Commission of Inquiry into the Construction Works at and near the Hung Hom Station Extension under the Shatin to Central Link Project

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FIFTH WITNESS STATEMENT OF KARL SPEED

I, **KARL SPEED** of 39/F Sun Hung Kai Centre, 30 Harbour Road, Hong Kong, say as follows:

1. I am the General Manager of Leighton Contractors (Asia) Limited ("**Leighton**"), the main contractor for the Hung Hom Station Extension contract (Contract SCL 1112) (the "**Project**") under the Shatin-Central rail link project. The project manager for the Project is MTR Corporation Limited ("**MTRCL**").

2. I am authorised to make this statement in response to Lo & Lo's three letters dated 26 March 2019 ("**Letters of 26 March 2019**") in my capacity as a director of Leighton.

3. I set out below a response to Issues 1 and 2 (as defined in the Letters of 26 March 2019).

4. Unless otherwise stated, the facts stated herein are within my personal knowledge and are true. Where the facts and matters stated herein are not within my own knowledge, they are based on the stated sources and are true to the best of my knowledge, information and belief.

Response to Issue 1: Three defective stitch joints at NAT

General – NAT area

5. The major construction works at the North Approach Tunnel ("**NAT**") involved building the North South Line ("**NSL**") tunnel box and East West Line ("**EWL**") rail track trough.

6. The simplified sectional drawings for the NAT and the Shunt Neck detailed four stitch joints that were required to be constructed, and the working drawings provided the full details of the construction that was required. These were as follows:

   a. a stitch joint at the NSL level at the interface of Contract SCL1111 and Contract SCL1112 (the "**NSL Stitch Joint 1111/1112**");

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b. a stitch joint at the NSL level between bay 5 and bays 6/7 of the tunnel structure within Contract SCL1112 (the "**NSL Stitch Joint 1112/1112**"); and

c. a stitch joint at the EWL level at the interface of Contract SCL1111 and Contract SCL1112 (the "**EWL Stitch Joint**"),

(the above three stitch joints are together referred to as the "**NAT Stitch Joints**"); and

d. a stitch joint at the Shunt Neck at the interface of Contract SCL1111 and Contract SCL1112 (the "**SNJ**") (although this subsequently was amended to a construction joint, as detailed in paragraphs 59 to 62).

7. The NAT Stitch Joints and the SNJ were the only stitch joints of this nature to be constructed on the Project, including at the interface with other projects.

8. The approved sequence for the initial construction works at the NAT, prior to the construction of the NAT Stitch Joints and SNJ, was as follows (with the party responsible for each step listed in brackets):

a. installation of pipe piles and grouting to form a temporary cofferdam by Leighton's specialist foundation sub-contractor (Wan Kei Geotechnical Eng. Co Ltd ("**Wan Kei**"));

b. installation of king posts to form permanent foundations and temporary excavation and lateral support by Leighton's specialist foundation sub-contractor (Falcon Construction Engineering Limited ("**Falcon**"));

c. dewatering and pump test of the temporary cofferdam to verify effective water cut off (Wan Kei);

d. submission of as-built record plans for pipe piles and pumping test results by Leighton to MTRCL, and from MTRCL to Buildings Department ("**BD**") (Leighton / MTRCL);

e. excavation down to approximately +2.0mPD, which was the typical level for the first layer of the temporary steel strutting (Leighton);

f. installation of temporary steel strutting S1 layer (Chi Keung Construction Engineering Limited ("**Chi Keung**"));

g. excavation down to approximately -1.0mPD, which was the typical level for the second layer of the temporary steel struts (Leighton);

h. installation and preloading (if required) of the temporary steel strutting S2 layer (Chi Keung);

i. excavation down to approximately -5.0mPD, which was the typical level for the third layer of the temporary steel struts (Leighton);

j. installation and preloading (if required) of the temporary steel strutting S3 layer (Chi Keung);

k. excavation down to approximately -9.0mPD, which was the typical level for the fourth layer of the temporary steel struts (Leighton);

l. installation and preloading (if required) of the temporary steel strutting S4 layer (Chi Keung);

m. excavation down to maximum -12.0mPD, which was the typical level for the formation of the NSL base slab (Leighton);

n. pouring the NSL base slab blinding concrete (Hills Construction Limited ("**Hills**"));

o. erecting formwork for the NSL base slab (Hills);

p. installation of the base slab waterproofing layer (Hop Shing Waterproof Construction Co. Ltd ("**Hop Shing**"));

q. fixing reinforcement bars ("**rebar**") for the NSL base slab (Wing & Kwong Steel Eng. Ltd ("**Wing & Kwong**"));

r. rebar inspection for the NSL slab (i.e. both routine informal inspections and the formal inspection for rebar fixing at a hold point) (Leighton and MTRCL).

s. formal inspection for pre-pour check and survey check at a hold point, prior to pouring concrete for the NSL base slab (Leighton and MTRCL);

t. pouring concrete for the NSL base slab and curing concrete (Hills)

u. backfilling between the base slab and cofferdam walls with mass fill concrete (Leighton);

v. removal of the temporary steel strutting S4 and S3 layers after mass filling achieved the required strength (Chi Keung);

w. installation of falsework for the NSL walls and roof (Hills);

x. installation of outer formwork for wall (Hills);

y. fixing reinforcement for the NSL walls (Wing & Kwong);

z. rebar inspection for the NSL walls (i.e. both routine informal inspections and the formal inspection for rebar fixing at a hold point) (Leighton and MTRCL).

aa. erecting inner formwork for the NSL walls and roof formwork (Hills);

bb. fixing reinforcement for the NSL roof (Wing & Kwong);

cc. rebar inspection for the NSL roof (i.e. both routine informal inspections and the formal inspection for rebar fixing check at a hold point) (Leighton and MTRCL).

dd. formal inspection for pre-pour check and survey check at a hold point, prior to pouring of the concrete for the NSL walls and roof (Leighton and MTRCL);

ee. pouring concrete for the NSL walls and roof and curing concrete (Hills)

ff. installation of NSL walls and roof waterproofing layer (Hop Shing);

gg. backfilling between the NSL permanent walls and cofferdam walls (Leighton);

hh. removal of the temporary steel strutting S2 layer after mass fill has achieved required strength (Chi Keung);

ii. backfilling on top of the NSL tunnel to EWL 0.5m below S1 strut level (Leighton);

jj. removal of the temporary steel strutting S1 layer (Chi Keung);

kk. recharging groundwater within cofferdam to 0.5mPD (Leighton);

ll. backfilling to the EWL base slab formation level (Leighton);

mm. installation of the EWL base slab waterproofing layer (Hop Shing);

nn. erecting formwork for the EWL base slab (Hills);

oo. fixing reinforcement for the EWL base slab (Wing & Kwong);

pp. rebar inspection for the EWL base slab (i.e. both routine informal inspections and the formal inspection at a hold point) (Leighton and MTRCL);

qq. formal inspection for pre-pour check and survey check at a hold point, prior to pouring concrete for the EWL base slab (Leighton and MTRCL);

rr. pouring concrete for the EWL base slab and curing concrete (Hills)

ss. erecting outer formwork for the EWL trough walls (Hills);

tt. fixing reinforcement for the EWL trough walls (Wing & Kwong);

uu. rebar inspection for the EWL trough walls (i.e. both routine informal inspections and the formal inspection at a hold point) (Leighton and MTRCL);

vv. formal inspection for pre-pour check and survey check at a hold point, prior to pouring concrete for the EWL trough walls (Leighton and MTRCL);

ww. erecting inner formwork and pouring concrete for the EWL trough walls and curing concrete (Hills); and

xx. backfilling trough walls to existing ground level (Leighton).

9. The timeline for the construction works, including the NAT Stitch Joints and SNJ (but excluding the remedial works) was as follows:

a. the permanent concrete works commenced in the NAT with the pouring of the first base slab at the NSL level on 27 January 2016;

b. the final structural concrete pour at the NSL level (being the roof of NSL Stitch Joint 1112/1112) was on 9 September 2017; and

c. the final structural concrete pour at the EWL level (being the EWL Bay 1 green roof) was on 16 December 2017.

10. Leighton has disclosed to the Commission:

a. plan view drawings of the NAT at the NSL and EWL levels (numbered LCAL.NAT.1.01 to LCAL.NAT.1.04 in the Second Index of Documents disclosed by Leighton ("**Index**"));

b. simplified sectional drawings of the NAT (numbered LCAL.NAT.1.06 to LCAL.NAT.1.09 in the Index); and

c. working drawings, including revisions, relating to the NAT Stitch Joints, (numbered LCAL.NAT.1.11 in the Index).

11. The plan view drawings show the location of the NAT Stitch Joints and the SNJ.

12. The Stitch Joint Typical Detail (numbered LCAL.NAT.1.05 in the Index) shows the typical construction detail for the NAT Stitch Joints and the SNJ.

13. The NAT Stitch Joints and SNJ were cast as late as possible after completion of backfilling and ground water recharge, as required by drawing 1112/W/000/ATK/C11/101A (see LCAL.NAT.1.11 in the Index).

General – NAT Stitch Joints

14. Leighton has disclosed to the Commission a table summarising the information requested at paragraph 1.6.3 of the NAT Letter of 26 March 2019 in relation to the construction of the NAT Stitch Joints (numbered LCAL.NAT.2.01 in the Index).

15. The following documents set out the standards and requirements for the rebar fixing and concreting works in the construction of the NAT Stitch Joints:

a. The drawings for the reinforcement (which have been revised in some cases) (numbered LCAL.NAT.1.11);

b. Appendices to the Buildings Department's letters of consultation for the works, which set out the supervision obligations for the Reinforced Concrete Works and Mechanical Coupler Works (see C13/8229-8309 and LCAL.NAT.2.02 in the Index);

c. Site Supervision Plan (numbered LCAL.NAT.2.03 in the Index);

d. The Method Statement and Inspection Test Plan ("**ITP**") (numbered LCAL.NAT.2.04 in the Index);

e. Materials and Workmanship Specification for Civil Engineering Works, Section 10 Steel Reinforcement [C5/3545-3773];

f. BOSA (coupler manufacturer/supplier) Technical and Quality Assurance Manual [C10/7009-7016];

g. LENTON (coupler manufacturer/supplier for SCL 1111) Technical and Quality Assurance Manual ELQ-01 (numbered LCAL.NAT.3.02 in the Index);

h. HK Code of Practice for the Structural Use of Concrete 2013 [C13/8348-8554]; and

i. Practice Note for Authorised Persons PNAP APP-68 [C13/8555-8580].

16. The NAT Stitch Joints were constructed approximately 9 months after the construction of the adjacent bays on the SCL1112 side of the NSL rail tunnel and EWL trough structure. The sequence of construction for the NAT Stitch Joints (with the party responsible for each step listed in brackets) should have been as follows:

a. installation of the Omega water seal (Hills);

b. scabbling of construction joint surfaces (Hills);

c. inspection of couplers installed into outer reinforced concrete structure on both sides of the joint to confirm the number is adequate, the diameter, alignment and spacing is correct and the thread appears undamaged (Wing & Kwong);

d. Cut, bend (as necessary) and install the rebar, including the threaded rebar, and couplers (Wing & Kwong);[1]

e. inspection of the rebar fixing (i.e. both routine informal inspections and the formal inspection at a "hold point")[2] (Leighton and MTRCL);

f. erecting formwork and falsework (Hills);

g. installation of hydrophilic waterproofing strips and re-groutable tubes (Hills);

h. formal inspection for pre-pour check and survey check at a hold point prior to pouring concrete (Leighton and MTRCL);

i. pouring concrete (Hills);

j. strip and remove formwork and falsework (Hills); and

k. carry out remedial grouting for any water leaks (if present) (Hills).

17. In summary, the procedure required to install rebar for the NAT Stitch Joints, as detailed in paragraph 16.d, should have been as follows:

a. the reinforcement in the base slabs of the NAT Stitch Joints for both the EWL and NSL level is installed from the bottom layers (B1 to B6) to the top layers (T5 to T1). The general spacing of the rebar is 150 millimetres centre to centre, the required layers and diameter varied for each joint and across the joints;

b. the B1 layer, which is the first layer to be installed, consists of transverse bars that are placed into a recess at the interface between the two structures which are to be connected by the stitch joint. The transverse bars are not threaded, with lapping provided for connection to the rebar installed in the wall. Cover is maintained using spacer blocks between the rebar and outer concrete structure;

[1] For NSL Stitch Joint 1111/1112 and EWL Stitch Joint, all couplers in the concrete structure on the SCL1111 side of the joint had been installed by the SCL1111 Contractor. For NSL Stitch Joint 1112/1112, all couplers were installed by Wing & Kwong.
[2] See paragraphs 40 to 43 below for an explanation of the "hold point" system adopted for the Project.

c. the threaded longitudinal rebar for layer B2 is inserted into the couplers installed into the outer concrete structure on both sides of the bay. The rebar is of sufficient length to achieve the required overlapping lap length within the bay;

d. subsequent layers of transverse and longitudinal bars are then installed (as required by the working drawings). Each layer of longitudinal bars is connected to the respective cast-in coupler layer on both sides of the bay;

e. the bottom layers of reinforcement are inspected by Leighton's engineers and the MTRCL's engineers;

f. the top reinforcement is then installed;

g. the layers of transverse and longitudinal bars are installed (as required by the working drawings). Each layer of threaded longitudinal bars is connected to the respective cast-in coupler layer on both sides of the bay.

h. shear ligature rebar is installed between the top and bottom layers of reinforcement; and

i. the top reinforcement is inspected by Leighton's engineers and MTRCL's engineers.

18. A similar process to that described in paragraph 17 above should have been conducted for both the walls and roof of the NAT Stitch Joints.

19. The SCL1111 Contractor used LENTON brand couplers (with a tapered thread) at the NSL Stitch Joint 1111/1112 and the EWL Stitch Joint. LENTON (i.e. tapered thread) rebar was therefore required and should have been used to connect the rebar to the couplers installed on the SCL1111 side of the NSL Stitch Joint 1111/1112 and EWL Stitch Joint.

20. BOSA (i.e. parallel threaded) rebar was required and should have been used to connect the rebar to the couplers installed on the SCL1112 side of the NSL Stitch Joint 1111/1112 and EWL Stitch Joint.

21. NSL Stitch Joint 1112/1112 is located within the NAT under Contract SCL1112. BOSA brand couplers were used at this stitch joint. BOSA threaded rebar was therefore

required and should have been used to connect the rebar to the couplers in the reinforced concrete structure.

22. Leighton has disclosed to the Commission a summary of the relevant testing and approval procedures for couplers and rebar (numbered LCAL.NAT.3.20 in the Index).

Materials (Couplers and Rebar)

23. In summary, the usual procedure for ordering rebar and couplers for the NAT Stitch Joints (with the party responsible for each step listed in brackets) should have been as follows:

    a. request materials of suitable quality and quantity in accordance with approved drawings (Wing & Kwong);

    b. propose supplier of rebar and couplers (Leighton);

    c. approve supplier of rebar and couplers (MTRCL);

    d. order reinforcement and coupler materials (Leighton);

    e. visually inspect materials upon delivery to site for quantity and quality compliance (Wing & Kwong and Leighton);

    f. select samples for testing (MTRCL);

    g. arrange rebar and coupler testing by sample batches (Leighton); and

    h. witness the testing of rebar and couplers in accordance with the relevant ITP (MTRCL).

24. The member of Leighton's construction engineering team who ordered each batch of rebar for the Project was responsible for arranging the sampling and testing of the rebar. The engineer would work with MTRCL's staff and Leighton's quality team in relation to the testing. Leighton has arranged for witness statements to be filed by the relevant engineers in response to the Letters dated 26 March 2019. Please refer to those witness statements for further details.

25. Leighton's Quality Assurance Plan ("**QAP**") (numbered LCAL.NAT.3.03 in the Index) outlines the systems and procedure to ensure that the correct materials are ordered and delivered.[3]

26. The use of couplers for the construction of the NAT Stitch Joints is detailed on the working drawings. The drawings only indicated the diameter and spacing of the rebar but did not indicate the requirement to suit the type of couplers that should be used.

27. The couplers were first discussed at an interface meeting attended by MTRCL, Leighton and the SCL1111 Contractor in 2014. The minutes of the interface meeting have been disclosed to the Commission (numbered LCAL.NAT.3.05 in the Index).

28. This was discussed again at an interface meeting attended by MTRCL, Leighton and the SCL1111 Contractor in 2015. The minutes of the interface meeting have been disclosed to the Commission (numbered LCAL.NAT.3.14 in the Index). The minutes state: "*T40 coupler is BOSA; others are Lenton – Approved.*"

29. T40 is a reference to rebar with a 40mm nominal bar diameter. The couplers installed in the NSL Stitch Joint 1111/1112 and EWL Stitch Joint were for rebar under 40mm nominal bar diameter. Therefore, according to the minutes of the interface meeting, the couplers on the SCL 1111 side of the interface joints should have been LENTON.

30. Leighton's records show that only BOSA (parallel) threaded rebar was ordered for the NAT Stitch Joints. There was no LENTON (tapered) threaded rebar ordered for the initial construction of the NAT Stitch Joints.

31. Please refer to the witness statements of Mr. Henry Lai and Mr. Joe Tam for more details regarding the couplers used during the initial construction of the NAT Stitch Joints.

[3] See section 11.7.2 and Table 11.3 of the QAP.

Defective Workmanship/Design Issue

32. The subcontractor responsible for the rebar fixing works for the NAT Stitch Joints was Wing & Kwong.

33. The subcontractor responsible for the formwork and concreting works for the NAT Stitch Joints was Hills.

34. Leighton has disclosed a copy of the relevant subcontracts with Wing & Kwong and Hills (numbered LCAL.NAT.4.01 and LCAL.NAT.4.02 respectively in the Index).

35. Leighton has disclosed to the Commission a list of the workers of Wing & Kwong and Hills who carried out the rebar fixing and formwork and concreting works at the NAT Stitch Joints (numbered LCAL.NAT.4.03 and LCAL.NAT.4.04 respectively in the Index).[4] Leighton did not employ any direct labour to carry out these works.

36. Leighton investigated reports of water seepage and concrete cracking at two of the NAT Stitch Joints (being NSL Stitch Joint 1111/1112 and EWL Stitch Joint) for the purpose of identifying any defects and then rectifying them. Leighton identified the defect as being rebar having been not connected to couplers. Once the defect was identified, Leighton's project management team directed staff on site to develop a rectification method, obtain approval from MTRCL and carry out the rectification. Please refer to the witness statement of Mr. William Holden for more details.

37. Leighton's investigation determined that the water seepage at NSL Stitch Joint 1111/1112 occurred as a result of the stitch joints opening between the stitch joint concrete and the tunnel structure. The opening of the joints resulted in cracks in the concrete, which permitted the inflow of water. At the NSL Stitch Joint 1112/1112, the water seepage occurred as a result of the failure of the installed permanent waterproofing measures.

38. During the rectification work for the NAT Stitch Joints, Leighton encountered difficulties with the concreting work due to the high level of rebar congestion, particularly when concreting the roof of the NSL Stitch Joint 1112/1112. This was

[4] This list reflects the "palm key" records maintained by Leighton for the relevant construction dates.

resolved during the rectification works through an approved method including a change to the concrete mix. Please refer to statement of William Holden for further details.

Supervision, Inspection and Records

39. Leighton has disclosed to the Commission the Organisational Charts for Leighton's staff (C7/5531-5539 and documents disclosed in section LCAL.NAT.2 of the Index). The members of Leighton's construction engineering team who were involved in supervising the construction of the NAT Stitch Joints are Henry Lai and Joe Tam. Leighton has arranged for witness statements to be filed by both individuals in response to the Letters dated 26 March 2019.

40. The construction engineering team was responsible for satisfying itself and obtaining the MTRCL's approval of the works and authorisation to proceed with the next step in the construction process. The primary means by which Leighton's engineers obtained MTRCL's approval and authorisation to proceed was by requesting formal inspections by, and conducting formal inspections with, MTRCL. The two critical inspections in relation to the installation of reinforcement were:

    a. the rebar fixing inspection, which was jointly conducted by a Leighton engineer and an MTRCL engineer; and

    b. the pre-pour check inspection, which was jointly conducted by a Leighton engineer and an MTRCL Inspector of Works ("**IoW**").

41. A system of "hold points" was established to ensure that work at key points in the construction process did not proceed to the next step until inspections and approval of the works by Leighton and MTRCL. This system is described in the ITP.[5]

42. A hold point can only be lifted after the inspection is completed. Hold points were imposed at two key points (so far as is relevant to the Inquiry):

    a. after the installation of the reinforcement; and

    b. prior to concrete being poured.

[5] As approved by MTRCL.

43. The two hold points were the times that Leighton and MTRCL conducted formal inspections for rebar fixing and pre-pour checks. These hold points were lifted once Leighton and MTRCL approved the works and authorised the subcontractor to proceed.

44. Leighton has reviewed its records relating to the supervision and inspection of the rebar fixing and concreting works for the NAT Stitch Joints. Leighton has found that:

a. physical inspections took place regarding the inspection and approval process for the NAT Stitch Joints[6];

b. while RISC forms were generated for pre-pour and as-built survey, no RISC forms were generated for the rebar fixing and pre-pour check inspections for the original construction works;

c. site diary entries (disclosed in section LCAL.NAT.2 of the Index) record the rebar fixing, pre-pour work and the concrete pours for the original construction work on the NAT Stitch Joints; and

d. RISC forms (numbered LCAL.NAT.6.23 to LCAL.NAT.6.47 in the Index) were completed (along with other relevant records) for the rectification work on the NAT Stitch Joints.

45. Please refer to the witness statement of Mr. Henry Lai for more details regarding the inspection and approval process for the NAT Stitch Joints. Leighton[7] was not aware that RISC forms had not been completed for the rebar fixing check and pre-pour check for original construction of the NAT Stitch Joints. Leighton's record management system tracked the status of all RISC forms that had been generated as a draft. However, the system did not keep track of the RISC forms which had not been generated for concrete pours and were still outstanding. As a result, Leighton did not determine that the relevant RISC forms for the NAT Stitch Joints were outstanding until after the investigation of the water leaks at those areas.

46. Mr. Henry Lai was the engineer responsible for ordering the rebar and couplers that were used at the NAT Stitch Joints. Please refer to the witness statement of Mr. Henry

[6] Please refer to the witness statement of Mr. Henry Lai.
[7] This refers to the knowledge of Leighton's management on the Project and Leighton's senior management.

Lai for an explanation as to why BOSA threaded rebars were used on both sides of the NAT Stitch Joints. It appears that certain members of Leighton's construction engineering team were aware that Gammon-Kaden SCL 1111 Joint Venture (the "**SCL 1111 Contractor**") was using LENTON brand couplers as a result of attending interface meetings with the SCL 1111 Contractor. However, this information was not communicated to Mr. Henry Lai.

47. Leighton[8] did not know there was any issue with the NAT Stitch Joints until after the investigation of the water leaks at those areas. In particular, Leighton did not know about the issues until the concrete in those areas was removed to expose the reinforcement.

Rectification Works

48. Please refer to the witness statement of Mr. William Holden for details of the investigation and defect rectification work that was carried out with respect to the NAT Stitch Joints. Leighton informed MTRCL and obtained their approval before commencing the rectification work. Thereafter, both Leighton and MTRCL inspected and approved the rectification work.

49. The fact that limited water seepage recurred at the NAT Stitch Joints is not material and does not in any way undermine the efficacy and quality of the rectification works. The recurring seepage was minor in nature and no cracking was observed. MTRCL did not consider it a major event that warranted elevation to the Buildings Department or Railways Development Office, and decided to manage the NCR process at site level. The seepage was rectified using an approved method through grout injection using polyurethane and acrylic grouts along the joints.

*Non-Conformance Reports ("**NCR**")*

50. Leighton has disclosed to the Commission:

    a. NCR No. 066 (numbered LCAL.NAT.5.01 in the Index);

    b. NCR No. 095 (numbered LCAL.NAT.5.02 in the Index); and

[8] See footnote 6 above.

c. NCR No. 096 (numbered LCAL.NAT.5.15 in the Index).

51. Leighton confirms that the NCRs listed above have been closed out. Leighton has disclosed to the Commission the closed-out versions of the NCRs (numbered LCAL.NAT.5.33, LCAL.NAT.5.24 and LCAL.NAT.5.34 respectively in the Index).

52. A further NCR No. 199 was issued by MTRCL to Leighton in relation to the NAT Stitch Joints (numbered LCAL.NAT.5.22 in the Index). During the rectification of NSL Stitch Joint 1112/1112, Leighton encountered some issues with the construction of the roof above the stitch joint area. The roof slab was not fully cast, and there was a void. The main contributing reason appeared to be due to a pumping pressure issue at the time of concreting. The high level of rebar congestion also contributed to the issue.

53. NCR No. 199 has been closed out as the defective roof slab was completely removed, re-cast and completed to the satisfaction of both Leighton and MTRCL. The inspection and approval of the works was recorded by RISC Form No. 13029. The closed-out version of NCR No. 199 and RISC Form No. 13029 have been disclosed to the Commission (numbered LCAL.NAT.5.32 and LCAL.NAT.6.41 respectively in the Index).

Structural safety and integrity of the NAT Stitch Joints

54. The NAT Stitch Joints have been reconstructed in accordance with the approved methods statements, design amendments and to the satisfaction of both Leighton and MTRCL. Please refer to the witness statement of Mr. William Holden. The inspection and approval of the works were recorded by RISC forms.

55. Leighton has disclosed to the Commission a summary table of the RISC forms associated with the reconstruction of the NAT Stitch Joints (numbered LCAL.NAT.2.01 in the Index).

Enhancement of quality systems

56. While Leighton has an established quality management framework, and it was the intent of Leighton to take all reasonable steps and measures during the construction of the

NAT Stitch Joints, it is acknowledged that the quality system did not function to the level that should be expected and that certain processes could be improved.

57. Leighton has a mandate to continually improve the efficiency and efficacy of its business processes. In 2018, Leighton established a Quality Assurance Task Force to work with the existing quality team to review, improve and implement changes to the quality management framework. As a result, an enhanced framework has been developed and is being progressively implemented. The key changes to the framework include:

a. simplified and easily accessible tools for the effective management of inspection processes and associated data;

b. user friendly digital technology on personal mobile devices to ensure the efficient and effective capture, storage and management of vital construction process data;

c. development and rollout of operational "Quality Best Practice" guidelines across key construction activities including concrete works, installation of rebar, concrete sampling and testing, concrete curing, formwork installation, construction joints, structural steelwork and so on;

d. implementation of operational "Quality Metrics" to quickly and efficiently identify and address critical areas of non-performance, while clearly communicating business expectations, increasing team productivity, driving accountability and creating the right culture across our projects; and

e. a structured and robust program of reviews to routinely measure and monitor the delivery of quality management processes across all of Leighton's projects, including "Project led Reviews", scheduled Senior Operational Management led "Project SHEQ Reviews", "External Accreditation Audits" and "Corporate led "In-house Reviews".

Response to Issue 2: Non-compliance issues at the NAT Shunt Neck (SNJ)

General

58. Leighton has disclosed to the Commission a table which summarises the information requested at paragraph 2.10 of the NAT Letter of 26 March 2019 in relation to the construction of the SNJ (numbered LCAL.NAT.2.01 in the Index).

59. While the relevant contract drawings indicated that a stitch joint was required at the SNJ, Leighton was instructed by MTRCL to build a construction joint instead, which only required couplers to be installed on the SCL 1111 side of the SNJ and did not require Leighton to install couplers in the adjacent bay on the SCL 1112 side of the SNJ.

60. On 15 February 2016, the SCL 1111 Contractor confirmed to Leighton that a construction joint should be built at the SNJ (numbered LCAL.NAT.8.06 in the Index).

61. On 16 May 2016, Leighton raised a Request for Information ("**RFI**") seeking clarification that a stitch joint was required at the SNJ. A copy of this RFI has been disclosed to the Commission (numbered LCAL.NAT.8.03 in the Index). The MTRCL's response to the RFI stated: "*No stitch joint at shunt neck except at interface with 1111*" (numbered LCAL.NAT.8.04 in the Index).

62. The SCL1111 Contractor built a construction joint using couplers on their side of the interface, and did not leave a recess for the construction of a stitch joint. In that context, and following MTRCL's direction, Leighton should have built a construction joint with continuous rebar connection using the couplers installed by the SCL 1111 Contractor.

63. The documents listed in paragraph 15 above set out the standards and requirements for the rebar fixing and concreting works in the construction of the SNJ.

64. In summary, the steps and procedures involved in the construction of the SNJ (with the party responsible for each step listed in brackets) were as follows:

    a. pouring of the blinding concrete for the base slab (Hills).

    b. applying the waterproofing layer (Hop Shing);

c. cutting and bending the steel reinforcement, and installation of the threaded rebars into couplers installed by SCL1111 Contractor (Wing & Kwong):

d. inspection of the rebar fixing (i.e. both routine informal inspections and the formal inspection at a hold point) (Leighton and MTRCL);

e. erecting formwork (Hills);

f. formal inspection for pre-pour check and survey check at a hold point prior to pouring concrete (Leighton and MTRCL); and

g. pouring concrete (Hills).

65. The usual procedure required to install rebar for the SNJ was the same as that required for the NAT Stitch Joints (as set out in paragraph 17 above).

66. As explained above, the SCL1111 Contractor used LENTON brand couplers (tapered thread couplers) at all stitch joints located at the interface of Contract SCL1111 and Contract SCL1112, including the SNJ. LENTON threaded (tapered) rebar was therefore required and should have been used to connect the rebar to the couplers installed in the reinforced concrete structure under Contract SCL1111.

67. The summary of relevant testing and approval procedures for couplers and rebar (numbered LCAL.NAT.3.20 in the Index) also applies for the SNJ.

Materials (Couplers and Rebars)

68. The usual procedure for ordering couplers and rebar for the SNJ was the same as that for the NAT Stitch Joints (as set out in paragraph 23 above).

69. Typically, Wing & Kwong, Leighton and MTRCL should visually inspect the couplers and rebar at the point of delivery for compliance before release to be incorporated into the works.

70. Leighton's QAP (numbered LCAL.NAT.3.03 in the Index) outlines the systems and procedure to ensure that the correct materials are ordered and delivered.[9]

[9] See section 11.7.2 and Table 11.3 of the QAP.

71. The use of couplers for the construction of the SNJ is detailed on the working drawings. The drawings only indicated the diameter and spacing of the rebar but did not indicate the requirement to suit the type of couplers to be used.

72. As explained above, the use of couplers was also discussed at an interface meeting attended by MTRCL, Leighton and the SCL1111 Contractor in 2016. The minutes state "*T40 coupler is BOSA, others are Lenton – Approved*".

73. Leighton's records show that only BOSA threaded rebar was ordered for the SNJ. No LENTON threaded rebar was ordered for the SNJ.

74. The members of Leighton's construction engineering team who were responsible for supervising the SNJ were Mr. Henry Lai and Mr. Joe Tam. Please refer to their witness statements for further information regarding the construction of the SNJ.

Defective Workmanship

75. Wing & Kwong and Hills were also the subcontractors responsible for the rebar fixing works and concreting works for the SNJ.

76. Leighton has disclosed to the Commission a list of the workers of Wing & Kwong and Hills who carried out the rebar fixing and formwork and concreting works at the NAT Stitch Joints and SNJ (numbered LCAL.NAT.4.03 and LCAL.NAT.4.04 respectively in the Index).[10] Leighton did not employ any direct labour to carry out these works.

77. Following Leighton's investigation of the issues at the NAT Stitch Joints, Leighton carried out similar investigations at the SNJ for the purposes of identifying any defects and rectifying them.

78. Leighton's investigation identified the following defects:

    a. BOSA (parallel) threaded rebar was used rather than LENTON (tapered) threaded rebar; and

[10] This reflects the "palm key" records available to Leighton for the relevant construction dates.

b. the diameter of some of the BOSA threaded rebar used was incorrect, as smaller diameter bar was used to connect some of the couplers, primarily on the trough walls.

79. Leighton is not aware of any issues with the concreting works by Hills.

80. Atkins was the permanent works designer of the SNJ for both Contract SCL1111 and Contract SCL1112. There was a mismatch between the detailing of the SNJ under Contract SCL1111 and Contract SCL1112. It appears as though Atkins deleted the requirement for the stitch joint on the approved drawings for Contract SCL1111 but did not update the same on the drawings for Contract SCL1112.

Supervision and Inspection

81. The members of Leighton's construction engineering team who were responsible for supervising the SNJ were Henry Lai and Joe Tam. Please refer to their witness statements for further information regarding the construction of the SNJ.

82. The role and responsibilities of the construction engineering team is explained in paragraphs 40 to 43 above, including with respect to the supervision and inspection of the rebar fixing and concreting works (i.e. conducting routine and formal inspections and the system of hold points). The construction engineering team had the same role and responsibilities with respect to the construction of the SNJ.

83. Leighton has reviewed its records relating to the supervision and inspection of the rebar fixing and concreting works for the SNJ. Leighton has found that

a. physical inspections took place regarding the inspection and approval process for the SNJ[11];

b. while RISC forms were generated for pre-pour and as-built survey, no RISC forms were generated for the rebar fixing and pre-pour check inspections for the original construction works; and

[11] Please refer to the witness statement of Mr. Henry Lai.

c. site diary entries (disclosed in section LCAL.NAT.2 of the Index) record the rebar fixing, pre-pour work and the concrete pours for the original construction works.

84. Please refer to the witness statement of Mr. Henry Lai for more details regarding the RISC forms for the SNJ. Leighton[12] was not aware that RISC forms had not been completed for the rebar fixing check and pre-pour check for the SNJ. Leighton's record management system tracked the status of all RISC forms that had been generated as a draft. However, the system did not keep track of RISC forms which had not been generated and were still outstanding. As a result, Leighton did not determine that the relevant RISC forms for the SNJ were outstanding until after its investigation of the SNJ.

85. Mr. Henry Lai was the engineer responsible for ordering the couplers and rebar that was used at the SNJ. Please refer to the witness statement of Mr. Henry Lai for an explanation as to why BOSA brand couplers and BOSA threaded rebars were used at the SNJ. It appears that certain members of Leighton's construction engineering team were aware that the SCL 1111 Contractor was using LENTON brand couplers and LENTON threaded rebar as a result of attending interface meetings with the SCL 1111 Contractor. However, this information was not communicated to Mr. Henry Lai.

86. Leighton[13] did not know there was any issue with the SNJ until after it identified issues at the NAT Stitch Joints. Having identified the issues at the NAT Stitch Joints, Leighton then decided to investigate the SNJ. Leighton did not know about the issues at the SNJ until the concrete was removed to expose the reinforcement. There were no visible cracks or other visible signs which indicated the issues.

87. Leighton is continually seeking to improve and taking measures to enhance its quality systems. Please refer to paragraphs 56 to 57 above.

Rectification Works

88. Please refer to the witness statement of Mr. William Holden for details of the investigations that were carried out with respect to the construction of the SNJ.

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[12] This refers to the knowledge of Leighton's management on the Project and Leighton's senior management generally.
[13] See footnote 12 above.

89. Please refer to the witness statement of Mr. William Holden for details of the rectification works that have been proposed for the SNJ.

90. Leighton is awaiting MTRCL's approval to proceed with the rectification works. The following steps have been taken to date:

(a) On 16 May 2018, Leighton submitted to MTRCL the "Remedial Proposal for Shunt Neck Connection at 1111/1112 Interface for North Approach Tunnel Structure" (numbered LCAL.NAT.9.01 in the Index);

(b) On 31 December 2018, MTRCL provided to Leighton comments from the Highways Department on the Remedial Proposal (numbered LCAL.NAT.9.02 in the Index); and

(c) On 11 February 2019, Leighton responded to MTRCL's comments regarding the Remedial Proposal (numbered LCAL.NAT.9.03 in the Index).

Non-conformance Reports

91. Leighton has disclosed a copy of NCR 267 (numbered LCAL.NAT.5.35 in the Index).

92. NCR 267 will be closed out once the rectification works referred to in paragraph 89 have been completed.

Dated the 2nd day of May 2019.

Signed: K.H. Speed

Karl Speed

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