

For discussion
on 1 February 2016

Legislative Council Panel on Housing

Final Report of the Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates

Purpose

This paper briefs Members on the findings of the Final Report of the Hong Kong Housing Authority (HA)'s Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates (Review Committee).

Final Report of the Review Committee

Background

2. The Review Committee was set up by HA on 24 July 2015 to, among other things, comprehensively review the present arrangements for quality control and monitoring in relation to the installation of fresh water supply system in Public Rental Housing (PRH) estates. The Review Committee held a total of 12 meetings and visited a public housing site under construction. Further to the submission of its Report on Interim Findings on 6 October 2015, the Review Committee also submitted its Final Report on 8 January 2016 (see **Appendix A**). The Chinese and English versions of the Final Report have been uploaded onto HA's website for public information. HA members also expressed their views on the Final Report at HA's Regular Open Meeting on 18 January 2016.

Report Findings

3. The Review Committee was of the view that the "excess-lead-in-water" incident was, to a large extent, caused by a "lack of awareness" in the industry, as well as within HA and the Housing Department (HD). In relation to the issue of a "lack of awareness", the Review Committee notes in its Final Report that HA/HD has been aware that only lead-free category soldering materials can be used in any installation for drinking water for human consumption, as stipulated in

relevant British Standards; such a “lack of awareness” within HA/HD refers to their not being aware that, although HA’s contracts has already prohibited the use of leaded solder, the risks of presence of lead in solder and of such presence leading to excess lead in water still exist.

4. HA/HD’s quality control mechanism is risk-based and has been drawn up having regard to the laws, industry practice, past experiences and known risks. The Review Committee notes that HD has the expertise and experience in devising and using quality assurance tools or measures for public housing construction in aspects where high risks have been identified, such as water leakage or the presence of bacteria in water. However, as HD was not conscious of the risks of presence of lead in solder and of such presence leading to excess lead in water in the past, it had not applied to such risks its quality assurance tools suited to high risks. Therefore, HD had not required frontline site inspection staff to check soldering materials upon delivery to site and during construction, and had not required them to check whether the soldering materials were lead-free when they inspected pipe joints in the past.

5. The Review Committee already recommended measures in its Report on Interim Findings, including requiring the main contractors to test water samples in accordance with the Water Authority’s requirements which include testing for lead, to check for the presence of lead in soldering joints, and to properly manage their plumbing sub-contractors. The Review Committee has made additional recommendations in its Final Report, including requiring HD to verify soldering materials upon delivery to site, to check soldering materials when inspecting pipe joints, and to train site inspection staff to inspect whether the main contractors have conducted their supervisory checks.

6. The Review Committee has also identified, in the course of its review, certain inadequacies at the regulatory and industry-wide levels. For example, before the “excess-lead-in-water” incident, the testing of water samples required by the Water Authority did not include lead or other heavy metals; the main contractors failed to fulfill the contractual requirement of using lead-free solder, and did not put in place monitoring measures to ensure that the soldering materials used on-site conformed to the approved samples; and the plumbing workers on-site lacked the knowledge to differentiate which type of soldering material was “lead-free”. The Review Committee has also made some recommendations in relation to these aspects.

7. After the HA's Regular Open Meeting on 18 January 2016, Chairman of HA said that he accepted the Review Committee's Final Report, and that the "body check" conducted by HA was very useful, as it allowed HA/HD to understand the inadequacies in its own quality control mechanism, such that improvements could be made. HD will actively follow up and implement the enhancement measures recommended in the Final Report. In accordance with the Review Committee's recommendation, HD will also keep in view the latest standards and requirements stipulated by the relevant authorities in relation to "lead-in-water" and other aspects, the latest industry-wide developments on the understanding of risks, and the future findings and recommendations of the Commission of Inquiry into Excess Lead Found in Drinking Water established by the Government.

Other Developments

8. Since the "excess-lead-in-water" incident, HA has been updating the public through various channels on the latest developments of the various follow-up actions. We also provided the Legislative Council with updates on the incident at this Panel's special meeting on 22 July 2015 and at the meeting on 2 November 2015, at the special House Committee meetings on 1 September and 8 October 2015, as well as at the Legislative Council meeting on 14 and 16 October 2015. The latest updates on various issues are summarised at **Appendix B** for Members' reference.

**Transport and Housing Bureau
January 2016**

**Report of the Hong Kong Housing Authority's
Review Committee on Quality Assurance Issues Relating to
Fresh Water Supply of Public Housing Estates**

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We would like to express our appreciation to the representatives from the Water Supplies Department who attended our meeting on 24 August 2015 and gave us useful information on the water supply system in Hong Kong as well as on the prevailing monitoring and control of inside service. We would also like to express our appreciation to all the main contractors, plumbing subcontractors, professional organisations, trade practitioners and stakeholders as well as training institutions who took the time to meet and share their views and experiences with us. They include (in alphabetical order) –

China State Construction Engineering (Hong Kong) Limited
Construction Industry Council
Golden Day Engineering Company Limited
Ho Biu Kee Construction Engineering Company Limited
Hong Kong Construction Industry Employees General Union
Hong Kong Licensed Plumbers Association Limited
Hong Kong Plumbing & Sanitary Ware Trade Association Limited
Paul Y. General Contractors Limited
REC Engineering Company Limited
Shui On Building Contractors Limited
The Hong Kong Construction Association Limited
The Hong Kong Institute of Architects
The Hong Kong Institute of Surveyors
The Hong Kong Institution of Engineers
The Vocational Training Council
Yau Lee Construction Company Limited & Ming Hop Company Limited

We are grateful for the assistance of Gammon Construction Limited in facilitating the Committee's visit to its construction site, Lei Yue Mun Estate Phase 3 on 8 October 2015. We would also like to express our appreciation of the Housing Department staff's conscientious efforts in supporting the work of the Review Committee, including in particular their initiative in providing us with papers and details covering the full range of our studies. We cannot emphasize enough the importance of the assistance, support, information and facilitation rendered by all the above-mentioned parties, without which the completion of this report would not be possible.

EXECUTIVE SUMMARY

The Review Committee was set up by the Hong Kong Housing Authority on 24 July 2015 to review, *inter alia*, the present arrangements for quality control and monitoring in relation to the installation of fresh water supply system in public rental housing estates. The Review Committee held a total of 12 meetings. In addition, it visited a public housing site under construction to understand how water pipes were jointed using soldering materials and whether the interim measures recommended by the Review Committee were practicable on the ground. The Review Committee also had exchanges with a number of professional organizations, industry stakeholders and training institutions on the “excess-lead-in-water” incidents, and on ideas about how to prevent recurrence of similar incidents in future. The Review Committee has made reference to information provided by Housing Department on how the department, as the executive arm of the Housing Authority, has ensured the quality of fresh water supply installations before and after the “excess-lead-in-water” incidents, as well as authoritative and expert information and findings including those from the Development Bureau’s Task Force on Excessive Lead Content in Drinking Water.

2. The Review Committee is of the view that the past mechanism for ensuring the quality of drinking water supplied to public rental housing estates has certain inadequacies.

3. The Review Committee notes that there had been some inadequacies at the regulatory and industry-wide level. It notes that, the above-mentioned Task Force was of the view that there had been inadequate awareness of the stakeholders in the construction industry on the use of leaded soldering materials and their consequences on the drinking water quality. The Review Committee notes that, before the “excess-lead-in-water” incidents, no checking was conducted on whether the solder joints contain lead and the testing of water samples did not include the four heavy metals namely lead, chromium, cadmium and nickel at that time.

4. The Review Committee also notes that the main contractors, who are the contractual parties with the Housing Authority, have been well aware of the contractual requirement of lead-free solder for copper pipe connections, but had failed to fulfill the contractual requirement. They did not pay due attention to the soldering materials purchased and used, and did not put in place quality control and supervision to ensure that the soldering materials used on-site conform to the approved samples. Besides, the Review Committee notes that

the plumbing workers on-site lacked the knowledge to differentiate which type of soldering material was “lead free” and hence safe for use in plumbing installations. This was partially attributed to the fact that the training courses for different levels of workers in the plumbing trade in the past had not put as much emphasis on the adverse consequences arising from the presence of lead in the plumbing system as on practical soldering techniques to prevent water leakage.

5. The Review Committee also notes inadequacies in Housing Authority/ Housing Department’s quality control mechanism in the past. It notes that the quality control system for material approval, site inspection and testing of various materials etc. are risk-based and have been drawn up having regard to the laws and regulations, industry and trade practices, past experiences and known risks. As a result, the past quality control mechanism had been geared towards known issues about safety and quality of fresh water in the past, such as the risk of Legionnaires’ disease. The department has the expertise and experience in devising and using quality assurance tools in aspects where high risks have been identified, and has put in place stringent quality control mechanism for public housing construction which covers different levels of checks and inspections by frontline site inspection staff. However, it had not been conscious of the risks of presence of lead in solder joints and of such presence leading to excess lead in water, and had not applied its quality assurance tools suited to high risks. Specifically, the department had not targeted soldering materials as a high risk item for contractors’ checking and monitoring upon delivery to site and during construction, and had not checked the lead content in soldering materials when pipe joints were inspected in the past.

6. Noting the inadequacies in Housing Authority/ Housing Department’s past quality control system, the Review Committee recommends that an enhanced system for site inspection and testing during construction of plumbing works has to be in place to prevent the use of leaded soldering material and non-conforming pipe fittings in future. Apart from complying with the Water Authority’s latest requirement to test water samples against additional parameters which include lead and other heavy metals for newly established inside service, the Review Committee recommends that the Housing Authority should also contractually require the main contractors to submit and comply with a stringent plumbing subcontractor management plan covering supervision and on-site monitoring. Such a plan may include measures such as central procurement of soldering materials by the main contractor or domestic subcontractor; checking soldering/ brazing materials upon delivery to site before

putting them under quarantine, and at any time during construction stage; and recording the works completed by individual workers so that they become more traceable etc. Quick test methods should be used to check for the presence of lead in soldering joints. Besides, soldering/ brazing alloys, and copper pipes and fittings should be included in the list of on-site delivery verification items. Soldering/ brazing joints should also be included in the list of plumbing items that require checking by the Housing Department's site inspection staff. The site inspection staff should be adequately trained to inspect whether the main contractors have duly conducted their supervisory checks.

7. At the industry-wide level, the Review Committee sees the need for training institutions such as the Construction Industry Council and the Vocational Training Council to enhance their training programmes for licensed plumbers and workers in the plumbing trade. They should put more emphasis on how to differentiate, by appearance or other methods, compliant soldering materials from non-compliant ones in the course of carrying out the works, and on the adverse consequences arising from the presence of lead in the plumbing system. The Review Committee also agrees with the above-mentioned Task Force that the Water Authority should review the Waterworks Ordinance and Waterworks Regulations to see if improvement is necessary to strengthen its regulatory regime on the construction of inside service.

8. Looking ahead, the Review Committee expects the Housing Authority/ Housing Department to keep in view the developments on the understanding of risks, including the future findings and recommendations of the Commission of Inquiry into Excess Lead Found in Drinking Water, and the latest statutory and administrative requirements, in respect of all aspects of water quality. Apart from ensuring full compliance with the relevant laws and regulations, the department should also conscientiously devise checks in accordance with the identified risks, and continue to consider implementing additional quality control measures for the Housing Authority's public housing projects.

PURPOSE OF THE REPORT

This report summarizes the deliberations and findings of the Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates (the Review Committee). It comprises six chapters as follows –

- (I) MEETINGS OF THE REVIEW COMMITTEE
- (II) HOUSING AUTHORITY'S QUALITY CONTROL MECHANISM FOR FRESH WATER SUPPLY SYSTEM IN PUBLIC RENTAL HOUSING ESTATES
- (III) FINDINGS OF THE REVIEW COMMITTEE
- (IV) ENHANCEMENT MEASURES
- (V) OBSERVATIONS ON WATER TEST RESULTS FOR PUBLIC RENTAL HOUSING ESTATES
- (VI) LOOKING AHEAD

TERMS OF REFERENCE OF THE REVIEW COMMITTEE

2. The Review Committee was set up by the Hong Kong Housing Authority (HA) on 24 July 2015. Its composition is at **Annex A**. In accordance with its Terms of Reference (TOR), the Review Committee shall –

- (a) comprehensively review the present arrangements for quality control and monitoring in relation to the installation of fresh water supply system in public rental housing (PRH) estates;
- (b) in the process of (a), critically review various aspects of quality inspection relating to materials used (including pre-fabricated components), quality inspection and works supervision at different stages of construction; and
- (c) report findings to the HA and recommend any improvement in procedures/ guidelines, and follow-up actions as necessary.

Separately, the Development Bureau set up a Task Force on Excessive Lead

Content in Drinking Water (Task Force)¹ which released its Final Report on 31 October 2015. The Government has also set up a Commission of Inquiry into Excess Lead Found in Drinking Water (Commission of Inquiry)² the hearings of which are under way.

¹ The TOR of the Task Force is to: (a) carry out investigation to ascertain the causes of the recent incidents leading to presence of lead in water drawn by households; (b) recommend measures to prevent recurrence of similar incidents in future; and (c) follow up on a recent case of Legionnaires' disease found at Kai Ching Estate.

² The TOR of the Commission of Inquiry is to: (a) ascertain the causes of excess lead found in drinking water in public rental housing developments; (b) review and evaluate the adequacy of the present regulatory and monitoring system in respect of drinking water supply in Hong Kong; and (c) make recommendations with regard to the safety of drinking water in Hong Kong.

(I) MEETINGS OF THE REVIEW COMMITTEE

3. In total, the Review Committee held a total of 12 meetings and conducted one site visit, and submitted its interim report to the HA Chairman on 6 October 2015. The Review Committee has made reference to information provided by Housing Department (HD) on how the department, as the executive arm of HA, has ensured the quality of fresh water supply installations before and after the “excess-lead-in-water” incidents, as well as authoritative and expert information and findings including those from the Task Force. Main papers that were reviewed by the Review Committee are at **Annex B**. An overview of the discussion of the Review Committee is summarized in paragraphs 4 to 24 below.

First meeting - Quality control and HA’s measures

4. At the 1st meeting on 30 July 2015, HD briefed Members on –
- (a) the prevailing mechanism, including statutory and non-statutory requirements, which the Government (namely, the Water Authority (WA)) had been put in place before the “excess-lead-in-water” incidents to ensure the quality of fresh water supply for all buildings in Hong Kong; and
 - (b) the measures put in place by the HA/HD for compliance with the prevailing statutory and related requirements to ensure the quality of fresh water supply in PRH estates.

Papers No. RC 2/2015 and RC 3/2015 are relevant. Members noted that independent administrative building control over all HA’s developments in line with the Buildings Ordinance (BO) (Cap. 123) and related requirements are exercised by the HD’s Independent Checking Unit without having to go through the sanction by the Buildings Department, whereas the water supply system in the developments are subject to the regulatory regime under the Waterworks Ordinance (WVO) (Cap. 102) exercised by the WA.

5. To facilitate Review Committee members to understand the existing mechanism, HD was requested to provide a comprehensive A to Z flow chart to illustrate the existing quality control mechanism for the fresh water supply system in PRH estates. Such a flow chart outlines the different stages of construction step-by-step, and illustrates the corresponding measures put in place by HA/HD to comply with prevailing statutory and non-statutory requirements. The Review Committee planned to examine the different stages

of construction in detail in subsequent meetings.

Second meeting – Flow Chart and the Pre-Contract Stage

6. At the 2nd meeting on 6 August 2015, HD briefed Members on –
 - (a) the major steps involved in building a fresh water supply system by way of a “Flow Chart for Design, Construction and Completion of Fresh Water Supply System in HA’s PRH Developments” (“Flow Chart”) (**Annex C**), which comprised 18 steps covering the entire process from the pre-contract design stage (steps 1 – 4), tendering stage (steps 5 – 6), post-contract construction stage (steps 7 – 13), and the completion stage (steps 14 – 18); and
 - (b) an overview of the pre-contract stage (i.e. steps 1 – 6 of the Flow Chart).

Papers No. RC 6/2015 and RC 7/2015 are relevant. In discussing RC 6/2015, HD briefed members that in the past the soldering materials of joints were not included in the list of over thirty types of material that were subject to on-site delivery checks by HD.

Third meeting – Design and Specifications, Contract Arrangements and the Post-Contract Stage

7. At the 3rd meeting on 17 August 2015, HD briefed Members on –
 - (a) details of the pre-contract stage, covering the design and specifications for plumbing installation in PRH estates (i.e. steps 1 – 4 of the Flow Chart) and HA’s building contract arrangements (i.e. steps 5 – 6); and
 - (b) an overview of the post-contract stage (i.e. steps 7 – 18 of the Flow Chart).

Papers No. RC 10/2015, RC 11/2015 and RC12/2015 are relevant. In discussing RC 10/2015, Members noted that copper water pipes, fittings and soldering materials are governed by relevant British Standards as stipulated in HA’s specifications and that upper limits for lead contents are stated in the respective British Standards. In discussing RC 11/2015, HD briefed members that there had been no contractual requirement in the HA’s building contracts in regard of the procurement procedure of soldering materials. The main contractors can decide if they would procure the soldering materials themselves or would sublet the procurement responsibility to their domestic subcontractors. Being one of the cost-insignificant sundry material items in building contracts,

soldering materials were not included in the monthly interim payment applications submitted by the main contractors to HA/HD.

Fourth meeting – Presentation by the Water Supplies Department

8. At the 4th meeting on 24 August 2015, representatives from the Water Supplies Department (WSD) were invited to give a presentation on –

- (a) an overview of the water supply system in Hong Kong; and
- (b) monitoring and control of inside service, including (i) application procedures for water supply in new buildings under the WWO and Waterworks Regulations (WWR) (Cap. 102A); (ii) design standards for pipes and fittings; and (iii) the role of Licensed Plumbers (LP) and Authorized Persons (AP). In particular, WSD informed Members it is stipulated under the WWO that construction of inside service except works of a minor nature shall be carried out by an LP.

Fifth meeting – Procurement, Material submission, Site Supervision and Testing

9. At the 5th meeting on 7 September 2015, HD briefed Members on –

- (a) details of the pre-contract stage, covering procurement matters (i.e. step 6 of the Flow Chart); and
- (b) details of the post-contract stage, covering material submission (i.e. step 9 of the Flow Chart), site supervision (i.e. steps 12 – 13 of the Flow Chart), and testing, commissioning and final inspection (i.e. steps 14 – 18 of the Flow Chart) for plumbing installation in PRH estates.

Papers No. RC 13/2015, RC 14/2015, RC 15/2015 and RC 19/2015 are relevant. In discussing RC 14/2015, HD briefed members that soldering/brazing alloys for copper pipes and fittings were not included in the list of materials to be checked upon delivery to site. Besides, checking of soldering joints for lead was not included in the various inspection guides developed to assist HD's site inspection teams to conduct in-process inspection.

Sixth meeting – Precast Concrete Components and Meeting with the Main Contractors

10. At the 6th meeting on 14 September 2015, HD briefed Members on the

quality control and supervision of off-site manufactured precast concrete components for use in HA's PRH projects. Paper No. RC 24/2015 is relevant.

11. Besides, the four main contractors involved in the PRH estates where excess lead content in drinking water was found in some of the samples tested, along with their plumbing subcontractors and some of their LPs, were invited to attend the meeting to exchange views with the Review Committee on the incident. In gist, all four main contractors considered that –

- (a) there had been a lack of awareness within the industry of the risk of lead in soldering materials and its implications for drinking water quality, as soldering materials for pipe connections had been considered as only a minor and insignificant part of plumbing installations; and
- (b) there was a general perception in the construction industry that the certificate on water supply connection (Form WWO 1005), issued by the WA, should have served as an assurance of the quality of the plumbing system and the drinking water having regard to the water sample test results.

The main contractors undertook to implement various improvement measures for future projects and projects still under construction, for example, central procurement of soldering materials, quarantine of soldering materials upon delivery to site, recording of the on-site movement of soldering materials, frequent on-site checks using quick test methods etc.

Seventh meeting – Maintenance and Improvement Works for Existing PRH, Observations on Water Sampling Tests and Draft Interim Findings

12. At the 7th meeting on 22 September 2015, HD briefed members on the maintenance and improvement (M&I) works carried out for the fresh water supply system in existing PRH estates. Paper No. RC 29/2015 is relevant. Members noted that these M&I works involving fresh water supply systems were carried out during routine maintenance; during vacant flat refurbishment; during large-scale renovation of estates; and during large-scale replumbing works. Soldering for copper pipe connections was generally not used in these M&I works except at isolated locations in cases of site constraints or unavailability of more suitable joint components to match existing installations. Members generally agreed that there was a lesser risk for the presence of lead in drinking water in association with these M&I works. Members also noted that following the “excess-lead-in-water” incidents, HA/HD has put in place additional measures to ensure the quality of plumbing works and drinking water

in connection with these M&I works, and these additional measures are not identical to those in connection with new PRH projects due to the different nature of these two types of works. Details are set out in paragraph 52 below.

13. Members also took note of HD's observations about the results of the systematic water sampling tests conducted by HD and WSD for PRH estates completed in or after 2005 so far. Paper No. RC 28/2015 is relevant. Members also discussed the draft report on the interim findings of the Review Committee.

Eighth meeting – Meeting with Professional Organizations and Industry Stakeholders, and Draft Interim Report

14. At the 8th meeting on 29 September 2015, relevant professional organisations/ bodies were invited to attend the meeting to exchange views with the Review Committee on the incident. They include The Hong Kong Institute of Architects, The Hong Kong Institute of Surveyors, The Hong Kong Construction Association Ltd., and Hong Kong Licensed Plumbers Association Ltd. The professional organizations shared their views on the future roles of different professional disciplines in quality assurance of plumbing works, whereas the industry representatives shared their views on how to enhance their awareness of the issue through more structured training and education. For example, professional organisations were of the view that while APs assumed an overall coordination and supervisory role, plumbing installations required specialised skills and knowledge, the supervision of which should be assumed by qualified persons (e.g. building services engineers). Industry representatives shared their views on the need to enhance the industry's awareness of the issue, and that they would approach training institutions (e.g. the Construction Industry Council) to discuss how a more structured training regime could be put in place so that the industry could be better equipped with the professional knowledge and skills.

15. Members also discussed the revised draft report on the interim findings of the Review Committee. Subsequently, the Review Committee submitted its report on interim findings to the HA Chairman on 6 October. The report was also uploaded onto the HA website on the same day.

Site visit

16. On 8 October 2015, members of the Review Committee visited Lei Yue Mun Estate Phase 3, a PRH development under construction. There were on-site demonstrations of copper pipe jointing using different materials, including lead-free solder wire, leaded solder wire, integral solder ring and brazing alloy.

From the demonstrations, members noted in particular that there was no material time difference between jointing by lead-free solder wire and jointing by leaded solder wire. Silver brazing, on the other hand, would take longer time to execute using oxy-acetylene at a much higher temperature than soldering. Members were also given a briefing on, and inspected, plumbing installations for a typical domestic floor. Members noted that the main contractor of the development had implemented more stringent plumbing subcontractor supervision and on-site monitoring as recommended by the Review Committee in its report on interim findings. Relevant measures included displaying posters to remind workers of the proper procedures involved in using soldering materials in jointing pipes; recording on-site movement and use of soldering materials by workers; using X-Ray fluorescence equipment (XRF) to check for the presence of lead in solder joints; and jointing pipes using soldering in a temporary workshop which also served as a storage area for soldering materials delivered to site. Members noted that the Review Committee's recommendation to require the main contractor to submit and comply with a stringent plumbing subcontractor management plan covering supervision and on-site monitoring, was practicable and would not impose undue burden on the main contractors.

Ninth meeting – Meeting with Industry Stakeholders and Training Institutions

17. At the 9th meeting on 12 October 2015, the Hong Kong Construction Industry Employees General Union, the Hong Kong Plumbing & Sanitary Ware Trade Association Ltd, the Construction Industry Council and the Vocational Training Council were invited to attend the meeting to exchange views with the Review Committee on the “excess-lead-in-water” incidents. Both trade associations (i.e. the Hong Kong Construction Industry Employees General Union and the Hong Kong Plumbing & Sanitary Ware Trade Association Ltd) considered that the focus of frontline workers in jointing/ inspecting pipes had been on how to avoid the risk of water leakage rather than on how to prevent excess lead in water. Central procurement of soldering materials by the main contractor or the domestic plumbing sub-contractor could be explored as a means to ensure lead free solder is used at site. Also, both trade associations were of the view that the roles and responsibility of LPs as well as their training should be enhanced.

18. The two training institutions (i.e. the Construction Industry Council and the Vocational Training Council) briefed members on the training courses and programmes in place to improve the technical skills and knowledge of practitioners in the plumbing trade. The courses mainly focused on

performance of the installations such as joint water tightness and avoiding risk of water leakage, and there was insufficient emphasis on how to differentiate lead-free category of soldering materials from leaded soldering materials. In light of the “excess-lead-in-water” incidents, the training institutions would review the suitability and room for improvement of the syllabus, content and assessments of these courses.

Tenth meeting – Meeting with the Hong Kong Institution of Engineers and the Final Report of the Task Force

19. At the 10th meeting on 13 November 2015, the Hong Kong Institution of Engineers (HKIE) was invited to attend the meeting to exchange views with the Review Committee. Paper No. RC 35/2015 is relevant. According to HKIE, both soldering and silver brazing are used in the private sector for water pipe connections, and the use of compression joints is not common. Silver brazing, although more expensive than tin solder, is preferred in the private sector for its robustness and being easier to be inspected. HKIE did not know whether a reduced risk of the presence of lead in soldering materials was also one of the considerations behind the use of silver brazing, and was not aware whether soldered joints would be tested for lead content in the private sector. HKIE also advised that for a private sector project in general at least half of the Clerks of Works have received relevant training on inspection of building services related works such as plumbing installations. HKIE also shared its views on the following issues –

- (a) central procurement of soldering materials;
- (b) training programmes for licensed plumbers and workers in the trade;
- (c) HA/HD should maintain its own list of plumbing subcontractors and that plumbing works should come under a separate contract; and
- (d) the role of Building Services Engineers in HD in plumbing installation works.

20. Members also noted the Task Force’s Final Report submitted to the Secretary for Development on 31 October 2015, which concluded that –

- (a) leaded solder joints were the cause of excess lead in drinking water in PRH developments; and

- (b) copper alloy fittings also leached lead but did not result in excess lead in drinking water in PRH developments.

In its Final Report, the Task Force stated that it had examined the inside service of the nine affected PRH developments other than Kai Ching Estate and Kwai Luen Estate Phase 2 (from which the Task Force had dismantled more than 100 components of pipes and fittings for testing). As the design of the inside service and the specifications of the pipes and fittings in these projects were similar to those of Kai Ching Estate and Kwai Luen Estate Phase 2, the Task Force considered that the cause of excess lead in drinking water in Kai Ching Estate and Kwai Luen Estate Phase 2 should be applicable to these nine RPH developments.

21. The Task Force considered that the “excess-lead-in-water” incidents reflected inadequate awareness of the stakeholders in the construction industry on the use of leaded soldering materials and its consequences on drinking water quality. It made recommendations to prevent recurrence of similar incidents in the future, which included enhancing site inspection and testing system for plumbing works, and testing for four additional heavy metals including lead in water samples as well as the lead content in soldered pipe joints; WA exploring the use of pipe materials free from the risk of misuse of leaded solder joints in plumbing works; HA considering the central procurement of soldering materials; and WA considering reviewing relevant legislation. Paper No. RC 36/2015 is relevant.

11th meeting – Technical studies in HD’s Development and Construction Division

22. At the 11th meeting on 8 December 2015, HD briefed members on technical studies carried out from time to time to facilitate the HA in discharging its duties under the Housing Ordinance (Cap. 283). Members noted that the studies carried out by the HA/HD were applied research and not scientific research. HA/HD has always been looking to the relevant statutory authorities (the WA for the implementation of the WWO, the Building Authority for the Buildings Ordinance, etc.) for the latest statutory and regulatory requirements and standards, as well as industry-wide processes, products, materials, technologies or systems. HA/HD had conducted studies to explore, develop or put in place processes, products, materials, technologies or systems that aimed to address problems specific and unique to the HA/HD’s role in public housing development, including issues concerning quality, regulatory, delivery, cost, environmental and safety aspects. Selection of topics

for studies is based on the risks involved and feedback received, and is geared towards problems known to the HA/HD. Many of these studies/ processes/ technologies were developed in conjunction with the relevant statutory authorities. For example, the W-trap system was developed in conjunction with the Buildings Department after the SARS outbreak to prevent the spread of foul air, germs and epidemic disease between floors. The twin roof tank system was developed in conjunction with WSD to minimise interruption of water supply to PRH tenants during cleansing of water tanks. HA/HD will continue to keep in view and implement any new stipulations and requirements as required by the authorities.

12th meeting – Organization structure for Delivery of HA’s Construction Projects and draft Final Report

23. At the 12th meeting on 31 December, HD briefed members on the involvement of different professional disciplines in HA’s construction projects. Members noted that different professions, grades and ranks worked as teams and within an integrated structure, in accordance with detailed internal guidelines promulgated for many aspects and stages of construction. As far as on-site inspection and monitoring was concerned, HD had devised detailed guidelines and instructions for the site inspection staff to carry out their duties. Members noted that in respect of fresh water supply systems the Clerks of Works had been playing key roles in on-site inspection and checking. While the checks conducted by the site inspection staff had already covered pipework installation and pipe joints, etc., the staff had not been required to check for the presence of lead in soldering joints before the “excess-lead-in-water” incidents. After the incidents, site inspection staff, including the Clerk of Works, have been required to check contractors’ quarantine of soldering materials upon delivery to sites, conduct 10% checks for solder joints, and witness the Direct Testing Contractors’ use of XRF to check for the presence of lead in solder joints. The Review Committee agrees that such additional tasks should be specified in the inspection duties of Clerks of Works. At the meeting, Members also discussed the draft Final Report of the Review Committee.

24. The Review Committee also noted the following developments that had taken place since the excess lead in drinking water incident –

- (a) WSD has, up to mid-December 2015, issued a total of eight Circular Letters on the latest requirements in respect of the construction of inside services, some of which target the risk of the presence of lead in solder

and excess lead content in drinking water³;

- (b) HA's Tender Committee announced on 30 September and 6 November 2015 successive regulatory actions at list management level against the main contractors, and at contract management level against the domestic plumbing sub-contractors and the LPs⁴; and
- (c) the hearings of the Commission of Inquiry had begun on 20 October 2015. The hearings held so far have revealed issues on how fresh water plumbing was done by the industry in general as well as the main contractors concerned. Members noted that the enhancement measures put in place by the HA/HD as well as WSD's Circular Letters since the incident would help address these issues.

Papers No. RC 41/2015, RC 42/2015, RC 43/2015, RC 44/2015 and RC 45/2015 are relevant.

³ The eight Circular Letters are -
1/2015 - Prohibition of Using Leaded Solder at Fresh Water Inside Services and New Parameters for Testing of Water Sample
2/2015 - Validity Period for General Acceptance of Water Pipes and Fittings
3/2015 - Updated Contact List of Case Officers for Application for Water Supplies
4/2015 - Soldering for Copper Pipe Connections
5/2015 - Water Sampling and Solder Joint Sampling and Testing for Newly Installed Fresh Water Inside service
6/2015 - Application for Water Supply Pipes and Fittings Approval
7/2015 - Revision of Application Forms and Pipes and Fittings to be Installed in Plumbing Works
8/2015 - Inspection of Plumbing Works and Point Penalty System

⁴ (a) The total period during which the four main contractors concerned (and two related companies) would not be considered for new works tenders invited by HA starting from 1 March 2015 are as follows –

- Shui On Building Contractors Limited: **8 months** (involving 8 tender opportunities);
- China State Construction Engineering (Hong Kong) Limited (and related company China Overseas Building Construction Limited) and Paul Y. General Contractors Limited (and related company Paul Y. Construction Company Limited): **10 months** (involving 11 tender opportunities); and
- Yau Lee Construction Company Limited: **12 months** (involving 12 tender opportunities).

(b) The total period during which the three domestic plumbing sub-contractors and the three LPs concerned would be debarred from working on HA's new works contracts starting from 1 March 2015 are as follows–

- Ho Biu Kee Construction Engineering Company Limited and Mr Lam Tak Sum: **8 months** (involving 8 contracts);
- Golden Day Engineering Company Limited and Mr Cheung Tat Yam: **10 months** (involving 11 contracts); and
- Ming Hop Company Limited and Mr Ng Hak Ming: **12 months** (involving 12 contracts).

(c) China State Construction Engineering (Hong Kong) Limited, Shui On Building Contractors Limited and Yau Lee Construction Company Limited would be removed from HA's Premier League of contractors with effect from 1 October 2015.

(II) HOUSING AUTHORITY'S QUALITY CONTROL MECHANISM FOR FRESH WATER SUPPLY SYSTEM IN PUBLIC RENTAL HOUSING ESTATES

25. Through deliberations during the 12 meetings as outlined above, Members have examined the key parts of the mechanism that are relevant to how the HA/HD has sought to ensure that the installation of fresh water supply system meets prevailing water safety and quality requirements. Details are highlighted in the paragraphs below.

General structure

26. The plumbing systems in HA's PRH estates are designed in accordance with the requirements stipulated in the WWO, WWR, as well as WSD's handbooks and guidelines. In order to ensure consistency among HA's projects in respect of statutory compliance, HD promulgates in-house design and site inspection guidelines.

27. On a project management level, the Chief Architect of HD takes up the role of Project Manager, Design Team Leader, as well as Contract Manager for building contracts. A project team is formed for individual projects with chief professionals of various disciplines plus senior professionals and professionals nominated by the chiefs. These senior professionals and professionals are delegated the authority as Contract Manager's Representatives to administer the part of the contract works which fall under their respective areas of expertise. In a building contract, a site inspection team comprises site staff from two disciplines, namely the Clerk of Works who inspects building works including plumbing installations, and the Buildings Services Inspector who inspects building services works (such as fire services and water pump installations). The Contract Manager's Representatives and the site inspection team carry out the checks, inspections and tests according to the provisions under the contract as well as HD's in-house site inspection guidelines.

Pre-contract Stage

28. To ensure that the fresh water supply system installed in public housing projects comply with the statutory requirements, HA/HD incorporates the requirements into contract specifications and effects quality control through contract management and site inspections. This includes the contract requirement that the contractor employs an LP. HD's Chief Architect or his/her representative submits to WSD Form no. WWO132 applying for new water

supply for the site. Unlike private developers who submit their WWO132 through their AP, HD is represented by its Contract Manager instead of by an AP⁵. Separately, the Chief Architect or his/her representative submits plumbing installation plans to WSD for approval. All the specifications for plumbing materials, including soldering alloys for copper pipeworks, as specified by HA/HD in the building contracts, comply with relevant British Standards as stipulated in the WWO and the WWR.

Post-contract Stage

29. Since HA does not have its own construction services arm, all construction works are executed by qualified contractors engaged through competitive tendering. HA enters into a contractual relationship with the main contractor, who will then be responsible for carrying out the works required, including the construction and installation of plumbing works. The main contractor is permitted to sub-contract part(s) of the works. HA adopts a nominated sub-contractor arrangement for certain works of the building contract which require relatively higher expertise in technical skills, such as building services including fire services and water pump installation works. HA selects the nominated sub-contractor on behalf of the main contractor for carrying out these specialist works. The main contractor then enters into contract with the nominated sub-contractor. The HA does not have a direct contractual relationship with the nominated sub-contractor. As the construction of plumbing installation works outside pump rooms for public housing developments are generally considered simple and relatively straight forward, the HA has not adopted the nominated sub-contractor arrangement for the plumbing installation works. The main contractor employs a domestic plumbing sub-contractor for carrying out the plumbing installation works in line with common practice in the industry. The LP, who is directly engaged by the domestic plumbing sub-contractor, is responsible for installation of the plumbing system outside pump rooms⁶. HA does not have any contractual relationship with the domestic sub-contractor or with the LP. For plumbing system installations inside pump rooms, they are carried out by the nominated fire services and water pump sub-contractor who employs a separate LP to discharge the duties under WWO.

⁵ See Development Bureau's Practitioner Guidelines for Helping Business Programme in respect of water supply connection and other works available on their website, which states that "instead of representing by AP, HD could be represented by Contract Manager of the development...For simplicity, the AP in this Practitioner's Guidelines shall also mean the Contract Manager of HD for Housing Authority's development."

⁶ For plumbing system installation, building works site staff inspects the installations outside pump rooms while building services site staff is responsible for inspecting the installations inside pump rooms under the fire services and water pump nominated sub-contract.

30. The HD's Contract Manager or his/her representatives and LPs notify the WA (via Part I of Form no. WWO 46) of the commencement dates and the scopes of plumbing works to be carried out and certify that the pipes and fittings installed/intended to be installed, including those as listed on the Annex to the Form WWO 46 and those not listed, are as prescribed by WWR.

Material approval

31. The main contractor then submits materials, including soldering materials and equipment (such as pumps and valves), of the plumbing system for HD's approval. Pursuant to the WWR and HA contract specifications, the main contractor shall use only lead-free category soldering materials, as soldering alloys with lead exceeding the upper limits stipulated in relevant British Standards are not permitted in any installations for water for human consumption.

32. In processing the main contractor's material submission for approval, HD checks the specifications against the main contractor's submission documents, including catalogues, samples, certificates, test reports, approval documents from respective regulatory authorities (including approval documents from the WSD) etc., as well as an undertaking by the main contractor that the materials are in full compliance with HA's and other recognized requirements. In addition to statutory requirements, consideration is also given to whether the materials have been used in other public housing projects and whether they have ever been listed under the "Material Quality Alerts"⁷. The main contractor will only proceed to place order for the materials upon receipt of HD's approval.

Surveillance and control during construction

33. Under the terms of the contract, the main contractor is responsible for giving continuous supervision of the site works to ensure that the quality of works, including plumbing installations, complies with the statutory and contractual requirements. HD's Contract Manager and technically competent persons (appointed by the Contract Manager) exercise periodic supervision by carrying out surveillance checks and tests.

34. For materials subject to on-site delivery verification as specified, HD site staff will check the materials upon their delivery to site, including visual

⁷ A "Material Quality Alert" is a notification issued to project teams when a component or material under surveillance checking is found failed in a laboratory testing or failed to comply with the specification requirements.

inspection and verification of materials against the approved samples, respective catalogues and certificates in accordance with the contractual requirements. HD also selects samples for checks on the appearance, construction, dimensions against relevant standards and whether there are visible defects. HD also conducts laboratory tests on samples for major components such as sink mixers and shower mixers to ensure compliance with the specified performance standards as stipulated in the contracts. If the tests fail, HD may reject the supply or re-test the same batch of components. HD will also post a “Material Quality Alert” for reference by other project teams.

35. Inspection by HD’s site inspection team for building works is currently divided into three categories depending on the level of risk, i.e. 100% checking, 10% checking and random checking (at least three times)⁸. For plumbing installations outside pump rooms, 100% checking is required for pipe testing (to ensure that there is no leakage in the installation) and cleaning of water tank/ pipeline, while 10% checking is applicable to pipe sleeve, materials, type and dimensions, pipe joint, expansion joint, pipework installation, valves, taps and strainers, pipe bracket and caulking pipe sleeves. No item under plumbing installations is on the random check list. Checks for lead content in soldering materials in pipe joints had not been carried out until after the “excess-lead-in-water” incidents. These checks are now being carried out (by XRF) under the 10% checking category.

Contract Completion Stage

36. Upon the completion of fresh water plumbing systems, the main contractor, the sub-contractors, nominated sub-contractor and the LPs conduct inspections and tests to ensure that the completed plumbing installations comply with the approved drawings, statutory requirements and contract specifications. HD conducts the final inspection and testing of the water supply system with the main contractor who arranges for cleansing and disinfection of all fresh water tanks and fresh water supply pipeworks, pressure tests as well as checks for leaks etc. The LPs apply to the WA for inspection and approval of the plumbing installations (via Part IV of Form WWO46). HD’s Contract Manager applies to the WA (via Part II of Form no. WWO 132) for connection of water supply, confirming that the plumbing installations are in full compliance with specified standards and requirements⁹.

⁸ For works executed by the building services nominated sub-contractors, inspections will be conducted according to the approved project inspection plans. The project inspection plan details the inspection percentages of different works with reference to the Building Services Site Inspection Guide.

⁹ Procedures at completion stage of the fresh water plumbing systems (Steps 14, 15 and 16 of the Flow Chart at Annex C refer).

37. WSD will collect water samples from water connection points for testing and analysis. The main contractor/LP will arrange for water samples to be collected from the inside service for tests against the WSD's specified parameters¹⁰ for drinking water quality. Upon WSD's satisfaction with the water test results, as well as the plumbing installations after site inspections, WSD connects permanent water supply to the premises and issues the certificate on water supply connection (Form WWO 1005). HD will only certify completion of the building works and apply for the Occupation Permit when all relevant tests have been completed with satisfactory results.

Other Measures

38. On top of measures for complying with the statutory requirements, HA/HD has also put in place additional measures to ensure the safety and quality of water supply –

- (a) upon completion of new estates, in addition to conducting water sampling tests to meet WSD's specified parameters¹⁰ for drinking water quality, HA/HD requires the main contractors to carry out additional water sampling tests. These additional tests are carried out to meet the assessment criteria for water quality under Building Environmental Assessment Method (BEAM) Plus version 1.2. For this purpose, the requirements specified in WSD's "Quality Water Supply Scheme for Buildings - Fresh Water" should be met. To achieve this, the water quality standard must firstly meet the prescribed standards¹¹. Secondly, all water samples should be taken in a manner described in ISO5667, i.e. they should be taken at all the farthest points of use in the distribution system from the storage tank of each zone, and should include samples from each water supply tank used in the building. Also, the water tests have to be conducted by a Hong Kong Laboratory Accreditation Scheme accredited laboratory or an HA recognised laboratory;

- (b) to address the risk of Legionnaires' disease, HA/HD has also required the main contractor to carry out an additional disinfection to the water supply system of newly completed estates shortly before occupation; and

¹⁰ Before the promulgation of WSD's latest Circular Letter No. 1/2015 in July 2015, water samples had been tested against the eight parameters stipulated in WSD Circular Letter No. 2/2012, which include pH, colour, turbidity, conductivity, free residual chlorine, E.coli, total coliforms and heterotrophic plate count.

¹¹ The test parameters required under the Quality Water Supply Scheme for Buildings – Fresh Water are basically the same as those in WSD Circular Letter No. 2/2012 except there is one additional test parameter (iron) while two test parameters are omitted (free residual chlorine and heterotrophic plate count).

- (c) during the course of the contract, HA/HD conducts quarterly Performance Assessment Scoring System (PASS) assessments with main contractors on-site to assess the quality of works including the main contractors' performance in plumbing installation works and management of his domestic and nominated sub-contractors. PASS scores affect the allocation of future tendering opportunities to main contractors and evaluation of their submitted tenders.

(III) FINDINGS OF THE REVIEW COMMITTEE

39. The Review Committee is of the view that the past mechanism for ensuring the quality of drinking water supplied to PRH estates has certain inadequacies.

Regulatory and industry-wide issues

40. The Review Committee notes that, as part of the overall regulatory regime in place to ensure the quality of the fresh water supply systems, it is stipulated in the WWO that construction of inside service except works of a minor nature shall be carried out by an LP, and that all pipes and fittings shall comply with the relevant British Standards in accordance with the WWR. The Review Committee also notes that, upon completion of inside service, WA conducts inspection before the inside service is connected to the Government mains. Besides, water samples are taken for testing against specified parameters before the WA issues the certificate on water supply connection (Form WWO 1005), but before the “excess-lead-in-water” incidents, no reference was made to the WHO’s “Guidelines for Drinking – Water Quality” for the purpose of issuing Form WWO 1005. The Review Committee notes that the Task Force has found that, before the “excess-lead-in-water” incidents, the testing of water samples did not include lead or other heavy metals¹⁰; and whether the soldering joints contain lead was not checked. The Task Force was of the view that there was inadequate awareness of the stakeholders in the construction industry on the use of leaded soldering material and its consequences on the drinking water quality. The Task Force is of the view that, among other things, an enhanced system for site inspection and testing during construction of plumbing works has to be in place to prevent use of leaded soldering material and non-conforming pipe fittings in future. The Review Committee also notes the Task Force’s recommendation in its Final Report (paragraph 5.1(d) under Chapter 5) that the WA should review the WWO and WWR to see if improvement is necessary to further strengthen its regulatory regime on the construction of inside service. The Review Committee also sees the need for such a review.

41. The Review Committee notes that after the “excess-lead-in-drinking water” incidents, WSD has up to mid-December 2015 issued a total of eight Circular Letters promulgating the latest requirements in respect of the construction of inside service, some of which target the risk of the presence of lead in solder and excess lead content in drinking water³.

42. The Review Committee notes the Task Force’s findings that copper alloy fittings also leached lead but did not result in excess lead in drinking water. Nevertheless, the Review Committee expects the HA/HD to collaborate with the authorities and industry stakeholders to raise the quality standard of sink mixers, other fittings and materials in the plumbing system, and to ensure full compliance with any new stipulations by the WA in this regard.

43. The Review Committee has the following observations on the industry’s practice –

- (a) according to some main contractors and plumbing subcontractors, the plumbing workers on-site lacked the knowledge to differentiate which type of soldering material was “lead free”;
- (b) the plumbing subcontractors had overlooked the significance of soldering materials used for pipe connections. Their on-site supervision in this respect had been lax before the “excess-lead-in-water” incidents. Purchase of soldering materials was sometimes left to their site supervisors or sub-subcontractors;
- (c) the non-compliant soldering materials could have been purchased by the sub-subcontractors. It is believed that in some cases, such purchases were made as an expedient to meet the immediate needs of the works, and the purchasers were not aware that the materials bought did not comply with the requirements. Whether or not there had been other considerations involved, such as cost minimization, is not clear;
- (d) it is not clear whether the LPs, who have a legal duty and liability under WWO to carry out the construction of inside service, understand the “lead-free” requirement for soldering materials as stipulated under the WWR or can tell the composition (including the lead content) from the appearance of different types of soldering materials available in the market;
- (e) the training courses for different levels of workers in the plumbing trade offered by the various training institutions in the past had not put as much emphasis on the adverse consequences arising from the presence of lead in the plumbing system as on practical soldering techniques to prevent water leakage; and
- (f) in general, there had been a lack of awareness in the construction industry, as well as the HA/HD, of the risk of the presence of lead in

solder and its implications for the drinking water quality and in turn, the associated health risks.

The subject main contractors

44. The Review Committee has the following observations on the subject main contractors, notably in respect of the main contractors' sub-contracting, appointment of LP and role of LP; purchase of materials after main contractors obtain the Contract Manager's approval of materials; the main contractors' checking of materials on delivery and storage; the main contractors' supervision of plumbing installation work; the main contractors' inspection and testing on completion; and competency of the main contractors' staff and LP as outlined below -

- (a) although the main contractors, who are responsible for continuous supervision and accountable to HA as the contractual party with HA, were well aware of HA's specification of using lead-free solder for copper pipe connection, they failed to fulfill the contractual requirement. The main contractors did not pay due attention to the soldering materials used, and never put in place sufficient safeguards to ensure that the soldering materials used on-site conform to the approved samples;
- (b) some main contractors did not have a clear understanding of the front-line practice of plumbing installation. They did not know who actually purchased the soldering materials nor did they have records of workers undertaking which part of the installation;
- (c) the main contractors generally did not check the soldering materials delivered to site or closely supervise the soldering process. They did not take note of the soldering materials actually used by workers, nor did they ensure that the materials used were the same types approved by the Contract Manager; and
- (d) the LP's role was unclear and communication among the main contractors, plumbing subcontractor and LP was weak. The main contractors and plumbing subcontractors overly relied on WA's approval and on the LP to communicate with the WA. The main contractors had not ensured that the administrative procedures of WA, such as notifying WA of changes in fittings used in the plumbing installations, were fully observed by the LP.

45. The Review Committee also notes that the Tender Committee of the HA decided to impose regulatory actions against the subject main contractors (and their related companies), and to debar the plumbing subcontractors and LPs concerned from working in a stipulated number of future HA contracts⁴. The Review Committee also notes that the licenses of three LPs involved in the construction of PRH developments found to contain excess lead in drinking water, have already been cancelled by the WA.

Inadequacies of Quality control mechanism for HA's projects

46. The Review Committee notes that, as set out in its Interim Report, the past quality control mechanism for HA's projects that had been in place before the "excess-lead-in-water" incidents was consistent with the industry's practice, the law (i.e. WWO and WWR) and other WSD's requirements. However, the Review Committee notes that the past system **had not focused on the presence of lead (or other heavy metals) in the fresh water supply system or in the water, and had not targeted soldering materials as a high risk item.** Inadequacies include –

- (a) in terms of the contract with the main contractor, HA/HD's system was compliant with the law and the requirements of the WA, in that the contract specified that the main contractor must employ a LP, that only lead-free soldering materials could be used, etc. However, HA/HD's system had not specifically required the main contractor to put in place a management plan to control, inspect or supervise the use of soldering materials, including quarantine upon delivery of materials;
- (b) in terms of in-process supervision, testing and commissioning, HA/HD's system had not checked for presence of lead in soldering joints; and
- (c) in terms of checks on completion of projects, HA/HD's system followed the then WA's requirements on tests of water samples for eight parameters, and did not include tests for lead.

47. In the past few months, the Review Committee examined HA/HD's past quality control mechanism with a view to finding out in particular why non-compliant soldering materials had been used in the fresh water supply systems in some PRH developments. It is noted that a typical HA project may involve over 1 000 types of materials and components and around 30 disciplines of trade practitioners (including those at the sub-contractor and worker levels). The Review Committee notes that, to ensure effective use of resources, HA/HD's quality control mechanisms for material approval, site inspection and

testing of various materials etc. are risk-based and have been drawn up having regard to the laws and regulations, industry and trade practices, past experiences and known risks. Therefore, HA/HD's past quality control mechanism, including the parts that sought to meet the statutory and WSD's administrative requirements, as well as the parts that were in addition to the statutory and WSD's requirements, were geared towards **known issues about safety and quality of fresh water in the past**, which focused on –

- (a) the physical performance of the water supply system, including the alignment of water pipes, position and quantity of brackets and whether they are firmly fixed, the adequacy and spacing of pipe sleeves, the connection of pipes, whether the materials used comply with contractual requirements, and whether there is water leakage or bursting of pipes in the system etc.;
- (b) the eight water test parameters as stipulated under WSD Circular Letter No. 2/2012, including pH, colour, turbidity, conductivity, free residual chlorine, E.coli, total coliforms and heterotrophic plate count¹⁰; and
- (c) the risk of Legionnaires' disease, for which HA/HD has been requiring the main contractors to carry out additional disinfection of the water supply system of newly completed estates before occupation.

48. The Review Committee notes that, as mentioned in paragraph 35 above, inspection by HD's site inspection team is divided into three categories (i.e. 100% checking, 10% checking and random checking) based on the level of risk involved. Given the known risks of water leakage and the presence of bacteria in water, HD's site inspection team has been carrying out 100% checking for pipe testing and cleaning of water tank/ pipeline. A 10% checking is applied to pipe sleeve, materials, type and dimensions, pipe joint, expansion joint, pipework installation, valves, taps and strainers, pipe bracket and caulking pipe sleeves. However, the lead content in soldering materials had not been checked when pipe joints were inspected in the past. Neither were soldering/ brazing alloys for copper pipes and fittings included in the list of materials requiring on-site delivery verification against approved samples, catalogues and certificates.

49. The Review Committee notes that, in the past, HA/HD had expected the main contractor to discharge its duty to ensure that the soldering materials used complied with contractual requirements through due supervision of their plumbing subcontractor and on-site monitoring of the use of soldering materials. HA/HD had been relying on the documents submitted by the main contractor and LP to satisfy itself that such contractual requirements had been met.

Besides, as it was generally believed that the certificate on water supply connection (Form WWO 1005), issued by the WA, should have served as an assurance of the quality of the plumbing system and the drinking water, checking for lead content in water had not been built into HA/HD's quality control system in the past.

50. The Review Committee notes that, while HA/HD has been aware that only lead-free category soldering materials can be used in any installation for water for human consumption, as stipulated in relevant British Standards, there had been a lack of awareness in HA/HD of the risk of the presence of leaded soldering materials in the plumbing system, owing to the belief that the industry as a whole had been using compliant soldering materials long before HA/HD started to adopt copper pipes for plumbing installations. The department has the expertise and experience in devising and using quality assurance tools in aspects where high risks have been identified. However, it had not been conscious of the risks of presence of lead in solder joints and of such presence leading to excess lead in water, and had not applied to such risks its quality assurance tools suited to high risks. Specifically, the department had not targeted soldering materials as a high risk item for contractors' checking and monitoring upon delivery to site and during construction, and had not checked the lead content in soldering materials when pipe joints were inspected in the past.

(IV) ENHANCEMENT MEASURES

51. Noting the inadequacies in HA/HD's past quality control system, the Review Committee has agreed that certain measures need to be put in place by HA/HD, in respect of new PRH projects under construction, to immediately reduce the risk of occurrence of the presence of lead in solder on joints and of excessive lead content in fresh water. The Review Committee notes that HA/HD has put in place the following measures as soon as practicable after the "excess-lead-in-water" incidents –

- (a) for projects which are approaching the completion stage, HA/HD will require the main contractor to test water samples for heavy metal content (including lead) in accordance with WSD's latest requirements¹². Concurrently, HA/HD will require the contractor to take additional water samples for the above test plus an extra water quality test;
- (b) HA/HD will contractually require the main contractor to submit and comply with a management plan covering stringent plumbing subcontractor supervision and on-site monitoring. Such a plan include measures such as central procurement of soldering materials by the main contractor or domestic sub-contractor, checking soldering/ brazing materials upon delivery to site and putting them under quarantine before releasing them for use by workers, recording the works completed by individual workers so that they become more traceable etc. Contractors will also be encouraged to use mechanical jointing of water pipes. HA/HD will also require the main contractor to ensure that workers receive sufficient training on soldering joint requirements before work starts, and to involve the LP in supervising plumbing installation works, submitting regular reports and attending regular meetings, to ensure compliance with specifications; and
- (c) at any time during construction stage, the main contractor and HA/HD staff will use non-destructive quick test methods to check for the presence of lead in soldering joints. In addition, HA/HD staff may order laboratory tests if deemed appropriate.

52. The Review Committee also agrees that certain enhancement measures need to be put in place by HA/HD, in respect of existing PRH estates that will

¹² On 13 July 2015, WSD issued Circular Letter No. 1/2015 to, among other things, remind about the use of lead-free solders for copper pipes at fresh water Inside Services as specified in the standard stipulated in the WWR, and promulgate additional test parameters of water samples covering the four heavy metals of lead, chromium, cadmium and nickel on top of the eight test parameters under WSD Circular Letter No. 2/2012.

undergo M&I works as mentioned in paragraph 12 above. The HA/HD has already started to implement the following enhancement measures, which are not fully identical to those applicable to the new works projects, as a stop-gap to reduce the risk of the presence of excess lead in drinking water in existing estates including those undergoing M&I works –

- (a) HA/HD will continue with the practice and require the contractor to use copper pipes with compression joints. If the use of soldering joint is unavoidable at isolated locations, the contractor will be required to submit an application for the HA/HD's approval, with supporting documents proving that lead-free soldering material has to be used, and a site control plan to ensure that only approved materials will be used on-site;
- (b) if soldering joints are approved for use at isolated locations, HA/HD will carry out checks for the presence of lead in soldering materials, by quick test methods upon material delivery to site, as well as when works are in progress;
- (c) HA/HD will require all contractors to re-submit materials for plumbing works for approval in accordance with WSD's Circular Letter No. 2/2015, which stipulates that WSD's acceptance of water supply pipes and fittings is valid for a maximum of five years from the date of issuance of the approval letter; and
- (d) for plumbing works involved in large-scale renovation of estates and large-scale replumbing works, upon completion, HA/HD will require the contractors to test water samples in accordance with WSD's latest requirements¹².

53. As noted above, after submitting its report on interim findings to the HA Chairman on 6 October 2015, the Review Committee has visited a PRH construction site and met some professional bodies, industry stakeholders and training institutions. In light of new observations and latest exchanges with stakeholders, the Review Committee has made the following additional recommendations –

- (a) It is necessary to further enhance HA/HD's quality control on soldering materials from delivery, inventory control to testing by HD's site inspection team. Soldering/ brazing alloys, and copper pipes and fittings should be included in the list of on-site delivery verification items.

Soldering/ brazing joints should also be included in the list of plumbing items that require 10% checking by HD's site inspection staff;

- (b) As a result of the enhancement measure in paragraph 51(b) above, the contractors will now be required to carry out management checks and supervision to the HA/HD's satisfaction. Therefore, HD's site inspection team should be adequately trained to inspect whether the main contractors have duly conducted their supervisory checks, and promptly involve the LPs in supervising plumbing installation works, submitting regular reports and attending regular meetings to ensure compliance with specifications; and
- (c) Training institutions such as the Construction Industry Council and the Vocational Training Council should consider enhancing their training programmes for licensed plumbers and workers in the plumbing trade. In addition to practical soldering techniques to avoid water leakage problem which has been the focus of training all along, emphasis should also be put on how to differentiate, by appearance or other methods, compliant soldering materials from non-compliant ones in the course of carrying out the works. Trainees and practitioners should also be taught on the adverse consequences arising from the presence of lead in the plumbing system.

54. The Review Committee notes that the above enhancement measures which are relevant to HA/HD have already been put into practice.

Other issues

55. Some other relevant issues have come up in the course of the Review Committee's deliberations, and the Review Committee's views on these issues are as follows –

- (a) There are views that the HA should consider adopting the nominated sub-contractor arrangement for plumbing installation works outside pump rooms or the arrangement under which there is a separate contract for plumbing works. However, given the enhancement measures already put in place to ensure the main contractor to better discharge its responsibilities in monitoring the performance of its subcontractors and the relative simplicity of the plumbing installation works outside pump rooms for domestic blocks, the Review Committee does not see the need for adopting the nominated sub-contractor arrangement for plumbing

installation works outside pump rooms or a separate contract for plumbing works.

- (b) It is noted that the Development Bureau maintains a List of Approved Suppliers of Materials and Specialist Contractors for Public Works under Category of Plumbing Installation, which covers the construction, repair and maintenance of plumbing installations. The Review Committee is of the view that the HA/HD may consider adopting the List for the main contractors to choose from in HA's future projects; and
- (c) There are suggestions that the HA/HD should be supported by its own in-house research and development team and should have knowledge about the dangers of the presence of lead in potable water. The Review Committee notes that while HA/HD has carried out technical studies from time to time, these studies have been carried out primarily for the purpose of facilitating the HA to discharge its statutory functions under the Housing Ordinance and have aimed to address problems specific for and unique to the HA/HD's role in public housing development, but not the wider industry issues. Selection of topics for study has been based on the level of risk involved and geared towards problems known to HA. In most cases, these studies were carried out in conjunction with the relevant statutory authorities within the Government (the WA in respect of WWO, the Building Authority in respect of the Buildings Ordinance, etc.). The Review Committee considers that it would not be practical for HA/HD to conduct its own research and development for every aspect of construction including, but not limited to, concrete, plumbing, lifts and escalators, electricity, fire services, gas and LPG etc. The HA/HD should continue to carry out its own studies to address its specific problems, while keeping in view latest developments and newly identified risks identified by the relevant authorities. The HA/HD should also continue to keep in view and implement any new stipulations and requirements as required by the authorities; and
- (d) There are suggestions that Building Services Engineers of HD should assume more responsibilities in plumbing installation works in HA's projects. In this regard, the Review Committee notes that different professions, grades and ranks in HD work as teams and within an integrated structure, in accordance with detailed internal guidelines promulgated for many aspects and stages of construction. As mentioned in paragraph 23 above, HD had put in place an on-site monitoring system with detailed guidelines and instructions for the site inspection

staff, including the Clerks of Works who played a key monitoring role, to carry out their duties. Site inspection staff were all along required to check pipework installation and pipe joints, etc., but had not been required to, specifically, check for the presence of lead in soldering joints before the “excess-lead-in-water” incidents. After the incidents, site inspection staff, including the Clerk of Works, have been required to check contractors’ quarantine of soldering materials upon delivery to sites before releasing for use, conduct 10% checks for soldering joints, and witness the Direct Testing Contractors’ use of XRF to check for the presence of lead in soldering joints. The Review Committee agrees that such additional tasks should be specified in the inspection duties of Clerks of Works. In this connection, the Review Committee agrees that there is no need to introduce material changes to the duties and responsibilities of HD’s Building Services Engineers.

(V) OBSERVATIONS ON WATER TEST RESULTS FOR PUBLIC RENTAL HOUSING ESTATES

56. The Review Committee notes that the HA/HD has completed water sampling tests for all PRH estates. For PRH estates completed after 2005, HD and WSD had carried out systematic water sampling tests for 46 PRH estates involving 83 PRH developments from early July to 24 September 2015. Out of around 4 740 samples taken, 91 samples from 11 PRH developments exceeded the World Health Organisation (WHO)'s limit of provisional guideline value for lead content. For PRH estates completed before 2005, HD and WSD carried out water screening tests for 144 estates involving around 2 640 samples. It is noted that all samples met the WHO's guideline limit. From these results, the Review Committee notes that –

- (a) it is unlikely that the “excess-lead-in-water” incidents are attributable to the use of prefabricated kitchens or bathrooms. With the exception of Kai Ching Estate, in all cases prefabricated kitchens and bathrooms did NOT have plumbing pre-installed; plumbing was installed on-site after the prefabricated components had been delivered to site, and plumbing was surface-mounted. Pre-installed plumbing in prefabricated kitchens and bathrooms was only used as a pilot in Kai Ching Estate. And even in the case of Kai Ching Estate, out of the seven flats from which water samples were found to contain excess lead content, only one involved a prefabricated component (a kitchen) with water pipes pre-installed;
- (b) Out of around 4 740 samples taken, only 91 samples from 11 PRH developments was found to contain excess lead content. The incidents are not confined to individual contractors, subcontractors or LPs. The 11 estates with water samples containing excess lead content involve four different main contractors, three different plumbing subcontractors and three different LPs;
- (c) the 11 estates with water samples containing excess lead content are not confined to the most recently completed estates. In fact, the completion years for these 11 estates straddle a number of years from 2008 to 2014; and
- (d) no sample taken from estates which did not use soldering joints has been found to contain excess lead content. This is consistent with the findings of the Task Force that leaded solder joints are the cause of excess lead in drinking water in PRH developments.

(VI) LOOKING AHEAD

57. The Review Committee was set up in response to the discovery of excess lead in drinking water in PRH estates. Therefore, in the course of examining HA/HD's past quality control mechanism for PRH projects, the Review Committee had focused on the inadequacies in the past system which had contributed to the presence of excess lead in drinking water, and recommended measures to prevent recurrence of similar incidents in future. The Task Force's preliminary findings, released on 25 September 2015, first established that leaded solder joints were the cause of excess lead in drinking water in some PRH estates. Given such findings, the Review Committee has also looked into the different aspects of HA/HD's quality control system which had let the use of non-compliant soldering materials escape unnoticed.

58. The Review Committee is mindful that its TOR is to review the arrangements for quality control and monitoring in relation to the installation of fresh water supply in PRH estates, which is wider than the mere issue of lead in solder, and may include other aspects of water quality. Water quality refers to the chemical, physical, biological, and radiological characteristics of water. In Hong Kong, the water quality is continuously monitored by the WA/ WSD through a series of physical, chemical, bacteriological, biological and radiological examinations. The Review Committee notes from WSD's departmental website that since August 2012, WSD has monitored the quality of drinking water according to the WHO's Guidelines for Drinking-water Quality, Fourth edition (WHO 2011). Notwithstanding the above, given the background of the "excess-lead-in-water" incidents, and that the work of the Review Committee can only be premised on updated, authoritative and expert information that has been brought to the attention of the Review Committee during the review period which include, in essence, the findings of the Task Force, the Review Committee have hence been focusing on how to reduce the risk of the presence of lead in solder on joints and of excess lead content in water in future PRH projects.

59. The Review Committee acknowledges that other aspects of water quality are also important in ensuring the supply of safe drinking water to tenants of HA's properties. Similarly, other aspects of construction are also crucial to HA's responsibility under the Housing Ordinance and towards the public. HA/HD's quality control mechanism for public housing developments will continue to observe laws and regulations stipulated by relevant statutory authorities in Hong Kong, and to adopt a risk-based approach based on industry and trade practice, past experiences and known risk levels. The Review

Committee expects the HA/HD to keep in view the developments on the understanding of risks, including the future findings and recommendations of the Commission of Inquiry, as well as to continue to keep in view the latest statutory and administrative requirements, and ensure full compliance with new stipulations by relevant authorities, including those to be promulgated by the WA pursuant to the latter's review. The HA/HD should also continue to consider implementing additional quality control measures for public housing projects, on top of complying with requirements stipulated by the authorities.

**Review Committee on Quality Assurance Issues
Relating to Fresh Water Supply of Public Housing Estates**

January 2016

Annex A

Membership of the Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates

Chairman: Mr CHEUNG Tat-tong

Members: Mr Albert AU Siu-cheung

Mr Stanley WONG Yuen-fai

Dr the Hon LO Wai-kwok

Mr Horace CHEUNG Kwok-kwan

Hon KWOK Wai-keung

Hon Dennis KWOK Wing-hang

Prof the Hon Joseph LEE Kok-long

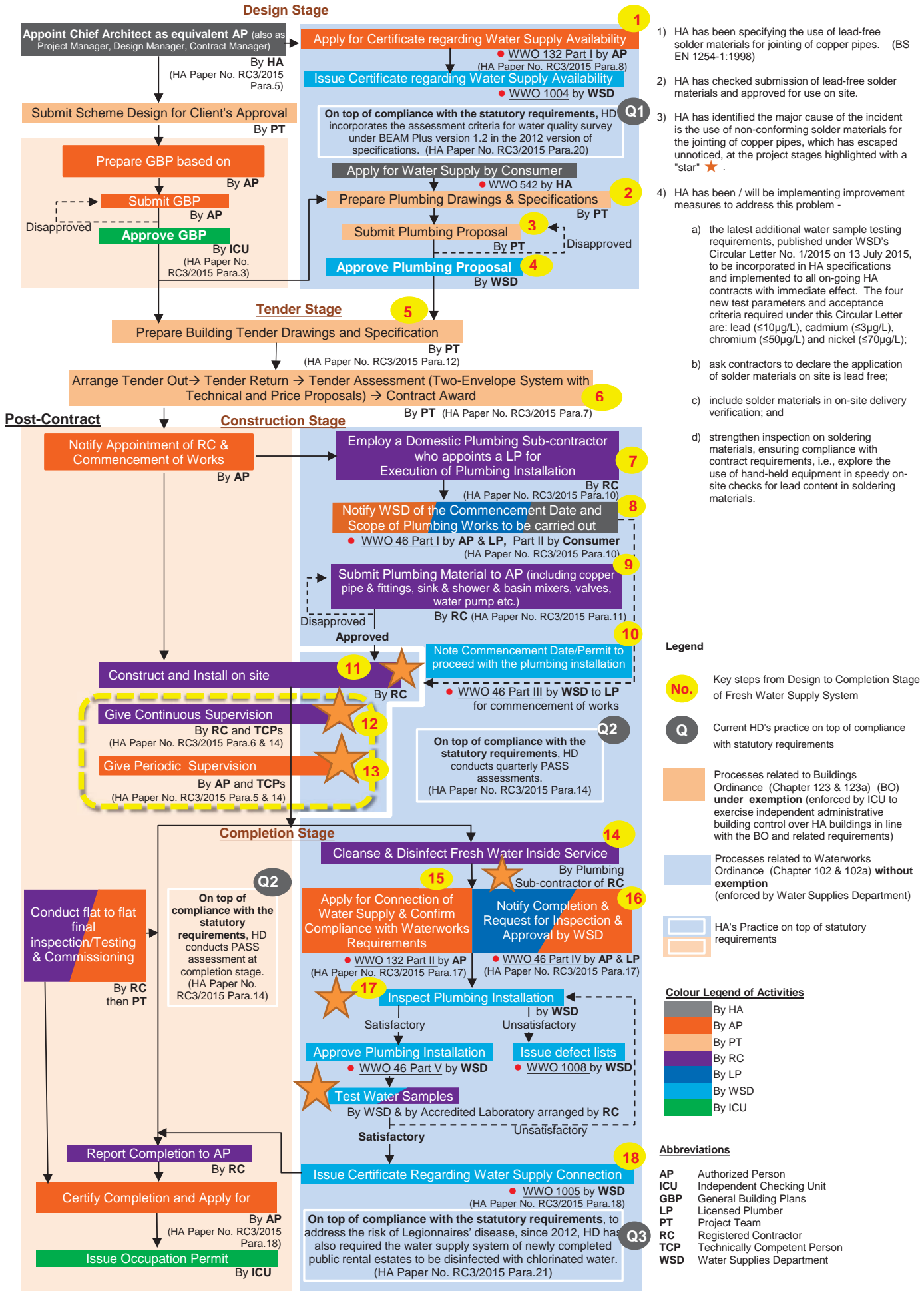
Annex B

List of Main Papers Reviewed by of the Review Committee on Quality Assurance Issues Relating to Fresh Water Supply of Public Housing Estates

Paper No.	Title
RC 2/2015	Quality Control of the Fresh Water Supply System in Hong Kong
RC 3/2015	Measures taken by the Housing Authority to ensure Quality of the Fresh Water Supply System
RC 6/2015	Flow Chart for Design, Construction and Completion of Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 7/2015	Outline of Processes in Pre-contract Stage in the Context of Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 10/2015	Design and Specifications for Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 11/2015	Contract Arrangements for Building Contracts relating to Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 12/2015	Outline of Processes in Post-contract Stage in the Context of Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 13/2015	Material Submission for Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 14/2015	Site Supervision for Installation of Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 15/2015	Procurement Matters Relating to Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 19/2015	Testing and Commissioning and Final Inspection for Fresh Water Supply System in Housing Authority's Public Housing Developments
RC 24/2015	Quality Control and Supervision of Off-site Manufactured Precast Concrete Components for Use in Housing Authority's Public Housing Developments
RC 28/2015	Test Results of Water Samples taken from Public Rental

	Housing Estates completed in or after 2005
RC 29/2015	Maintenance and Improvement Works for Fresh Water Supply System in Public Rental Housing Estates
RC 35/2015	Meeting with The Hong Kong Institution of Engineers
RC 36/2015	Final Report of the Task Force on Excessive Lead Content in Drinking Water
RC 41/2015	Report on Imposition of Regulatory Actions Against Building Contractors and other Actions Against Related Parties
RC 42/2015	Organization Structure for Delivery of Housing Authority's Construction Projects
RC 43/2015	Water Supplies Department's Circular Letters Issued after the "Excess-lead-in-water Incident"
RC 44/2015	Evidence by Contractors and Housing Authority's Additional Quality Assurance Measures
RC 45/2015	Quality Assurance Measures for Fresh Water Inside Service

Pre-Contract



Updates on the “Excess Lead in Drinking Water in Public Rental Housing Estates” Incident

Water Sampling Tests

Systematic water sampling tests for Public Rental Housing (PRH) estates completed in and after 2005

On 24 September 2015 the Housing Department (HD) and the Water Supplies Department (WSD) completed the systematic water sampling tests for PRH developments completed in and after 2005. A total of 46 PRH estates, involving 83 PRH developments, were involved. Among them, water samples taken from 11 PRH developments exceeded the World Health Organisation (WHO)’s Provisional Guideline Value¹. Around 4,740 water samples had been taken, among which 91 were found to contain excess lead.

Screening tests for PRH estates completed before 2005

2. As the WSD’s Task Force on Excessive Lead Content in Drinking Water confirmed that leaded solder joints were the cause of excess lead in drinking water in PRH developments, and given that in general PRH estates completed before 2005 did not use soldering in water pipe connections, the risk of excess lead in drinking water in these estates is lower. Such a lower risk was confirmed by the test results of water samples (all below the WHO’s guideline limit) taken from nine estates that did not use soldering but had also been covered under the systematic water sampling tests for PRH estates completed in and after 2005.

3. Having regard to the above findings, HD and WSD carried out a two-step water screening test for PRH estates completed before 2005, with a view to obtaining objective and representative results about the quality of drinking water in these estates within a shorter timeframe. The first step involved a representative screening of these estates by batches. Depending on the size of the estates, HD and WSD would select several blocks from each of them, and take water samples from each of the selected blocks. If individual estates were found to have water samples containing excess lead content in the first stage, HD and

¹ The provisional guideline value of WHO’s Guidelines for Drinking-water Quality (2011) is not more than 10 micrograms per litre for lead in drinking water.

WSD would conduct systematic water sampling tests (as with tests conducted for estates completed in and after 2005) for each block within that estate, covering every independent fresh water supply system in each block, to determine the overall water quality of that estate in terms of lead content.

4. On 18 November 2015, it was announced that HD and WSD had completed water screening tests for all PRH estates completed before 2005. A total of around 2,640 water samples were taken from 144 PRH estates completed before 2005, and all of them met the WHO's guideline limit. None of these PRH estates had been required to undergo the second-stage systematic sampling tests.

Relief Measures to Assist Affected Tenants

5. Since the "excess-lead-in-water" incident, to minimise the inconvenience for tenants of the 11 affected PRH developments in gaining access to safe drinking water, the Government and the Hong Kong Housing Authority (HA) have taken a series of measures including the supply of bottled water, standpipes, and requesting the contractors concerned to install temporary water points by connecting pipes from the roof-top tank to each floor of the block, as well as to install filters and replace filter cores within two years from the date of their installation for affected domestic households free of charge.

6. Filter installation has been completed and the temporary water points in all 11 developments have been put into use. As tenants in the estates are now able to gain access to safe drinking water through water filters and the temporary water points, HA ceased the distribution of bottled water to the 11 affected developments altogether on 28 December 2015. Up to that time, HD had distributed a total of 9.96 million bottles of bottled water, involving a total cost of around \$60 million.

Water Tests for PRH Estates with Filters Installed

7. In accepting the relevant contractors' proposals on filters to be installed for affected households, one of the conditions of HA was that the filters had to have U.S. National Sanitation Foundation (NSF) 53 certification for lead reduction. According to the NSF, it has in place a strict procedure for certification approval, including testing for lead-reducing effectiveness and inspecting the production process, to ensure the continued effectiveness of individual brands in lead-reduction.

The Government Laboratory has also conducted tests to test the effectiveness of the filters. Nevertheless, some affected tenants were still concerned about whether the water, as filtered by filters installed by the contractors, met the WHO's guideline limit. To ease tenants' concerns, water tests were conducted again for the units in the 11 affected PRH developments in which samples with excess lead content had been found and filters were subsequently installed by the contractors. HA announced on 2 November 2015 that such water tests, involving 76 units in total, had been completed, and all test results met the WHO's guideline limit.

Water Charge Subsidy Scheme

8. On 11 November 2015, HA announced that tenants in the 11 PRH developments in which excess lead in drinking water was found would receive subsidies for offsetting part of the water and sewage charges payable. The cost for implementing this subsidy scheme, involving around \$20 million, is provided by the four contractors concerned as a matter of good faith, good will and civic mindedness. Under the scheme, each domestic household, and each non-domestic tenant in a domestic block, in the 11 affected PRH developments, will receive a subsidy of \$660. Since 1 January 2016, the subsidy has been allocated to a subsidy reserve for each of the tenants on a daily basis throughout 366 days, for paying the tenant's water bills within three years. If the subsidy is less than the sum of water charges and sewage charges payable, any excess amount will have to be paid by the tenants themselves. If the subsidy is larger than the sum of charges payable, any unutilised amount will remain in the subsidy reserve until the three-year period expires. In cases where existing tenants move out of any of these affected developments during the three-year period, any unutilised subsidy will apply to the new tenants moving in.

9. Based on the data of the most recent water bills of domestic households in the 11 affected PRH developments, the subsidy of \$660 is equal to or more than the sum of water charges and sewage charges payable by each of the some 21,000 (70%) domestic households in these developments in a year. Among these 21,000 domestic households, around 5,100 did not need to pay any water charges under those past water bills.

Permanent Rectification Works

10. Apart from the immediate relief measures mentioned above, HA has requested the four contractors concerned to rectify the non-compliant water pipes in the 11 affected PRH developments. As announced by HA on 30 December 2015, the four contractors have been carrying out a trial since early January 2016 to prove their intended method in the common area of one block in one of their relevant estates, before rollout of the rectification works in all 11 developments. The four affected developments where the trials are now being carried out are Lower Ngau Tau Kok Estate Phase 1, Kai Ching Estate, Wing Cheong Estate and Kwai Luen Estate Phase 2. The trial works are expected to be completed within February 2016. HA has asked the contractors to minimise the inconvenience caused by the works to tenants during the trials, which may include temporary water suspension, dismantling of laundry racks, workers using gondolas and passenger lifts, occupation of public space by large storage facilities etc.

11. The contractors/ HA will determine the parts of the water pipes which need to be replaced by using quick test methods to check for the presence of lead in soldering joints. After the trials, a more detailed work plan and timetable for the rectification works will be worked out based on data and practical experience drawn from the trials. The current plan is to replace the non-compliant water pipes in the common area first, before replacing the non-compliant water pipes inside individual units in the next stage. We will announce the arrangements for the rectification works as soon as possible after the trials are completed and the relevant details are confirmed.

Follow-up Action in Relation to the Contractors Concerned

Provision of a Performance Bond by the Contractors

12. Since the incidents, HA has repeatedly said that it will hold the contractors accountable. As noted above, the four contractors concerned have been cooperative in carrying out follow-up actions with HA.

13. In addition, on 6 November 2015 HA's Tender Committee announced that the four contractors concerned have agreed to provide a performance bond to HA, in respect of the affected PRH developments, to provide additional commitment to implementing measures to provide safe water supply to residents and to complete necessary rectification of the water pipes and joints. The bond is provided by the contractors as a

matter of good faith, good will and civic mindedness, and covers the following measures:

- (a) at its own expense, each contractor has installed water filters in affected flats and will maintain them for two years from the date of the installation;
- (b) at its own expense, each contractor has installed temporary water supply pipes at every floor of each individual block of the affected estates and will maintain them until completion of the rectification of pipes and joints;
- (c) at its own expense, each contractor will rectify all water pipes and joint fittings of the fresh water supply systems of the PRH estates which are necessary under the contract, and the remedial works will include a 12-month maintenance period commencing from the date of completion as certified by HD; and
- (d) each of the contractors is requested to provide HA with a performance bond of \$5,000 per flat within 21 days from the date (either 18 or 19 January this year) of notification letters from HA. In the event that the contractors are verified to be in default of performing any of the above measures, HA will seek recovery in accordance with the terms of the performance bond.

Regulatory Action against the Contractors and Relevant Parties

14. As for taking regulatory actions against the contractors, HA has all along acted in accordance with the established mechanism, including giving due consideration to the actual circumstances and details of non-compliance. As far as the “excess-lead-in-water” incident is concerned, HA’s Tender Committee, having taken into account the additional commitment mentioned in paragraph 13 above, announced on 30 September and 6 November 2015 successive regulatory actions at list management level against the contractors and their related companies, and at contract management level against the domestic plumbing sub-contractors and the Licensed Plumbers (LPs). Details are as follows –

–

- (a) The total length of period during which the four contractors concerned (and two related companies) would not be considered for new works tenders invited by HA starting from 1 March 2015, are set out below respectively –

- (i) Shui On Building Contractors Limited: 8 months (involving 8 tender opportunities);
 - (ii) China State Construction Engineering (Hong Kong) Limited (and related company China Overseas Building Construction Limited) and Paul Y. General Contractors Limited (and related company Paul Y. Construction Company Limited): 10 months (involving 11 tender opportunities); and
 - (iii) Yau Lee Construction Company Limited: 12 months (involving 12 tender opportunities).
- (b) The total length of period during which the three domestic plumbing sub-contractors and the three LPs concerned would be debarred from working on HA's new works contracts starting from 1 March 2015, are set out below respectively –
- (i) Ho Bui Kee Construction Engineering Company Limited and Mr Lam Tak Sum: 8 months (involving 8 contracts);
 - (ii) Golden Day Engineering Company Limited and Mr Cheung Tat Yam: 10 months (involving 11 contracts); and
 - (iii) Ming Hop Company Limited and Mr Ng Hak Ming: 12 months (involving 12 contracts).
- (c) China State Construction Engineering (Hong Kong) Limited, Shui On Building Contractors Limited and Yau Lee Construction Company Limited were removed from HA's Premier League of contractors with effect from 1 October 2015.

Establishment of the Independent Commission of Inquiry

15. The Commission of Inquiry into Excess Lead Found in Drinking Water (COI), set up by the Government, has begun hearings. If the COI considers that follow-up action is required in respect of the responsibilities of any person or organisation, HA will follow up solemnly in accordance with the established mechanism.

Expenses Incurred in Relation to the Incident

16. A total of about \$90 million has been provided by HA in 2015-16 on remedial measures relating to the incidents, which includes provision of bottled water to the affected tenants (about \$60 million), temporary staff resources for handling the incident (about \$20 million) and fee for engaging external lawyers for the purpose of COI hearings (about \$10 million). The provision will be absorbed within the approved budget for 2015-16. The actual amount of expenses will be finalized after close of the financial year.

Implications on the Public Housing Construction Programme

17. We reported to this Panel in November 2015 that the progress of tender approval for public housing by HA had been affected by the “excess-lead-in-water” incident, and the completions of individual projects were expected to delay for about one to two months. These projects include Kiu Cheong Road East in Ping Shan, Ngan Kwong Wan Road East, Ngan Kwong Wan Road West and Shek Mun Estate Phase 2. As the incidents are still developing, there may be further implications for the public housing construction. We will keep in view the latest developments, including any new statutory and administrative requirements promulgated by WSD and their impact, if any, on public housing construction, and will seek to minimise the effect of the incidents on the supply of public housing.

**Transport and Housing Bureau
January 2016**