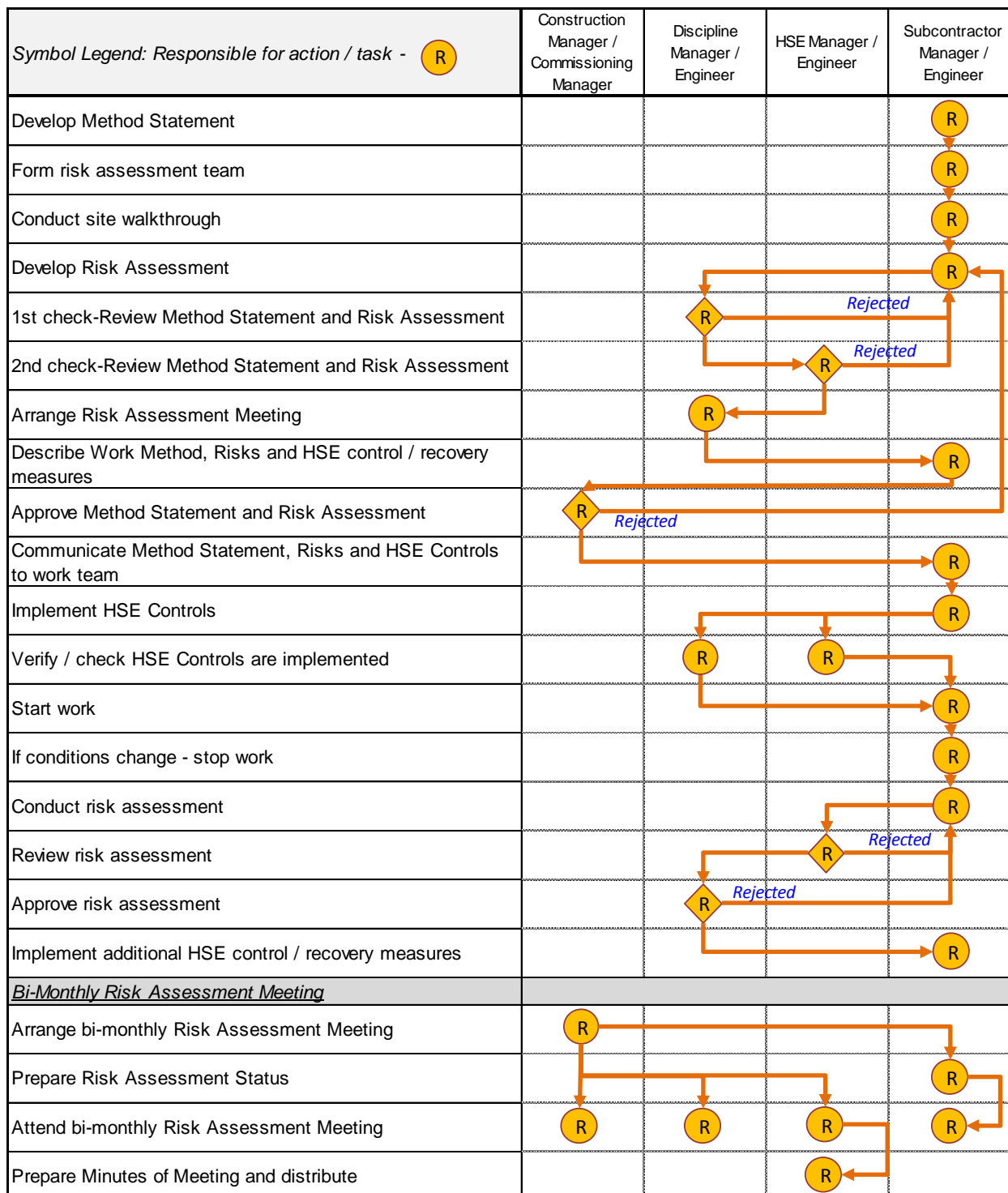
A = Hazard MUST be avoided (or level of risk reduced significantly & reliably by controls)  
B = Hazard SHOULD be avoided (or level of risk reduced significantly & reliably by controls)  
C = Risk to be controlled as far as reasonably practicable  
D = Risk is controlled as far as reasonably practicable  
- = No control measures necessary

## ANNEX P-8-II RISK ASSESSMENT PROCESS

	<h1>Risk Assessment Procedure</h1>	<p>Doc. No. : HEC-AH-H04-H03</p> <p>Rev. No. : 1</p> <p>Rev. Date: 28 FEB 2019</p> <p>Page : 6 of 12</p>
---	------------------------------------	--

## 5.0 Requirements

### 5.1 Risk Assessment Process



ANNEX P-8-III HEC CORPORATE HEALTH,SAFETY AND ENVIRONMENTAL  
MANAGEMENT SYSTEM DOCUMENTS

## HEC Corporate Health, Safety and Environment Management System Documents

#	Reference	Document Name	Attachments / Forms
1	HEC-AH-H04	HSE Management Plan (Rev.1)	
2	HEC-AH-H04-H01	Control of HSE Legal and Other Requirements	List of HSE Legal and Other Requirements Documents HSE Legal Register and Action Plan
3	HEC-AH-H04-H02	HSE Management of Subcontractors	Tenderer's Health, Safety, Environmental Suitability Evaluation HSE Prequalification Evaluation Guidelines
4	HEC-AH-H04-H03	Risk Assessment Procedure	Risk Assessment Form Job Hazard Analysis
5	HEC-AH-H04-H04	Permit To Work Procedure	PTW & Certificate Forms PTW Audit Checklist PTW Written Examination Form
6	HEC-AH-H04-H05	HSE Training and Awareness Procedure	HSE Training Request Form New Employee HSE Commitment Form HSE Training Attendance Form HSE Training Evaluation Form Individual HSE Training Passport HSE Training Register Monthly HSE Training Status Report
7	HEC-AH-H04-H06	HSE Coordination & HSE Meetings	HSE Minute of Meeting Form (MOM) Toolbox Meeting Form HSE Topic Schedule Monthly HSE Meeting Log
8	HEC-AH-H04-H07	HSE Incentive Program	Sample Certificate of Safest Work of the Month Proposed Incentive Budget Computation Recommendation Form
9	HEC-AH-H04-H08	Disciplinary Action Procedure	HSE Violation Notice (Form) HSE Violation Register (Form)
10	HEC-AH-H04-H09	HSE Monitoring and Measurements Procedure	
11	HEC-AH-H04-H10	HSE Inspection Procedure	HSE Inspection Schedule Daily HSE Inspection Report Form Monthly Weekly HSE Inspection Check List Weekly HSE Inspection Report Monthly HSE Inspection Report HSE Inspection Action Tracking Register Sample of Color Coding Sticker
12	HEC-AH-H04-H11	HSE Audit Procedure	HSE Audit Report Form
13	HEC-AH-H04-H12	Corrective and Preventive Action	HSE Non-conformity Report Form HSE Non-conformity Report Registry Work Stop Notice HSE NCR Hold Sticker and Tag
14	HEC-AH-H04-H13	Emergency Response Procedure	Emergency Reporting Instruction - Template Emergency Contract List Emergency Drill Planning and Critique Form
15	HEC-AH-H04-H14	Incident Investigation and Reporting	Incident Notification and Investigation Form Near Miss Report Form
16	HEC-AH-H04-H15	BBS Program	Safety Observation Card(SOC)
17	HEC-AH-H04-H16	Management Review and Improvement Process	HSE Management Review Committee Meeting Memorandum HSE Management Review Report Cover
18	HEC-AH-H04-H17	Excavation Safety Procedure	Excavation Safety Checklist Excavation Work Permit
19	HEC-AH-H04-H18	Working at Height Safety Procedure	
20	HEC-AH-H04-H19	Scaffolding Safety Procedure	

#	Reference	Document Name	Attachments / Forms
21	HEC-AH-H04-H20	Lifting Safety Procedure	Illustrations Daily, Weekly Inspection Checklists Weekly Lifting Gear, Equipment, Appliances Report Letter of Appointment(Lifting Supervisor) Letter of Appointment(Crane Operator) Crane Operator Record Letter of Appointment(Rigger) Letter of Appointment(Signalman) Particulars of Crane Operation Team Notification of Lifting Equipment Signals for Lifting Operations
22	HEC-AH-H04-H21	Control and Use of Plant and Equipment Procedure	
23	HEC-AH-H04-H22	Confined Space Entry Procedure	Confined Space Entry Certificate Confined Space Entry Log Sheet
24	HEC-AH-H04-H23	Fire Prevention	
25	HEC-AH-H04-H24	Temporary Electrical Safety Procedure	Electrical Equipment Safety Checklist Temporary Electrical Tag
26	HEC-AH-H04-H25	Welding Safety Procedure	
27	HEC-AH-H04-H26	Site Radiography	Radiography Certificate Radiography Notification
28	HEC-AH-H04-H27	Portable Tools	Master Tool Registry Portable Tools Color Coding Sticker Template
29	HEC-AH-H04-H28	Personal Protective Equipment	Issue of Personal Protective Equipment Record Fall Arrest Equipment Inspection Report
30	HEC-AH-H04-H29	Manual Handling	
31	HEC-AH-H04-H30	Hydrogen Sulfide Safety Procedure	
32	HEC-AH-H04-H31	Asbestos Safety Procedure	
33	HEC-AH-H04-H32	Medical and First Aid Facility	
34	HEC-AH-H04-H33	Sanitation and Food Hygiene	Food Handling and Storage Checklist
35	HEC-AH-H04-H34	Control of Substance Hazardous to Health	COSHH Assessment Form Monthly Chemical Inventory Log Sheet
36	HEC-AH-H04-H35	Heat and Cold Stress	
37	HEC-AH-H04-H36	Environmental Management	
38	HEC-AH-H04-H37	Identification of Environmental Aspect	Environmental Aspect Identification and Assessment Report Significant Environmental Aspect Registry Environmental Aspects Identification Instruction Guidelines of Environmental Aspect Assessment Subcontractor Environmental Aspect Identification Report
39	HEC-AH-H04-H38	Waste Management	
40	HEC-AH-H04-H39	Site Security	ID Card Status Registry Visitor's Log Sheet Visitor's Pass Vehicle Pass Registry Materials, Tools and Waste Manifest Security Officer Daily Report Form
41	HEC-AH-H04-H40	Office Safety	Office Safety Checklist
	HEC-AH-H04-H41	Site Traffic Control Procedure	Safety Seat Belt Policy Alcohol and Drug Policy Speed Limit Policy Journey Management Slip Daily Driver's Check List
	HEC-AH-H04-H42	Working on or near water	



## ANNEX P-8-IV HSE ROLES AND RESPONSIBILITIES

	<h2>HSE Management Plan</h2>	<b>Doc. No. :</b> HEC-AH-H04 <b>Rev. No. :</b> 1 <b>Rev. Date:</b> 22 FEB 2019 <b>Page :</b> 76 of 78
---	------------------------------	--

[Attachment 4] Details on HSE Roles and Responsibilities



Description	SM	CM	DM	HSEM	AM	PCM	SSM
Monthly HSE Committee Meeting	X	X	X	X	X	X	X
Risk Review Meeting		X	X	X			X
Weekly HSE Meeting		X	X	X			X
Mass Toolbox Meeting		X	X	X			X
Toolbox Meeting	X	X	X	X	X	X	X
Arrange HSE training				X			
Ensure project personnel is trained	X	X	X		X	X	X
Operating PTW system		X	X	X			X
Conduct PTW audit	X	X	X	X	X	X	
Develop Risk Assessment and Method Statement			X				X
Review and Approve Risk Assessment and Method Statement	X	X	X	X			
Conduct incident investigation	X	X	X				X
Review and approve incident report	X	X		X			
Follow-up and close out HSE observation and NCRs		X	X		X	X	X
Maintain Action Tracking Register				X			
HSE Reporting				X			X
Equipment/tools inspections off-site and documentation review			X	X			X
Equipment/tools inspection on-site			X	X			
Periodic inspection of equipment and plant			X	X			X
HSE Committee Site Inspection	X	X	X	X	X	X	X

Description	SM	CM	DM	HSEM	AM	PCM	SSM
Weekly HSE Inspection				X			X
Daily HSE Inspection				X			X
Audit Annual Internal	X			X			
Annual Subcontractor Audit			X	X			
Act Emergency role according to emergency plan	X	X	X	X	X	X	X
Contract for medical services and supplies					X		
Operation of site clinic				X			
Contract for emergency services (e.g. rescue professionals, fire brigade)						X	
Operation of rescue professionals and fire brigade at site		X	X	X			X
Provide HSE facilities (e.g. barricades, hole-covers, fall-protection nets, illumination etc.)							X
Provide and maintain sanitation and welfare facilities at site						X	X
Provide and maintain sanitation and welfare facilities at camp					X		X
Provide PPE and signage				X			X
Medical examination (initial, periodic)					X		X
Special medical examination (e.g. confined space)					X		X
Special working time regime and breaks (e.g. heat / cold stress)	X	X					X
Waste management and waste water at site			X		X		X
Waste management and waste water at camp					X		X

Description	SM	CM	DM	HSEM	AM	PCM	SSM
Housekeeping at site		X	X				X
Housekeeping at camp					X		X
Environmental arrangements (e.g. water spraying) at site		X				X	X
Environmental monitoring (e.g. noise, air quality)				X		X	X
Chemical storage at site		X	X			X	X
Evaluation of proposed subcontractor's HSE capabilities (bidding)	X			X		X	
Traffic management at site		X		X		X	
Traffic management at camp				X	X		
Journey management					X	X	X
Security contract					X		
Security facility					X	X	
Security operation at site				X			
Security operation at camp					X		

SM	Site Manager	AM	Administration Manager
CM	Construction / Commissioning Manager	PCM	Project Control Manager
DM	Discipline Manager	HSEM	HSE Manager
SSM	Subcontractor Site Manager		

## ANNEX P-8-V FIRST AID FACILITY



	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 140 OF 158</b>

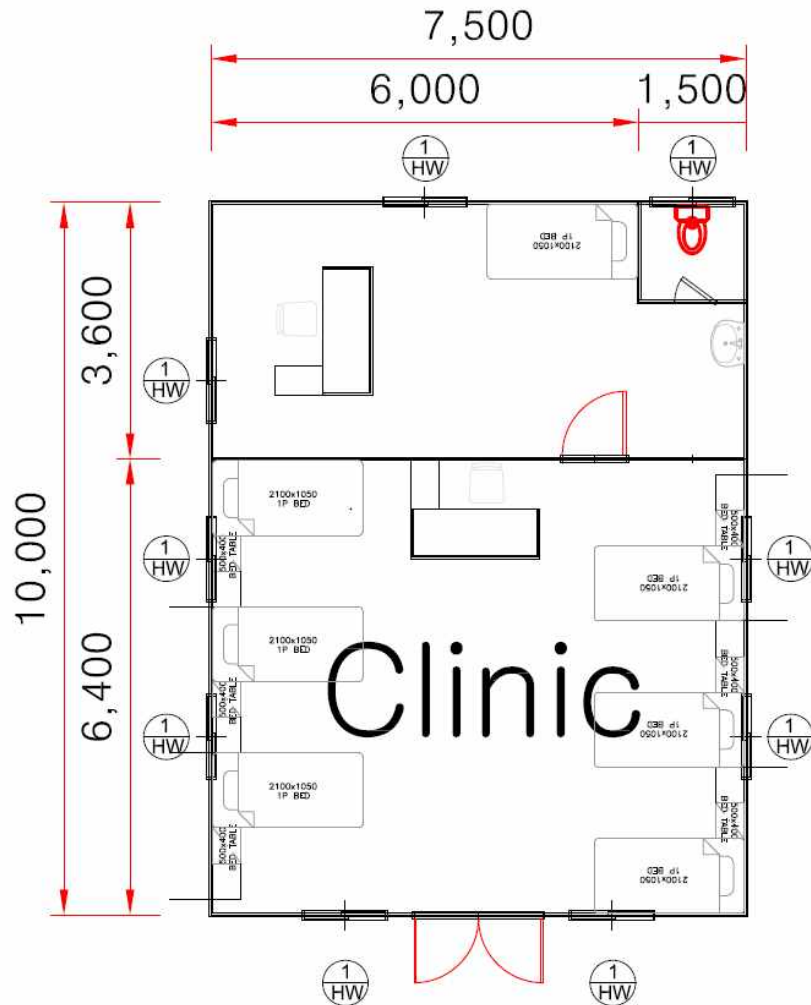
### ***ANNEX C – FIRST AID FACILITY***

The First Aid Facility will be located at the site office. HEC will be responsible for the facility, which will function as the main medical facility for the Project workers (Figure C.1).

The six-bed facility will be operated by two shifted licenced nurses, certified by the Solomon Islands Ministry of Health and Medical Services, during construction work hours. The facility will be properly divided into two separate spaces with partitioning screens for privacy. The nurses will provide basic first aid, and in the event of a severe injury and/ or medical emergency, transport the patient to the hospital by on-site ambulance.

For further information, please see the Annex D Injury Management and Rehabilitation Procedure.

	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 141 OF 158</b>





**Figure C.1 First Aid Facility Floorplan**

Additionally, all on-site managers and 2<sup>nd</sup> in charge supervisors (i.e. an alternative for each manager) will be trained in first aid at minimum and will provide assistance in the event of an emergency.

HEC H&S Emergency Supervisor will designate the site first aid personnel and ensure they are adequately experienced/trained.

HEC will obtain approval from the Ministry of Health and Medical Services that the facility is properly set up and run with adequate health and safety protocols.

	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 142 OF 158</b>

## **ANNEX D – INJURY MANAGEMENT AND REHABILITATION PROCEDURE**

### **1. PURPOSE.**

This procedure and guidance have been developed to ensure that HEC and its Subcontractors comply with all Statutory and Contractual obligations combined with their own duty of care by providing adequate First Aid Facilities and Trained Personnel within their working areas.

### **2. SCOPE.**

To be used by members of the Tina River Hydropower Development Project (TRHDP) Management Team, Supervisors and Subcontractor's personnel who have legal and moral obligations to take initial care of injured or sick person(s) prior to the arrival of an ambulance or delivery of the injured or sick person(s) to Professional Medical Personnel.

This procedure and guidance have not been developed to train persons in first aid techniques (this training will be provided by qualified doctor), but to establish that first aid responsibilities are defined and suitable facilities and personnel are available on all TRHDP at all times.



### **3. RESPONSIBILITY.**

#### **3.1 Site Project Manager.**

- 3.1.1 Ensure that members of the TRHDP Management Team and Subcontractors fully understand their legal, contractual and moral obligations towards the provision of adequate first aid facilities in areas of their responsibility.
- 3.1.2 Ensure that members of the Health & Safety Team and Subcontractors supply adequate first aid facilities in areas of their responsibility.
- 3.1.3 Ensure the provision and funding of adequate medical facilities, staff, training and supplies.
- 3.1.4 Assign the Management and Supervision of medical personnel to the Site HSE Manager and the Administration Manager.

#### **3.2 HSE Manager.**



	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 143 OF 158</b>



- 3.2.1 In association with the Administration Manager manage and supervise the project medical facilities.
- 3.2.2 Review the planned provision of medical facilities and staffing against the site requirements.
- 3.2.3 Continuously review the actual provision against the site requirements.
- 3.2.4 Ensure that arrangements where applicable exist for off-project treatment of serious injuries or illness and maintain ongoing communication with such services.
- 3.2.5 Ensure that medical personnel maintain treatment records, perform analysis of first aid, injury and illnesses as directed and fulfill their duties and responsibilities in accident reporting and investigation.
- 3.2.6 Ensure that medical facilities are maintained in sanitary and operable condition and that adequate supplies are maintained.
- 3.2.7 Ensure that plans exist and are regularly drilled for dealing with major medical emergencies.
- 3.2.8 Ensure that Subcontractors provide and maintain their own adequate first aid facilities and where applicable ensure that Subcontractors make use of the Project medical facilities.

### **3.3 Administration Manager.**

- 3.3.1 In association with the HSE Manager manage and supervise the project medical facilities.
- 3.3.2 Make arrangements for the necessary training of personnel in first aid or arrange for adequate numbers of qualified personnel to be provided on site.
- 3.3.3 Liaise with the local emergency authorities to provide information on project locations to assist in a fast response from the local authorities to emergency situations for transportation to hospital.
- 3.3.4 Liaise with Subcontractors regarding provision of their own first aid arrangements prior to commencing work on TRHDP.
- 3.3.5 Supply or order adequate stocks of first aid equipment as recommended by the HSE Manager or appointed representatives.

### **3.4 Site Security Personnel.**

- 3.4.1 Arrange site traffic control and provide assistance to the local authority emergency vehicles arriving at the project to enable them to reach the scene

	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 144 OF 158</b>

of the sick or injured person(s) as quickly as possible.

### **3.5 Line Management and Supervisors.**



- 3.5.1 Report immediately to the HSE Manager or his representatives any injury or illness to persons under their control.
- 3.5.2 Provide details to Security personnel of the location of the injured or sick person(s).
- 3.5.3 Ensure that adequate first aid facilities are provided in areas of their control.

### **3.6 Subcontractors.**

- 3.6.1 Provide adequate first aid facilities and trained personnel to administer professional first aid treatment to all persons employed by them directly or indirectly.
- 3.6.2 Ensure that facilities provided are kept clean and suitably maintained and those stocks of equipment are regularly inspected and refurbished as necessary.

### **3.7 Physician**

- 3.7.1 The Physician visits the site once a month for a medical check. The Physician's visit schedule will be notified in advance to identify those who want to be examined and workers performing dangerous tasks will also be screened.
- 3.7.2 Conducts medical and physical examination to employees and write the necessary recommendation.
- 3.7.3 Attends to outpatients and performs the necessary examinations and prescribes the corresponding treatment.
- 3.7.4 Dispenses medications to patients.
- 3.7.5 Makes the necessary hospital referral for cases that to his judgment cannot be treated at the First Aid Facility. Before any hospital referral shall be made, the Physician shall coordinate with the HSE Manager or his designated representative. The Physician shall fill-out a Hospital Referral Form of which a copy shall be provided to the HSE Manager.
- 3.7.6 He shall conduct periodic inspections of the job-site and its premises regarding the health and hygiene standards of the site.
- 3.7.7 He shall conduct periodic health inspections at the camp facilities.
- 3.7.8 The Physician shall have the authority to issue a 24-hour bed rest/no work

	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 145 OF 158</b>

status when necessary. The patient must report back to the First Aid Facility the following day for further evaluation.



### **3.8 Nurse**

- 3.8.1 Nurses shall competently perform the following duties and responsibilities and must be willing to perform other duties and responsibilities asked for by the HSE Manager.
- 3.8.2 They shall maintain a record of all cases attended to.
- 3.8.3 They shall maintain a file of all patients attended to and keep them in a locked filing cabinet.
- 3.8.4 They shall keep an inventory of medicines dispensed and all equipment and supplies of the Medical Facility.
- 3.8.5 They shall ensure that instruments are autoclaved/sterilized in a proper manner. Instruments shall be disinfected or soaked in a prescribed soaking solution prior to use.
- 3.8.6 They shall ensure that needles/blades shall be one time used and shall be disposed of accordingly in a designated sharps only receptacle.
- 3.8.7 They shall ensure that sterile gloves are used in all invasive or open cases when blood or body fluids shall come into contact with any part of the body.
- 3.8.8 They shall keep the First Aid Facility in a hygienically sound condition and at the cleanest level at all times. Paper bed covers shall be changed for each patient seen.
- 3.8.9 They must be able to perform CPR and must have undergone CPR/ BLS Training Course.
- 3.8.10 They must conduct weekly check for defibrillators.

## **4. DEFINITIONS.**

### **4.1 First Aid**

**The initial care of the injured or sick.** It is the care administered by a concerned person as soon as possible after an accident or illness. It is this prompt care and attention that sometimes means the difference between life and death, or between a full or partial recovery. **First Aid Saves Lives.**



	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 146 OF 158</b>

## 5. First Aid Facility

- 5.1.1 The First Aid Facility located at the site office is under responsibility of HEC and will function as the main medical facility on the project.
- 5.1.2 The Subcontractor recognizes the fact that the health and welfare of the employees and that their basic health needs must be met at the highest level in order for them to perform and execute their assigned tasks safely and efficiently as well as immediate treatment of injuries and illnesses directly benefit the employee and the project.
- 5.1.3 The First Aid Facility shall be manned by two (2) competent and skilled nurses certified by the Solomon Islands Ministry of Health and Medical Services. It shall be equipped with the basic equipment, medicinal supplies. The facility shall be designed to attend to minor medical and surgical procedures and have adequate supplies for emergency treatment and stabilization before transporting a patient to a major medical facility outside the project.
- 5.1.4 All other cases which after examination and evaluation by the on-site nurse determines further consultation is necessary by a specialist shall be referred to a medical facility outside the project for further evaluation and treatment.
- 5.1.5 The objectives of having a First Aid Facility on the project are as follows:
- To provide and meet the basic health care needs of project employees.
  - To attend to all First Aid Cases, injuries requiring medical treatment and other medical emergencies.
  - To maintain an acceptable level of health and hygiene within the site, laydown areas and man camp.
  - To conduct and participate actively in health care promotion and coordinate with the HSE Manager for the implementation of the No Accidents Program.
  - To conduct medical visits to admitted patients and make daily progresses notes and report them to the HSE Manager.
- 5.1.6 All employees shall be notified where the First Aid Facility is located.
- 5.1.7 The HSE Manager is responsible for visiting the First Aid Facility and establishing protocols for treatment, return to work policies, medical surveillance programs etc. with the selected nurse.

## 5.2 Nurse Qualification

- 5.2.1 Two (2) nurses are required on this Project. They must be accredited by the Nursing Council of the Solomon Islands. They must have 2 years hospital based experience as an emergency room nurse.

	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 147 OF 158</b>

### **5.3 Hospital Referral**

- 5.3.1 When cases are complicated as in severe injuries/medical emergencies the patient must be transported to the hospital immediately.



## **6. INSTRUCTIONS.**

### **6.1 Training of First Aid Personnel.**

- 6.1.1 An appropriate number of suitable persons trained to render first aid will be appointed by HEC and its Subcontractors to an extent where a first aid trained person/s is on duty and available to all workgroups as required.
- 6.1.2 Training must include as a minimum but not limited to: arterial bleeding, burns, trauma, shock, heat/cold stress, fractures, strains, sprains and CPR (Cardiac-Pulmonary Resuscitation).
- 6.1.3 It also advisable to train other persons to act as appointed persons for first aid duties.

### **6.2 First Aid Rooms.**

- 6.2.1 A First Aid Facility will be installed at the camp.
- 6.2.2 Minimum facilities must include: -
- 1) The first aid room must always be in charge of a trained nurse, responsible for the room and its contents during working hours.
  - 2) The room should be positioned within easy access for transport and preferably close to the main entrance gate.
  - 3) All facilities should be effectively ventilated, heated, lit, kept clean (daily) and maintained.
  - 4) Sink with running hot and cold water.
  - 5) Drinking water if mains water is not available.
  - 6) Disposable cups.
  - 7) Soap.
  - 8) Paper towels.
  - 9) Bowl.
  - 10) Smooth topped working surfaces.
  - 11) First aid equipment to at least the standard of first aid boxes:
    - gauze pads (at least 4 x 4 inches)
    - large gauze pads (at least 8 x 10 inches)

	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 148 OF 158</b>

- box adhesive bandages (bandaids)
- packages of gauze roller bandage at least 2 inches wide
- triangular bandages
- wound cleaning agent such as sealed moistened towlettes
- scissors
- tweezers
- blankets
- adhesive tapes
- latex gloves
- Elastic wraps
- Splints

12) Chairs.

13) A bed with pillow and blankets.

14) Suitable lockable storage facilities for first aid equipment.

15) Clean protective garments for first aiders.

16) Suitable refuse containers lined with disposable plastic bags.

17) Accident book and treatment record.

18) The room should only be used for first aid treatment and always ready for immediate use.

19) Notices displayed providing information on emergency contact numbers.

20) Clearly marked as a first aid room by means of a prescribed first aid sign

21) Notices affixed providing the names and locations of first aiders

22) Resuscitation bag, airway, or pocket mask

23) Two portable defibrillator device



24) Directions for requesting emergency assistance

### **6.3 Stretchers.**

6.3.1 A suitable number of stretchers shall be located around the site to assist in the movement of injured/sick personnel.

6.3.2 The position of stretchers shall be clearly marked and unobstructed.

6.3.3 An emergency stretcher capable of rescuing persons in a vertical position to be provided for retrieving persons injured or sick whilst working at height or below ground.



	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 149 OF 158</b>

#### **6.4 First Aid Boxes.**

6.4.1 The HSE Manager in conjunction with the Administration Manager will carry out an

Initial and ongoing assessments to determine the numbers and positioning of first aid boxes for the Project.

- 1) Each box should be placed in a clearly identified and accessible location.
- 2) Boxes constructed to protect the contents from dampness and dust.
- 3) First Aid boxes to be clearly marked with a white cross on a green background.
- 4) Boxes must be checked frequently by first aiders, appointed persons or members of the HSE Management Team to ensure they are fully stocked and all items are in a clean and usable condition.
- 5) First Aid boxes should contain sufficient quantities of first aid materials and nothing else. The following provisions are recommended as being sufficient for the majority of cases: -
  - ① General guidance card on first aid treatment.
  - ② Emergency contact numbers.
  - ③ 20 individually wrapped sterile adhesive dressings (assorted sizes) appropriate for the workplace.
  - ④ 2 sterile eye pads.
  - ⑤ 6 individually wrapped triangular bandages.
  - ⑥ 6 safety pins.
  - ⑦ 6 medium sized individually wrapped sterile unmedicated wound dressings (approx. 10cm x 8cm).
  - ⑧ 2 large sterile individually wrapped unmedicated wound dressings (approx. 13cm x 9cm).
  - ⑨ 3 extra-large sterile individually wrapped unmedicated wound dressings (approx. 28cm x 17.5cm).
  - ⑩ 3 x 300ml of sterile water or sterile normal saline solution (0.9%) in sealed disposable containers (where mains water is not readily available for eye irrigation).
  - ⑪ Individually wrapped moist cleaning wipes (where soap and water are not available).

	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 150 OF 158</b>

- ⑫ Additional items such as may be necessary may also be kept in the first aid box, but only where the first aider has been suitably trained in their use.
- ⑬ Medicines or tablets must not be kept in first aid boxes, or administered by first aiders or appointed persons.



## **6.5 Traveling First Aid Boxes.**

- 6.5.1 Small traveling first aid boxes should be provided where persons work in small groups in areas remote from a first aid box.
- 6.5.2 Small first aid boxes will be provided at the Batching Plant, Crushing Plant, equipment shop and in all vehicles.
- 6.5.3 Contents of these traveling boxes should reflect the foreseen work hazards, but should contain at least the following items: -
  - 1) General guidance card on first aid procedures.
  - 2) Emergency contact numbers.
  - 3) 6 individually wrapped sterile adhesive dressings.
  - 4) 1 large sterile unmedicated dressing.
  - 5) 2 large triangular bandages.
  - 6) 2 safety pins.
  - 7) Individually wrapped moist cleaning wipes.

## **6.6 General Considerations when an Accident or Illness occurs.**

- 6.6.1 Should an accident or illness occur the first aider, appointed person or other concerned persons should: -
  - 1) Send for assistance and if required an ambulance or other form of emergency transport.
  - 2) Take care not to become a casualty themselves.
  - 3) Separate the cause and the victim if possible, e.g. switch off electricity supplies; turn off power plant before assisting the casualty.
  - 4) Move the casualty only to prevent further injury.
  - 5) Check the heart and breathing; giving emergency CPR as necessary.
  - 6) Stop any bleeding; raise the injured part and apply pressure (care must be taken regarding rising of the injured part and applying pressure in case of fractures).
  - 7) Keep the victim warm and reassured.





	<b>WORKERS HEALTH AND SAFETY PLAN</b>		
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 151 OF 158</b>

- 8) Do not remove evidence.
- 9) Inform supervision as soon as possible as to the accident / illness and assist in reporting.
- 10) **Rescuers / First aiders etc should not put themselves in danger.**  
Another casualty often reduces the chance of providing rapid assistance to the first injured person.

## 6.7 Rehabilitation

Rehabilitation of employees injured at work shall be the responsibility of HEC. Tina Hydropower Limited (THL) shall review the HEC rehab programs to ensure consistency and effectiveness.

[APPENDIX. I Illustration-Basic Information on Cardiac - Pulmonary Resuscitation.]

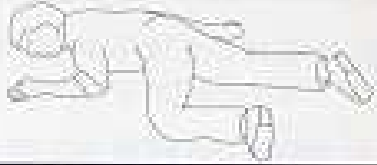
 <b>HYUNDAI</b> ENGINEERING CO., LTD.	<b>WORKERS HEALTH AND SAFETY PLAN</b>	 Tina Hydropower Limited	
<b>TINA RIVER HYDROPOWER DEVELOPMENT PROJECT</b>	<b>HEC-CDSB-CESMP- PPP-008</b>	<b>REV. 12</b>	<b>PAGE 152 OF 158</b>

# EMERGENCY AID

## 1 RECOGNISE A LACK OF OXYGEN


Along with:  
ELECTRIC SHOCK  
DROWNING  
POISONING  
HEAD INJURY  
GASING etc.

May be causing:  
UNCONSCIOUSNESS  
NOISY OR  
NO BREATHING  
ABNORMAL COLOUR



## 2 ACT AT ONCE

SWITCH OFF ELECTRICITY, GAS etc.  
ONLY REMOVE CASUALTY TO PREVENT FURTHER INJURY  
SEND SOMEBODY FOR HELP  
GET A CLEAR AIRWAY ...  
REMOVE ANY OBSTRUCTION ...




**TILT HEAD BACK** ... **LIFT JAW**


BREATHING MAY RESTART ... IF NOT

## 3 APPLY RESCUE BREATHING


START WITH FOUR QUICK DEEP BREATHS.  
SEAL NOSE AND BLOW INTO MOUTH  
or  
SEAL MOUTH AND BLOW INTO NOSE  
KEEP FINGERS ON JAW BUT CLEAR OF THROAT  
MAINTAIN HEAD POSITION



AFTER BLOWING INTO MOUTH or NOSE  
WATCH CASUALTY'S CHEST FALL AS YOU BREATHE IN  
REPEAT EVERY 5 SECS




AFTER FIRST FOUR BREATHS TEST FOR RECOVERY SIGNS:  
1. PULSE PRESENT?  
2. PUPILS LESS LARGE?  
3. COLOUR IMPROVED?



**PULSE POINTS**


## 4 IF NONE, COMBINE RESCUE BREATHING & HEART COMPRESSION

PLACE CASUALTY ON A FIRM SURFACE  
COMMENCE HEART COMPRESSION  
HEEL OF HAND ONLY ON LOWER HALF OF BREASTBONE  
OTHER HAND ON TOP (FINGERS OFF CHEST)



KEEP ARMS STRAIGHT AND ROCK FORWARD TO DEPRESS CHEST 40mm

APPLY 15 COMPRESSIONS ONE PER SECOND ... then GIVE TWO BREATHS



RE-CHECK PULSE ... IF STILL ABSENT CONTINUE WITH 15 COMPRESSIONS TO TWO BREATHS  
IF PULSE RETURNS! CEASE COMPRESSIONS BUT CONTINUE RESCUE BREATHING

## ANNEX P-8-VI HAZARD ASSESSMENT OF TUNNELLING

**ANNEX P-8-VI HAZARD ASSESSMENT OF TUNNELLING**

Activities	Hazards / Impacts	Mitigation Measures	Remark
TBM Assembly / Dismantling / Launching / Retrieval	Lifting Failure / Overload	<ul style="list-style-type: none"> <li>• Permit to Hoist system</li> <li>• Attend the specialist riggers</li> <li>• Prepare the method statement for lifting work</li> </ul>	
	Poor Ground Condition	<ul style="list-style-type: none"> <li>• Prepare the designed crane foundation and fully extended outriggers</li> <li>• Survey check on foundation</li> <li>• Prepare the designed working platform by PE</li> </ul>	
TBM Operation	Over Excavation	<ul style="list-style-type: none"> <li>• Sufficient borehole investigations</li> <li>• Probing through TBM face</li> <li>• Skip count</li> <li>• Review and check the tunneling parameters and calculated volume loss</li> </ul>	
	Sinkholes and Blowouts	<ul style="list-style-type: none"> <li>• Real time monitoring of tunneling parameters</li> <li>• Review face pressure and grout pressure</li> <li>• Continual surface observation</li> <li>• Standby traffic cones and barriers</li> <li>• Mobilization for recovery team ASAP</li> </ul>	
	Collapse / Loss of Face Pressure	<ul style="list-style-type: none"> <li>• Compressed air workers on standby</li> <li>• Medical lock &amp; manlock operational readiness</li> <li>• Preparedness on emergency evacuation in compressed air works</li> </ul>	
	TBM Out of Alignment	<ul style="list-style-type: none"> <li>• Review the alignment drawings</li> <li>• Develop the correction curve</li> <li>• Wrinkle survey before the ring erection</li> </ul>	
	Compressed Air Works / Confined Space Works	<ul style="list-style-type: none"> <li>• Certified compressed air workers on standby</li> <li>• Training on confined space rescue</li> <li>• Prepare on emergency evacuation in compressed air work</li> </ul>	
	Segment Lining Collapse	<ul style="list-style-type: none"> <li>• Prepare of rescue operation for injured</li> <li>• Standby FA Kit and stretcher at TBM</li> <li>• Unobstructed access way at all time</li> </ul>	
	Rolling Stock Operation	<ul style="list-style-type: none"> <li>• Protocol of horning at various stages</li> <li>• Operate an authorized operator only</li> <li>• Prepare emergency stop system</li> <li>• Well maintained track access, track rails and bolting</li> <li>• Placement of signalman to guide IN / OUT</li> </ul>	
Material Lifting & Transportation	Crawler / Gantry Crane Operation	<ul style="list-style-type: none"> <li>• Communicate with operator and rigger via radio</li> <li>• Check and use the approved lifting gears</li> <li>• Maintenance of gantry crane rails and luminous demarcation</li> <li>• Prepare the rotating lights / siren and speed regulation</li> <li>• Check the limit switches before / during / finish the work regularly</li> <li>• Proper control of load swings</li> </ul>	

		<ul style="list-style-type: none"> <li>• Check for damage and deformation of crane attachment and wire</li> </ul>	
General Tunneling Works	Confined Space	<ul style="list-style-type: none"> <li>• Health and safety training</li> <li>• Sign in and out procedures</li> <li>• Ventilation</li> <li>• Continuous gas monitoring</li> <li>• Emergency communication and rescue procedures</li> <li>• Provision of emergency beathing apparatus or similar</li> </ul>	
	Use of Explosives	<ul style="list-style-type: none"> <li>• Refer C-11 Drill and Blast Management Plan</li> </ul>	
	Electrocution / Fire	<ul style="list-style-type: none"> <li>• Continuous gas monitoring</li> <li>• Permit to Work (Cold Work and Hot Work)</li> <li>• Place the fire extinguishers at prominent place</li> <li>• Provide the dedicated rest bay</li> <li>• All electrical materials shall be waterproof products</li> </ul>	
	Noise / Vibration / Dust	<ul style="list-style-type: none"> <li>• Adhere to IFC standards for EHS exposure</li> <li>• Mainly hydraulic drill machine will be used</li> <li>• Low noise generated machinery will be used</li> <li>• Machine / equipment shall be shut down between work periods or throttled down to an idling state</li> <li>• Unsealed roads and working yard will be sprayed to minimize dust</li> <li>• Speed limits (under 20km/h) shall be applied all equipment and vehicles</li> <li>• Dump trucks shall be covered</li> <li>• Provide ear plugs and dust masks for workers</li> <li>• Installation of sound barrier at the working yard</li> <li>• Ventilation system will be provided for tunnel works</li> </ul>	
	Waste Water Treatment	<ul style="list-style-type: none"> <li>• Use non-toxic drilling mud where possible</li> <li>• Wastewater generated from the tunneling works shall be treated by the wastewater treatment facility (Q=1,000ton/day) in temporary treatment yard</li> <li>• Treated wastewater shall be tested and comply with project water quality standards prior to discharge (refer M-1 and M-2).</li> <li>• After treatment (pH dosing, sediment flocculation etc.), treated water shall be discharged to waterway</li> <li>• The remaining sludge is collected by a local treatment company for disposal and spoil disposal sites (if non-toxic) by Faith Holdings</li> </ul>	

# ANNEX P-8-VII TUNNEL WORK SAFETY GUIDELINE

# Tunnel work safety guide line

---

Tina River Hydropower Development Project, Solomon Islands

2020. 04. 15



## ■ CONTENTS

1. Tunnel opening work
2. TBM excavation work
3. Grouting work
4. Lining forms work
5. Tunnel reinforcement work



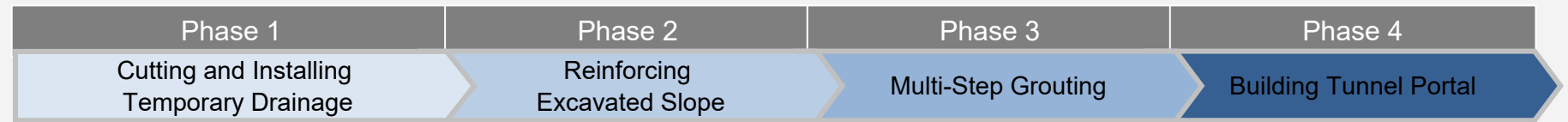
# 1. Tunnel opening work



## 1. Task Overview

- This task is designed to ensure the stability of the slope of a tunnel opening by placing it at right angles to the stable natural slope of earth not affected by lateral earth pressure and the activity of the slope.

## 2. Process Flow



## 3. Resources

Equipments	Jumbo drill, dump truck, shotcrete machine, excavator, bulldozer, dump truck, boring machine
Tools	Electric drill, high-speed cutting machine, welding machine, personal tools
Protective Guards	Safety helmet, safety footwear, safety belt, safety glasses, dust mask, earmuffs, spat, safety vest (luminous)
Materials	Ignition blaster, explosives, detonator, shotcrete, wire mesh, lock-bolt, H-beam
Relevant Personnel	Check the qualifications of the personnel assigned to the task (Leader, Director, Supervisor, etc.) needed for the job. -Site Manager, construction manager, vendor site manager, equipment operator, foreman, technicians

# 1. Tunnel opening work



## 4. Safety Control Points

### ■ Safety Standards for Major Hazardous Operations

#### □ General Precautions for Tunnel Opening Construction

1. Decide on the location of a tunnel portal after a thorough review of measures for the impact of an adjacent structure and slope collapse.
2. Make sure that the tunnel opening does not cause an eccentric slope, a steep slope or large cut slope, and minimizes environmental damage.
3. Decide on the type of portal based on topography, soil conditions, drainage plan and compatibility with the surroundings.
4. Make sure that the drainage near the opening is functioning properly after the excavation.
5. Construct the opening after proposing an appropriate method factoring in slope collapse, surface subsidence, lack of bearing capacity, and future maintenance, and getting the supervisor's approval.
6. Avoid using the equipment for making the opening (backhoe, bulldozer, and boring machine) for purposes other than specified, and make sure the safety devices are always functioning and maintained.
7. Assess risks of equipment, personnel and materials when reinforcing the opening.

#### Improvement Example



Drainage on Top of Tunnel Slope



Reinforcing Opening



Mechanized Construction

#### Common Safety Measures

1. Inspect the equipment used for tunnel opening construction thoroughly.
2. Perform the work according to the Explosives Safety Standard and have qualified personnel handle explosives during blasting.
3. Comply with the Safe Work Procedure when installing temporary facilities, such as an earth retaining system.
4. Employees are required to wear protective equipment.
5. Create a signal system and limit employee access to the work area.



# 1. Tunnel opening work



## 5. Work Order (Risk Factors/Safety Measures)

Major Control Points for Tunnel Opening Works

Attention needs to be paid to risks such as slope collapse or falls from high steep slopes when creating a tunnel opening.

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Install Temporary Drainage</b> 	<ol style="list-style-type: none"> <li>Collision with excavator when a dump truck reverses during surface mining.</li> <li>Bucket dropping from excavator during strip mining with excavator.</li> <li>Floating rocks and excavator rollover while smoothing steep grading.</li> <li>Slope collapse in the tunnel opening in the rainy season</li> </ol>	<ol style="list-style-type: none"> <li>Assign guidance personnel, limit access to work area, watch the rear-view mirror, and mount a rear camera on machine</li> <li>Check the clamping state of safety pin on the excavator bucket</li> <li>Set appropriate height and slope when planning grading</li> <li>Install a temporary drainage system on top of the slope and perform curing with a slope tent</li> </ol>	★
<b>Reinforce Opening Slope</b> 	<ol style="list-style-type: none"> <li>Collapse of excavated slope in the opening due to rain and wind after left unattended for a long time.</li> <li>Falls from a platform on shotcrete machine during placement.</li> <li>Face injury by shotcrete due to carelessness while placing shotcrete.</li> </ol>	<ol style="list-style-type: none"> <li>Place shotcrete before earth in the opening weathers due to rain or wind</li> <li>Install safety belt equipment on the boom of the aerial platform, and fasten safety harness.</li> <li>Wear safety glasses and a mask when placing shotcrete. Conduct training not to direct the shotcrete spray nozzle toward workers' faces or bodies.</li> </ol>	★★




# 1. Tunnel opening work



## 5. Work Order (Risk Factors/Safety Measures)

Major Control Points for Tunnel Opening Works

Attention needs to be paid to risks such as slope collapse or falls from high steep slopes when creating a tunnel opening.

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Multi-Step Grouting</b> 	<ol style="list-style-type: none"> <li>1. Falls from a platform while boring an opening</li> <li>2. Slope collapse due to over-excavation of the opening</li> <li>3. Falls while working on ribs on a ladder or other makeshift.</li> <li>4. Falls while injecting grout in the mixer</li> <li>5. Overturning on the slope during grouting</li> </ol>	<ol style="list-style-type: none"> <li>1. Install guard rails on the platform, install an automatic platform</li> <li>2. Maintain the grading and reinforce slope</li> <li>3. Install a platform or a mobile platform for steel rib works</li> <li>4. Install a board on the feed opening of mixer.</li> <li>5. Install a safe board when working on the slope</li> </ol>	★★
<b>Construct Tunnel Opening</b> 	<ol style="list-style-type: none"> <li>1. Falls while installing an earth retaining system on steel ribs</li> <li>2. Slips or falls when lifting and lowering steel ribs.</li> <li>3. Electric shocks during welding</li> <li>4. Sliding of floating rocks along the slope</li> <li>5. Eye injury risks by scattering shotcrete during placement</li> <li>6. Collapse of the face of tunnel portal</li> </ol>	<ol style="list-style-type: none"> <li>1. Create a safe platform such as sky rental</li> <li>2. Wear safety harness equipment and harness</li> <li>3. Wear insulation protective equipment and shock prevention system during welding</li> <li>4. Clean up floating rocks before work.</li> <li>5. Wear safety glasses w</li> <li>6. Maintain the core when</li> </ol> 	★★★★



# 1. Tunnel opening work



## 6. Examples of Accidents

No.	Examples of Major Accidents
<b>Accident Trend</b>	Fall and slope collapse accidents usually occur while reinforcing a slope or boring an opening on a platform.
1	Collapse occurs due to failure to comply with the grading without considering soil conditions during excavation.
2	Collapse due to a delay in reinforcement to prevent collapse after excavation
3	Hit by a flying rock while blasting a tunnel opening
4	Collapse of the opening due to penetration of rainwater at the top of the opening
5	Fall while installing a beam on the opening

### ● Fall During Survey on Steps at Tunnel Opening



#### ■ Accident Overview

In this accident, the victim fell while surveying the top of the slope of a tunnel opening.

#### ■ Safety Measures

Install a temporary stairway (passageway) on a scaffold for easier access or install safety harness equipment (lifeline, rope) and make sure workers wear safety harnesses and fasten hooks to the rope

### ● Collapse of Opening of Cut-and-Cover Tunnel



#### ■ Accident Overview

In this accident, the victim was buried due to collapse of slope of the cut-and-cover tunnel

#### ■ Safety Measures

Excavate the surface with an appropriate slope (1:0.5 for soft rock). In case of possibility of collapse due to rain penetration after the large cut slope has been exposed for a long time, install an appropriate earth retaining method (rock anchor, etc.) or take necessary steps like installing a slope cover

# 1. Tunnel opening work



## 7. Safety Checklist

Classification	Tunnel Opening Works	Detailed Class	Tunnel Opening Works	
Contractor		Date		
Checklist		Results		Measures
		Construction Mgr.	Safety Manager	
<b>Preparation Phase</b>				
<ol style="list-style-type: none"> <li>1. Risk assessment has been conducted</li> <li>2. Safe Work Permit has been approved and made available.</li> <li>3. Work Plan has been approved</li> <li>4. Equipment operator is licensed, and site safety training has been conducted.</li> <li>5. Employee status checked: health, wearing protective equipment</li> <li>6. Equipment has been checked by the person responsible before work</li> <li>7. Passageway and a path for equipment have been created before work</li> <li>8. Related documents on the equipment have been collected and are appropriate</li> </ol>				
<b>Construction Phase</b>				
<ol style="list-style-type: none"> <li>1. Rear warning lights and safety signs have been installed</li> <li>2. Excavation slope is appropriate for soil quality when excavating the slope</li> <li>3. Boom and bucket connector are tightly fastened when working on the slope</li> <li>4. Employee access is limited to the bottom of the slope</li> <li>5. Slope reinforcement system has been installed</li> <li>6. Allowable load of earth has been loaded. There is a risk of overturning of equipment.</li> <li>7. Temporary drainage system and guard rails have been installed at the top of the slope.</li> <li>8. Protective system of the mobile construction equipment is functioning properly</li> </ol>				
Construction Mgr.	(SIGNED)	Safety Manager	(SIGNED)	

## 2. TBM excavation work



### 1. Task Overview

- TBM is a machine used for tunnel excavation using the reaction force of an adjacent wall. As the cutter advances, the machine makes holes in rock surfaces and drills along the way.

### 2. Process Flow



### 3. Resources

Equipments	TBM, crane, hopper car, compressor, exhaust system, lighting system, ventilation system, backhoe, battery car
Tools	Welding machine, high-speed cutting machine, grinder, chain block, personal tools
Protective Guards	Safety helmet, safety footwear, safety glasses, safety belt, dust mask, earmuffs, spat, safety vest (luminous)
Materials	Beam, shotcrete, rock bolts, cement milk, lock belt filler
Relevant Personnel	Check the qualifications of the personnel assigned to the task (Leader, Director, Supervisor, etc.) needed for the job. -Site Manager, construction manager, vendor site manager, equipment operator, foreman, technician

## 2. TBM excavation work



### 4. Safety Control Points

#### ■ Safety Standards for Major Hazardous Operations

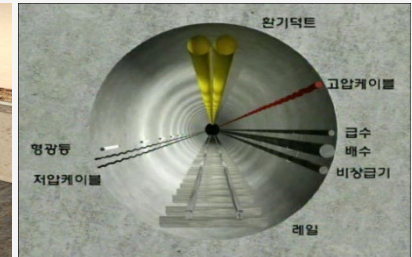
##### □ General Precautions for TBM Excavation

1. Make and execute a plan for machine erection taking into consideration terrain, passageway, and type of temporary platform.
2. Put down front and back supports when loosening a clamping pad after one stroke of boring. Increase pressure while keeping pad balance when pressing the clamping pad against the wall.
3. Maintain lighting at over 150 lux around TBM.
4. Assign a supervisor when replacing the cutter between head and tunnel face, check the rock and water status before entering the face. In case of poor rock quality, reinforce the rocks before boring.
5. Check dust and exhaust status and wear PPE such as a dust mask. Do not stack materials in the passageway at the top of TBM. Always keep neat and tidy.
6. Assign a supervisor to ensure that materials are not stacked on the way, a warning system is working and the conveyor belt is not overloaded when removing debris.
7. Polluted water arising from boring will be treated according to Industrial Waste Management Act

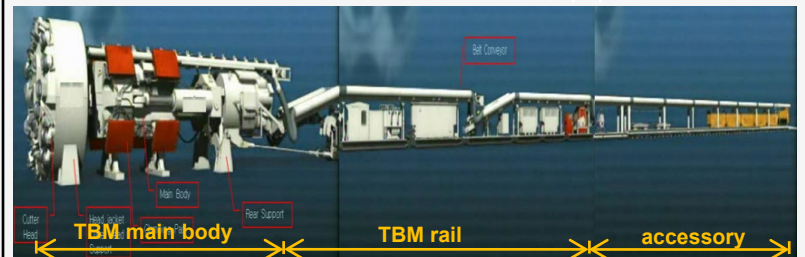
#### Improvement Example



TBM Tunnel Layout



TBM Excavation Auxiliary Equipment



TBM Structure

#### Common Safety Measures

1. Complete a Mobile Construction Equipment Work Plan
2. Appoint a supervisor and work under the supervisor's direction
3. Only qualified personnel are allowed to work
4. Wear protective equipment during tunnel boring
5. Conduct face-mapping and observational procedure
6. Check if the following system is operating properly






## 2. TBM excavation work



### 5. Work Order (Risk Factors/Safety Measures)

Major Control Points for TBM Excavation

High risks of falling and collision due to instability of heavy equipment transport and ropes when erecting TBM

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Machine Receipt/Erection</b>   	<ol style="list-style-type: none"> <li>1. Injury when entangled between cargo and object when bringing in machine</li> <li>2. Risk of machine falling due to damage to lift equipment</li> <li>3. Risk of machine falling due to broken sling belt or wire ropes</li> <li>4. Risk of worker contacting the lift cargo</li> <li>5. Fall from heights without a lift platform</li> <li>6. Overturning of a mobile crane during lifting</li> <li>7. Falling object when lifting with only one rope</li> <li>8. Electric shock when using a welder or electric tool</li> <li>9. Accidents during erection due to failure to wear protective equipment</li> </ol>	<ol style="list-style-type: none"> <li>1. Make sure workers keep away from the lift cargo and do not go between cargo and object</li> <li>2. Select appropriate lift equipment and check before work</li> <li>3. Check the sling belts and wire ropes before work</li> <li>4. Assign signal persons and check signals</li> <li>5. Install a mobile scaffold before erection</li> <li>6. Take measures to prevent overturning, such as compacting soil surface for mobile crane erection and increasing outriggers</li> <li>7. Check the safety of suspended ropes during lift and check the crane hook loosening system</li> <li>8. Check the safety of the welder and electric tools. Check frequently during use. Install earths and leakage circuit breakers.</li> <li>9. Wear safety belts when working at heights. Wear protective equipment during welding</li> </ol>	<p>★★</p>


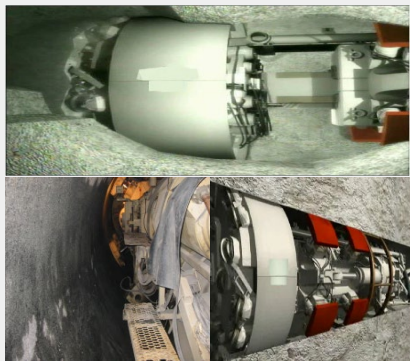
## 2. TBM excavation work



### 5. Work Order (Risk Factors/Safety Measures)

#### Major Control Points for TBM Excavation

Collapse, falls and entanglement during cutter replacement or repairs, or electric shocks and collisions due to poor installations of ducts, high-pressure cables, and water distribution line

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Pilot Tunnel Entering</b> 	<ol style="list-style-type: none"> <li>1. Overturning of TBM due to subsidence during the entering of a pilot tunnel</li> <li>2. Collision with machine in the excavated area while entering the tunnel</li> <li>3. Worker entangled between TBM and tunnel face while entering the tunnel</li> </ol>	<ol style="list-style-type: none"> <li>1. Prevent accidents such as subsidence by compacting surface and paving the TBM entrance with concrete</li> <li>2. Ensure only qualified operator can enter the tunnel and assign guidance personnel</li> <li>3. Restrict employee access between tunnel inside and equipment when entering the tunnel</li> </ol>	★
<b>Boring</b> 	<ol style="list-style-type: none"> <li>1. Collapse of tunnel during boring</li> <li>2. Collapse of tunnel face during TBM face reinforcement (earth retaining system, shotcrete)</li> <li>3. Overturning when moving to TBM head</li> <li>4. Falling cutter due to the failure of a chain block when replacing cutter</li> <li>5. Electric shock when using electric machines</li> <li>6. Falls from platform and equipment when repairing/operating TBM</li> </ol>	<ol style="list-style-type: none"> <li>1. Conduct geotechnical investigation and ensure safety of fractured zones and joints before boring</li> <li>2. Reinforce the tunnel face after eliminating risks of falling rocks</li> <li>3. Do not rush or unstable behavior while moving to TBM head (only experienced persons)</li> <li>4. Check the chain block when replacing the cutter</li> <li>5. Earth and install leakage circuit breakers for electrical equipment</li> <li>6. Create vertical/horizontal passageways in the TBM</li> </ol>	★★

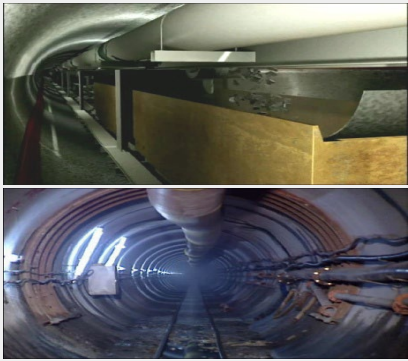

## 2. TBM excavation work



### 5. Work Order (Risk Factors/Safety Measures)

#### Major Control Points for TBM Excavation

Collapse, falls and entanglement during cutter replacement or repairs, or electric shocks and collisions due to poor installations of ducts, high-pressure cables, and water distribution line

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Debris Removal</b> 	<ol style="list-style-type: none"> <li>1. Overturning of a car used for removal of debris after derailment</li> <li>2. Collision with the car while an employee passes through the path</li> <li>3. Fall from the top of a conveyor system while loading debris</li> <li>4. Entanglement when the conveyor suddenly starts during repairs</li> <li>5. Collision between successive system and car</li> </ol>	<ol style="list-style-type: none"> <li>1. Frequently check the rail status and enforce the speed limit</li> <li>2. Workers from next process are not allowed to move into the tunnel. Install an evacuation post and restrict operation of the next process. Create a warning signal system</li> <li>3. Install a supervising platform for loading debris on the edge of the conveyor system. Wear safety harnesses</li> <li>4. Switch off the conveyor system during maintenance. Install safety signs</li> <li>5. Only qualified operators can operate the car</li> </ol>	★
<b>Dismantling TBM</b> 	<ol style="list-style-type: none"> <li>1. Overturning of TBM due to poor working conditions</li> <li>2. Falling equipment due to poor rope holder state</li> <li>3. Electric shock when using electrical tools for dismantling</li> <li>4. Fall from the box when loading the dismantled machine on a truck</li> </ol>	<ol style="list-style-type: none"> <li>1. Conduct a thorough geotechnical investigation before dismantling</li> <li>2. Check rope holder clamping and check if two ropes are used. Check wire rope and sling belts</li> <li>3. Check the exterior of electrical tools, check 3-P cable and leakage circuit breaker</li> <li>4. Identify risks and conduct training</li> </ol>	★★

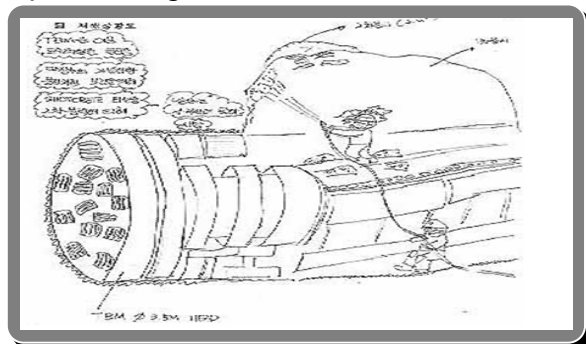
## 2. TBM excavation work



### 6. Examples of Accidents

No.	Examples of Major Accidents
Accident Trend	Falls due to instability in heavy equipment transport and ropes when erecting TBM. Collapse, falls, and entanglement when replacing cutters or during repairs. Electric shocks or collisions due to poor installation of ducts, cables, and water supply line.
1	Fall when erecting TBM
2	Falling machine due to broken rope when lifting TBM
3	Falling cutter due to failure of chain block when replacing the TBM cutting head
4	Rollover of a car due to derailing while removing debris
5	Fall from the top of the conveyor system while loading debris

#### ● Collapse During TBM Tunnel Face Reinforcement



##### ■ Accident Overview

In this accident the victim was killed by a falling rock after the secondary collapse of the face crown while placing shotcrete on a TBM conveyor to reinforce the previously collapsed area

##### ■ Safety Measures

Check the terrain of the collapsed area of face, take preventive measures, predict future collapse, restrict access.

#### ● Death by Falling Cutter Head While Replacing It



##### ■ Accident Overview

In this accident, the victim was killed when entangled with the falling cutter head of TBM as a shaft bolt got broken by the heavy load of the head when cutting 6 joints with an oxygen welder.

##### ■ Safety Measures

Make a Heavy Object Handling Work Plan and stack heavy objects temporarily before work



## 2. TBM excavation work



### 7. Safety Checklist

Classification	TBM Excavation	Detailed Class.	TBM Excavation	
Contractor		Date		
Checklist		Results		Measures
		Construction Mgr.	Safety Manager	
<b>Preparation Phase</b>				
<ol style="list-style-type: none"> <li>1. Risk assessment has been conducted</li> <li>2. Safe Work Permit has been approved and made available.</li> <li>3. Work Plan has been approved</li> <li>4. Equipment operator is licensed, and site safety training has been conducted.</li> <li>5. Employee status checked: health, wearing protective equipment</li> <li>6. Equipment has been checked by the person responsible before work</li> <li>7. Passageway and a path for equipment have been created before work</li> <li>8. Related documents on the equipment have been collected and are appropriate</li> </ol>				
<b>Construction Phase</b>				
<ol style="list-style-type: none"> <li>1. Mobile crane for machine erection has been checked</li> <li>2. Soil surface for machine erection has been compacted</li> <li>3. Measures taken to prevent collisions between machine and tunnel face during pilot tunnel entering</li> <li>4. Safety measures taken, such as removal of floating rocks on the path for a car</li> <li>5. Safety facilities (emergency lighting, air supply, emergency phone, food, etc.) as well as ventilation, drainage, and lighting systems related to excavation are available</li> <li>6. The car operator is qualified and the safety rules for operating are complied with.</li> <li>7. TBM operators (boring, maintenance) are qualified.</li> <li>8. Safety electrical installations such as earthing and leakage circuit breaker available</li> </ol>				
Construction Mgr.	(SIGNED)	Safety Manager	(SIGNED)	

# 3. Grouting work



## 1. Task Overview

- This task involves the method of creating a beam arch by arranging high-strength FRP tubes in an umbrella shape and integrating reinforcing materials and the ambient soil using a penetrating agent. It provides waterproofing and reinforcement.

## 2. Process Flow



## 3. Resources

Equipments	Drill, aerial lift, charging car
Tools	Hammer, drill
Protective Guards	Safety helmet, safety footwear, safety glasses, dust mask, earmuffs, spat, safety vest (luminous)
Materials	Grout solution, multi-step grout tube
Relevant Personnel	Check the qualifications of the personnel assigned to the task (Leader, Director, Supervisor, etc.) needed for the job. -Site Manager, construction manager, vendor site manager, equipment operator, foreman, technicians

# 3. Grouting work



## 4. Safety Control Points

### ■ Safety Standards for Major Hazardous Operations

#### □ General Precautions for Grouting

1. Only the tools needed for work at heights should be loaded on the platform; load limits must not be exceeded
2. Check equipment performance before receipt and check frequently during use
3. Make sure all doors to the lower control panel are closed after the engine turns on. Use only the upper control panel on the platform.
4. Reduce the boom and get the platform near the surface. Shut off the upper control panel, lower control panel, and main switch in order.
5. Assign signal persons around equipment.
6. Conduct training about the location of signal persons and signaling method
7. Monitor hydraulic pressure and flow and provide and make employees wear PPE, such as glasses and dust masks before grouting
8. Do not work at top and bottom at the same time. Clean up materials on top of the platform.
9. Assign a supervisor

#### Common Safety Measures

1. Complete a Mobile Construction Equipment Work Plan
2. Appoint a supervisor and work under the supervisor's direction
3. Only qualified personnel are allowed to work
4. Secure path for MCE, check compactness, width and slope
5. Create a signal system and limit personnel access to the work area

#### Improvement Example



No Working At Top and Bottom At once; Supervisor Assigned



Installing Boards on Top of Bucket

6. Reverse the vehicle according to the alarm, rear view (rear camera) and guidance person's direction
7. Do not work at top and bottom at the same time during grouting
8. Workers at top of platform must wear safety harnesses and glasses
9. Safety review of charging car must be verified beforehand (do not exceed load limits)



# 3. Grouting work



## 5. Work Order (Risk Factors/Safety Measures)

### Major Control Points for Grouting

Attention needs to be paid to falling rocks, collisions, entanglement, and falls during special tunnel reinforcement (multi-step grouting)

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Drilling</b> 	<ol style="list-style-type: none"> <li>1. Serious accidents due to lack of training about working procedures and due to defects in machine/equipment</li> <li>2. Collisions and overturning due to narrow work space and poor working conditions</li> <li>3. Floating rocks falling during face-mapping and drilling</li> <li>4. Electric shocks caused by leakage due to lack of cable rack and exposure of charge part</li> <li>5. Collision with adjacent worker during adjustment of drilling locations and during drilling</li> <li>6. Entanglement by physical contact with the rotating part of the drill</li> </ol>	<ol style="list-style-type: none"> <li>1. Eliminate accident factors by conducting safety training and checking the required machines and equipment</li> <li>2. Make sure there is enough ventilation and clean up materials near the work area</li> <li>3. Check the tunnel face and ensure it is sufficiently sealed after removal of floating rocks</li> <li>4. Hang the board reel of cable on the cable rack. Check leakage frequently. Protect the charge part. Fabricate temporary cables, use the power cord of the leakage circuit breaker</li> <li>5. Assign guidance personnel, create a signal system, and restrict access when moving machine</li> <li>6. Conduct safety training to avoid bodily contact with the rotating part and comply with safety rules</li> </ol>	★★
<b>Steel Pile Penetration</b> 	<ol style="list-style-type: none"> <li>1. Falls and collisions caused by unqualified persons working at heights</li> <li>2. Risks arising from defects in the machine/equipment</li> <li>3. Entanglement and overturning by the weight of steel piles when penetrating piles</li> <li>4. Falling piles while putting them into holes</li> <li>5. Fall from the tilting platform due to pressure applied while penetrating piles</li> </ol>	<ol style="list-style-type: none"> <li>1. Eliminate psychological and physical risks by monitoring alcohol use and blood pressure and conducting safety training before working at heights</li> <li>2. Conduct training about work procedures and check the charging car and platform thoroughly</li> <li>3. Do not overwork when penetrating piles. Two workers form a team, and safety manager should be available 24/7</li> <li>4. Form teams based on the length of pile and do not overload pipes on the platform</li> <li>5. Do not apply excessive force on the platform and always wear safety belts</li> </ol>	★★





# 3. Grouting work



## 5. Work Order (Risk Factors/Safety Measures)

### Major Control Points for Grouting

Attention needs to be paid to falling rocks, collisions, entanglement, and falls during special tunnel reinforcement (multi-step grouting)

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Injection</b> 	<ol style="list-style-type: none"> <li>1. Entanglement and falls due to employee's unstable behavior while mixing materials</li> <li>2. Risks from defects in machine/equipment</li> <li>3. Eye and skin injuries due to scattering particles and grout when using the mixer</li> <li>4. Falls and slips while putting grout in mixer</li> <li>5. Getting cuts by the blades of the mixer while mixing grout</li> <li>6. Electric shock caused by loss of function due to accumulated particles in the mixer power supply and switchboard</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the employee's psychological and physical conditions and conduct safety training before mixing materials</li> <li>2. Conduct safety training and machine/equipment check to eliminate potential risks</li> <li>3. Employees must wear protective equipment such as safety glasses and dusk mask</li> <li>4. Install a toe board and warning sign in the feed opening of the mixer</li> <li>5. Install a lid on the mixer to prevent contact and inspect the mixer. Stop the machine for repairs</li> <li>6. Get power supply from the leakage circuit breaker, earth the enclosure, and clean regularly</li> </ol>	★
<b>Grouting</b> 	<ol style="list-style-type: none"> <li>1. Skin disease due to physical contact with grout</li> <li>2. Reflux of cement milk and mortar from feed opening and scattering when injecting grout and penetrating agent</li> <li>3. Collision due to the obstruction of grout injection pipe</li> <li>4. Collision due to falling materials or tools due to unauthorized access and work</li> <li>5. Failure to conduct training about work procedures</li> </ol>	<ol style="list-style-type: none"> <li>1. Employees must wear protective equipment such as safety glasses and dusk mask</li> <li>2. Control grout pressure and flow and provide and make employees wear PPE such as safety glasses and dusk mask</li> <li>3. Measure injection pressure and flow, keep distance from the pipe for passage</li> <li>4. Do not work at the top and bottom at the same time. Clean up materials and tools from the platform top.</li> <li>5. Conduct training for persons responsible and employees and share accident examples</li> </ol>	★★

# 3. Grouting work



## 6. Examples of Accidents

No.	Examples of Major Accidents
<b>Accident Trend</b>	Entanglement and falls from an aerial platform during grouting or electric shocks when using a drill
1	Entanglement and fall accident on an aerial platform
2	Electric shock caused by an electrical machine during drilling
3	Electric shock due to lack of a leakage circuit breaker
4	Employee falls when the machine moves due to lack of subsidence-prevention system on the aerial platform
5	Collision between machine and worker

### ● Electric Shock when Checking Pump to Drill Tunnel Face



#### ■ Accident Overview

Electric shock while checking a water pump to drill a tunnel face.

#### ■ Safety Measures

Use electrical machines with sufficient electrical capacity and mechanical strength. Perform earthing on metal enclosures and install leakage circuit breakers.

### ● Entanglement on Tunnel Ceiling due to Wrong Operation of Basket



#### ■ Accident Overview

Entanglement on a tunnel ceiling due to mis-operation of the basket

#### ■ Safety Measures

Bring the basket up to a work area when using an aerial platform, stop the Up/Down lever before work. Assign a supervisor to monitor employees' unstable behavior

### 3. Grouting work



#### 7. Safety Checklist

Classification	Grouting Works	Detailed Class.	Grouting Works	
Contractor		Date		
Checklist		Results		Measures
		Construction Mgr.	Safety Manager	
<b>Preparation Phase</b>				
1. Risk assessment has been conducted 2. Safe Work Permit has been approved and made available. 3. Work Plan has been approved 4. Equipment operator is licensed, and site safety training has been conducted. 5. Employee status checked: health, wearing protective equipment 6. Equipment has been checked by the person responsible before work 7. Passageway and a path for equipment have been created before work 8. Related documents on the equipment have been collected and are appropriate				
<b>Construction Phase</b>				
1. Rear warning lights and safety signs have been installed 2. Hydraulic and safety devices of aerial lift are functioning properly 3. Leakage breaker has been installed when using electric machines like a drill 4. Fall-protection system has been mounted on top of the aerial lift 5. Holder system has been installed at the bottom of the aerial lift 6. Employees have low back pain or muscle pain after excessive boring 7. Lighting is sufficient within the tunnel during grouting				
Construction Mgr.	(SIGNED)	Safety Manager	(SIGNED)	

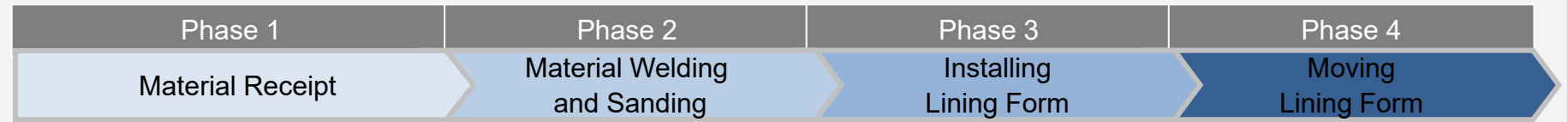
# 4. Lining forms work



## 1. Task Overview

- A lining form is a large steel form that is installed in a tunnel after finishing excavation in order to place lining concrete.

## 2. Process Flow



## 3. Resources

Equipments	Crane, forklift truck
Tools	Welding machine, high-pressure gas cutting machine, personal tools
Protective Guards	Safety helmet, safety footwear, safety glasses, dust mask, earmuffs, spat, safety vest (luminous)
Materials	Steel form, square tubes, H-beam, steel plates
Relevant Personnel	Check the qualifications of the personnel assigned to the task (Leader, Director, Supervisor, etc.) needed for the job. -Site Manager, construction manager, vendor site manager, equipment operator, foreman, technicians

# 4. Lining forms work



## 4. Safety Control Points

### ■ Safety Standards for Major Hazardous Operations

#### □ General Precautions for Lining Form Works

1. Conduct a structural review of the lining form and check if the assembly drawing is appropriate.
2. Check equipment performance before receipt, and check frequently during use
3. Take protective measures (rear warning systems for backhoes and dump trucks, rear surveillance cameras and bucket safety pins)
4. Separate paths for pedestrians and for equipment when making a lining form
5. Assign signal persons when working with equipment
6. Conduct training about signal persons' locations and signaling method
7. Set safety zones within the radius of falling materials when dismantling the lining form with a crane
8. Decide traffic paths before working with the equipment
9. Construct the rail for operating equipment and perform periodic check

#### Improvement Example



Installing Reflective Safety Signs



Temporary Safety Facility for Lining Form Fabrication

#### Common Safety Measures

1. Complete a Lining Form Erection Work Plan
2. Assign a supervisor and follow the supervisor's direction
3. Ensure safety of rails for moving a lining form (rail installment)
4. Verify the safety review of the lining form
5. Create a signal system and restrict employee access
6. Reverse the vehicle according to the alarm, rear view (rear camera) and guidance person's direction
7. Prepare lift equipment for employees to access lining form.
8. Set safety zones within the lining form work area.
9. Perform work according to the erection/dismantling plan




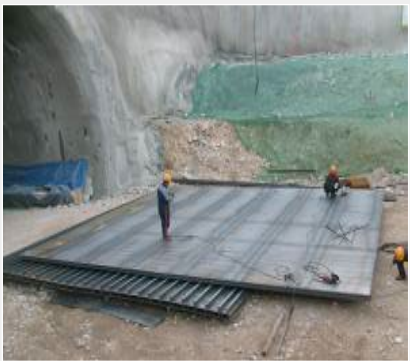
# 4. Lining forms work



## 5. Work Order (Risk Factors/Safety Measures)

Major Control Points  
for Lining Form Works

Accidents involving lining forms include entanglement when handling heavy objects, collisions with trucks, and falls from the platform while erecting and dismantling lining forms

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Material Receipt</b> 	<ol style="list-style-type: none"> <li>1. Accidents due to employee's unstable behavior and physical problems</li> <li>2. Falls and collisions due to failure to wear PPE such as a helmet</li> <li>3. Falls and collisions due to the use of inappropriate wire ropes and sling belts and of inappropriate methods</li> <li>4. Collisions due to unauthorized access to working areas of the lift and truck</li> <li>5. Collisions due to poor maintenance and swaying during unloading</li> </ol>	<ol style="list-style-type: none"> <li>1. Insecure employees will be assigned to appropriate positions after blood pressure monitoring and health check before working at heights</li> <li>2. Make sure employees wear PPE and give warnings to those who do not</li> <li>3. Check wire ropes and sling belts, and conduct special safety training for crane operator, signal persons and persons responsible</li> <li>4. Guidance personnel must wear red helmets and restrict employee access to the work area</li> <li>5. Check the side brake and braking system of the truck, and install speed bumps on the slope</li> </ol>	★
<b>Welding and Sanding</b> 	<ol style="list-style-type: none"> <li>1. Eye injury and skin disease caused by scattering particles during welding and sanding due to failure to wear PPE</li> <li>2. Electric shock due to an aged welder and failure to install shock prevention system</li> <li>3. Electric shock due to leakage when using an electric tool like drill or sanding machine</li> <li>4. Falls due to lack of safety facilities and failure to wear safety belts</li> </ol>	<ol style="list-style-type: none"> <li>1. Employees must wear safety glasses and dusk masks and follow the work procedures.</li> <li>2. Do not bring in welders without shock prevention systems or aged welders. Check the welder first and put a Pass mark on it</li> <li>3. Check the electric devices for leakage before use</li> <li>4. Install safety ropes and facilities before sanding the upper part. Employees must wear belts</li> </ol>	★★


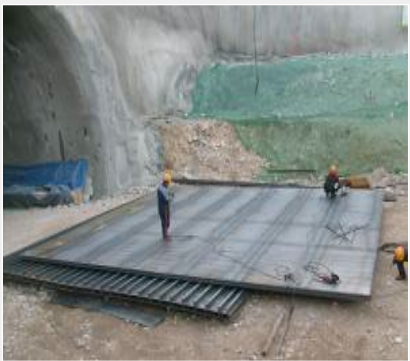
# 4. Lining forms work



## 5. Work Order (Risk Factors/Safety Measures)

Major Control Points  
for Lining Form Works

Accidents involving lining forms include entanglement when handling heavy objects, collisions with trucks, and falls from the platform while erecting and dismantling lining forms

Workflow	Risk Factors	Safety Control Measures	Level of Danger
<b>Installing Lining Form</b> 	<ol style="list-style-type: none"> <li>1. Accidents due to employee's unstable behavior and physical problems</li> <li>2. Fall from the top of the form while cleaning such as removing rust</li> <li>3. Entanglement due to sudden movement of the lining form</li> <li>4. Collision with a worker moving at the bottom when erecting/removing a lining form</li> <li>5. Electric shock while grinding the surface of a lining form</li> <li>6. Collapse of a lining form due to failure to follow the erection/dismantling procedures</li> <li>7. Falling members and collisions due to the use of inappropriate wire ropes and inappropriate method</li> </ol>	<ol style="list-style-type: none"> <li>1. Insecure employees will be assigned to appropriate positions after blood pressure monitoring and health check before working at heights</li> <li>2. Install safety belt equipment at top of the lining form and make sure employees wear safety swigs</li> <li>3. Install a bump on the lower rail to anchor the form.</li> <li>4. Restrict employee access to the lower part of the form and have the safety manager available 24/7</li> <li>5. Connect to the leakage circuit breaker when using electrical tools</li> <li>6. Conduct training of the work procedures before erecting/dismantling the form, and conduct trial training</li> <li>7. Check wire ropes and sling belts, and conduct special safety training for crane operator, signal persons and persons responsible</li> </ol>	<p>***</p>
<b>Moving Lining Form</b> 	<ol style="list-style-type: none"> <li>1. Collision and entanglement due to failure to wear PPE when moving a lining form</li> <li>2. Overturning of a lining form due to signal disagreement between equipment and signal person</li> <li>3. Lack of proactive accident response and measures due to lack of safety training for employees and supervisors</li> </ol>	<ol style="list-style-type: none"> <li>1. All employees wear PPE including safety helmets and belts. Restrict access to the work area</li> <li>2. Signal persons must know the work procedure and receive safety training. Safety manager should be available 24/7</li> <li>3. Conduct safety training for all employees. Create a scenario to respond to an accident and conduct training</li> </ol>	<p>**</p>

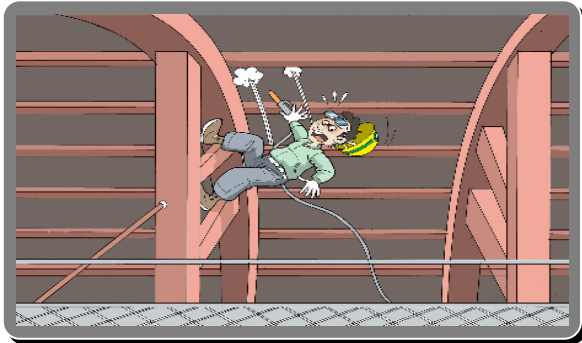
# 4. Lining forms work



## 6. Examples of Accidents

No.	Examples of Major Accidents
<b>Accident Trend</b>	Fall risks when employees move up and down on a lining form platform
1	Fall from the edges of the platform while dismantling a lining form
2	Steel plates falling as temporary welded areas come off while lifting the plates to make a lining form
3	Fall to the ground while elevating on the lining form platform
4	Fall while welding the lining form
5	Crane rollover while lifting lining form materials

### ● Fall While Welding Lining Form



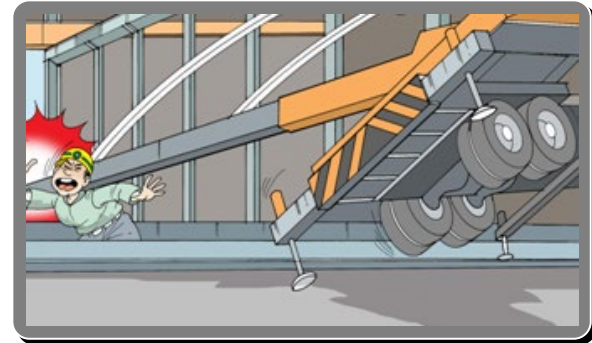
#### ■ Accident Overview

In this accident the victim fell about 6 meters and died while stepping off a toe board and welding at the top of the arch beam to perform welding.

#### ■ Safety Measures

Install a scaffold or toe boards on the vertical and horizontal members of a lining form or install a safety net at the bottom when welding to prevent falls.

### ● Crane Rollover While Lifting Lining Form



#### ■ Accident Overview

In this accident the victim was killed by getting entangled in a mobile crane that has rolled over while lifting lining form materials

#### ■ Safety Measures

Secure safety clearance from the surroundings when installing a lining form. Assign a supervisor, review the safety of a crane and install an outrigger (rope holder)



## 4. Lining forms work



### 7. Safety Checklist

Classification	Lining Form Works	Detailed Class.	Lining Form Works	
Contractor		Date		
Checklist		Results		Measures
		Construction Mgr.	Safety Manager	
<b>Preparation Phase</b>				
1. Risk assessment has been conducted 2. Safety review of the lining form has been verified 3. Work Plan has been approved 4. Safety zones have been set when erecting a lining form 5. Employee status checked: health, wearing protective equipment 6. Equipment has been checked by the person responsible before work 7. Passageway and a path for equipment have been created before work 8. Related documents on the equipment have been collected and are appropriate				
<b>Construction Phase</b>				
1. There are obstacles when moving the lining form 2. There is a temporary safety facility for the lining form platform 3. Erection and dismantling sequences for lining forms are complied with 4. Access to the work area is restricted 5. Signal persons are available 6. The lining form has been erected according to the drawing, and the work is supervised during concrete placement 7. Erection is performed based on the drawing. 8. Employees are aware of the operating procedures for lining forms				
Construction Mgr.	(SIGNED)	Safety Manager	(SIGNED)	

# 5. Tunnel reinforcement work



## 1. Task Overview

- This task aims to reinforce a tunnel with wire meshes, shotcrete, and rock bolts to prevent bearing capacity from deteriorating due to the relaxed surface and to ensure stability until the lining concrete process is finished.

## 2. Process Flow



## 3. Resources

Equipments	Drill, charging car, aerial lift
Tools	Spanner, impact, high-speed cutter, welder, high-pressure gas cutter
Protective Guards	Safety helmet, safety footwear, safety glasses, dust mask, earmuffs, spat, safety vest (luminous)
Materials	Steel ribs, rock bolts, wire mesh, shotcrete, PVC pipes, high tension bolts, admixtures for concrete, cement mortar
Relevant Personnel	Check the qualifications of the personnel assigned to the task (Leader, Director, Supervisor, etc.) needed for the job. - Site Manager, construction manager, vendor site manager, foreman, equipment operator, technicians

# 5. Tunnel reinforcement work



## 4. Safety Control Point

### ■ Safety Standards for Major Hazardous Operations

- General Precautions for Tunnel Reinforcement
  1. Check the clamping of a rope binding steel ribs, flatness of a traffic path for vehicles, clamping of bolt joints. Do not work at the top and bottom at the same time.
  2. Remove floating rocks on a sprayed surface. Thoroughly clean up floating rocks through face-mapping.
  3. Do not overload a platform with materials, install a toe board and guard rails to prevent falls, and have them checked before work.
  4. Safety devices (over-lift protection system, head guard, emergency stop switch) must be installed on a service car and functioning properly.
  5. Install a drill on an immobile floor. Install an outrigger tightly. Assign guidance personnel, create a signal system and restrict access to the work area.
  6. Install a toe board and guard rails around the feed opening of a grout mixer. Personnel handling cement must wear a dust mask and safety glasses.
  7. Install a safety system and use safety harnesses to prevent falls when climbing onto equipment.

### Improvement Example



Primary Shotcrete Placement



Installing Wire Mesh and Steel Ribs



Secondary Shotcrete Placement/



Rock Bolt Construction

### Common Safety Measures

1. Conduct a risk assessment, approve and make available a Safe Work Permit
2. Employees are required to wear protective equipment
3. Only qualified personnel are allowed to operate the equipment
4. Create a signal system and limit personnel access to the work area.
5. Ensure that lighting is sufficient within the tunnel
6. Check floating rocks thoroughly



# 5. Tunnel reinforcement work



## 5. Work Order (Risk Factors/Safety Measures)

### Major Control Points for Tunnel Reinforcement

Attention needs to be paid to a risk of soil collapse while transporting heavy objects during reinforcement

Work Flow	Risk Factors	Safety Measures	Level of Danger
<b>Mounting Steel Ribs</b> 	<ol style="list-style-type: none"> <li>1. Entanglement of fingers due to the loosening of rope when unloading steel ribs</li> <li>2. Falling rocks while erecting steel ribs</li> <li>3. Entanglement between ribs and car while aligning the ribs because of the moving car</li> <li>4. Entanglement in ribs because an inappropriate method is used in erecting ribs.</li> <li>5. Falls due to overload while using a rock drill on a steel rib platform</li> </ol>	<ol style="list-style-type: none"> <li>1. Check the clamping of ropes and signal agreement between workers. Check the work order again.</li> <li>2. Check for floating rocks, and ensure workers wear safety helmets and vests (embossed)</li> <li>3. Ensure the flatness of a path, speed limit, and install an outrigger for a service car before transporting steel ribs.</li> <li>4. Create an anchor point with a holder before erecting ribs. Tightly fasten the bolts, assign a supervisor.</li> <li>5. Do not use equipment for other purposes. Use a dedicated service car for steel ribs.</li> </ol>	<p>★★★★</p>
<b>Placing Shotcrete</b> 	<ol style="list-style-type: none"> <li>1. Intake of harmful substances and eye injury due to failure to provide/wear PPE.</li> <li>2. Spraying of concrete residue hardened while cleaning a spray hose.</li> <li>3. Overturning and falling due to the loosening of a hose under pressure after the hose gets separated while spraying.</li> <li>4. Falling shotcrete while spraying shotcrete</li> <li>5. Employee gets stuck between reversing ready-mix concrete truck and spray machine</li> <li>6. Overturning of the spray machine while carrying it with an excavator</li> </ol>	<ol style="list-style-type: none"> <li>1. Provide dusk masks and safety glasses and check employees are wearing them.</li> <li>2. Check the hose location and make sure the hose will not be directed toward people.</li> <li>3. Check the clamping of hose connector and use a hose that meets the required pressure.</li> <li>4. Follow the spraying work order (from side to top). Restrict access to the lower part during spraying</li> <li>5. Assign guidance personnel for the equipment.</li> <li>6. Use appropriate equipment, ensure path flatness, and provide a distance between worker and machine.</li> </ol>	<p>★★</p>



# 5. Tunnel reinforcement work



## 5. Work Order (Risk Factors/Safety Measures)

### Major Control Points for Tunnel Reinforcement

Attention needs to be paid to a risk of soil collapse while transporting heavy objects during reinforcement

Work Flow	Risk Factors	Safety Measures	Level of Danger
<b>Rock Bolt Type</b> 	<ol style="list-style-type: none"> <li>1. Collisions between the cage or employee with the protruding area of an excavated surface</li> <li>2. Employee working at bottom gets hit by resin fragments while inserting rock bolts.</li> <li>3. Collision due to a moving boom loose from an operator's seat while drilling</li> <li>4. Falls due to floating rocks while installing rock bolts</li> <li>5. Flying hardened mortar while cleaning the hose of an injection machine. The hose becomes loose under pressure after the hose gets separated</li> </ol>	<ol style="list-style-type: none"> <li>1. Assign a supervisor and create a signal system with the operator.</li> <li>2. Restrict access to the bottom of a rock bolt working area</li> <li>3. Prohibit the operator from leaving the seat. Restrict access near the equipment while drilling.</li> <li>4. Wear PPE such as a helmet and a falling object protector. Assign guidance personnel to monitor floating rocks.</li> <li>5. Make sure to take out the hose in a direction where there is no person when cleaning the hose. Check the clamping of hose frequently</li> </ol>	★
<b>Special Reinforcement</b> 	<ol style="list-style-type: none"> <li>1. Falls and slips while injecting grout into a mixer.</li> <li>2. Getting cuts by the blade of the mixer while mixing grout</li> <li>3. Entanglement of a body part in the rotating part of a drill</li> <li>4. The worker falls off a platform as the platform starts tilting due to excessive force while drilling</li> <li>5. Employees get hit by falling rocks</li> <li>6. Electric shock due to loss of insulation due to accumulated particles in the power supply and switchboard of the mixer</li> <li>7. Overturning of a drill due to overload</li> </ol>	<ol style="list-style-type: none"> <li>1. Install a toe board around the feed hole of the mixer.</li> <li>2. Take measures to avoid contact (lid) when mixing grout. Stop the mixer to make adjustments.</li> <li>3. Restrict access near the equipment while drilling. Do not make adjustments or repairs while drilling.</li> <li>4. Wear safety belts and do not apply an excessive force on the platform.</li> <li>5. Clean up floating rocks thoroughly.</li> <li>6. Get power supply from a leakage circuit breaker, ground the switchboard enclosure, and clean regularly.</li> <li>7. Stop the floor when installing a drill. Install an outrigger.</li> </ol>	★★



# 5. Tunnel reinforcement work



## 6. Examples of Accidents

No.	Examples of Major Accidents
Accident Trend	Falling rocks while placing shotcrete, falling steel ribs while erecting them, falls from a platform, and electric shocks while drilling
1	Falling rocks while placing shotcrete in a tunnel
2	Hopper overturning and death while placing shotcrete on a tunnel face
3	Entanglement on a tunnel ceiling due to wrong basket control
4	Fall while drilling the tunnel ceiling after installing the drill on a working platform
5	Falling steel ribs while erecting the ribs in a charging car

### ● Entanglement on Tunnel Ceiling Due to Wrong Basket Control



#### ■ Accident Overview

In this accident, the victim was killed as his head was entangled between a tunnel ceiling and a basket while lifting up the basket in a charging car to install pins for measuring the ceiling

#### ■ Safety Measures

When using a charging char, lift its basket up to a working position, stop the control lever and basket first.

### ● Falling Rocks While Checking Floating Rocks at Top of Tunnel



#### ■ Accident Overview

In this accident, the victim was killed as rocks started falling and hitting his head and abdominal area while checking for floating rocks on a tunnel ceiling.

#### ■ Safety Measures

Take measures to prevent risks caused by falling rocks. (Eliminate floating rocks)

# 5. Tunnel reinforcement work



## 7. Safe Work Check List

Classification	Tunnel Reinforcement	Detailed Class.	Tunnel Reinforcement	
Contractor		Date		
Check List		Result		Measures
		Construction Manager	Safety Manager	
<b>Preparation Phase</b>				
<ol style="list-style-type: none"> <li>1. Risk assessment has been conducted</li> <li>2. Safety review was conducted when changing the tunnel reinforcement method</li> <li>3. Related teams (SEQ+ Technology) jointly checked before tunnel reinforcement</li> <li>4. PCM was conducted to correct problems before tunnel reinforcement.</li> <li>5. Special safety training (Employee alcohol use, health check, signal system)</li> <li>6. Related documents on the equipment (S/C, jumbo drill, service car, D/T, B/H, etc.) have been collected and operators are qualified.</li> <li>7. The load limits of the platform of a service car was reviewed, and a protective system was installed and is operating.</li> <li>8. Appropriate illumination is secured in a work area in the tunnel</li> <li>9. Employees have received and are wearing appropriate PPE.</li> </ol>				
<b>Construction Phase</b>				
<ol style="list-style-type: none"> <li>1. Clamping of a rope binding steel ribs, flatness of a traffic path for vehicles</li> <li>2. Clamping of bolt joints on steel ribs. Prohibition of work both at the top and bottom is complied with.</li> <li>3. Floating rocks on a sprayed surface were removed. Floating rocks are controlled through face mapping.</li> <li>4. The platform is overloaded with materials. Toe boards are in place to prevent falls.</li> <li>5. Created a plan to reduce gradual overbreak and took measures.</li> <li>6. Clamped bolts on the boom joint of a service car and the joints were properly welded.</li> <li>7. Installed guard rails and safety belt equipment on the platform of a service car.</li> <li>8. Safety devices on a service car are functioning -Over-lift protection device/ head guard system / emergency stop switch</li> <li>9. Grout hydraulic pressure and flow under control. Injection pressure and flow measured.</li> <li>10. Erected a drill on the still floor. Installed an outrigger properly.</li> <li>11. Assigned guidance personnel and created a signal system. Restrict access to the work area.</li> <li>12. Install appropriate toe board and guard rails on the feed opening of grout mixer</li> <li>13. Installed appropriate wedges between steel ribs and blast surface.</li> <li>14. Installed a safety facility to prevent the falls of workers on the equipment.</li> </ol>				
Construction Manager	(Signature)	Safety Manager	(Signature)	