



MINISTRY OF
MANPOWER



MINISTRY OF TRANSPORT

17 May 2005

GOVERNMENT RESPONSE TO THE FINAL REPORT OF THE COMMITTEE OF INQUIRY INTO THE NICOLL HIGHWAY COLLAPSE

The final report of the Committee of Inquiry into the collapse of Nicoll Highway was submitted on 11th May 2005. The Government thanks Senior District Judge Richard Magnus, Dr Teh Cee Ing and Er Lau Joo Ming for their conscientious efforts in unravelling the complex chain of events that led to this accident. Faced with the monumental task of piecing together information from 193 witnesses¹ and volumes of documents, they performed their duty with professionalism and dedication, and elucidated clearly the crucial errors and persons responsible for the collapse of Nicoll Highway.

2 The Report lays bare a string of lamentable errors relating to design, construction, monitoring and supervision, regulatory weakness and the lack of defensive systems and emergency planning. The COI also highlights human and organisational failures which contributed to the collapse. In the COI's words: "Warnings of the approaching collapse were present from an early stage but these were not taken seriously."² It concludes that "the death of four persons was the direct result of the collapse"³ and that "[t]he Nicoll Highway collapse could have been prevented."⁴

¹ 173 witnesses of fact and 20 experts.

² COI Report, Executive Summary, page vi (4th paragraph)

³ COI Report, page 202 para 83.

⁴ COI Report, executive summary, page vii (4th paragraph).

3 The Government accepts in full the findings and recommendations of the COI. The Report has concluded that Nishimatsu Construction Co. Ltd breached its statutory duties under the Factories Act to ensure that places of work be of sound construction and properly maintained, and as far as reasonably practicable, made safe for any persons working there. It has also found that these contraventions were facilitated by the neglect of three of its officers - the project director, project co-ordinator and design manager. In relation to the project co-ordinator and design manager, the COI has noted alternative contraventions under s 304A of the Penal Code, for causing death by a rash or negligent act. In addition, the COI has found that the Qualified Person appointed by LTA under the Building Control Act to supervise the building works breached his statutory duties of due diligence and reasonable care in monitoring the excavation works, assessing the readings and instructing the builder to take corrective action. Such failures are completely unacceptable. The Report has been submitted to the Attorney-General to consider if criminal proceedings ought to be instituted. The Ministries will also examine if more severe penalties are warranted for companies and persons who have wantonly flouted safety laws that are meant to protect workers and prevent destruction to property.

4 Immediately after the Nicoll Highway collapse and following the Interim Report, the various agencies had acted to ensure the safety of other Circle Line and deep excavation projects. But beyond this, the Government decided to review the construction safety regulatory framework, and also address the systemic weaknesses identified in the COI Interim Report. In May 2004, a Joint MND-MOM Review Committee (JRC) was convened to examine safety standards in the construction industry. The Report of the JRC, which also covers the recommendations of the COI Final Report, was released today.

5 The JRC reviewed the entire life-cycle of a construction project from design through procurement to construction, and proposed fundamental changes to improve safety systems. These include centralising building control functions at the Building and Construction Authority to preserve the integrity of the system and maintain public

accountability; strengthening disciplinary actions against professionals; incorporating safety records in tenders for public sector projects; tightening regulation for deep excavation projects and temporary works; and requiring licensing for specialist contractors. The Government recognises that incremental changes will not result in a quantum improvement of safety standards, and so has decided to implement these comprehensive reforms involving multiple Ministries.

6 Earlier this year, MOM had also announced a major reform of its occupational safety and health framework to raise safety standards and embed a safety culture at the workplace. By the end of this year, MOM will pass a new Workplace Safety and Health Act which will mandate risk assessments for workplaces, raise safety training requirements for workers and enhance accountability and penalties for poor safety management. Ministers for National Development and Transport will also subsequently highlight measures their respective agencies will take. The Annex summarises the key weaknesses identified by the COI and the corresponding measures to address them.

7 The combined efforts of Ministries must ultimately increase safety awareness and inculcate safe practices to reduce injuries and lives lost due to workplace accidents. However, all stakeholders must take ownership to improve safety outcomes. Employers must invest time and resources to build a safety culture within their companies. The Government will reward employers who achieve high standards, and penalise those with poor safety records. Professional associations and industry partners must maintain standards and uphold the integrity of their members. Workers should not be allowed to perform tasks until they possess the competency and awareness to do them safely. Training and accreditation will be stepped-up, so that workers are better able to appreciate risks and alert the relevant authorities of unsafe work practices. Regulatory agencies within Government must work in a concerted manner to reduce injuries and fatalities. We must engage all stakeholders effectively if we are to achieve the safety targets.

8 Some changes can be made quickly. But changing mindsets to internalise safety into our daily work habits will require continuing efforts, even after the memory of the Nicoll Highway collapse has faded. Every individual involved in the work process from regulator, builder, professional, manager to the last worker has to accept responsibility for the work environment, for his own safety and health, and for those under his charge. The Government is confident that if we each do our part to maintain safety standards, we will make Singapore one of the safest places in the world to work.

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Summary of COI Recommendations and Corresponding Measures

COI Recommendation	Corresponding Measures
<p>(1) Effective Risk Management</p> <p>(Executive Summary pg xiv and xv)</p> <p>(a) Accidents must be prevented through effective risk management. The potential for major accidents whether due to the construction process or deficiencies in design must be recognised and expeditiously controlled.</p> <p>(b) It is inappropriate to leave the control of risk wholly to contractors.</p> <p>(c) Risk assessment should also consider major hazard events, which could affect the public and not simply risks to individuals at work. Identified risks can be communicated to others by preparing and making available the risk register.</p> <p>The owner, builder and operators must honour and respect their own risk analysis, assessment, and reports.</p> <p>(d) New and unfamiliar</p>	<p><u>Reform of OSH framework</u></p> <p>Contractors will be required to have a comprehensive safety and health plan for every worksite, which includes a structured risk assessment, names of persons responsible for safety for each aspect of work, and contingency planning. The risk assessment must also address the potential risk/impact of the work to members of public. There must be emphasis on translation of the plan into ground action.</p> <p>Developers as a key stakeholder will in future also be required to ensure that the designers they appoint also assess and address any major design risks.</p> <p><u>MND-MOM JRC</u></p> <p>Requirement for OSH management certification (OHSAS18001 standards) will be extended from tier 'A' contractors only to <i>all</i> contractors in BCA's Contractors Registry System. OHSAS18001 provides a framework for risk identification, avoidance, mitigation, monitoring and control. It will also require the collation of safety information for the purpose of preventing potential accidents.</p> <p><u>LTA</u></p> <p>LTA has set up comprehensive risk</p>

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<p>technologies require particular review, as do major projects with the potential to cause significant harm to workers or the public.</p>	<p>registers for each site. The risk register identifies the hazards/risks involved in each construction activity with associated risk index and describes the risk mitigation measures to be undertaken to bring the residual risks to an acceptable level.</p> <p>The risk register, as a live document, is monitored and updated at weekly risk assessment meetings at the project/site level with the contractor. Risk owners, from contractor to LTA, are tasked to implement the mitigation measures, monitor and close-out the risks accordingly.</p> <p>A non-conformance procedure and 'defects' register system have also been set up. The procedure requires the project team to monitor, track and close out works that are not in compliance with the specification and the design drawings for the temporary works. Work will not be allowed to proceed unless the safety critical non-conformances have been closed out.</p> <p>At the macro level, the Project Directors/Senior Project Managers and the Design Managers will apprise senior management on a weekly basis of any safety concerns arising from the instrumentation readings either breaching or likely to breach the predetermined instrumentation review levels. Senior management may direct that additional mitigation measures be implemented where necessary.</p>
<p>(2) Managing Uncertainties and Quality (Executive Summary, pg xvi)</p>	<p><u>Reform of OSH framework</u></p> <p>Duties will be prescribed for all stakeholders (e.g. owners, employers,</p>

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<p>(a) There is a need for a high quality management, which recognises the presence of uncertainties and fosters a generative culture where responsibilities are shared, mistakes are quickly learned and conflicts are well managed. Roles and responsibilities must be clearly established.</p> <p>(b) Owner's and builder's management must seek a balance between production pressures and quality and safety goals.</p> <p>(c) There must be honest and regular consultations between the owners and the builder, the QP(ST) and the PE, and the owner's and the builder's designers.</p> <p>(d) An effective management is one, which demonstrates the effective commitment from the senior management level and involves everyone at work including their safety representatives.</p>	<p>designers, suppliers) in the proposed Workplace Safety and Health Act to strengthen accountability.</p> <p>Contractors' safety and health plans must consider the flow of safety information among parties. Their risk assessments must clearly set out the triggers for stopping work.</p> <p><u>MND-MOM JRC</u></p> <p>Safety considerations must be integrated into the established planning and coordinating processes at the worksite. This could be done through the Site Safety Coordinating Committee or other existing Committees.</p> <p>Contractors to adopt a 'Permit to Work' system for identified classes of hazardous work. This ensures a systematic assessment of safe work environment and conditions is undertaken prior to execution, which clarifies and removes any uncertainties.</p> <p>Tougher penalties for professionals (PEs and architects) who do not perform their duties with due diligence. The maximum period of suspension for moderate contraventions should be raised from 1 to 2 years. The period before a registered professional can apply for reinstatement to the register after being struck off should be raised from 2 to 3 years. The PEB and BOA shall also be given flexibility to impose a combination of disciplinary actions, rather than be restricted to only one action.</p>

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	<p><u>LTA</u></p> <p>On each contract/project there are weekly design review and instrumentation and monitoring meetings. The procedure has now been standardised at all the sites where Project Managers, Design Managers, and the contractors' design / geotechnical staff as well as the PE(TW) and QP(S) are required to attend the meetings. Issues related to design and construction matters are discussed and work will not be allowed to proceed till all parties are satisfied on safety and quality.</p> <p>Design and quality shortcomings as well as instrumentation breaches of alert and work suspension levels are to be immediately reported to higher management.</p> <p>LTA has in place a formal Corporate Safety Organisation. LTA will reinforce the safety message through its Corporate Safety Committee (CSC) chaired by its Chief Executive and comprising senior management, who are responsible for setting and driving Corporate safety policies. Safety implementation monitoring and control are undertaken by the Project Safety Committees chaired by the respective Project Directors. (See attached chart) LTA has also developed safety management processes to ensure the "Safe to Build" and "Safe to Use" aspects of our projects.</p>
<p>(3) Management and Monitoring of Geotechnical Instrumentation and Data</p>	<p><u>MND-MOM JRC</u></p> <p>Licensing will be introduced for specialist contractors engaged in critical geotechnical</p>

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<p>(Executive Summary, pg xvi)</p> <p>(a) There should be appropriate instruments deployed. There should be proper use and management of the collated data. The monitoring system must determine the qualitative and the quantitative data sufficient to meet all design and construction needs. In particular, monitoring during construction must be meticulously undertaken with an eye to safety.</p>	<p>work such as soil investigation and instrumentation.</p> <p>PE (Geotec) will be responsible for instrumentation and monitoring for TERS in deep excavations, including data interpretation and specification of review trigger levels.</p> <p>AC (Geotec) will have to conduct field reviews and site inspections, including review of data interpretation and trigger levels.</p> <p>It will be mandatory for PE (Geotec) and contractor's Technical Controller to stop works when the relevant trigger levels are exceeded.</p> <p>Critical information, which has impact on safety, could be disseminated through the proposed Site Safety Coordinating Committee or other existing Committees.</p> <p><u>LTA</u></p> <p>For new projects, LTA will be engaging specialist instrumentation contractors to carry out the instrumentation and monitoring works.</p> <p>For ongoing projects, where there are existing contracts, LTA has instituted quality control of the instrumentation contractors.</p>

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<p>(4) Robustness of Design</p> <p>(Executive Summary, pg xvii)</p> <p>(a) A robust design is essential. This robustness is provided by identifying the hazards and checking that the proposed design can adequately withstand them. The design should also have sufficient redundancy to prevent a catastrophic collapse in the event of a failure of any particular element.</p> <p>(b) The design must have built-in factors to cater for material deficiencies and construction imperfections.</p>	<p><u>MND-MOM JRC</u></p> <p>A technical committee has been set up under SPRING Singapore to develop a code for deep excavation works in Singapore. The code will cover the design issues highlighted by the COI (i.e. design robustness and redundancy, design review, time sensitivity, and guidelines and procedures for multi-prop level retaining wall).</p> <p>PE (Geotec) and AC (Geotec) will be required to comply with requirements of SPRING's excavation code. Pending the finalisation of this code, BCA has issued an advisory note covering these guidelines.</p> <p>Construction of all temporary structures will have to be supervised and certified by a PE before being subjected to its intended loading. The PE for the permanent works should be consulted where appropriate.</p>
<p>(5) Design Review and Independent Check</p> <p>(Executive Summary, pg xvii)</p> <p>(a) A design review must be carried out where there is structural distress or when instrumentation readings show deviation or aberrations. This requires a planned program at the inception of the project.</p>	<p><u>MND-MOM JRC</u></p> <p>AC (Geotec) will be required to undertake independent review of design.</p> <p>AC (Geotec) has to meet prescribed requirements in terms of qualifications and experience in geotechnical works.</p> <p>AC (Geotec) has to be appointed independently by the owner and not the contractor, as with the AC in permanent</p>

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<p>(b) Independent checks should be undertaken in all temporary works for deep excavation as is the current practice for permanent works.</p>	<p>works.</p> <p><u>LTA</u></p> <p>LTA has engaged external independent consultants/ QP(Supervision) to check the design of temporary works prepared by the contractor.</p> <p>To ensure the independence of the PE(Temporary Works), LTA will require that the PE(Temporary Works) engaged by the contractor shall not be an employee of the contractor or have financial interest in the firm.</p>
<p>(6) Numerical Modelling in Geotechnical Design</p> <p>(Executive Summary, pg xvii)</p> <p>(a) Numerical analysis should supplement and not supplant sound engineering judgement and practice.</p> <p>(b) Those who perform geotechnical numerical analysis must have a fundamental knowledge of soil mechanics and a clear understanding of numerical modelling.</p>	<p><u>MND-MOM JRC</u></p> <p>SPRING's Excavation Code will also address the use of numerical modelling.</p> <p>Design and supervision of TERS will have to be done by PE (Geotec) and AC (Geotec). These are persons who will have specialist knowledge and experience of geotechnical engineering.</p> <p>Courses will be developed and incorporated as part of the requirements under the existing Continuing Professional Development (CPD) Programme for PEs. The PEB will work with BCA, MOM and industry to accredit these courses. The PEs will be required by the relevant authorities to show proof that they have attended accredited courses on the critical design codes and software, which they have used in their submissions to</p>

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	<p>authorities for approval.</p> <p><u>LTA</u></p> <p>Training for staff to increase their professional and job competencies will be stepped up. Engineers will be sent for specialised training to develop core & functional competencies. Internal sharing sessions are regularly conducted. LTA has been working in partnership with ACES for technical talks to be given to our staff and industry professionals, including joint conferences.</p>
<p>(7) Jet Grout Piling (JGP)</p> <p>(Executive Summary, pg xviii)</p> <p>(a) There must be a rigorous review to secure a rational understanding of the behaviour of JGP with respect to its function in the designated structure, ground conditions, the construction process and other known experience.</p> <p>(b) It would be useful to tap into the available body of knowledge such as in the learned journals, codes of practice and published guides.</p>	<p><u>MND-MOM JRC</u></p> <p>SPRING's Excavation Code will also cover the use of JGP in deep excavations.</p> <p>Pending finalisation of the code, BCA has issued an advisory note recommending that JGP be restricted to ground strengthening/soil improvement works, but not used as a compressive strutting system in TERS. This is in view of the uncertainties involved.</p> <p><u>LTA</u></p> <p>LTA has reviewed its specifications and tightened the requirements on quality control during production of the JGP and in the verification of the quality of the JGP by rigorous testing in accordance with BS EN 12716:2001.</p>

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<p>(8) Codes and Specifications</p> <p>(Executive Summary, pg xviii)</p> <p>(a) Relevant Codes for deep excavation and strutting system should be developed. Specifications to improve the performance of the design and construction process should be specific.</p>	<p><u>MND-MOM JRC</u></p> <p>SPRING's Excavation Code being developed will address this issue.</p>
<p>(9) Stop Work</p> <p>(Executive Summary, pg xx)</p> <p>(a) Stop work order must be an exercisable and realistic option.</p> <p>(Executive Summary, pg xiv)</p> <p>(b) Workers should be empowered to 'whistle blow' on unsafe workplace practices, as well as remove or eliminate work hazards.</p>	<p><u>Reform of OSH framework</u></p> <p>Powers of safety officers will be enhanced.</p> <p>MOM will provide a hotline for workers to call if they think that their work conditions are unsafe and warrants a stop work.</p> <p>MOM will conduct an outreach programme to educate workers on their basic rights, including their right to a safe working environment.</p> <p><u>LTA</u></p> <p>LTA has issued a checklist to its staff to provide greater clarity on when the stop-work orders should be issued i.e. where there is serious concern about unsafe practices, for example:</p> <ul style="list-style-type: none"> • Major works carried out without approved Method Statements; • Breaches of instrumentation review

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	limits; <ul style="list-style-type: none"> • No clearance to proceed to next stage of work.
<p>(10) Emergency Preparedness</p> <p>(Executive Summary, pg xviii)</p> <p>(a) Worksites should develop a contingency plan to address all safety related emergencies. The plan should address the various scenarios that could occur and spell out the procedure to evacuate all affected workers. The plan must be communicated to all staff.</p>	<p><u>MOM</u></p> <p>The requirement for emergency plans already exists under the Factories Act. Such plans should be frequently reviewed to account for changes in the worksite. The shortcoming lies in the activation of these plans when the situation requires. MOM will work with SCDF and other relevant agencies to strengthen this.</p> <p><u>LTA</u></p> <p>Better access and evacuation facilities are provided at LTA worksites.</p> <p>There are now regular drills in which workers have to evacuate a site in less than 10 minutes.</p>
<p>(11) Competence of Professionals, Contractors and Sub-contractors</p> <p>(Executive Summary, pg xviii)</p> <p>(a) Personnel engaged in specialist functions need to have the minimum knowledge, qualification, and experience. Further, as part of their professionalism, specialist sub-contractors must go</p>	<p><u>MND-MOM JRC</u></p> <p>Require specialised PE (Geotec) and AC (Geotec) in design and supervision of TERS in deeper excavations.</p> <p>General building contractors and critical specialist contractors to be licensed.</p> <p>Specification of number, qualifications and experience of supervision teams for</p>

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<p>beyond mere contractual compliance and alert the employer of any deficiency in design, drawing and method of construction which impacts safety.</p> <p>(Executive Summary, pg xiv)</p> <p>(b) There is a need to nurture and sustain a core group of technically skilled and competent local workers.</p>	<p>structural works.</p> <p>All supervisors to attend mandatory safety training.</p> <p>Contractors must engage an accredited inspection firm to survey the fabrication process for welded steel structures</p> <p>The feasibility of a Tradesmen Registration Scheme is being explored.</p>
<p>(12) Contract and Tender Evaluation System</p> <p>(Executive Summary, pg xix)</p> <p>A strict weightage system should form part of the contract and tender evaluation system. The weightage system should include non-technical and non-commercial attributes such as safety records and culture of the bidder, and its core or corporate competency.</p> <p>Such a weightage system should apply even if the tenderer is a joint venture or a consortium.</p>	<p><u>MND-MOM JRC</u></p> <p>Use of current price and quality (including safety) attributes in tender evaluations will be formalised for public sector projects through the Price-Quality Method (PQM). This is recommended as the preferred method of procurement for public works.</p> <p><u>LTA</u></p> <p>For all its major projects, LTA adopts a prequalification process to evaluate, assess and pre-qualify potential bidders based on their technical competencies shown in past projects and their safety performance track record. A more structured safety dimension will be added for future tender evaluation in line with the proposed Price Quality Method (PQM).</p>

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<p data-bbox="185 264 472 300">(13) Safety Culture</p> <p data-bbox="185 365 594 401">(Executive Summary, pg xxi)</p> <p data-bbox="185 466 651 789">(a) There must be a continuous and demonstrable commitment by management and workers, accompanied with a frank and honest consultative approach, to ensuring safety and health, from inception of design to execution of the project.</p>	<p data-bbox="695 365 1073 401"><u>Reform of OSH framework</u></p> <p data-bbox="695 466 1295 606">Drive change in safety culture through prescribed duties for all stakeholders and requirement for comprehensive safety and health plans and risk assessments.</p> <p data-bbox="695 672 1295 779">Enforcement will focus on systemic and cultural issues, rather than physical lapses only.</p> <p data-bbox="695 844 927 879"><u>MND-MOM JRC</u></p> <p data-bbox="695 945 1295 1085">Extension of requirement for OSH management certification from tier 'A' contractors only to <i>all</i> contractors in BCA's Contractors Registry System.</p> <p data-bbox="695 1150 756 1186"><u>LTA</u></p> <p data-bbox="695 1251 1295 1577">LTA will reinforce the "Safety First" culture. It has implemented the Occupational Safety and Health Management (OSHM) framework for its major projects since July 2001. This requires that hazard identification and risk assessment be carried out from the concept design, detailed design to the construction stages of the project life cycle.</p> <p data-bbox="695 1642 1295 1854">LTA also actively promotes safety for our staff as well as contractors' staff, in the form of safety training, workshops, as well as the Annual Safety Award Convention (ASAC) to give recognition to parties who excel in safety performance.</p>

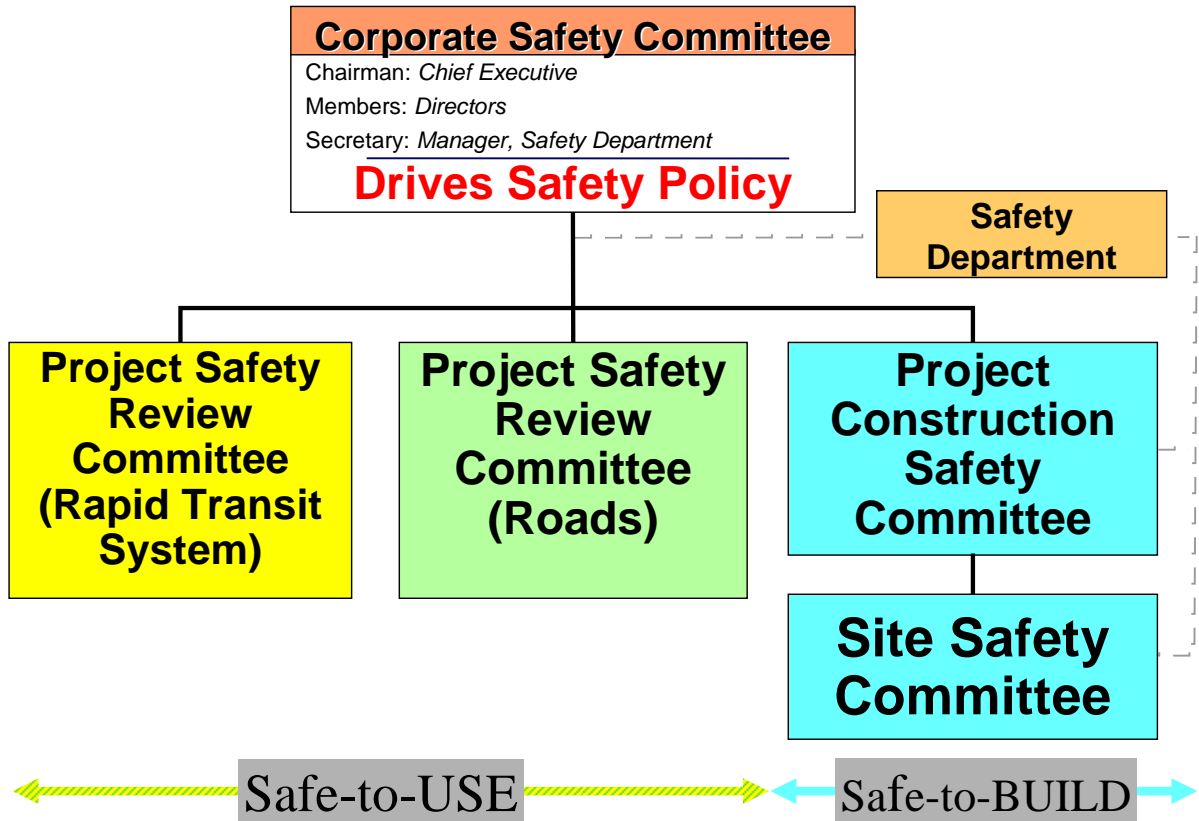
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	<p>To encourage and reward safety excellence, LTA has implemented a performance scheme for new civil works contracts. Contractors with good safety performance will be rewarded an additional 0.5% of the contract sum, up to a maximum of \$1 million. Conversely, contractors with poor safety performance may have a deduction of up to one-third of the 1.5% of the contract value set aside, also subject to a cap of \$1 million. LTA will review this cap with the view to raising it so as to further incentivise safety at worksites.</p>
<p>(14) Chain of Command</p> <p>(Executive Summary, pg xii)</p> <p>(a) The chain of command has to be well established and communication must be effective.</p>	<p><u>Reform of OSH framework</u></p> <p>Duties will be prescribed for all stakeholders (e.g. owners, employers, designers, suppliers) in the proposed Workplace Safety and Health Act to strengthen accountability.</p> <p>This will translate to clarity in the chain of command. <u>LTA</u></p> <p>Weekly design review and instrumentation and monitoring meetings are held. These meetings are attended by the PE(TW), QP(S) as well as the LTA and the Contractor's project and design staff. All areas of concern are elevated to higher management of LTA.</p>

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<p data-bbox="185 317 561 352">(15) Independence of QP</p> <p data-bbox="185 415 584 451">(Executive Summary, pg xii)</p> <p data-bbox="185 514 667 877">The independence of the QP (ST) is essential to avoid situations of conflict of interest so that building works can be constructed with proper and impartial supervision. In this regard, it would be advisable for LTA to consider appointing an independent QP(ST) from outside the organisation.</p>	<p data-bbox="695 317 927 352"><u>MND-MOM JRC</u></p> <p data-bbox="695 415 1300 779">Currently, the BC Act prohibits the QP (Supervision) from being associated with the builder or contractor, but not the client or developer. The relationships between the QP and the developer/client, as well as various parties such as project managers, will be reviewed and addressed (where necessary) by BCA in consultation with industry. This is to uphold the independence of the QP (Supervision).</p> <p data-bbox="695 842 756 877"><u>LTA</u></p> <p data-bbox="695 940 1305 1234">LTA is phasing in the complete segregation of the QP(S) role from that of the Project Director's role for all projects. It will expedite the process of engaging external QPs for all its other major contracts and bring about the necessary changes to the project management structure by the end of July 2005.</p>
<p data-bbox="185 1409 667 1444">(16) Building Control Functions</p> <p data-bbox="185 1507 459 1543">(Volume 1, pg 338)</p> <p data-bbox="185 1606 643 1858">The Committee is reminded that the MND-MOM review on construction safety will also review the delegation of building control functions by BCA to the BCUs and to see how this relationship can be improved.</p>	<p data-bbox="695 1409 927 1444"><u>MND-MOM JRC</u></p> <p data-bbox="695 1507 1292 1724">Building control functions should be centralised at BCA to remove any doubts that BCU staff will undertake their work with impartiality and independence. This will also maintain public accountability and confidence in the regulatory framework.</p>

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