The Extended Commission of Inquiry into the Hung Hom Station Extension under the Shatin to Central Link Project

23rd August 2019

EXPERT REPORT

PREPARED BY

STEVE ROWSELL

Expert Witness appointed by the Commission of Inquiry into the Construction Works at and near the Hung Hom Station Extension under the Shatin to Central Link Project (the "Extended Inquiry")

23rd August 2019

STEVE ROWSELL

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Specialist Field	:	Advising on issues relating to corporate management and governance in the public sector, project management, contract management, stakeholder engagement and procurement strategy, as further detailed in **Appendix I**
Appointed on behalf of	:	Commission of Inquiry into the Construction Works at and near the Hung Hom Station Extension under the Shatin to Central Link Project (the "**Commission**")
Prepared for	:	The Commission
On instructions of	:	Messrs. Lo & Lo, Solicitors for the Commission ("**Lo & Lo**")
Subject matter / Scope of engagement	:	To assist the Commission in discharging its duties under the Expanded Terms of Reference and by acting as an expert witness in the Inquiry hearings.
Documents	:	I was given access to the documents in the hearing bundles. References in the text of this Report are references to pages in the hearing bundles.
Meetings with relevant persons	:	I have had no further meetings to the two meetings identified in my Original Report with MTRCL and Turner Townsend held for the purposes of the Original Inquiry.

The Expanded Terms of Reference ("ToR") of the Commission

In relation to the Extended Inquiry, an additional paragraph (a)(2) relating to the construction works at the North Approach Tunnels (**NAT**), the South Approach Tunnels (**SAT**) and the Hung Hom Stabling Sidings (**HHS**) has been added to the original Terms of Reference. The Expanded ToR [**AA1/1**] are as follows:

'Regarding the MTR Corporation Limited ('MTRCL')'s Contract No. 1112 ('Contract') of the Shatin to Central Link Project:

(a)(1) in respect of the diaphragm wall and platform slab construction works at the Hung Hom Station Extension,

(i) to inquire into the facts and circumstances surrounding the steel reinforcement fixing works, including but not limited to those works at locations that have given rise to extensive public concern about their safety since May 2018;
(ii) to inquire into the facts and circumstances surrounding any other works which raise concerns about public safety; and
(iii) to ascertain whether the works in (1)(i) and (ii) above were executed in accordance with the Contract. If not, the reasons therefor and whether steps for rectification have been taken;

(2) in respect of the construction works at the North Approach Tunnels, the South Approach Tunnels and the Hung Hom Stabling Sidings,
(i) to inquire into the facts and circumstances surrounding any problem relating to the steel reinforcement fixing or concreting works, including but not limited to any lack of proper inspection, supervision or documentation of such works undertaken, any lack of proper testing of the materials used for such works and of proper documentation of such testing, and any deviation of such works undertaken from the designs, plans or drawings accepted by the Highways Department or the Building Authority;
(ii) to inquire into the facts and circumstances surrounding any works or matters which raise concerns about public safety or substantial works quality; and
(iii) to ascertain whether the works and matters involved in (2)(i) and (ii) above were executed in accordance with the Contract. If not, the reasons therefor and whether steps for rectification have been taken;

(b) to review, in the light of (a) above,
(i) the adequacy of the relevant aspects of the MTRCL's project management and supervision system, quality assurance and quality control system, risk management system, site supervision and control system and processes, system on reporting to Government, system and processes for communication internally and with various stakeholders, and any other related systems, processes and practices, and the implementation thereof; and
(ii) the extent and adequacy of the monitoring and control mechanisms of the Government, and the implementation thereof; and

(c) in the light of (b) above, to make recommendations on suitable measures with a view to promoting public safety and assurance on quality of works.'

Instructions

I have been instructed by Lo & Lo to give my opinion on paragraphs (b) and (c) of the Expanded TOR. The scope of my expert opinion is as follows:

1) In relation to paragraph (b)(i) of the Terms of Reference:
   a. In the light of matters in paragraph (a)(2) of the Expanded TOR, please identify issues of non-compliance, inadequacies and deficiencies (if any)

in **MTRCL**'s project management and supervision system, quality assurance and quality control system, risk management system, site supervision and control system and processes, system on reporting to Government, system and processes for communication internally and with various stakeholders, and any other related systems, processes and practices, and the implementation thereof.

2) In relation to paragraph (b)(ii) of the Terms of Reference:
   a. The incidents which gave rise to the present Extended Inquiry have occurred notwithstanding the monitoring and control mechanisms implemented by the Government. There were consultation and approval processes by the BD and HyD on quality assurance plans, site supervision plans and building plans and drawings. There were a great variety of regular meetings and discussions. There was the "check the checker" approach with the support of an external M&V Consultant which was engaged to monitor MTRCL's works through review of project documents and carrying out necessary site inspection, identification of and providing advice on key issues of the SCL project on cost, programme and public safety.
   b. In the light of matters in paragraph (a)(2) of the Expanded TOR, please comment on the extent and adequacy of the monitoring and control mechanisms of the Government, and the implementation thereof and identify issues of inadequacies and deficiencies (if any).

3) In relation to paragraph (c) of the Expanded TOR, please provide your opinion (with a view to promoting public safety and assurance on quality of works) on how the system of supervision, monitoring, control and management may be strengthened and enhanced to avoid future incidents of non-compliances, inadequacies and deficiencies.

INTRODUCTION TO MY REPORT

1. My appointment as an expert to assist the Extended Commission of Inquiry follows on from the expert role I performed at the Original Inquiry. My new instructions cover three main aspects which are similar to those I covered in producing my first report for the Original Inquiry ("**my Original Report**") [**ER1/Tab 1**]. I have had access to the documents collected by the Commission which form the paginated hearing bundles as updated from time to time, the daily transcripts of the hearing and written submissions by the parties and Counsel for the Commission. I have had the benefit that many of the documents I reviewed for the Original Inquiry are also applicable to the Extended Inquiry. In addition, I have reviewed documents in the new bundles which in my judgement I considered may be helpful in understanding and reviewing events and issues that led to the Commission being extended. My overall approach to reviewing the three main aspects in my instructions is in line with my Original report and is set out below.

2. The **first part** of my new instructions required me, in relation to the Expanded TOR, to identify issues of non-compliance, inadequacies and deficiencies (if any) in **MTRCL**'s project management, supervision, assurance, control and reporting systems, processes and practices and their implementation. In order to identify any such issues, I have set out in my report the obligations placed on MTRCL in undertaking their duties. For the purposes of my report I have used my experience and professional judgement to identify what I consider to be the main obligations relating to the events and issues that have arisen.

3. I explained in my Original Report that the overarching obligation on MTRCL is to carry out the Entrustment Activities with the skill and care reasonably to be expected of a professional and competent project manager in an analogous role. I pointed out that on a project of this scale and complexity not everything will go perfectly to plan. It is inevitable that some errors or mistakes will be made in the delivery of services and the execution of the works. The standard required of MTCRL is not such that all mistakes are avoided but that it carries out its duties with reasonable skill and care and in a professional and competent manner.

4. In the light of the above, in undertaking my investigations I have not sought to review the witness statements and other documents with the aim of identifying each and every deficiency. My approach is to consider the adequacy of the overall systems, controls, checks and balances which MTRCL had in place to minimise the risk of mistakes occurring and to enable any such mistakes to be identified and rectified. In my evidence however, I use individual examples to illustrate how systems and procedures were intended to operate and the possible consequences if they were not robustly implemented.

5. The **second part** of my instructions requested me to comment on the extent and adequacy of the monitoring and control mechanisms of the **Government**, and the implementation thereof and identify issues of inadequacies and deficiencies (if any). As with the first part of my investigations, my approach has been to take a high-level view of the Government's monitoring and control mechanisms in identifying the risks of inadequacies and deficiencies. I have however, used individual examples to indicate how those risks may materialise in practice.

6. The **third part** of my instructions requested me to provide my opinion on how the system of supervision, monitoring, control and management may be strengthened and enhanced to avoid future incidents of non-compliances, inadequacies and deficiencies with a view to promoting public safety and assurance on quality of works. My approach has been to review the issues that have arisen and to seek to understand their causes, and to consider how similar risks have been addressed and mitigated on other major projects elsewhere and particularly in the United Kingdom. I recognise that there will be differences in regulatory and governance frameworks and in delivery cultures, but I have sought to base my opinions on good practice principles which I consider may be applicable notwithstanding any such differences.

PART 1: ADEQUACY OF MTRCL'S PROJECT MANAGEMENT SYSTEM AND OTHER SYSTEMS

MTRCL's Obligations Under The 2012 Entrustment Agreement

7. In my first report for the Original Inquiry ("**my Original Report**") I set out MTRCL's obligations flowing from the Entrustment Agreement ("**EA**") for Construction and Commissioning of the Shatin to Central Link dated 29 May 2012 [**G7/5595+**] relevant to the matters being investigated under the Original Inquiry. I consider that the comments I previously made in relation the EA [**§8, my Original Report**] also apply to the Extended Inquiry. The EA obligations on which I have something to add to my Original Report are in relation to:

   a. EA Clause 4.6(C) [**G7/5613**] – this clause is particularly relevant to the issues under investigation in the Extended Inquiry. It states that MTRCL shall act in accordance with MTRCL's management systems and procedures including the following areas:
      - Organisation and management responsibilities;
      - Project management and control; and
      - Relevant project management and procurement procedures;

      My observations: in relation to the topics covered by these bullets, I comment on these requirements later in this report insofar as new evidence has been presented to the Extended Inquiry which adds to the observations and recommendations I made in my Original Report.

   b. EA Clauses 16 & 17 **[G7/5625-5629]** – as fully set out in my Original Report [**§8, p.12**] these clauses relate to Consultation, Project Monitoring and Verification (including the as-constructed documents in Appendix K [**G7/5697-5699**]). The only aspect of these clauses on which I have anything further to add to my Original Report is in relation to the following obligation:
      - MTRCL to submit to Government, at the relevant time, preliminary and final versions of the as-constructed documents listed in Appendix K, allowing Government a reasonable time for review of the documents. Appendix K states that MTRCL shall use its reasonable endeavours to ensure that the documents are

available at the time of the final report to be provided to Government which is required within three months following the issue of the Handover Certificate, and in any event within six months of the issue of the Handover Certificate.

My observations: The as-constructed documents listed in EA Appendix K include, at item 5 [**G7/5698**]*, inspection and testing certificates. This would appear, in my opinion, to include RISC forms which provide a record of contractual inspections and provide the certification required for work to be progressed. In my opinion this is in line with the PIMS Practice Note PIMS/PN/02-4/A1 Archiving of Project Records* [**BB16/9838-9865**] *which identifies items to be captured in ePMS and items to be handed over in hard copy. The PIMS document identifies at paragraph 7.3* [**BB16/9849-9860**] *that retention item 11.47.1 "Holdpoints/Witness Points Inspection Records"* [**BB16/9854**] *should be retained on ePMS but that hard copies do not need to be retained after project completion. It also identifies that retention item 11.18 "Inspection Certificates"* [**BB16/9853**] *should be retained on ePMS and also retained as hard copies after project completion. I recognise that the position is not fully clear but, in my opinion, the RISC forms provide both a record of inspection and also certification that work has been approved. On that basis they are required to be retained on ePMS and also in hard copy format following project completion. If MTRCL was in any doubt about whether the RISC forms were required as part of the as-built records then as they are a matter covered by the EA, MTRCL should have confirmed the position with the Government.*

The potential importance of the RISC forms in forming part of the as-built records required by the EA should, in my opinion, have been recognised by MTRCL when it became aware of the problem of RISC form procedures not being followed by the Contractor. This should have helped ensure that action was taken promptly to address the lack of RISC forms.

MTRCL's Obligations Under the Instrument of Exemption and the Instrument Of Compliance

8. I set out the relevant obligations under the Instrument of Exemption ("**IoE**") [**H7/2220**] in my Original Report [**§§9, 11-15**]. I also explained in paragraph 10 of my Original Report that the Instrument of Compliance does not apply to the Hung Hom Station. In relation to the matters being considered by the Extended Inquiry, the obligations of the IoE which may be impacted on by issues under consideration are as follows:

   a. Clause 2(b) – MTRCL to appoint a competent person, who shall take up the responsibilities and duties of Authorized Person / Registered Structural Engineer, to co-ordinate and supervise each area of the works in accordance with the agreed proposals, to certify the preparation of plans or documents and to certify to the relevant authorities upon completion of works.

   b. Clause 2(d) – appoint registered general building contractors and registered specialist contractors, as appropriate, to supervise and carry out each area of the works in accordance with the agreed proposals.

   c. Clause 2(e) – instigate an assurance system and control scheme to ensure that management of the construction of the works are at a standard not inferior to that required under the Buildings Ordinance and Regulations.

My observations on MTRCL's obligations under the IoE

9. *The issue to be considered is whether MTRCL has co-ordinated, supervised and carried out its duties in accordance with agreed proposals and to the necessary standards. MTRCL was required to deliver the project in accordance with the formally approved Project Management Plan* ***("PMP")*** [**B4/1825-2502, A-F**] [**BB12/8058-8195, G**] *which included use of MTRCL's Project Integrated Management System* ***("PIMS")*** [**B3/1058**+]. *In relation to the supervision and RISC procedures used to carry out the required roles, I comment on their compliance with the PMP and with PIMS procedures later in this report.*

MTRCL's Obligations Under the Project Management Plan

10. In my Original Report I set out the role the PMP plays in defining how the project is to be managed by MTRCL in order to demonstrate that the management

process will meet the exemption requirements under Buildings Ordinance and the Entrustment Agreement for the SCL project [**§§18-24, my Original Report**]. The PMP relies heavily on MTRCL's PIMS documents to define the processes and procedures used to manage delivery of the project.

11. The PMP also sets out at section 9.1 [**B4/1846 (A)**] [**B4/1972 (B)**] [**B4/2104 (C)**] [**B4/2239 (D)**] [**B4/2372 (F)**] [**BB12/8079 (G)**] the position in relation to Statutory Submission Procedures and the requirements for Consultation with the Buildings Department and Highways Department. Paragraph 9.1.3 states that "Consultation shall apply to all civil engineering works constructed under the provisions of the IoE and IoC. The structural design and construction sequence of the SCL and related works that may affect existing or proposed nearby private buildings / structures (excluding railway premises) shall be submitted to BD and RDO for Consultation."

12. The PMP requires cooperation and frequent communication between the parties. Paragraph 9.1.4 states that "RDO & BO shall make every effort to expedite the turnaround time for Consultation submissions for the SCL project. It is envisaged that this can be achieved through frequent communication and co-operation between RDO, BO and MTR Corporation throughout the Consultation process. A meeting protocol to facilitate close coordination among RDO, BO and MTR Corporation is detailed in Section 10".

13. Also, in relation to the need for close communication and partnership working, paragraph 10.1.1 [**B4/1848 (A)**] [**B4/1975 (B)**] [**B4/2107 (C)**] [**B4/2242 (D)**] [**B4/2500 (E)**] [**B4/2375 (F)**] [**BB12/8082 (G)**] states that "In order to meet the tight schedule for reviewing the project submissions, a partnering approach with effective communication between MTR Corporation, RDO and BD is considered necessary. A 3-Tier Meeting Protocol, namely at working level, management level and senior management level, is established to facilitate close communication on technical and project management issues that have common concerns to both parties".

My observations on MTRCL's obligations under the PMP

14. *In my Original Report the key points I made in relation to the PMP included:*

a. *The PMP is too generic in nature and should contain more specific detail on how the generic PIMS procedures will be applied to the project* [**§§20-21, 24 and 29, my Original Report**].

b. *There is a lack of clarity in relation to the role of the Engineer within the MTRCL organisation and the ownership of procedures. The Engineer is responsible for administering the Contract but many PIMS procedures do not clearly recognise the need for the Engineer to be involved in contractual decisions* [**§22, my Original Report**].

c. *The PMP is lacking in detail on the requirements for site records and associated responsibilities* [**§22, my Original Report, on para 7.6.1 of PMP**].

d. *The PMP is lacking in detail in relation to non-conformance procedures and responsibilities and the NCR requirements set out in the PMP are not fully aligned with the PIMS procedural note Monitoring of Site Works* ***[B3/1581-1717]*** [**§22 and 87-99, my Original Report**].

e. *Overall, I was of the opinion in my Original Report that there are gaps and omissions in the PMP which carry the risk that procedures are not consistently applied and that some requirements may get overlooked* [**§24, my Original Report**].

15. *I consider that the events being considered by the Extended Inquiry reinforce my previous conclusions in relation to the PMP and also highlight other key aspects of project delivery which are not addressed in the PMP. Other aspects which in my opinion are lacking include:*

a. *No specific mention of interface risks which are identified as a key process in PIMS procedural documents.*

b. *No reference to resource management or job specific training requirements.*

c. *The role of leaders in establishing the appropriate culture and behaviours in relation to safe and compliant working procedures and establishing effective lines of communication.*

I cover these aspects in more detail later in this report.

16. *In relation to design Consultation submissions, it appears to me that the Consultation arrangements as set out in the IoE and the PMP were intended to apply comprehensively to the design of the project including design modifications. MTRCL and Leighton have put forward an argument that design changes relating to splicing methods, and the use of couplers rather than lapped reinforcement, were only minor changes and did not require approval* [**§84, MTRCL's Closing and §78, Leighton's Closing**]. *The Government has responded on the basis that the Consultation requirements do not make provisions for the exemption of minor changes* [**§127, Government's Closing**]. *In my opinion, and recognising that this is primarily a legal issue, this was not a decision that MTRCL / Leighton should have taken unilaterally particularly in the light of the provisions in the EA for close cooperation on Consultation matters* [**§8i, my Original Report**]. *I consider that the appropriate project management approach would have been for MTRCL / Leighton to check with BD / RDO whether or not Consultation was required. This would have avoided any misunderstanding and would also have been in line with the requirements set out in the PMP for cooperation, partnership working and frequent and close communication in relation to Consultation submission procedures* [**§9.1.4 and §10.1.1, PMP**]. *I also consider however, from a project management point of view, that it would be sensible for the Government to review arrangements for considering minor changes and the development of a fast-track Consultation process for such changes. I understand that BD has, in fact, a "curtailed check" (or fast track) system under PNAP ADM-19 whereby "non-fundamental issues" will not be checked and will not be raised as "disapproval items"* **[C13/8556]**. *These relate generally to matters that do not affect the basic design of the proposed building. However, there is evidence given in the Original Inquiry which suggests that the provision of PNAP ADM-19 would not apply to this Project which is subject to the IoE* **[Original Inquiry, T37/112:10-114:16, Cheung Tin Cheung**]. *Dr Cheung, Director of Buildings, considered that it was clear that PNAP ADM-19 did not apply but in my opinion, there would be benefit in clarifying or confirming the position in relation to PNAP ADM-19 when an IoE*

applies to a project and also in making provision for minor changes when PNAP ADM-19 may not apply.

17. *Overall, I consider that the PMP is at too high a level and is lacking in detail in some key respects. There appears to be a clear risk that in its current format there are gaps in the content and there is also scope for different interpretations on key issues meaning that the document cannot be fully relied upon to give the Government the level of confidence it may be expecting. I am also concerned that communication and liaison between Government departments and MTRCL have not worked in the way intended as set out in Section 10 of the PMP which requires a partnering approach to facilitate close communications on technical and project management issues that have common concerns to both parties* [**B4/1848 (A)**] [**B4/1975 (B)**] [**B4/2107 (C)**] [**B4/2242 (D)**] [**B4/2500 (E)**] [**B4/2375 (F)**] [**BB12/8082 (G)**].

MTRCL'S Project Integrated Management System (PIMS)

18. MTRCL has put considerable effort over the years into developing its Project Integrated Management System ("**PIMS**"). It is reassuring that MTRCL's management systems and organisation have achieved ISO 9001 accreditation in relation to the project management of new railways. The Master List of PIMS documents [**B2/1048+**] contains about 154 manuals and project procedure notes. The documents provide generic guidance and need to be translated into project-specific Management Plans. Some documents date back to 2008 with others being issued well after the start of the new Hung Hom Station works.

19. In my Original Report [**§24**] I noted that major revisions were made to MTRCL's PIMS documents [**B3/1058+**] to align with the new requirements in ISO 9001:2015 [**B9/6521+**]. For example, the ISO standard has a new key focus on leadership and commitment as set out in clause 5 of the ISO 9001:2015 document [**B9/6535-6536**]. This new requirement is reflected in the PIMS document PIMS/MAN/004/A5 "Organisation and Management Responsibilities" which was revised in October 2015 [**B3/1147**] and is included in the master list of PIMS documents attached to the PMP **[B2/1048]** and included in the relevant PIMS documents at **[B3/1147-1210]**.

My observations on MTRCL'S Project Integrated Management System

20. *In my Original Report* [**§§28-34**] *the key points I made in relation to the PIMS documents included:*

    a. *MTRCL's PIMS has been demonstrated to be an effective system conforming with good industry practice* [**§28**]*;*

    b. *it would be desirable to review and update the older documents and consider rationalising and combining some of the related documents* [**§28**]*;*

    c. *there is a need to improve the communication and training of the procedural requirements, and ideally to identify relevant procedures for specific job roles* [**§30**]*;*

    d. *ensure that procedures are fully aligned with conditions of contract and contractual roles and responsibilities* [**§31**]*;*

    e. *consider joint training of the Engineer's and Contractor's site teams to ensure common understanding of key procedures* [**§32**]*;*

    f. *give greater attention to the role of leaders in establishing the right culture, behaviours and required ways of working* [**§§33-34**].

21. *In my opinion, the evidence arising from the Extended Inquiry reinforces my previous findings in relation to PIMS. It is a good system but the main challenge is to ensure that site teams are aware of and understand the requirements and put them into practice in a consistent way. This requires, in my opinion, increased training, enhanced communications and stronger leadership. I comment in more detail on these aspects further below in the section of my report on "Specific Issues Relating To MTRCL Project Management Procedures Arising From The Obligations".*

22. *I provide more detailed comments later in this report on specific areas of concern relating to:*

    a. *the lack of RISC forms;*

b. ineffective site inspections;

c. leadership, commitment and culture;

d. general site supervision and record keeping;

e. interface management and planning; and

f. testing of reinforcement steel.

MTRCL'S Obligations Under the Contract With Leighton

23. In my Original Report [§35] key points I made in relation to the PIMS documents, which I consider to be also relevant to the issues raised in the Extended Inquiry, include:

a. Clause 1.1.26 Disallowed Cost [**C3/1816-1817**] – the contract is a target cost contract. The commercial basis of the target cost contract is that the Contractor is paid its actual costs and is incentivised through a pain/gain mechanism to manage actual costs to below the contractual target cost. The payment of actual costs is subject to the contractual provisions for Disallowed Cost. Provisions for Disallowed Cost are scattered throughout the contract. The contract provisions set out costs which are reimbursable in the Schedule of Cost Components at Appendix F [**C3/1981-1985**]. Costs are reimbursed for the Execution of the Works which is defined at Clause 1.1.33 [**C3/1818**] and includes "the correction of defects in the Works".

My observations: I have included this aspect of the contract in my report because I consider that the form of contract and associated incentive arrangements have a significant effect on the project management systems required to support successful project outcomes. The defective works associated with the joints which have been investigated by the Extended Inquiry demonstrate the need for robust and reliable record-keeping including amongst other things, supporting the application of the contractual provisions for Disallowed Cost and the commercial payment arrangements. I am not aware that the Extended Inquiry has received any evidence relating to Disallowed Cost and in any event, it is not for me to assess whether specific aspects of work should be treated as Disallowed Cost. I do consider however, that it is important that the commercial arrangements under a target contract do provide the necessary incentives to deliver work which is right first time

and is built as efficiently as possible. It is also important that provisions in procurement procedures for passing risk down the supply chain through sub-contracts are done so in a fair and reasonable way. I consider that the events under review by the Extended Inquiry strengthen the recommendations I made in my Original Report in relation to the procurement and management of sub-contracts and that the provisions for disallowed cost should be reviewed and rationalised to ensure that they operate as effectively as possible in the overall target cost incentive. The aim should be to incentivise good quality, "right first time" work and achieving best value for money.

b. Clause 2.1(e) states that the Contractor shall take instructions and directions from the Engineer only.

My observations: in my Original Report I highlighted my concerns about the lack of alignment between roles and responsibilities set out in PIMS procedural documents and those provided for in the conditions of contract. I consider it very important that the position of Engineer to the Contract is understood and that wider roles and responsibilities within the MTRCL organisation respect the need for the Engineer to act impartially in the administration of the contract and to ensure that contractual communications are properly controlled. I am of the opinion that a lack of understanding and application of the contractual roles and responsibilities may have been a contributory cause to some of the problems being investigated by the Extended Inquiry. This would include issues such as responsibilities for resource management, training and development of site staff, application of PIMS procedures and communications with the Contractor to resolve issues of non-compliance.

c. Clause 16 is headed "Methods of Manufacture, Construction or Installation" [**C3/1847-1849**]. Clause 16.1 requires the Contractor to obtain the Engineer's acceptance to proposed methods of construction. Clause 16.2 states that the Contractor shall not change the methods of manufacture, construction or installation which have received the Engineer's consent without the further consent in writing of the Engineer.

*My observations: I understand from the evidence I have seen, that no method statement was specifically produced for the construction of the original 3 stitch joints. There was just a generic "NAT Method Statement of Permanent Structure Construction of EWL and NSL at NAT" [**BB1/202-305**]. In my opinion, this was a failure to deliver the contract requirements and it also breached the interfacing requirements set out in Appendix Z2 of the Particular Specification [**BB420**] which also required a method statement to be produced and which I discuss in more detail later in this report. If a detailed method statement submission for the stitch joints had been made, I consider it would have been more likely that the Contractor would have identified the existence and implications of different types of coupler in use at the interface with the C1111 contract. If the Contractor had not identified this then the Engineer would have been in a position, from his interface obligations, to have been aware of the use of the different couplers and should have pointed out the potential problem. The Method Statement subsequently produced for the reconstruction of the joints following the detection of the defects, "Method Statement for NSL Stitch Joints Reconstruction" [**CC3/1914-1972**], does identify the different types of coupler at either side of the interfaces.*

d. Clause 57.4 Quality Plan **[C3/1881-1882]**: this requires that the Contractor shall by the date stated in the Specification submit to the Engineer for Approval a quality plan, which shall set out details of the quality management system to be implemented by the Contractor in order to control all design, procurement, manufacture, construction and installation activities required by the Contract in such a way as to ensure completion of the Works in accordance with the Contract, with the Approved Design Data and with any drawings or documents submitted by the Contractor pursuant to Clause 8 and Approved **[C3/1835-1836]**.

My observations: the Contractor's Quality Plan was required to incorporate MTRCL's requirements in relation to RISC forms, inspection procedures and record-keeping. It was one of MTRCL's roles to ensure that the Works were delivered in accordance with the Quality Plan. When it became apparent that the RISC procedures were not being fully applied then the Engineer should have taken appropriate contractual action to rectify the position. Whilst it appears that the problem was raised by MTRCL with the Contractor this did

not result in the problems being resolved. In my opinion, MTRCL as the Engineer and the PM, should have taken firmer action to ensure that the Quality Plan was followed. If the Contractor had justifiable reasons why the RISC form procedure could not be applied as intended then one option would have been to require the Contractor to submit an alternative procedure for acceptance. This would have regularised the position and ensured that MTRCL's site teams could have continued to operate in a way that was approved under the contract. In the circumstances that have been presented to the Extended Inquiry, it is apparent that the Contractor failed to ensure full compliance with the required procedure and MTRCL, as Engineer and Project Manager, failed to ensure that the provisions of the contract and the PIMS procedures were implemented by the Contractor. I discuss this in more detail below in the section on the lack of RISC forms.

e. Clause 60.1 Examination of Work before Covering Up **[C3/1885]**: this requires that no work shall be covered up or made unavailable for testing or examining without consent of the Engineer.

My observations: in my Original Report I highlighted the potential for confusion between formal hold-points requiring RISC form procedures and the general contractual provision in Clause 60.1 that no work shall be covered up or made unavailable without the consent of the Engineer. This contractual provision does not require the Engineer to inspect every element of the work but the Contractor should give the Engineer the opportunity to do so or to confirm that the work can go ahead without inspection. The position means that whilst for formal hold-points, notification of a request for inspection should be given via a RISC form, for other inspections the method of notification is not specified and could be given by a variety of different methods. The risk is that inconsistent approaches may have contributed to the non-application of the specified procedures for the formally defined hold-points.

Specific Issues Relating To MTRCL Project Management Procedures Arising From The Obligations

Issue A: Lack of RISC Forms

24. MTRCL's procedures for formal inspections and approvals of site works are based on the use of Request for Inspection/Test/Survey Check (**RISC**) forms. The RISC form procedures are set out in Section 5.1 of the PIMS document PIMS/PN/11-4/A6 Monitoring of Site Works [**B3/1673-1676**]. The obligation on MTRCL to follow this procedure flows from the EA Clause 4.6(C) [**G7/5613**] which requires MTRCL to act in accordance with its management systems and procedures. The obligation is reinforced by the issue of the IoE for the SCL Project [**H7/2220-2233**] which took account of the draft PMP dated 22 November 2012 [**H7/2220**]. The PMP refers to the requirements for RISC forms and also includes the application of MTRCL's PIMS to the SCL Project which sets out the RISC form process requirements.

25. The overall RISC form procedure requires the development of Inspection and Test Plans ("**ITPs**") for required elements of the works. The ITPs set out Quality Hold Points and Quality Control Points to be applied at key stages of construction including at the completion of the fixing of steel reinforcement bars and also prior to the pouring of concrete [**BB1/291-296, NAT**]; [**BB13/8937-8942, SAT (EWL)**]; [**BB13/9109-9114, SAT (NSL**)][**BB8/5218, §12, WS2 of Michael Fu**].

26. The PIMS Document PIMS/PN/11-4/A6 Monitoring of Site Works at para 5.1.1(d) [**B3/1674**] requires the SConE to agree a list of ITPs with the Contractor and such list should identify the inspection and test plans for activities that are planned to commence within 3 to 6 months' time, in addition to those already underway. The General Specification at paragraph G9.2.3 [**C3/2107-2108**] sets out the requirements for Inspection and Test Plans including the need to identify the levels of inspection required. It also requires the Contractor to submit ITPs to the Engineer for approval at least 4 weeks prior to the commencement of the related works. The notifications process could have been used by the Engineer to develop a forward programme of the RISC inspections that would be required which would have helped with resource planning. I have seen no evidence however, to show that this was done.

27. Obligations in relation to inspections and RISC form procedures are passed on to the Contractor by way of the Contract, the General Specification and the Particular Specification. As set out above, the Contract at Clause 60.1, Examination of Work before Covering Up [**C3/1885**], states that no work shall be covered up or made unavailable for testing or examining without consent of the Engineer and the Contractor shall afford full opportunity for the Engineer to examine and measure any work which is about to be covered up. The General Specification at paragraphs G12.4.1 to G12.4.4 [**C3/2118**] sets out the requirements for the Contractor to give notice of work and that no work is to commence until notice has been given to the Engineer and the Engineer's requirements for inspection have been verified. Paragraph G12.4.3 requires that where no period of notice is stated in the Contract, such notice shall be not less than 3 days of normal working time before the work is ready for final inspection.

28. For the defined Hold Points the Contractor is required to issue a RISC form to the Engineer requesting an inspection. The Particular Specification in Volume 10 Appendix BJ "Proformas" includes the standard RISC form template [**C4/3002**] to be used by the Contractor in requesting the Engineer to undertake an inspection.

29. The PIMS procedure sets out the RISC form procedure to be applied. It requires at paragraph 5.1.2(a) [**B3/1674-1675**] the SConE/SIOW/SLS to ensure that an administration system is set up to receive, log and monitor the status of inspections and tests. I note in particular the requirement to ensure that the system is monitored.

30. At paragraph 5.1.2 (c) [**B3/1675**] the PIMS Monitoring of Site Works procedure requires that ePMS is used if possible, to administer the RISC procedures. If this is not possible the SIOW is required to set up an independent register to control and monitor the RISC process. The PIMS procedure recognises the importance of controlling and monitoring formal inspections as part of a quality assurance system. The use of ePMS is also covered in PIMS /P/11/A3 Construction Management which at Paragraph 5.2.1 [**B3/1381**] states that MTRCL's ePMS shall be adopted, with suitable modifications if required, to suit the nature and requirements of the Project, in establishing the Project ePMS. The requirements for the Contractor to use the ePMS shall be clearly defined in the Contract

documents and the CM shall assist the Contractor in the implementation of the ePMS through the provision of adequate training and prompt resolution of issues.

31. The PIMS procedures do however, recognise that there may be a need for flexibility and they set out a requirement that there will be a cooperative approach when procedural problems arise. PIMS procedure PIMS/P/11/A3 Construction Management at paragraph 5(e) [**B3/1381**] sets out that there should be a flexible, proactive and cooperative approach to the achievement of contractual obligations and discharge of contractual duties and responsibilities by all parties.

32. In relation to contract compliance, paragraph 5.4.2 [**B3/1382**] states that the CM/SConE shall work closely with the Contractor to resolve and overcome any unforeseen or unexpected circumstances that may arise throughout the course of the works. Although the CM/SConE is not empowered to amend any terms of the Contract nor to deviate from his responsibilities under the Contract, where agreed to be necessary or desirable, the CM/SConE will liaise with the P&CD team to consider modifications to the Contract requirements, for the benefit of the project. Such proposed modifications shall then be presented for consideration by MTRCL's Project Control Group in accordance with P&CD procedures.

33. The PIMS procedures also require MTRCL to support the Contractor in relation to resource planning and management. Paragraph 5.3.1 [**B3/1378**] states that the PM and CM shall ensure that appropriate resources, from both MTRCL and the Contractor, are available and in place for the Works. Regular reviews of the Project requirements, any changes to the Works, Contractor's resources, market climate and both the Contractor's and MTRCL's workload together with appropriate forward planning should be undertaken to ensure that the appropriate resources are in place throughout the full project cycle.

34. A further requirement on resource planning is set out in paragraph 5.3.2 [**B3/1382**] which states that the CM shall offer and provide appropriate assistance or advice to the Contractor, with respect to the level of resources and plant, wherever possible, for the benefit of the Project, taking into consideration the Contractor's experience and performance.

My observations in relation to the lack of RISC forms

35. *As described above, the requirements for inspection planning, notification and execution, including the application of the RISC form procedures, are set out in a range of documents including the contract, the general specification, the particular specification, various PIMS procedural documents and the PMP. Taken as a whole, the procedures described in the documents would in my opinion, if they had been fully implemented, have provided a robust inspection regime and a good degree of confidence that the works were provided in accordance with specified requirements. Unfortunately, it is clear that there were a number of failures in the way that the procedures were delivered by both the Contractor and the Engineer/PM. To put it simply, members of the Contractor's team failed to apply the required RISC procedures and members of the Engineer's/PM's team were willing to operate to inappropriate and unapproved arrangements.*

36. *It is apparent from evidence provided by witnesses at the Extended Inquiry that the RISC procedures were not always followed and for some important elements of the works the procedures were seriously lacking. In the Final Verification Study Report at Table 1 [**BB16/9963**], the required RISC Forms at the NAT location are stated to be 64 and 59 for rebar fixing and pre-pour respectively and the available RISC Forms are 21 (33%) and 13 (22%) respectively. At the SAT location the required RISC Forms are stated to be 42 and 44 for rebar fixing and pre-pour respectively and the available RISC Forms are 23 (55%) and 27 (61%) respectively. At the HHS location the required RISC Forms are stated to be 659 and 661 for rebar fixing and pre-pour respectively and the available RISC Forms are 287 (44%) and 344 (56%) respectively.*

37. *It is not clear when procedures first departed from the formal RISC procedure nor is it clear to me what initially led to the RISC procedure not being followed and alternative communications and arrangements being used. However, Mr Kit Chan, the former CM of MTRCL, was aware of the problem of missing RISC forms as early as May 2015* [**BB8/5198/§38**]. *He did not consider the problem to be serious enough to step in and ensure that the Contractor rectified the problem in relation to the lack of RISC forms* [**T13/136:6-9**]. *Mr Chan has put forward 5 reasons to explain the missing RISC Forms* [**T14/1:13-2:23**][**CA1/Tab 1, COI Closing**

§§157-178]. *In my opinion, reasons which may have contributed to the departure from the formal procedure may have included:*

a. *pressure of work causing insufficient time to follow the specified procedure;*
b. *insufficient resources to apply the formal procedure within the required time tables;*
c. *lack of training and understanding in the site teams of the need to follow the formal RISC procedures as part of a quality assurance system;*
d. *the introduction of less formal approaches by the Contractor, for reasons of expediency, to avoid the work programme being delayed;*
e. *tolerance of informal and unapproved procedures by MTRCL staff who did not want to be the cause of delays to the programme and went along with the alternative arrangements;*
f. *a mistaken belief that the alternative approach was acceptable as it supported the contract partnering principles;*
g. *insufficient oversight of inexperienced inspectors and engineers by their line managers and a lack of direction on the priorities that the site teams should apply due to work pressures;*
h. *younger generation engineers being more comfortable with technology systems rather than administering a paper-based system;*
i. *lack of monitoring of the RISC system records by Senior Inspectors to ensure that it was kept up-to-date with compliant records;*
j. *ineffective communications between inspectors and senior managers which failed to identify, elevate and address the non-conformance issues; and*
k. *a lack of quality audits directed at the application of the RISC procedure.*

38. *Any or all of the above possible reasons may have contributed to the problems associated with the RISC form procedure and each represents a risk which should be addressed in considering how best to learn lessons and ensure that the situation is not repeated on future projects.*

39. *There was a suggestion that the unapproved and non-compliant approach to inspections was considered acceptable by members of MTRCL's inspection teams because it showed a partnering relationship to working with the Contractor* [**WS of Chan Chun Wai Chris WW1/Tab 3*;* BB1/115/§20 and BB1/117/§27**]. *This in my opinion is a misunderstanding of partnering or collaborative working which must ensure that contractual responsibilities are fulfilled and contractual*

requirements are delivered. This indicates to me the need to provide training in the application of partnering arrangements and ensuring that it is not seen as a way of avoiding contractual obligations or governance requirements.

40. *It is not the case that the RISC procedure was totally ignored. The RISC administrative system was established as required and it was used effectively by some members of the site teams. It appears however, that some site staff either struggled or were not inclined to implement the system. As set out above, it was the responsibility of the SIOW to establish and monitor the RISC system. It is apparent that there was a lack of understanding in relation to individual responsibilities for entering data into MTRCL's RISC register. Tony Tang, MTRCL's Inspector of Works, considered that whoever was responsible for the hold-point inspection is responsible for inputting the information* [**T12/76:18-21**]. *However, Kappa Kang, MTRCL's Construction Engineer II, did not consider it to be her responsibility to update the RISC register following inspections* [**T12/17:10-19:20**]. *In my opinion, the SIOW was responsible for establishing and monitoring the RISC system and part of that responsibility included the need to communicate requirements to those involved in implementing the procedures. The evidence indicates that those responsibilities were not effectively fulfilled. It should in my opinion, have been apparent from a proper monitoring process that RISC forms were not being submitted and completed as required. The monitoring process should also have acted as a management tool to help line managers ensure that individuals, for whom they were responsible, were undertaking their roles as required and were delivering satisfactory performance. In my opinion, the line managers in the site teams were either failing to monitor performance in relation to the application of quality procedures or were placing a low priority on the need to comply with the procedures.*

41. *The use of alternative informal arrangements for the initiation of inspections were developed by the site teams utilising social media applications such as WhatsApp supported by photographs of the works being inspected* [**§§26-38, 43-44 of Victor Tung's WS1, BB8/5253-5257 & 5259**] [**Whatsapp messages and photos provided by Victor Tung, BB14/9421-9456**] [**§§4-5 of Victor Tung's WS2, BB14/9497.2-9497.3**] [**Exhibit A to Victor Tung's WS2, BB14/9497.5-9497.14**] [**§§11 & 15 of WS of Kang Pu, BB14/9465-9467**] [**Exhibits to WS of Kang Pu, BB14/9467-9473**]. *It is apparent that these were not used as part of a controlled*

system. This type of approach may have fulfilled the immediate communication requirements to initiate inspections but it could not provide the control and monitoring required to give good assurance that the inspection requirements and record keeping requirements were being delivered.

42. *The use of technology and social media by the site teams to improve the efficiency of the processes and to avoid programme delays could be seen as a positive indication of their desire to innovate and to improve. I can understand that a form-filling and paper-based system may have seemed old-fashioned and very inefficient to a new generation of engineers accustomed to working with technology based-systems. The problem was of course, that the alternative approach was not developed in a structured way that ensured that all issues and requirements were considered. The alternative arrangement did not provide an approach that delivered the record-keeping requirements or the transparency to readily confirm that inspections had been arranged and completed. Without structured records there is a risk that inspections could take place without knowing if previous Hold-Point inspections had been completed or completed satisfactorily. The position on record keeping was discussed on Day 12 of the hearing* [**T12/57:18-65:15**] *with Ms Kappa Kang, a Construction Engineer II with MTRCL, who had responsibility for carrying out Hold-Point inspections of the steel reinforcement. The discussion concluded with Ms Kappa Kang agreeing that without the RISC forms being filled out as they should have been, the other methods for checking who had done inspections and who hadn't were all somewhat casual.*

43. *Evidence presented to the Extended Inquiry suggests to me that site inspectors and construction engineers were left to their own devices to do what they thought was best without being given clear direction by line managers* [**§12 of WS of Victor Tung, BB8/5251**] [**§11 of WS of Kang Pu, BB14/9465-9466**] [**T13/19:1-20:17, Victor Tung**] [**Victor Tung's reply to the Chairman's question at T13/72:1-73:14**]. *The breakdown in the RISC procedures was known at management levels above the site inspection teams over a period of time. Mr Kit Chan, former CM of MTRCL, said in his witness statement that he was aware of the problem of late or non-submission of RISC forms in May 2015* [**BB8/5197-5198; §§37-38**]. *Whilst MTRCL's concern was expressed to Leighton, it did not appear to be considered sufficiently serious to ensure that action was taken to resolve it. In my opinion, the issue should have been escalated to MTRCL senior management to address with*

Leighton senior management. In my opinion, the failure of quality systems places corporate reputations at risk and the situation should not have been allowed to continue for as long as it did.

44. *I consider that MTRCL managers could and should have taken a more proactive approach to resolving the lack of compliance with the RISC form procedure. In addition to complaining to Leighton that the formal procedure was not being followed, consideration should have been given to ensuring that a suitable temporary alternative process was applied. This could have been implemented whilst the problems with the application of the RISC process were being investigated and resolved. This would have been in line with procedure PIMS/P/11/A3 Construction Management which sets out at paragraph 5(e)* [**B3/1381**]*, that there should be a flexible, proactive and cooperative approach to the achievement of contractual obligations and discharge of contractual duties and responsibilities by all parties. In relation to contract compliance, paragraph 5.4.2* [**B3/1382**] *states that the CM/SConE shall work closely with the Contractor to resolve and overcome any unforeseen or unexpected circumstances that may arise throughout the course of the works. I have not seen any evidence to indicate that this was done to maintain contract compliance in relation to the RISC forms.*

45. *A key consideration in ensuring compliance in the application of quality systems is training in the importance of quality assurance and the application of defined procedures. In my Original Report* [**§§30, 32 and 188**]*, I made some recommendations for further enhancement of the system and also set out my view that greater attention is required to the training of project staff in the requirements and the operation of the PIMS system. I am pleased to note therefore, the plans set out in the witness statement of Dr Peter Ewen* [**BB8/5152-5186**] *in relation to the cultural development and the enhanced training of frontline construction staff in the implementation of PIMS. I consider it important that, due to the overall scale of the PIMS system in covering a very wide range of topics and procedures, training is focused on specific PIMS procedures that are of key relevance to the roles of individuals in their site jobs. It is also important that individual training records and qualifications are easily accessible to managers who are responsible for resource management and task planning to help them confirm that individuals have the appropriate competences for the work they are asked to perform.*

46. *In relation to the planning of resources for the forward programme of inspections, I consider that MTRCL could have done more to monitor the position on RISC forms and to identify late submissions and that processes were breaking down. Evidence has been given that the Contractor did not submit RISC forms requesting inspections at the time required by the provisions of the contract. I find it surprising that MTRCL did not appear to have a system which would have identified when inspections were expected and would have allowed them to chase the submission of RISC forms if they were not received on time. I would have expected MTRCL therefore, to have had a forward programme of inspections and to have known when to expect RISC forms to be submitted.*

47. *My overall view is as follows:*

a. MTRCL has developed a robust and comprehensive procedure in relation to the inspection regime.

b. The various elements of the procedures are set out in a range of documents and there would be benefit in pulling the requirements together into a single location so that it is easier to identify and understand the full requirements.

c. Contractor's staff failed to apply the required RISC procedure.

d. MTRCL's staff were willing to proceed with work on the basis of inappropriate procedures.

e. MTRCL managers failed to take effective action to rectify the defective procedures and failed to notify senior managers of the extent of the problem.

f. The Contractor failed to rectify the defective procedures.

Issue B: Ineffective Site Inspections

48. Notwithstanding the lack of RISC forms, evidence has been presented to the Inquiry which indicates that inspections of work were carried out in the absence of formal RISC form procedures [**§§20 & 27 of WS of Chris Chan, BB1/115 & 117] [§16 of WS of Tony Tang, BB1/125] [§§20-25 of WS of Victor Tung, BB8/5252-5253] [§10 of WS of Kang Pu, BB14/9465**]. We know however, that despite any inspections that did take place, defects in the steel fixing and coupler connections were discovered in the opening-up of the stitch joints. The lack of RISC forms, as discussed above, is a serious non-compliance issue but it is even more worrying that inspections, if they were carried out, did not identify the

significant defects. Consideration is required therefore, as to why the inspections failed to identify the issues.

49. A key aspect of project management is resource planning, including the identification of required resources with the necessary competences, skills and experience. The PIMS procedures anticipate that competent people will be available and will be deployed to perform the roles. MTRCL's PIMS procedure document PIMS/P/11/A3 Construction Management at paragraph 5.3.1 [**B3/1382**] states that the PM and CM shall ensure that appropriate resources, from both MTRCL and the Contractor, are available and in place for the Works. Regular reviews of the Project requirements, any changes to the Works, Contractor's resources, market climate and both the Contractor's and MTRCL's workload together with appropriate forward planning should be undertaken to ensure that appropriate resources are in place throughout the full project cycle.

50. It is also necessary to have the right resource available at the right time. This requires reliable forward work programmes on which to base resource plans. As set out above in relation to the lack of RISC forms, PIMS/P/11-4/A6 [**B3/1674**] requires the SConE and the Contractor to agree a list of ITPs for activities that are planned to commence within 3 to 6 months' time. The General Specification [**C3/2107-2108**] requires ITPs to be submitted at least 4 weeks prior to commencement of the related works. The General Specification also requires the Contractor to give notice to the Engineer of the need for inspection before work proceeds. Paragraph G12.4.3 [**C3/2118**] specifies that where no period of notice is stated in the Contract, such notice shall be not less than 3 days of normal working time before the work is ready for final inspection. The specification of minimum periods of notice is important in supporting resource and work planning and helps ensure that the inspection team can prepare for the tasks and ensure that they have the necessary up-to-date plans and information.

51. Final inspections of completed work are made easier if there is confidence that the work has been completed correctly prior to inspections being requested. This is helped by robust supervision of work by the Contractor and surveillance of the site work by the Engineer's inspection team. The General Specification at paragraph G3.9.1 [**C3/2040**] requires the Contractor to arrange the works so that the works are supervised at a minimum ratio of 1 supervisor to no more than 10

workers. The Original Inquiry heard evidence about the supervision requirements in relation to couplers. The Quality Supervision Plan for the Installation of Couplers [**B6/4096-4114**] requires that the frequency of the quality supervision should be full time and continuous supervision by the Contractor of the mechanical coupler works [**§5)1.i, B6/4103**], and by MTRCL a supervision of at least 20% of the splicing assemblies [**§5)2.i, B6/4103**]. I gave my opinion on the definition of "full time and continuous" in my Original Report [**§78**]. The Extended Inquiry has heard evidence from individuals who carried out supervision and surveillance but I have not seen detailed records to confirm that the required levels of supervision and surveillance resources were in place in the areas under investigation.

My observations in relation to ineffective inspections

52. *Potential contributory factors in the non-identification of defects during the inspections which, in my opinion, may have included:*

   a. *lack of knowledge in the inspection teams of the different types of couplers;*
   b. *lack of training in the mechanical fitting of couplers and the need for different types of reinforcement bars;*
   c. *access difficulties in the work area to examine couplers connections closely and being able to see that they were inappropriately slotted in rather than screwed in;*
   d. *possible insufficient resources in the supervision, surveillance and inspection teams to cover the large site with many working areas, putting pressure on the time available for individual inspections;*
   e. *a desire in the inspection teams not to cause delays to the work programme;*
   f. *reduced periods of notice given by the Contractor that inspections were required to be carried out by the informal social media platforms and the failure to follow the formal RISC procedures;*
   g. *a willingness by MTRCL staff to undertake inspections despite inadequate notice being given and appropriate procedures being followed;*
   h. *failure to ensure full-time supervision of the coupler works by the Contractor and for MTRCL to provide 20% attendance;*
   i. *lack of oversight by senior inspectors/engineers to ensure that inspections were being undertaken effectively;*

j. the lack of site audits or their failure to identify that procedures were not being applied and problems were not being detected;

k. lack of availability of the latest working drawings to all staff; and

l. doubt has been expressed as to whether some inspections actually took place.

53. *In my opinion, inspections are most effective when they are properly planned and undertaken by people with the necessary competences and experience. This requires adequate notice to be given to allow the right people to be available and to allow those people time to prepare and to ensure that they are familiar with the detail of the work to be inspected. The General Specification* [**C3/2118**] *requires three days' notice to be given that work will be ready for final inspection. This requirement does not appear to have been generally applied to work which is the subject of the Extended Inquiry. In his evidence on Day 13, MTRCL's Mr Victor Tung (SIOWII) estimated that the period from the Contractor submitting a RISC form to undertaking the inspection could be about one day* [**T13/14:6**]. *Other evidence suggested that where WhatsApp communications were used, rather than RISC forms, then there may have been very little notice that an inspection was required. For example, in paragraph 37 of his witness statement* [**BB8/5257**], *Victor Tung said that "Had we insisted on proper submission of RISC forms by Leighton strictly before each and every hold-point inspection was allowed to take place, site progress would have been seriously affected". In my opinion, the proper planning of work and resources in accordance with quality procedures is more likely to prevent delay than cause delay to the programme. I consider that it is very important that appropriate procedures are applied including the provision of necessary notice periods. An experienced contractor should be able to identify what work will be undertaken over the coming few days, how long work will take and should be able to predict fairly reliably when inspections will be required. Forward planning is critical to the successful implementation of a robust quality management system and failure to apply specified quality procedures poses a serious risk to the quality of the works.*

54. *In my experience it is not unusual for contractors to seek to find ways of speeding up or avoiding procedures in order to shorten the programme and reduce costs. This can be done in appropriate or inappropriate ways. It is appropriate for the Engineer to respond positively to requests for revising and improving procedures provided that quality standards are maintained. Such requests do however, need*

to be formally submitted and carefully considered in accordance with the contract. It is entirely inappropriate in my opinion, for quality procedures to be ignored or replaced by site teams or individuals on an informal or unapproved basis. I have seen no evidence to indicate that the Contractor sought formal approval to an alternative procedure to replace the RISC form procedure.

55. *It should be borne in mind that the lack of RISC forms and the ineffectiveness of inspections would have had little consequence if the steel-fixing work and coupler connections had been undertaken correctly in the first place. Similarly, if the Contractor's supervision or the Engineer's surveillance had identified the defective work prior to inspections being requested then the consequence of the lack of RISC forms would have been insignificant. I have seen little evidence about the extent of supervision and surveillance in relation to couplers in the Extended Inquiry. I would have expected the parties to have been able to produce documented evidence if it had been carried out as required. In view of the defects that were subsequently revealed, it is difficult to understand how they could have occurred if the supervision and surveillance requirements had been fully performed.*

56. *Suggestions have been made that RISC procedures were not followed due to the pressure of work and possibly due to insufficient resources being available* **[§29 of WS1 of Henry Lai, CC1/93] [§6 of WS2 of Henry Lai, CC6/3787] [§20 of WS of Raymond Tsoi, CC6/3795] [§19 of WS of Sean Wong, CC6/3804-3805] [§20 of WS of Jeff Lii, CC6/3814] [§22 of WS of Alan Yeung, CC6/3824] [§19 of WS of Ronald Leung, CC6/3832] [§19 of WS of Saky Chan, CC6/3843] [§23 of WS of Daniel Teoh, CC10/6502-6503]**. *Whilst there are requirements on resource planning and management in the PIMS procedures (§5.3 in PIMS/P/11/A3)* [**B3/1382**]*, I have not seen any evidence to show what specific actions MTRCL's PM and CM took to ensure that appropriate resources, from both MTRCL and the Contractor, were available and in place for the Works. I also note that the PMP does not contain anything on resource planning. I would have expected the PMP to set out at a high level how MTRCL would identify the required resources and how they would be trained and briefed in order to deliver the specific requirements on the project.*

57. *The Extended Inquiry has heard evidence that the most up-to-date working drawings were not available to all members of the inspection teams. In setting out*

MTRCL's opening statement on Day 2 of the hearing, Mr Boulding explained that the MTRCL construction engineers were typically responsible for inspecting the rebar fixing works, and the reason for this is that they had the most up-to-date working drawings and the relevant design amendment sheets and the RFI responses [**T2/63:6-10**]. *It does concern me that not all of the inspection teams had access to the most up-to-date drawings. Apart from restricting the flexibility in who could undertake rebar inspections, it could have meant that inspectors of subsequent inspections, prior to concrete pours, may not have had the latest drawings and may not have had the opportunity to spot any defects that may have previously gone unnoticed. I find it quite worrying that the document management system would not allow all site staff to be able to access up-to-date drawings and information. I recognise that there can be a small delay between design revisions being agreed and for them to be updated on the drawings but the drawings needed to have been available to the steel fixing teams undertaking the work and so should also have been available to inspection teams. This is also an example of why it is necessary to specify a minimum period of notice that an inspection will be required, which in this case was a minimum of three days. This provides time for the nominated inspector to ensure that he or she has the latest drawings, to make sure that they are clear and to become familiar with the requirements.*

58. *Evidence has been given to the Extended Inquiry indicating a potential lack of training in the PIMS procedures and also in relation to technical on-the-job training particularly for less senior engineers* [**T12/65:18-66:2, Kang Pu**] [**T12/131:5-7, Tony Tang**] [**T14/12:23-25, Kit Chan**] [**T4/116:19-23, T5/4:18-6:18, T5/20:10-14, T5/116:8-12, T5/126:10-127:13 Henry Lai**][**T9/16:12-18, Joe Tam][T9/91:5-92:24, Sebastian Kong]**. *As part of their development I would have expected junior engineers and inspectors to have been accompanied on inspection on occasions by more senior managers, particularly early on in the project, to ensure they knew that they were competent and were following appropriate procedures. I have seen little evidence to show that this happened on a routine basis.*

59. *In relation to training, Dr Peter Ewen, MTRCL's Engineering Director, sets out in his witness statement* [**BB8/5172 & 5173/§§71, 76-80]** *the steps MTRCL are taking to improve training arrangements. Much of this relates to training for better PIMS implementation. He also describes in paragraph 80 the development*

of staff competency mapping and training for specific roles that the Projects staff members perform. He identifies that MTRCL has had a model for staff training competency mapping for staff in its Operations Division for many years and is now working to develop one that is suitable for the Projects Division. In my opinion, a specific system for linking required skills, competences and qualifications to individual roles in Project teams would be highly desirable.

60. *I support the development plans that MTRCL have put in place to address the competency mapping and training requirements for specific roles. The best systems I have seen elsewhere allow managers immediate access to individual training records and qualifications so that appropriate people can be allocated to specific tasks. For example, an effective technology-based competence mapping system would identify if a person allocated to the inspection of BOSA couplers had undertaken the appropriate training session.*

61. *I am surprised that there has been little reference in the evidence provided by MTRCL relating to any investigations as to why the inspections failed to identify defective work; why the RISC procedures broke down; or as to the cause of the defective work that resulted in the joints needing to be reconstructed. As a learning organisation I would have expected MTRCL, in liaison with the Contractor, to have carried out rigorous investigations to learn lessons and to inform the development of enhanced procedures to prevent future recurrences. I am aware of the wider review of project management procedures but I have not seen any evidence of investigations into the specific problems which are the subject of the Extended Inquiry.*

Issue C: Leadership, Commitment and Culture

62. I commented on leadership issues in my Original Report [**§§27-34, 140, 151-152**] and included recommendations for improving the effectiveness of leaders. I have also set out above, in the section on MTRCL's obligations under PIMS, requirements relating to leadership. The PIMS procedure PIMS/MAN/003/A5 "Project Integrated Management System Requirements" **[B3/1067-1076]**, which was updated in 2016 to take account of the revised ISO 9001:2015 standards in relation to Leadership and Commitment, includes at paragraph 3.1 **[B3/1069]**:

Top management of Projects Division shall demonstrate leadership and commitment with respect to the PIMS by:

a) taking accountability for the effectiveness of the PIMS;

b) ensuring that the PIM Policy and Implementation Strategy are established for the PIMS and are compatible with the context and strategic direction of the Projects Division;

c) ensuring the integration of the PIMS requirements into the Projects Division's business processes;

d) promoting the use of the process approach and risk-based thinking;

e) ensuring that the resources needed for the PIMS are available;

f) communicating the importance of effective quality management and of conforming to the PIMS requirements;

g) ensuring that the PIMS achieves its intended results;

h) engaging, directing and supporting persons to contribute to the effectiveness of the PIMS;

i) promoting improvement; and

j) supporting other relevant management roles to demonstrate their leadership as it applies to their areas of responsibility.

63. *It is widely recognised that leadership plays a key role in establishing the culture, corporate values and behaviours across an organisation. This is reflected in the focus that is given in ISO 9001:2015 on the importance of effective leadership. The challenge for organisations seeking to achieve ISO 9001 accreditation is to convert policy and strategies into practice which embed the appropriate culture and behaviours throughout the organisation.*

My observations in relation to leadership, commitment and culture

64. *Issues raised in the Extended Inquiry, in my opinion, place greater weight on my previous comments. Key aspects of leadership that need to be rigorously implemented to prevent the types of problem that are being investigated as part of the Extended Inquiry include:*

a. *the importance of the leadership role in establishing a culture that embeds corporate values across the organisation and ensures that staff understand the importance of applying quality management and assurance procedures;*

b. ensuring that effective communications systems are established to ensure staff are kept informed of issues which impact on their jobs and that there is a process in place to measure the effectiveness of communications;

c. leaders should have a regular and visible presence within offices and on site and take opportunities to reinforce cultural requirements and to communicate key messages directly to staff;

d. leaders must regularly monitor resources and ensure that they are receiving reports which identify any pressures;

e. ensuring that staff are given adequate training and have the competences and capabilities required to perform their individual roles.

65. *As described above, PIMS/MAN/003/A5 Project Integrated Management System Requirements sets out the requirements on MTRCL's top management in demonstrating leadership and commitment to the organisation. In my opinion, one of the most relevant and important leadership attributes is sub-paragraph (f) **[B3/1069]** "communicating the importance of effective quality management and of conforming to the PIMS requirements". This requires that the application of quality procedures needs to be part of the culture and adhered to despite any work pressures that may arise. Small delays resulting from the application of procedures are minimal compared to major delays that can occur if work has to be repeated.*

66. *In putting the EA in place, the Government placed considerable reliance on the appointment of companies who have strong reputations and track records for their quality systems and their successful project delivery. Government was willing to pay the appropriate price for an experienced company and robust systems and it expected that they would be maintained over the course of the project. MTRCL and appointed contractors need to ensure that they put in place the resources with the necessary capabilities, qualifications and experience to be able to demonstrate that the procedures are properly applied to help maintain their corporate reputations. Part of this is that quality systems need to have a means of identifying when procedures are at risk of breaking down and processes for rectifying non-compliances before they become major problems.*

67. *Whilst I am sure that MTRCL's senior leaders fully understand and support this ethos I have not seen evidence as to how the leadership ensure that the required*

culture, behaviours and desired way of working is embedded throughout the organisation. Indeed, there has been evidence indicating that some members of inspection teams have not fully grasped the importance of effective quality management and of conforming to PIMS requirements [**T11/9:1-10:14, Michael Fu**]. *I consider that it would be highly desirable for MTRCL to reflect on the priorities that they have identified for their top management in relation to the leadership of PIMS and review how these priorities are being achieved.*

68. *I consider that leaders also have a wider role in establishing effective communications which are essential for the successful delivery of complex civil engineering projects. Communications need to be controlled within systems that are shared by relevant parties and provide appropriate records and audit trails for contract activities. The PIMS procedures require good communications to support the operation and monitoring of their implementation. I have not identified however, a specific document that sets out MTRCL's approach to its communication strategy. I also note that the PMP* [**B4/1825-2502, A-F**][**BB12/8058-8195, G**] *does not have a section setting out MTRCL's communications protocols and systems which apply to the project. Clearer direction on communication strategy may have helped prevent some of the problems that have been identified during the Extended Inquiry.*

Issue D: General Site Supervision and Record Keeping

69. MTRCL's obligations in relation to record keeping were set out in my Original Report [**§§77-86**] and I highlight below those that are most relevant to the Extended Inquiry. Some aspects of record keeping have been covered earlier in this report in relation to the lack of RISC forms. It is also apparent that other record keeping requirements have not been applied as effectively as required. If they had been fully implemented then it should have been straightforward to confirm what inspections were undertaken.

70. In granting exemption from the Buildings Ordinance for the specified parts of the project, one of the conditions imposed by the Buildings Department was for site supervision to be undertaken in accordance with the agreed proposals (as set out in MTRCL's PMP) including reference to the BD's Code of Practice for Site Supervision [**B5/2676+**]. This sets out a range of specific requirements for

recording and reporting of site inspections including the handling of non-conformities. The requirements include at Para 6.6 of the CoP **[B5/2705]** that inspection records should be kept for each member of the supervision team (who should report any non-conformities to the RSE, RGE or AS [Authorised Signatory], as the case may be). Para 10.2 [**B5/2739**] requires that site supervision reports be completed by all TCPs whenever they carry out site safety supervision activities. These reports should be filed and maintained at the site office for the inspection of the BA. AP/RSE/RGE/AS are required to keep their inspection records at site such as notes/photo records and the works items inspected on site, particularly during the critical stages of works.

71. Site supervision also has to be in accordance with the procedures set out in the PMP which was a condition of the award of the IoE. There is however, little direct reference in the PMP to site supervision; paragraph 7.6.1 [**B4/1843 (A)**] [**B4/1969 (B)**] [**B4/2101 (C)**] [**B4/2236 (D)**] **[B4/2495 (E)]** [**B4/2369 (F)**] [**BB12/8076 (G)**] sets out in less than three lines, the requirements for site records and focuses on RISC forms. The PMP does however, call up MTRCL's PIMS document PIMS/PN/11-4/A6 "Monitoring of Site Works" [**B3/1672+**] which describes the processes of monitoring and recording of key site work activities and it supplements the implementation requirements set out in the PMP.

72. Relevant requirements of the Monitoring of Site Works PIMS procedure include the following:

a. Section 5.1 **[B3/1673-1676**] sets out the requirements for establishing Inspection and Test Plans (ITP) and for processing Request for Inspection/Test/Survey Checks (RISC).

b. Paragraph 5.1.2 (c) [**B3/1674-1675**] requires that if possible, the project specific ePMS system should be used to administer the RISC process, otherwise the SIOW should set up an independent register to control and monitor the RISC process.

c. Section 5.3 [**B3/1677**] sets out the procedure for issuing Nonconformance Reports (NCR) for nonconforming works. Paragraph 5.3.4 states that a NCR shall only be issued to the Contractor for a Works NCR as defined in the

guidelines provided in Exhibit 7.9. It should be noted that version 6 of this PIMS procedure (ie. PIMS/PN/11-4/**A6**), issued on 24/3/2017 deleted section 3 of Exhibit 7.9/1 [**B3/1706**]. In the earlier versions of the PIMS procedure section 3 set out examples where works NCR should not be raised which included the late submission of various documents and also poor housekeeping on site but these examples were deleted in version 6.

d. Paragraph 5.7.1 [**B3/1679**] sets out that site surveillance is to be carried out by site inspectorate teams to monitor day-to-day site works of the Contractor. The intention is to have site issues identified early for prompt remedial action by the Contractor, in addition to and prior to the formal inspection of the Works.

e. Paragraph 5.7.5 [**B3/1680**] requires that all site activities should be recorded and agreed with the Contractor's personnel on a daily basis. The SIOW is to agree the format of these daily records, typical examples are provided in Exhibits 7.13 and 7.14.

f. In relation to the site photographs, paragraph 5.7.7 [**B3/1680**] states that photographs are also required for specific records and these should be coordinated by the site team to ensure that critical issues are covered. Typical examples of issues that should be photographed are provided.

g. Section 6 [**B3/1681**] sets out the records that the Senior Construction Engineer is required to retain which include RISC records, NCR records and constructional records (e.g. site photographic records, site diary).

73. The PIMS document PIMS/MAN/003/A5 PIMS Requirements at paragraph 5.4 [**B3/1072**] sets out at a high level that the Procedures and Practice Notes identify the records to be maintained by the Projects Division throughout the duration of a project to provide evidence of conformity to requirements and the effective operation of the PIMS. Records shall be legible, readily identifiable and retrievable.

My observations on General Site Supervision and Record Keeping

74. *I made comments and recommendations on record keeping in my Original Report* [**§§77-86**] *and I consider that events identified during the Extended Inquiry give greater weight to my previous comments.*

75. *Issues A & B discussed earlier in this report on the lack of RISC forms and ineffective inspections include detailed failings in relation to site supervision and record keeping requirements. The consequences of those failures may have been reduced if other requirements had been comprehensively provided. For example, PIMS requires all site staff to produce individual daily site diaries which should record events such as inspections carried out. PIMS also requires that records shall be legible, readily identifiable and retrievable. If these PIMS requirements had been followed then there would have been a safety net to the lack of RISC forms and replacement records could have been established.*

76. *PIMS provides guidance on the use of photos to support site surveillance duties* [**PIMS/PN/11-4/A6 "Monitoring of Site Works", Sections 5.7.6, 5.7.7 and 5.8, B3/1680-1681**] *but it appears that inspectors and engineers used photos in a largely uncontrolled manner* [**T12/132:9-134:9, Tony Tang**]. *It also appears that in some cases photos were stored on smart phones without being transferred to MTRCL's data storage systems making retrieval very difficult and potentially impossible if phones were lost* [**WS1 of Kappa Kang, BB14/9466, §15**] [**T12/13:13-14:21; T12/50:12-51:6, Kappa Kang] [T12/74:12-75:19; T12/132:9-134:9, Tony Tang**]. *PIMS/PN/11-4/A6 sets out that photographs are required for specific record purposes and should be coordinated by the site teams* [**Section 5.7.7, B3/1680**] *and wherever possible the site specific ePMS system should be used for record keeping* [**Section 5.8.2, B3/1681**]. *It does not appear to me that the arrangements described by Tony Tang and Kappa Kang met the PIMS requirements for the coordination and recording of photographs. A more structured and controlled approach to the use and storage of photos would, in my opinion, be highly desirable.*

77. *The wider use of digital systems supported by connected IT devices that can be used on site would clearly have been very beneficial and should be a priority for introduction on future projects. Alongside this it would, in my opinion, be desirable to review site record keeping requirements and ensure that they are communicated effectively to site staff. Staff also need to be reminded of the*

importance that site records play in demonstrating that quality requirements have been delivered and also in supporting commercial assessments.

78. *I understand that Non-Conformance Reports (NCRs #097 to 196)* **[BB12/8389-8446; BB8/5223/§21, Footnotes 3 & 4]** *were eventually issued by MTRCL to Leighton in relation to the lack of RISC forms. It is not clear to me however, that PIMS/PN/11-4/A6 "Monitoring of Site Works"* [**B3/1672+]** *at section 5.3* [**B3/1677**] *required a NCR to be issued for this type of breach of requirements. It would, in my opinion, be desirable to review the guidance for issuing NCRs and ensure that there are sanctions which can be used by the Engineer to help ensure that failures are rectified promptly.*

Issue E: Interface Management and Planning

79. Interface risks are widely considered in the construction industry to represent one of the biggest risks that can impact on the successful delivery of projects. This can be as a result of designs not being fully compatible, construction works not being fully aligned and/or work programmes being delayed and disrupting the planned work at interfaces. In my experience it is common for interface risks to feature as a key risk in project risk registers and for there to be a close management focus on the mitigation of the associated risks.

80. PIMS procedure PIMS/P/11/A3 Construction Management [**B3/1379**] includes interface coordination as one of the key processes set out in Section 4 [**B3/1380**]. In addition, paragraph 8.1.1 [**B3/1386**] states that a proactive approach is required for co-ordination and interface management. Although overall co-ordination is normally the Contractor's responsibility, MTRCL's CM is required to maintain close liaison with all internal and external interfacing parties and take timely action to intervene or expedite the works where appropriate.

81. In relation to site interfaces, paragraph 8.3.1 [**B3/1387**] states that interfacing activities shall be fully coordinated and planned to allow issues to be identified and resolved efficiently avoiding the creation of additional safety hazards and ensuring that high safety standards are maintained. The SConE is required to liaise with all contractors to ensure the requirements and interfaces of the Project are fully understood and reflected in a coordinated programme. Assistance shall

be given by the HQ Programme Department as required. The programme shall incorporate appropriate levels of detail to demonstrate satisfactory integration, delivery, installation and testing and commissioning. The CM is required to hold regular construction coordination meetings to coordinate and manage the works.

82. In relation to the contract interfaces between Contracts 1111 and 1112 the contractual responsibilities are set out in the Particular Specification at Appendix Z2 – Interfacing Requirements between Contract 1111 and Contract 1112 [**BB1/420–432**]. Overall contractual responsibility lies with the Contract 1112 Contractor, Leighton, but the interface requirements as set out in the Particular Specification also place requirements on MTRCL in its role as Engineer under the contract, as follows:

a. Clause Z1.3 of Appendix Z2 [**BB1/422**] states that the interfaces, responsibilities and obligations set out in the Appendix are not exhaustive and do not relieve the Contractor of his obligation under Clause 46.5 of the Conditions of Contract to ensure that all interfaces are identified and satisfactorily resolved. Linked to this is Clause 46.5 [**C3/1876**] which requires the Contract 1112 Contractor to take all reasonable steps to ensure that the execution of the works is coordinated and integrated with the works of interfacing contractors with the aim of ensuring that all interfaces are satisfactorily resolved.

b. Clause Z1.8 [**BB1/422**] requires the interfacing contractors to review and finalise their respective Works and how the interface will be managed prior to submission of the details for Approval. Any anomalies in respect of the content of the Physical Interface Schedule shall be reported to the Engineer two months before the commencement of the interface works.

c. Clause Z3.1 of Appendix Z2 [**BB1/423**] states that the Contract 1111 Contractor and 1112 Contractor shall exchange and update design information through the Engineer.

d. Clause Z3.2 of Appendix Z2 [**BB1/423**] states that the Contractors shall meet together with the Engineer on a minimum of a fortnightly basis.

e. Clause Z4.1 of Appendix Z2 [**BB1/423**] states that the Contract 1111 Contractor and Contract 1112 Contractor are responsible for the coordination, preparation and execution of inspection (including tests, as applicable) in the presence of the Engineer or his/her representative to ensure the requirements described in this Interface Requirements Specification have been fulfilled. The required presence of the Engineer should have helped ensure that risks were identified and resolved satisfactorily.

f. Table Z2.1.1 of Appendix Z2 at item 1.7 [**BB1/425**], requires the two Contractors to carry out joint inspections of the interface works with the aim of confirming that as-built waterproofing system, couplers and protection measures to couplers are properly provided. This joint inspection should have ensured that all parties were aware of the different types of couplers and the associated fixing requirements. Clause Z4.1 [**BB1/423**] requires that inspections are executed in the presence of the Engineer.

g. Table Z2.1.2 of Appendix Z2 at item 1.3 [**BB1/429**], requires the Contract 1111 Contractor to provide the necessary detailed drawings showing the as-built information at the interface location, and requires the Contract 1112 Contractor to review and take into account of the information provided by the Contract 1111 Contractor in its construction sequence and method statement for Contract 1112. The General Specification at paragraph G3.7.3 [**C3/2039**] requires that method statements are submitted to the Engineer for acceptance.

83. It can be seen that roles or duties for the Engineer are included in the requirements of sub-paragraphs b, c, d, e, f and g in the preceding paragraph.

84. In addition to the requirements set out in Appendix Z2, Drawing No. 1112/B/000/ATK/C11/101A at Note 2 [**BB1/463**], which sets out typical tunnel stitch joint details at the NAT Tunnels, provided the following contractual requirement: "The stitch joint shall be cast as late as possible in the construction sequence, and preferably after groundwater recharge, to minimise the amount of differential movement after casting. Casting of the stitch joint shall not be carried out until after completion of backfilling." I discuss below the lack of clarity provided by the wording of this requirement.

My observations on interface management and planning

85. *Contract 1112 at Appendix Z2* [**BB1/420 – 432**] *contains a detailed specification for the interfacing requirements with the Contract 1111 works. In accordance with the contractual requirements, construction of the interface works were carried out as part of the requirements for the Contract 1112 works. The Extended Inquiry has heard evidence that problems occurred at the three stitch joints at the North Approach Tunnels. This was due, at least in part, to the wrong type of steel reinforcement bar being used in the Contract 1111 / Contract 1112 interface works in connecting with Lenton couplers installed as part of the Contract 1111 works* [**§§28-30 of WS of Michael Fu, BB1/80-81**] [**§§19 and 30 of WS5 of Karl Speed, CC1/57 and 59**] [**T8/75:19-24, William Holden**] [**§42 of Ng Man Chun, EE1/371.19**].

86. *Appendix Z2 is supplemented by MTRCL's PIMS procedures* [**B3/1379-1394**] *which set out requirements for the management of interface risk. I consider that the requirements as to how the interface work should be managed as set out in Appendix Z2 and in the PIMS Construction Management guidance provide good procedures aimed at minimising the interface risks. If the procedures had been fully followed by Leighton and MTRCL, it is difficult to envisage how it would not have been identified that different types of couplers were being used on either side of the interface and that they required different types of reinforcement bars and coupling techniques.*

87. *My opinion is that the contract and the project management procedures are good in theory but were not robustly applied in practice. Ultimately, this resulted in the site teams not being aware of construction detail and the wrong reinforcement being provided for use in the Lenton couplers. Aspects of the interface planning and management which in my opinion, were not fully effective included:*

    a. *MTRCL, in their role as Engineer, was required to be involved in the exchange of design between the interfacing contractors. MTRCL should therefore, have ensured that the contractors were exchanging information as required and they should have identified any issues relating to non-compatibility of design.*

b. *Interface meetings were not held at fortnightly intervals as required in Appendix Z2* [**BB1/423**]. *These meetings should have provided the Engineer with the opportunity to ensure that the necessary planning was in place to allow the interface works to be completed as smoothly and as efficiently as possible. The notes of the interface meetings* [**BB3/1678-1795**] *indicate that they did not appear to get down to the level of detail needed to address potential construction problems. In my opinion, this should have included identification of the technical work that would be required to prepare the interfaces such as the breaking away of concrete for the exposure of couplers and potential risks that the process would involve. I would also have expected specific components such as the type of couplers to be identified together with any constraints on the requirements for associated materials (eg. tapered or non-tapered steel reinforcement bars). I would also have expected the meetings to confirm that the detailed information had been clearly communicated to the site teams who would be involved in the implementation of the interface work.*

c. *In my opinion, it may have been helpful, in addition to the formal interface meetings, to have held an interface workshop involving key members of the site teams covering the two contracts and MTRCL. This may have been a better forum for the detailed requirements to have been reviewed to inform the development of a method statement which should have been produced but it appears that it was not produced* **[T8/84:6-12, William Holden] [T10/96:16-97:8, Michael Fu]**.

d. *The notes of the interface meetings did not, in my opinion, follow good practice by identifying who had responsibility for resolving actions.*

e. *The meeting notes contained important information about the couplers* **[Meeting No. 8, 5 December 2014, BB3/1684 (Item 8.4.2) and BB3/1690 (Appendix B)] [Meeting No. 16, 6 October 2015, BB3/1740 (Item 15.3.5) and BB3/1740-1760 (Contractor's materials related submission forms and related documents)] [Meeting No. 17, 17 November 2015, BB3/1763 (Item 17.3.4)] [Meeting No. 18, 18 December 2015, BB3/1769 (Item 17.3.4)] [Meeting No. 19, 18 January 2016, BB3/1774 (Item 19.3.3)] [Meeting No. 20, 8 April 2016, BB3/1782 (Item 19.3.3)] [Meeting No. 21, 2 September 2016, BB3/1787 (Item 19.3.3)] [Meeting No. 22, 6 January**

2017, BB3/1792 (Item 19.3.3)] *but it does not appear that this was communicated directly to the site teams. Instead it appears that they were expected to find out the information by locating the meeting notes in the ePMS system and finding out for themselves if they contained anything important* **[T11/70:2-72:17, Chris Chan]**.

f. *The meeting notes show that an action to check the compatibility of the Contract 1111 couplers was carried forward repeatedly for a period of well over a year with nobody taking responsibility for completing the action* **[Meeting No. 8, 5 December 2014, BB3/1684 to Meeting No. 22, 6 January 2017, BB3/1792] [T11/72:18-74:12, Chris Chan]**.

g. *The Engineer, MTRCL, should have been present at joint inspections with the contractors to ensure that interface requirements were fulfilled. I am not aware of any evidence to show that this happened* [**T8/142:4-143:9, Joe Tam] [T11/20:25-23:14, Michael Fu] [T11/67:25-70:2, Chris Chan] [T13/89:24-96:3, Jacky Lee**]. *If it did, then it would have been reasonable to expect all parties to have been fully aware of the Lenton couplers under Contract 1111, and the associated steel reinforcement requirements would have been recognised and actioned.*

h. *Evidence has been presented to the Extended Inquiry that MTRCL staff (and Leighton staff) had not received training in the installation and connection of the different types of coupler* **[T12/53:10-54:3, Kappa Kang]** [**T12/140:13-141:13, Tony Tang] [T7/43:16-44:5, Jeff Lii] [T9/72:2-11, Saky Chan] [T9/93:5-8, Sebastian Kong] [T10/49:10-13, Alan Yeung]**. *Ms Kappa Kang, a Construction Engineer II with MTRCL, had responsibility for carrying out Hold-Point inspections of the steel reinforcement. She told the Commission that she had not received any training in relation to the connection of rebar and couplers and that at that time she had no knowledge about the proper connection or whether they were properly connected* **[T12/53:10-54:3, Kappa Kang]**.

i. *It does not appear that a Method Statement for the interface works was produced as required by the General Specification at paragraph G3.7.2 [**C3/2039**] and also as required by the Interface Requirements in Appendix Z2*

*(Item 1.3 of Table Z2.1.2) [**BB1/429**]. If there was any doubt about whether a Method Statement was required, it was still necessary for the Contractor to prepare works procedures as set out in paragraph G3.7.2 and MTRCL should have ensured that these were in place.*

j. Overall it is my opinion that the requirements for the sharing of information and joint inspections should have been robustly applied and facilitated by the Engineer. These arrangements would have provided opportunities for the use of the Lenton couplers on Contract 1111 to have been identified and taken into account by Leighton in the development of its method statement for the interface construction works. In my opinion, it would be desirable on projects of this nature to appoint an Interface Manager in the Engineer's team who has responsibility for ensuring that interface planning and related communications are delivered as required by the procedures and requirements.

88. *In relation to the requirement for the stitch joints to be cast as late as possible in the construction sequence as set out in Drawing No. 1112/B/000/ATK/C11/101A at Note 2* [**BB1/463**]*, there does not appear to be any issue between the parties about the timing of when the work was carried out* **[T10/97:9-101:19, Michael Fu] [CA1/Tab 1, COI Closing §7]**. *The requirement is however, in my opinion, poorly worded as it is not sufficiently specific and does not define the engineering basis on which the timing should be determined. There was a potential risk that the parties may not have agreed on the requirement.*

89. *Overall, in relation to the planning and execution of the interface works, there were in my opinion, failures by MTRCL and Leighton in respect of communications, preparation of a detailed methodology, supervision, inspections, training in the use of couplers, and in failing to order the appropriate steel reinforcement.*

Issue F: Testing of Reinforcement Steel

90. The Extended Inquiry has heard evidence from Mr Karl Speed, Director of Leighton, that of the 57,000 tonnes of rebar used on the entire project, approximately 7% of the rebar was not tested by a HOKLAS certified laboratory [**WS6, Karl Speed, CC6/3761, §60**] [**T8:40:19-42:7; 60:21-63:20, Karl Speed**]. There has also been evidence of minor failings in the testing of other materials

but this does not appear to have been any more than would be expected on a typical project and so I have focused solely on the testing of steel.

91. The requirements for the testing of reinforcement steel were explained in the witness statement of Mr Lok Pui Fai, BD Senior Structural Engineer **[WS5, Lok Pui Fai, DD9/12281-12282, §§16-19]**. His evidence refers to the application of Construction Standard CS2:1995 - Carbon Steel Bars for the Reinforcement of Concrete ("**CS2:1995**") [**H10/4751-4786**] and the Building Department's Practice Note for Authorised Persons and Registered Structural Engineers, PNAP-45 (Testing of Reinforcement for Concrete)("**PNAP-45**") [**H10/4787-4789**].

92. PNAP-45 states at paragraph 6 [**H10/4788**] that "For steel reinforcement other than carbon steel bars, every batch of steel delivered to the site should be tested to verify the mass, bend and tensile properties…". Reinforcement bar is made of carbon steel as set out in CS2:1995 [**H10/4751**]. This would indicate that not every batch of normal carbon steel delivered to site should have been required to be tested in order to comply with PNAP-45.

93. The different classes of reinforcement are set out in paragraph 2 of Appendix A to PNAP 45 [**H10/4789**] as follows; "Reinforcement produced by Quality Assured Manufacturers and handled by a QA Stockist will be classified either Class 1 - fully lot traceable, or Class 2 - not lot traceable. Reinforcement produced by non-Quality Assured manufacturers will be classified Class 3. Reinforcement not handled through a QA Stockist will also be classified Class 3 irrespective of whether it is quality assured material or not". My understanding is that the reinforcement steel used on Contract 1112 was Class 1 as it came with mill certificates and should therefore, have required less frequent testing.

94. The section on Quality Assurance in CS2:1995 at paragraph 11 [**H10/4753**] states that the frequency of testing [for reinforcement delivered to site before it is used in the construction work] will depend on the classification of the reinforcement; less frequent testing for Class 1 reinforcement where much is known about the manufacture and testing history; an increasing frequency of testing for Class 2 and Class 3 reinforcement where less is known about the quality of the

reinforcement. (I understand that the latest revision of CS2, CS2:2012, has deleted Class 3 reinforcement)[1].

95. Paragraphs 12 and 13 of the foreword to CS2:1995 [**H10/4753**] set out that the long-term objective is to rely on the third-party certification of product conformity based on testing and continuous product surveillance and on the quality assurance of the stockists. The aim (as set out in CS2:1995) is that the QA scheme would allow the purchaser to know the quality of the reinforcement being received and would not need to carry out further testing for quality assured reinforcement. CS2:1995 sets out, however, that during the initial stage of introducing the scheme, the end purchaser testing of quality assured reinforcement should continue.

96. CS2:1995 requires that all reinforcement arriving on site shall be tested by the purchaser; that all tests shall be performed by a laboratory accredited by HOKLAS and for the purpose of testing, the reinforcement is to be subdivided into batches. Each batch shall consist of reinforcement of the same steel grade and the same nominal diameter. Test specimens shall be taken from each batch and the rate of testing shall be in accordance with Table 9 [**paragraph 5.1.1, H10/4777**].

97. Table 9 of CS2:1995 [**H10/4778**] sets out the number of test specimens required per batch of steel reinforcement. In respect of Class 1 reinforcement, the testing requirement is basically as follows:

a. 3 specimens to be tested for tensile strength per batch of up to 60 tonnes for bars of nominal size 6mm to 16mm; per batch of up to 80 tonnes for bars of nominal size 20mm to 32mm; and per batch of up to 100 tonnes for bars of nominal size > 32mm.

b. For batches exceeding those tonnages an additional specimen is to be tested for each 60/80/100 tonnes respectively for the different bar sizes.

My observations on the testing of reinforcement steel

98. *I understand that CS2:1995, which applied to this project, has been superseded by CS2:2012 but based on Mr Lok Pui Fai's evidence, it does not appear that the*

[1] https://www.cedd.gov.hk/filemanager/eng/content_77/cs2_2012.pdf

updated standard was applied to the project following its publication. My comments are based on the requirements of CS2:1995 although some of the issues I raise are addressed in the updated standard CS2:2012.

99. *The testing of reinforcement steel as set out in CS2:1995 and PNAP-45 is based on batches. There is however, no formal definition of a batch, the descriptions of a batch in the two documents are not fully aligned and the two documents appear to be inconsistent in relation to the frequency of testing:*

a. *CS2:1995 sets out a procedure for subdividing reinforcement into batches consisting of reinforcement of the same steel grade and the same nominal diameter* [**paragraph 5.1.1 and Table 9, H10/4777-4778**]. *PNAP-45 refers, however, to the testing of every batch of steel delivered to the site indicating that a batch is a delivery load of steel* [**paragraph 6, H10/4788**].

b. *PNAP-45 indicates that not every batch of steel delivered to site needs to be tested* [**paragraph 6, H10/4788**]. *CS2:1995 however, sets out sampling rates for each batch of steel, without being clear on exactly what comprises a batch* [**paragraph 5.1.1 and Table 9, H10/4777-4778**].

100. *I understand that in the latest version of CS2 (CS2:2012), published in 2012, a definition of batch has been included as follows* [**paragraph 1.2.1**]*:*

- *Definition of 'batch' for purchaser testing:*
  - *the quantity of steel reinforcing bars delivered to site within a week under one delivery order, of one nominal diameter, and one steel grade and produced by the same manufacturer;*
  - *≤ 200 tonnes for bars of diameter ≥ 20 mm;*
  - *≤ 100 tonnes for bars of diameter < 20 mm.*

I note that the new definition relates a "batch" to the quantity of steel delivered from the same source under one delivery order within the period of one week. I am not clear what difference the new definition of a batch would have made to the quantity of steel that needed to be tested on Contract 1112 but it would appear that it could have led to a reduction in the testing required. The introduction of this new definition should clarify the position in the future.

101. *I note that the HK Government's Construction Standard (CS2:1995) and BD's Practice Note (PNAP-45), published in 1995 and 1996 respectively, set out that the long-term objective is to rely on the third-party certification so that the quality of*

the reinforcement is known and would not need further testing by the purchaser. The purchaser testing arrangements set out in CS2:1995 were said to be an initial arrangement covering the introduction of the scheme. It appears that 24 years later, the initial arrangements are still in place, despite the publication of CS2:2012, and the long-term objective of avoiding the need for further testing has still to be achieved. There would, in my opinion, be clear benefits in achieving the stated objective; efficiency in the processing and use of reinforcement steel, and maximisation of steel utilisation, leading to reduced wastage as well as reduced cost of materials whilst maintaining product integrity and reduced administration costs. In the UK, this has been achieved through the Certification Authority for Reinforcing Steels (CARES) scheme[2], and I understand that as of February 2019 the scheme is now available in Hong Kong[3].

102. *Despite the long-term objective not yet being achieved, I would have expected to have seen some progress towards reduced purchaser testing over the intervening years. Where steel from specific sources is reliably and consistently achieving successful test results, I would have expected the specifications to have been developed to allow a reduced level of testing to deliver benefits in the form of more efficient working and reduced costs.*

103. *The position is however, that the Contractor has accepted that approximately 7% of reinforcement was not tested as required by the specification* [**DD12/13667**]. *The only explanation I have seen for this was provided by Mr Henry Lai of Leighton who said in his witness statement that he did not arrange for the sampling and testing of 56 batches. He said this was because his workload got very heavy later on and he did not have time to arrange for the testing of the remaining batches. He said he was constantly busy supervising the works in order to meet the progress, completing inspections and attending to other necessary tasks to avoid causing delay to the works* [**WS2, Henry Lai, CC6/3789, §16**]. *As I set out earlier in my report, senior managers in both the Contractor's and the Engineer's organisations had responsibilities to ensure that the Works were being adequately resourced.*

104. *I find it surprising that MTRCL did not have more robust procedures in place to ensure that it was aware of steel deliveries to site and to verify that the testing of*

[2] **https://www.ukcares.com/about**
[3] **https://www.ukcares.com/news/article/10108**

the steel had been requested. MTRCL should have been aware that material had been ordered because paragraph G15.1.6 of the General Specification provides for the Contractor to forward to the Engineer copies of all internal and external orders placed by the Contractor for Plant and Materials at the time of issue. All orders are required to state the Engineer's requirements for inspection and testing and also to state the sub-section of the works for which the Plant and Materials are required [**C3/2130**]. *This provision should in my opinion, have alerted the Engineer to the testing that would be shortly required on delivery of the materials.*

105. *In the cross-examination of MTRCL's Mr Michael Fu, he said that if the Contractor did not inform MTRCL that rebar had been delivered to site then it would rely on MTRCL's inspectors noting the new materials during their daily patrols* [**T10/123:1-124:23, Michael Fu**]. *It should in my opinion, have been possible to develop a more robust procedure to ensure that both parties were aware of materials being delivered to site which required testing.*

106. *Mr Henry Lai's evidence raised another issue about the steel and this was that steel was available for use in the Works before the test results were known* [**T5/127:13-128:14, Henry Lai**]. *This indicates a failure in the Contractor's quality assurance procedures and also a failure by MTRCL to ensure that arrangements were in place to prevent this practice from happening. It is normally straightforward to segregate tested steel from steel that is either awaiting testing or awaiting test results. Normally the use of colour coding, as applied on this project* [**T9/28:16-29:3, Joe Tam**]*, works effectively to identify tested materials provided that steps are taken to separate out the batches and the MTRCL's site teams were familiar with the colour coding system* [**T11/116:19-20, Chris Chan**]. *I understand from Mr Joe Tam's evidence that following some initial problems of a lack of separation of tested and untested batches, the storage arrangements were improved to reduce the risk* [**T9/29:4-18, Joe Tam**]. *This would also, in my opinion, have been something that should have been identified by the Engineer's site team and if necessary the Contractor ought to have been instructed to remedy the arrangements.*

107. *Overall, I am of the view that whilst the specific testing requirements for the Contract were not fully achieved, the successful testing of 93% of the steel delivered to the site should give a good degree of confidence that the reinforcing steel used in*

the project has met the required standards. I understand that all of the steel that was tested achieved the specified requirements and the structural review under the Verification Study concluded that no "suitable measures" (as defined in §15 *of the Executive Summary) are required as a result of the deficiencies in the rebar testing* [**Verification Report, §§3.1.9 and 5.3, BB16/9965 and 9980**]. *The use of quality assured and certified steel from accredited mills in other countries has significantly reduced the required level of on-site testing.*

REPORT PART 2: ADEQUACY OF THE GOVERNMENT'S MONITORING AND CONTROL MECHANISMS

108. In my Original Report, I considered aspects of the issues under investigation that either involved Government directly or where there was an interface with Government **[Part 2, my Original Report**]. I set out my opinion in the report on how systems for supervision, monitoring, control and management could be strengthened. I set out a range of recommendations including, in relation to the Government's organisation to support project delivery, project monitoring arrangements, conflicts of interest policy, rationalisation of documents, strengthening of the Project Management Plan and clarification of design submission requirements [**Part 3, my Original Report**].

109. The Government responded positively to the recommendations in my Original Report. I was also pleased to note that the Government had already commenced a number of initiatives to make improvements to site supervision and communications in the light of the issues that were investigated in the Original Inquiry [**§§153-154, 160-161, Government's Closing**].

110. I consider that the suggestions and recommendations I put forward in my Original Report are equally applicable based on some of the matters investigated in the Extended Inquiry and I will not repeat those recommendations in this report. I do however, set out below new and emphasised matters arising from the evidence presented during the Extended Inquiry.

The role of Pypun, the Monitoring and Verification (M&V) Consultant

The scope of the M&V role

111. *PYPUN-KD & Associates Limited's ["**Pypun**"] role was discussed in the Original Inquiry* [**§§447-449, Commission's Interim Report**] [**§§122-128, my Original Report**]. *From a project management point of view, I do have an ongoing concern about the definition and adequacy of the role that Pypun was required to perform. My concern relates to whether the M&V role was sufficiently comprehensive to provide the Government with adequate confidence that the project was being delivered in accordance with the required procedures and standards. I also have a*

concern that the services Pypun delivered during the course of the Contract may have been driven by the resources that were available rather than being based on everything that the Government needed. This should not be taken as a criticism of Pypun and I have no reason to doubt that they performed the required services diligently and professionally.

112. *My concerns about the adequacy of Pypun's role are best illustrated by reference to the witness statement of Yueng Wai Hung, Director of Pypun* [**WS2 of Yueng Wai Hung, GG1/26-51**].

113. *Pypun's roles and responsibilities are set out in §§ 7 & 8 of his witness statement* [**GG1/27**] *and are repeated frequently in the statement using the phrase "cost, programme and public safety". At §§ 12 and 20* [**GG1/28 & 29**], *Mr Yueng states that these matters are clearly unrelated to construction quality or construction record keeping. I do not agree with that statement as, in my opinion, poor construction quality leading to the need for remedial works could have an impact on the cost of the works and also on the programme. Liability for the cost will depend on the provisions of the Contract and any relevant sub-contracts and whether the costs are classified as Disallowed Costs. Depending on the circumstances, the cost of remedial works may not be classed as disallowed under the Target Contract and could fall to the Government. I note that Pypun's Monitoring Plan* [**K1/146-179**] *makes no mention of Disallowed Costs in its monitoring process.*

114. *Construction record keeping (as mentioned in §§12 and 20 of Mr Yueng's witness statement)* [**GG1/28 & 29**] *has an important role in relation to maintaining discipline in quality assurance procedures and also in supporting contractual and commercial decisions. Where work is not undertaken correctly and has to be remedied or repeated then record keeping will help to inform decisions by the Engineer, relating to liability and commercial entitlement. The lack of adequate records may in my opinion, have an impact on the outcome of claims and could impact on the Government's commercial position. On this basis, record keeping could have an impact on aspects of cost, programme and public safety and should in my opinion be a role of the M&V Consultant.*

115. *I also have concern about Pypun's view that construction quality has no linkage to public safety. At § 81 of his witness statement* **[GG1/43]**, *Mr Yueng states that "public safety" under the M&V Agreement meant safety to the public when the construction works for the Project are being carried out, and not quality or integrity of the permanent works constructed. This is not based on a definition in the M&V Agreement but is based on the explanation provided on page 4 of the Inception Report* [**K1/45**] *which was produced by Pypun. It appears that this was Pypun's interpretation rather than a definition clearly set out by the Government, although they did not appear to disagree with Pypun's view at that time. I also note however, that in § 65 of his witness statement* [**GG1/38**], *Mr Yueng referred to a tender for a similar M&V role on the subsequent XRL project, in which the Government changed the wording of the role to cover "cost, programme, safety and quality" rather than "cost, programme and public safety" as applied on the SCL project. This indicates to me that the Government may have recognised that construction quality is a necessary part of the M&V role* **[see also §§137-145, Government's Closing]**. *I would support that view.*

M&V Resource Levels

116. *In § 80 of Mr Yueng's witness statement* [**GG1/42**], *he states that while Pypun's work was very extensive, it did not (and could not) cover all monitoring and verifying of all works on this very large and complex project. It is necessary however, to have access to sufficient resources and to have flexibility in resources to provide a reasonable degree of confidence that the work is being delivered in line with requirements. I do not know what steps the Government took to ensure that Pypun had sufficient resources to undertake the work that could arise from the project. In my opinion, it is a fundamental part of the appointment procedure by an Employer to ensure that a service provider has the necessary capacity and capability to deliver the required services. Whilst I accept it is not feasible to verify everything on a project of this scale, it does appear that there are some aspects which may have benefitted from more audit and verification. I am concerned that there was a risk that the level of services could in part have been constrained by Pypun's resource capacity although I have not seen any evidence to confirm this was the case.*

117. *My level of concern about resources is raised further because the scope of Pypun's services increased substantially following their initial appointment. As set out in the new §32 in the corrigendum to his witness statement* [**GG1/51.2**]*, Mr Yueng states that 100 contracts were originally envisaged in the Verification Plan. This was subsequently increased substantially by the Government to 340 contracts, which are detailed in §80 of his witness statement* [**GG1/42-43**].

118. *In view of this large increase, I would have expected the Government to satisfy themselves that Pypun had the necessary resources to fulfil the role. If Pypun did not have sufficient resources then there was a significant risk that the level of monitoring and assurance could have been below desirable levels. In view of the scale of the project and the numbers of contracts to be monitored, an alternative option could have been to appoint an additional M&V consultant to work alongside Pypun to provide greater flexibility of resource.*

119. *I was also concerned to note the position on the reimbursement of the M&V Consultant which was raised with Mr Yueng during his cross-examination at the Extended Inquiry. On Day 15 of the hearing of the Extended Inquiry, in response to Mr Pennicott's question as to whether Pypun was paid an increased amount of remuneration for the increased number of contracts within the scope of Pypun's role, Mr Yueng replied "unfortunately no"* [**T15/32:16-19, Yueng Wai Hung**]. *I do not know the detail of Pypun's contract, but in my opinion a contract is unlikely to be very successful where it requires a service provider to deliver a significantly higher volume of work without additional compensation. The incentive on a service provider in those circumstances is likely to result in resources being stretched as thinly as possible and seeking to minimise the level of additional resources to be provided. I am not saying that is what happened on this occasion, but that is a risk of that type of approach. In my opinion, contracts should contain fair provisions for reimbursement to ensure that required levels of service are not put at risk by the commercial arrangements.*

The M&V risk-based approach – interface risks

120. *It appears to me that there was a lack of clarity in relation to the strategic risks identified by Pypun which were used to focus their resources, particularly in relation to interface risks. At §16 of his witness statement* [**GG1/29**]*, Mr Yueng sets*

out that Pypun adopted a risk-based approach to its work. At §14 of his witness statement [**GG1/28**]*, Mr Yueng sets out that the Pypun's Monitoring Plan stated that contract interfaces were a readily identifiable key risk* [**K1/156, Section 2.2.1]**. *However, contract interfaces are not included in the Strategic Risk Groups which Mr Yueng lists at §35 of his witness statement* [**GG1/32**]. *The list he provides includes "interfaces with the Operational Railway" but not "contract interfaces".*

121. *I also note that the list of Strategic Risk Groups set out in the Monitoring Plan at Section 2.2.2* [**K1/157**] *is different to that identified by Mr Yueng at §*35 *of his witness statement* [**GG1/32**]. *The list in the Monitoring Plan includes "Interfaces"* [**K1/157**]. *In addition, Section 4.1.2 of the Monitoring Plan* [**K1/162**] *states that a key aspect of this project is the interfaces between contractors, both internal and external to the project, and Pypun will review this aspect carefully. Overall, it is not clear to me therefore, whether contract interfaces were considered to be a key strategic risk or not, and what actions Pypun took to monitor them. In my opinion, contractual interfaces should have been identified as a key risk particularly as there are 340 contracts with numerous interfaces. The industry generally recognises that contract interfaces are a high risk and clients typically put in place resources and measures to manage them. Whilst Pypun would not have been able to monitor all contract interfaces, it could have prioritised those where interface risks were the most complex.*

The M&V's role in relation to the NAT defective stitch joints and replacement works

122. *According to the Chronology provided by the Government, Pypun became aware of the defective stitch joints in March 2018 and that demolition and replacement works were required* [**DD14/15213/item 5**] [**see also WS2, Yueng Wai Hung, §91**]. *I would have expected however, for lines of communication to be in place to ensure that the M&V Consultant was informed that a major problem had arisen requiring replacement work particularly as I understand that Leighton has estimated the replacement works to cost around $50 million* [**T6/159:16-22, John Kitching**] *and the work extended over several months. If Pypun had been made aware, I would have expected them to make inquiries about cause and liability as*

it was possible that all or some of the costs would fall to the Government and that the remedial works could have impacted on the completion programme.

123. *At §90 of his witness statement* [**G1/44**]*, Mr Yueng states that prior to about March 2018, Pypun had no role or responsibility to identify, discover or investigate Issue 1 being considered as part of the Extended Inquiry. I do not fully agree with that statement because when the problem was discovered, the cause, and hence liability for it, was not known. There was the potential, therefore, for the Government to face significant additional costs and also potential delays to the programme. In the circumstances, I consider that it would have been reasonable for Pypun to have taken a proactive approach and suggested to the Government that investigations should be made to understand the issues before remedial work was undertaken.*

124. *At §§ 62 and 89 of his witness statement* [**G1/38 and 44**]*, Mr Yueng states that there was no reason why a site inspection or audit of the construction works concerning any stitch joints should have taken place prior to the problems being discovered. As set out above, however, Pypun did identify contract interfaces as being a key risk and so it would seem reasonable to expect that site inspections would have been undertaken at some contract interfaces. In addition, there would also appear to be a good case for inspections and investigations to have been made of the defects and replacement works after the problems had been discovered.*

The Government's expectation for a proactive approach from the M&V Consultant

125. *In §§ 67-70 of his witness statement* [**GG1/39**]*, Mr Yueng discusses the requirement for the M&V Consultant to act proactively and this was also discussed in the Original Inquiry* [**§§448-449, Commission's Interim Report**]*. Mr Yueng states that Pypun was not obliged to go in search of potential issues over and above those that could be identified when it was performing its duties. He also states that in the circumstances of the project, being proactive could only mean the speed in which issues identified by Pypun were followed up. I do not fully agree with these statements as it appears to me that the Government was expecting more than this when it said it wanted Pypun to act proactively. On the basis of Pypun's interpretation, they would in reality only be reacting to issues after they have*

arisen. This could not have been the intention of the Government in engaging a M&V Consultant.

126. *I would accept, however, that the scale of the role, complexity of the project and the constraints on the level of available resources would have made a more proactive approach by Pypun difficult to achieve. In my opinion, the Government included the requirement for being proactive without clearly defining what it expected in this respect. There was a risk that without being clear at the outset of the contract, then the M&V Consultant would not have been able to determine what further resources may have been required to deliver the Government's expectations. It may be that the Government was expecting too much of the single M&V consultant when it set out its Brief for the role. In my opinion, the Government needs to ensure that expectations set out in briefs for services of this nature are very clear in terms of what is expected from service providers.*

My observations on the Government's scrutiny of Project Management Plan

127. *In my Original Report I expressed my opinion that the Government should exercise greater scrutiny over draft PMPs on projects of this nature to ensure that they provide clarity on requirements without extensive cross-referencing to generic documents. I suggested that the M&V Consultant or a similar Project Representative role could be used to review draft PMPs as part of the Government acceptance procedures* [§§**139-140, my Original Report**]. *I also indicated in §141 of my Original Report some other aspects of project delivery which should in my opinion be included in the PMP but which were not included in the Contract 1112 PMP.*

128. *Based on the evidence presented to the Extended Inquiry, other aspects of the PMP which in my opinion are lacking include:*
    a. *No specific mention of interface risks which are identified as a key process in PIMS procedural documents.*
    b. *No reference to resource management or job specific training requirements.*
    c. *The role of leaders in establishing the appropriate culture and behaviours in relation to safe and compliant working procedures and establishing effective lines of communication.*

129. *In my opinion, the Government should put in place measures to monitor the ongoing implementation of the PMP and, in particular, to focus on the leadership role and the management and development of resources. I consider that it would be desirable to require MTRCL to provide a quarterly report on the actions that the senior management of MTRCL are taking to embed the desired culture and behaviours.*

REPORT PART 3: OPINION ON HOW SYSTEMS FOR SUPERVISION, MONITORING, CONTROL AND MANAGEMENT MAY BE STRENGTHENED

130. Based on my opinions set out in Parts 1 and 2 of this report, I set out below my recommendations for actions that I consider would help strengthen existing supervision, monitoring, control and management systems. These actions should be read in conjunction with the actions I identified in my Original Report which I have not repeated below but there may be a degree of overlap. I have classified the actions into various categories for ease of presentation.

Leadership and Culture

131. MTRCL should review and reflect on the priorities that it has identified for their top management particularly in relation to culture and the application of corporate procedures. MTRCL should review how effectively the leadership priorities set out in PIMS/MAN/003/A6 at paragraph 3.1 **[B3/1080-1081]** are being achieved. MTRCL should develop an improvement action plan to maintain progress in the implementation of the leadership priorities.

132. MTRCL should consider how successful the leadership has been in embedding throughout the organisation, the culture and behaviours which flow from the leadership priorities set out in PIMS/MAN/003/A6. It would be desirable to establish a method for monitoring and measuring company culture on an ongoing basis.

133. Senior leaders should develop a coordinated programme of office and site visits to support the communication of corporate values, behaviours and priorities directly to MTRCL staff throughout the organisation.

134. MTRCL should review its processes for monitoring resource levels throughout the organisation and identifying potential pressure points. It should ensure that:
    a. line managers at all levels are applying systems to measure the performance of individuals in relation to the application of required quality procedures and are reporting the findings to top management;

b. individuals are encouraged to report resource pressures which may put the implementation of quality procedures at risk; and
c. line managers should consult with senior managers about priorities in the event that resource pressures are identified.

RISC Form and Inspection Procedures

135. MTRCL should investigate and introduce new technology-based RISC form procedures which can be implemented by site staff using portable devices such as tablets. MTRCL should ensure that roles and responsibilities in relation to the RISC procedures and the recording of results are clear and communicated to all those involved in the procedures on a project specific basis.

136. Requirements relating to RISC form procedures and inspections are set out in a number of different documents. MTRCL should consider whether it would be beneficial to pull the information together into a single source covering requirements on individual projects.

137. MTRCL should review and clarify procedures in relation to inspections which are not formal hold-points. Ideally procedures for informal and formal procedures would be administered and recorded using the same technology and systems.

138. MTRCL should review its arrangements for ensuring that its site staff have access to the latest working drawings to support more reliable surveillance and inspections of the works. It is likely that this would be best facilitated through the use of technology solutions and mobile devices.

139. MTRCL should consider ways of improving the forward planning of formal inspections. Forward programmes should be informed by the notice periods provided by the submission of Inspection and Test Plans. The plans should be used to support MTRCL's resource planning and to monitor when inspections are expected and ensure that they are being requested and completed.

140. MTRCL should review responsibilities and procedures for ensuring that non-compliances with procedures by the Contractor are addressed promptly and that action is taken to remedy non-compliances. MTRCL should ensure that

responsibility is clearly seen to lie with the Engineer and that appropriate action is taken in accordance with the provisions of the contract.

Training and Development of Staff

141. MTRCL should review its training strategies and plans to ensure that staff are being provided with the necessary training required to perform their roles effectively. Individual training and development plans should be maintained and regularly updated to ensure that they develop the necessary skills and competences for the tasks they are performing.

142. Training modules on PIMS procedures should be developed which align with the requirements of individual roles. Training for different roles should focus on specific PIMS procedures which are of particular relevance to the role.

143. MTRCL should maintain a readily accessible system which records training undertaken and qualifications achieved by individuals. A system that links required skills, competences and qualifications to individual roles and duties within project teams would be highly desirable. The system should be used to confirm that individuals allocated to key tasks have completed necessary training schemes including the use of technical components specific to the project.

144. Induction training for new staff should be reviewed to ensure that it is effectively covering corporate culture, values and behaviours. The importance of working within MTRCL's quality management system should also be covered. Induction training should be mandatory and opportunities found to refresh the messages at regular intervals.

145. As part of the development of project staff, line managers should implement mentoring arrangements for team members which would include them being accompanied on occasions by experienced staff whilst they become familiar with their roles and the tasks they are performing. This should be used to identify any weaknesses in their technical or procedural knowledge and to identify requirements for training and development.

146. MTRCL should assess the understanding throughout project organisations of the understanding of non-contractual project partnering where it is applied to projects. Where necessary, further direction and training should be provided on the behaviours expected of staff working in a partnering environment. It should be emphasised that partnering arrangements are not an excuse for failing to implement specified procedures.

PIMS Procedures and Documentation

147. MTRCL should review its arrangements for training staff in the use of PIMS and seek to ensure that training modules are focused as closely as possible on the roles of individuals. Training should cover the procedures to be followed and also provide an understanding of the importance of applying quality procedures.

148. MTRCL should review its arrangements for communicating updates and revisions to staff and should develop procedures for targeting relevant staff who are mainly responsible for implementing new guidance and procedures.

149. PIMS procedural document PIMS/PN/11-4/A6 Monitoring of Site Works includes requirements for the issue of Non-conformance Reports. MTRCL should review this guidance to ensure that it is consistent with BD's Code of Practice for Site Supervision.

150. MTRCL should review its requirements for site record keeping and develop clearer and more comprehensive guidance which is communicated effectively to site staff. This should be supported by technology solutions and devices which make the procedures as simple and as efficient as possible.

151. MTRCL should review and update PIMS guidance on the use of photographs as a record of works inspections. This should ensure that photographic records are controlled and stored in a structured system.

152. MTRCL should consider the development of a PIMS manual on the development of project communication strategies setting out roles, responsibilities, systems and reporting requirements.

Project Management Plans

153. MTRCL, in liaison with the Government, should review the content and use of Project Management Plans and ensure that they are effectively performing the role expected of them. Consideration should be given to including sections in PMPs on the following:
    a. resource planning;
    b. training and development plans for project purposes;
    c. project communication strategies;
    d. interface risk management; and
    e. leadership roles in establishing appropriate culture and behaviours.

MTRCL Organisational Roles

154. MTRCL should consider and clarify roles and responsibilities in relation to their obligations as Project Manager in delivering Entrustment Activities and also as Engineer to the Contract. In particular, clarification and guidance should be given to project team members in relation to reporting and communication requirements both internally within the MTRCL organisation and externally with the Contractor and stakeholders.

155. MTRCL should review its systems and procedures for escalating problems and disputes up through the organisation to senior management. Senior management should encourage the reporting of issues where there may be doubt about whether to elevate them, so that senior management can consider their significance and decide whether to get involved.

Interface Risk Management

156. MTRCL should ensure that interface risks are generally treated as potential key risks in its procedural documents, risk management and reporting procedures.

157. Interface management meetings should ensure that actions are clearly allocated and communicated to the responsible individuals. Meeting notes containing relevant information about interface issues should be communicated to all

members of site teams who may be involved in the execution and supervision of the interface works.

158. Consideration should be given, where appropriate, to holding interface workshops attended by relevant site team members, to ensure that the works are adequately planned and risks are identified and mitigated.

159. MTRCL should ensure that method statements are required from contractors for the execution of works at interfaces.

160. MTRCL should consider the appointment of a project interface manager in the Engineer's team who has responsibility for ensuring that interface planning and communications are delivered as required.

Steel Testing

161. MTRCL should develop procedures for ensuring that the Engineer's team is notified by the Contractor that a delivery requiring testing has arrived on site.

162. MTRCL should ensure that requirements are included in contracts to achieve effective segregation on site of tested and untested steel to avoid the risk of untested steel being used in the works.

Investigating Failures

163. MTRCL should review its procedures for reviewing problems that have occurred and learning lessons to avoid them being repeated. In the case of the need for major remedial works there should be an automatic requirement for an investigation to the causes of the problems.

Government Related Enhancements

164. The Government should review and confirm its requirements for as-built records particularly in relation to the need for hard copies of RISC forms. The review should take account of the development of the increasing use of technology to

create drawings and records and should ensure that requirements can be met as efficiently as possible.

165. The Government should review its Consultation procedures in relation to design revisions and clarify arrangements for fast-tracking the Consultation process for minor design changes.

166. The Government should review its requirements in relation to Project Management Plans and should ensure that they cover all of the key aspects that need to be in place to achieve successful outcomes. Consideration should be given to inclusion of the additional contents suggested in the section above on PMPs.

167. The Government should review the way that liaison and communications have worked between RDO, BD and MTRCL. Consideration should be given as to whether the aim of a partnering approach to facilitate close communication on technical and project management issues as set out in the PMP has been achieved. Ways of improving communications and working relationships should be explored, such as more frequent site visits at a working level by members of RDO and BD.

168. The Government should review its requirements for the testing of steel that has been delivered to sites from quality accredited sources in line with the long-term objectives set out in CS2:1995.

169. In relation to the role of the Monitoring and Verification consultant, the Government should consider the following:

a. The M&V role should include construction quality and checks on construction records as failures in these areas can impact adversely on cost, programme and safety.
b. The Government should review its procedures for satisfying itself that the M&V consultant has sufficient resource capacity and flexibility of resource to deliver required services.
c. The Government should review its commercial arrangements for M&V contracts to ensure that they do not act as a disincentive to the delivery of comprehensive services. The Government should ensure that contracts provide a fair return for a good service.

d. The Government should consider on major complex contracts whether there could be benefit in appointing more than one M&V consultant to provide more flexibility and resilience of resource in delivering requirements.

e. The Government should ensure that M&V consultants treat interface risks as potential key risks as part of their risk-based approach to the identification of review priorities.

f. The Government should consider ways of ensuring that M&V consultants are advised promptly of construction problems and defective work which may require remedial works and could have significant cost and programme implications. This could include the possibility of the M&V consultant having an entitlement to sit in on Project progress meetings not normally attended by the Government.

Expert's Declaration

I, STEVE ROWSELL DECLARE THAT:

1. I declare and confirm that I have read the Code of Conduct for Expert Witnesses as set out in Appendix D to the Rules of High Court, Cap. 4A and agree to be bound by it. I understand that my duty in providing this written report and giving evidence is to assist the Commission. I confirm that I have complied and will continue to comply with my duty.

2. I know of no conflict of interests of any kind, other than any which I have disclosed in my report.

3. I do not consider that any interest which I have disclosed affects my suitability as an expert witness on any issues on which I have given evidence.

4. I will advise the Commission if, between the date of my report and the hearing of the Commission, there is any change in circumstances which affect my opinion above.

5. I have exercised reasonable care and skill in order to be accurate and complete in preparing this report.

6. I have endeavoured to include in my report those matters, of which I have knowledge or of which I have been made aware, that might adversely affect the validity of my opinion. I have clearly stated any qualifications to my opinion.

7. I have not, without forming an independent view, included or excluded anything which has been suggested to me by others, including my instructing solicitors.

8. I will notify those instructing me immediately and confirm in writing if, for any reason, my existing report requires any correction or qualification.

9. I understand that:
   (a) my report will form the evidence to be given under oath or affirmation;

(b) questions may be put to me in writing for the purposes of clarifying my report and that my answers shall be treated as part of my report and covered by my statement of truth;

(c) the Commission may at any stage direct a discussion to take place between the experts for the purpose of identifying and discussing the issues to be investigated under the Terms of Reference, where possible reaching an agreed opinion on those issues and identifying what action, if any, may be taken to resolve any of the outstanding issues between the parties;

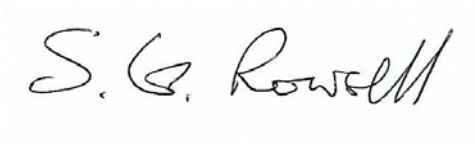
(d) the Commission may direct that following a discussion between the experts that a statement should be prepared showing those issues which are agreed, and those issues which are not agreed, together with a summary of the reasons for disagreeing;

(e) I may be required to attend the hearing of the Commission to be cross-examined on my report by Counsel of other party/parties;

(f) I am likely to be the subject of public adverse criticism by the Chairman and Commissioners of the Commission if the Commission concludes that I have not taken reasonable care in trying to meet the standards set out above.

Statement of Truth

I confirm that I have made clear which facts and matters referred to in this report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. I believe that the opinions expressed in this report are honestly held.



Steve Rowsell

23rd August 2019

Appendix – CV

- *As provided in my Original Report.*