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上午9時32分恢復聆訊

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Wednesday, 17 February 2016

(9.32 am)

PROF JOHN FAWELL (on former affirmation)

(All answers in English)

Examination-in-chief by MR SHIEH (continued)

(All questions of Prof Fawell in English)

MR SHIEH: Good morning, Prof Fawell. We shall pick up from where we stopped yesterday, and that is about the existence of some type of registration system for plumbers.

You were telling us that in Scotland they started a regime or system of having registered plumbers, or the equivalent, after the saga that we have seen in the papers. You were telling us that Hong Kong was, in a way, a pioneer in having a centralised system of registration of plumbers.

So are you telling us that even for jurisdictions like Britain -- England and Wales, I should say -- or other systems that you have had experience of, they do not have any systems of accreditation or registration, or recognition of plumbers?

A. Not a formalised system, that they have now in Scotland and you have in Hong Kong. In England and Wales, the water companies are introducing their own system to register plumbers, because they have given up on the

government coming up with a scheme. And in the United States, for example, it just depends on individual states and what they decide to do.

So there are very few national registration schemes. Hong Kong's was certainly one of the first, and it makes a great deal of sense. The problem is you've got to make sure that that scheme works properly and that it is maintained, and that people realise that if you are registered, it is important that you take the responsibilities that go with registration.

Q. We would obviously look at the way the Hong Kong licensed plumber system works. I understand you actually have something to say about that in the later part of your report.

A. Yes.

Q. But just jumping the gun a bit, very often you have workers, numerous types of workers, in a construction site.

A. Yes.

Q. You have people laying bricks, you have general workers and stuff like that.

A. Yes.

Q. And very often, these would be regarded as run-of-the-mill, general type of workers, and obviously people, when they are training to be workers, they would

learn plumbing skills. The question could well be asked: what's the big deal with plumbing? Anyone can just go and fix two lengths of pipes together.

A. That's the problem. There are two stages in that. One is understanding the correct materials to be used and the correct fittings in the correct circumstances. The second is the quality of the work that is carried out. One of the problems with the leaded solder joints is that if the work is not carried out well, you get solder running down the inside of the pipe, and therefore the surface area of lead solder, in other words lead-carrying material, is much greater.

So the workmanship has a big impact on the concentrations that you may get in particular circumstances.

The other thing is understanding why things are being done. I've mentioned this several times in my report. I'm very concerned that people need to understand why things are being done. If they don't understand why, then they lose sight very quickly of what they need to be doing. So why is lead important? Because it has an impact on health. We've seen evidence from a number of people, who ought to have known, saying that they weren't aware that lead was a problem for health.

So understanding why and understanding why you are doing things is important. Having a registration system and training system that goes with the licensed plumbers is a very good start, so that you have a key person who is properly trained, licensed, understands more widely and is there, in my view, to supervise the other plumbers who are technically trained, but to make sure that they understand what's required.

So I think the licensed plumber position is actually a very important one. I've had some discussions regarding what that might mean in Hong Kong in terms of the large projects, and I understand that sometimes perhaps plumbing is seen as a very low -- a small part of the whole process, so it's not very high profile, whereas --

Q. That's why I asked you the question. Electricity has this glamour about it; people go to college and they do double E engineering and all that. Plumbers, people may say, "It's just a worker welding two pieces together; what's the big deal about it?"

A. They have a level of knowledge and that level of knowledge and the implementation of that knowledge is very important in terms of the public health dimension of plumbing. And we see from things like the WHO documents, the health aspects of plumbing, that this is

an important area. Plumbing is an important part of the chain of delivering safe drinking water, and safe drinking water is an important public health item.

Q. Thank you. I will come to that part of your report in due course, but as I said, I was jumping the gun a bit.

Can I return to paragraph 6 of your report.

A. Yes.

Q. Page 92 of the bundle. Paragraph 6, let me complete it:

"New guidance to health professionals, with regard to lead in drinking water was issued by Health Protection Scotland in 2012, which included guidance on investigations and water sampling at the tap to identify if lead is present."

I'm not going to read the underlying document, because obviously it says what it says, and you are referring to it basically as an international or, you know, as an incident which had happened with leaded solder. I'm not going to go through that underlying document.

Paragraph 7, "Background of the Incident":

"It is my understanding that between April and June 2015, samples of water taken from taps in some public rental housing in Hong Kong (Kai Ching Estate, Kowloon) were shown to have lead levels above the [WHO] provisional guideline value of 10 micrograms per litre.

This finding was in spite of the fact that, in drinking water systems in buildings in Hong Kong, there are no recently installed lead pipes, lead in the form of lead solder is not permitted and the level of lead in metal alloy fittings is restricted. Subsequently further samples showed that some met the WHO provisional guideline value and others did not. As a consequence the [WSD] established a Task Force with the following terms of reference:

(a) To carry out investigation to ascertain the causes of the recent incidents leading to the presence of lead in water drawn by households;

(b) To recommend measures to prevent recurrence of similar incidents in future; and

(c) To follow up on a recent case of Legionnaires' Disease found at Kai Ching Estate.

This last issue is dealt with separately later in my report."

Paragraph 8:

"I have studied the final report prepared by the Task Force set up to investigate the source of elevated lead concentrations in drinking water in some housing units in Hong Kong.

As a consequence I made further enquiries to ascertain the sampling protocol that have been used to

take water samples at the tap to identify the proportion of affected properties. It was confirmed that where samples had been taken from the kitchen tap inside apartments the water had been flushed for 2 to 5 minutes before a sample was taken for analysis. The consequences of this approach for identifying properties in which lead solder has been used are considered in more detail below.

10. In order to answer this and other questions regarding the quality of drinking water in Hong Kong and the procedures in place to assure drinking water quality, I made a visit to Hong Kong from the 9th to the 13th November 2015. During this visit I met with staff from the WSD, the WSD led Task Force on Lead in Drinking Water, the Housing Department and the Government Laboratory. I also made two visits to Water Treatment Works in Hong Kong, WSD Laboratories and Public Housing Developments at which investigations had been carried out. I was able to see the samples of pipework and fittings, including soldered joints and to ascertain the quality assurance procedures in place to ensure that the analysis for lead and other metals was of an appropriate standard. At all points I was afforded access to all the information that I requested and all questions were answered openly.

11. I have read statements and depositions regarding the detection of elevated concentrations of lead in drinking water in some public housing estates in Hong Kong and also on mechanisms in place in Hong Kong to ensure the safety and quality of fresh water (drinking water). These have formed the basis for my conclusions regarding the current situation in Hong Kong.

My Opinion Regarding the Investigations and Conclusions of the Task Force.

12. The WSD led Task Force has carried out a thorough investigation of the affected systems using appropriate technology. They have taken a sound systematic approach using techniques that have proved of value in similar investigations this other parts of the world such as in Scotland. The source of lead is confirmed as being primarily within the final stages of the distribution system inside the housing blocks, ie after the water meter.

13. The conclusions of the Task Force that lead solder used for soldering copper pipe joints is the major cause of the lead concentrations that were shown to exceed the WHO guideline value is supported by the evidence presented and the results from the investigations carried out by and on behalf of the

Task Force.

14. Detailed examination has revealed that in some places solder containing very high levels of lead (basically lead solder) has been used in installing copper pipe and fittings. This lead solder has resulted in the deposition of lead carbonates and hydroxides downstream of soldered joints on the inside of the pipes."

Pausing here, it may be because of my simplistic mind -- "downstream of solder joints" simply means that physically, it is at a point after water has flowed past a particular solder joint?

A. Correct.

Q. It doesn't actually mean somewhere along a down pipe or a particular position on the horizontal pipe on the corridor?

A. No.

Q. It simply means at a point after water has flowed past the lead source?

A. Absolutely. We see that with the photographs of some of the samples that were in the report from the task force, where they show that there are white deposits that are around and below the point where the soldered joints were.

Q. And it has to be downstream, obviously --

A. Yes, because --

Q. -- because water doesn't flow backwards?

A. Well, it can, but you've got problems.

Q. Water doesn't normally flow backwards?

A. Normally, that doesn't happen.

Q. Paragraph 15:

"Static tests have shown significant leaching of lead from these joints. In view of lead concentrations greater than 10 micrograms per litre observed in some flushed tap samples, I would conclude that there is the additional possibility of particles of lead carbonates/hydroxides appearing in water samples taken to assess lead concentrations at the tap. A number of copper alloy fittings were also shown by elemental analysis to contain more lead than would be allowed if they were to meet the requirements of the relevant British Standard. However, all copper alloy fittings do contain some lead and leach some lead into water, although at very much lower rates than lead solder."

Pausing here, I want to do it stage by stage. In the earlier part of this paragraph, you were saying that a number of copper alloy fittings were also shown by elemental analysis to contain more lead than would be allowed under the relevant BS, but in the second sentence, in the sentence starting "However", you say

"all copper alloy fittings", et cetera, et cetera.

A. Yes.

Q. In the last sentence, you were intending to convey the message that even if the alloy fittings are within the British Standard, you would still expect a little bit of leaching of lead, right --

A. Yes.

Q. -- even though not significant or at much lower rates?

A. You may or may not be able to detect it, with the techniques that we've been using, with the detection limits, but there will be a small amount of lead.

Q. Even if the alloy fittings are otherwise within the relevant BS?

A. If it meets the British Standard for low lead, it still is likely to have some lead in there, because that improves the milling characteristics of the alloy. It reduces the amount of brittleness in the alloy --

Q. Because it softens it, right? Lead is a softening --

A. That's right. It prevents it cracking so easily.

Now, since I presented my report, I have seen some new developments for unleaded materials that are being tested, and which are looking to be very interesting in terms of their potential to replace the leaded alloy fittings.

Q. Right.

Paragraph 16:

"Isotope analysis of the lead in the water does, however, confirm that lead solder is the main source of the lead in the water where elevated concentrations of lead have been found."

So the logic of this -- we have heard it from Prof Lee -- but basically you are saying that even though some lead would be expected to leach from these copper alloy fittings --

A. Yes.

Q. -- and even though some of these copper alloy fittings actually do not comply with the relevant British Standard in terms of lead content, in our case, still, upon isotopic analysis, any lead leached from these "non-compliant" copper alloy fittings are not the main source of the lead found in the drinking water?

A. That's correct. The main source is the leaded solder, and the evidence from the task force is very clear in that respect. What we don't have, unfortunately, but that would be a research project, is a situation where we have the higher lead fittings, the copper alloy fittings, no leaded solder, and an analysis on a model system of what the actual contribution would be from those.

Q. You need a control experiment --

A. Yes.

Q. -- of some sort?

A. Absolutely.

Q. Eliminating the solder source of lead --

A. Yes.

Q. -- and seeing what would be the pure contribution from the copper alloy?

A. Yes, and the whole thing is being complicated by the deposition of the lead compounds in the pipe, because they -- I can't prove that, but the evidence indicates that these may form particles that will be dislodged at different times and might well contribute, in fact is probably contributing, to the variation and odd outliers that we get in some of these systems.

Q. Of course there is also a separate question of how these non-compliant copper alloy fittings came to be used in the first place.

A. Yes, that's -- yes.

Q. But that of course is for another part of the study or another study.

Paragraph 17:

"The potential for cumulative leaching of lead from copper alloy fittings, valves, water meters and taps, appears to be small in relation to the leaded solder joints, although there are copper alloy fittings

containing a greater proportion of lead in the alloy than permitted by the relevant British Standard."

That's what we have discussed.

"A number of the copper alloy fittings are associated with the down pipe and here the surface area available for leaching in relation to the volume of water is small. In addition the down pipe is unlikely to have extended periods of zero flow. This means the concentrations of lead in the water will be small. The contribution of copper alloy fittings will primarily come from the meter to the tap and the volume of water is small enough to allow it to be flushed quite quickly and the contribution to lead concentrations will be much lower than lead solder joints. In the absence of lead solder the concentrations will be much lower, although lead may be detected at low concentrations. The modelling carried out by the Task Force supports the conclusion that, although these components do contribute to the lead in water, they on their own are very unlikely to result in concentrations in excess of the WHO provisional guideline value.

18. In paragraph 3.2 of the Task Force Report, the Task Force considered that the design of the inside service and the specifications of the pipes and fittings in the other 9 affected developments were similar to

Kai Ching and Kwai Luen Estates and suggest that all findings in the report should be applicable to all the 11 affected developments. The design, construction of and the contractors used in building all of the 11 estates were similar and there is no clear evidence to suggest that the level of supervision of the plumbing installations was greater or less than with Kai Ching and Kwai Luen. Consequently, it is reasonable to make a worst case assumption that the findings of the report would apply to all of the developments and to assume that lead solder was also used in those developments. While sampling and examination of the additional estates would have taken more time and delayed the publication of the report and the process of identifying suitable remedial actions, the assumption would need to be confirmed by further testing for lead solder in joints or by suitable water sampling."

This last sentence, are you basically suggesting that it's all very well for the report to have come out within the constraints of time, having only done limited tests --

A. Yes.

Q. -- but in an abundance of caution, if they want to make doubly sure, they should actually carry out tests for the rest?

A. Not just making doubly sure, but actually to be able to determine what actions need to be taken, the advice that needs to be given to consumers, et cetera, you actually need to know. Here, we are basically suggesting, on the basis of the evidence, the worst case it's probable. We don't know that that actually is true, and the evidence from the study from Prof Lee indicates there are some that have got lead solder and others that do not have lead solder.

So actually finding out the facts and determining exactly what the situation is will require a proper study, getting more information. Without that information, you are just estimating.

Q. "Samples taken from water supplies in a number of housing blocks might be considered to show that the extent of contamination giving rise to lead concentrations above the WHO provisional guideline value is limited but these findings must be treated with caution because the approach used for taking samples may underestimate the presence of lead."

The next section, "Sampling Protocol of the WSD and the WSD Task Force":

"According to information provided by the WSD ... and in particular section 7 thereof, Water Sampling Procedure with reference to ISO 5667 part 5 and fourth

witness statement of Chan Kin Man, the practice of taking samples for water quality testing in Hong Kong has been based on using samples in which the system is flushed ie the pipes were flushed for 2-5 minutes or longer if necessary at a uniform rate before samples were collected. Where the sample is to be taken from a consumer's tap, the water actually sampled is likely to represent the water as supplied from the public water supply distribution system, or at least the water in the roof storage tank and down pipe, and does not fully reflect the water in the internal distribution system that has been in contact with the associated plumbing after the meter for an extended period of time. While this is appropriate for examining the water quality parameters that will not be affected by the internal distribution system, it is not suitable to ascertain the concentration of parameters that will change as a result of contact with or which arise wholly from the internal distribution system. These last parameters include lead, copper, nickel and sometimes cadmium and zinc where galvanised pipes have been used, as was the case in Hong Kong in the past and possibly antimony. While it is quite possible that there is only limited contamination with lead in the public housing stock, the data cannot be used to conclude that under normal

conditions of use there is no possibility of the WHO guideline value being exceeded in any sample unless it is known and verified that plumbing standards were met during construction or alteration, ie no leaded solder was used and fittings all meet the requirements for low lead."

Just pausing here, in a simplistic way, what you are saying is if you flush the system, you may actually find out the quality of water which has come from the catchment all the way down to the water tank --

A. Yes.

Q. -- or before it gets to what one would call the internal system --

A. Absolutely.

Q. -- the internal pipes or whatever. So being happy about the first part of the distribution system doesn't actually necessarily tell you that there is no possibility of the guideline being breached, unless you are sure that what happens inside the building also conforms. There's no problem with the --

A. Yes. We are looking at the guidelines for metals particularly, which may be changed -- the concentrations may change as a consequence of the internal distribution system, the internal plumbing system, or may arise completely from that system. Then you need to take into

account how that will work within that system.

So looking at the water before it arrives, basically, at the tap, which is what you are basically doing, will tell you about all the other parameters. It will also tell you whether those particular metals are present in the water coming through, and in fact nickel is an example. You do find some nickel which is present in the raw water, before treatment.

So you actually get a background, but it doesn't tell you exactly how much will be coming from the internal plumbing.

Q. Again, in my simple mind -- leaving aside ISO or whatever nice points of interpretation, going back to primary school science experiment, the control, you want to find out whether the internal system is doing anything bad to the water.

A. Yes.

Q. Basically, you start off with finding out the quality of the water before it gets to the inside service.

A. Absolutely.

Q. Then you find out from a separate testing the quality of water after it has stayed for a while in the inside system.

A. Yes.

Q. And you compare the two?

A. You do. That will tell you how much is coming from the internal distribution system --

Q. What extra stuff has been done --

A. Yes.

Q. -- by the inside system --

A. Absolutely.

Q. -- to the water as delivered to the building block?

A. Yes, and that's very important, and because there is such a variation in the use of water and exposure to any contaminants that might be there that arise from the internal distribution system, what you are trying to do is to identify what is there and what is arising from that system.

So you are not trying to meet some particular standard particularly, you are not looking at a health standard, you're not trying to say on a public health basis because you simply can't do that. It's not practical.

What you can say in this case is, well, we have these substances, we know that they are arising in the internal distribution system, and now we need to investigate more closely.

Q. Can I return to your paragraph 20. I stopped at the sentence:

"... unless it is known or verified that plumbing

standards were met during construction or alteration, ie no leaded solder was used and fittings all meet the requirements for low lead. In this case there is no need to take water samples for lead because no source of excessive lead will be present in the system. Equally, because lead concentrations can vary widely over a 24-hour period, compliance with the guideline value cannot be assured with single samples, unless these reflect the worst case."

Now, can you elaborate on this whole idea about lead concentrations varying over a 24-hour period, and so you can't really be sure about compliance by a single sample, unless it reflects the worst case?

A. The amount of lead that will be -- let's stick with lead -- the amount of lead that will be in the water is a function of the surface area of lead and the period of time that it is in contact with the water, as well as the volume of the water. So you've got a volume of water, and if it is static over that surface of lead for a period of time, the lead will leach in. The longer that you have the water in contact with the lead, then the greater the amount of lead that will dissolve in the water. If you then have a normal system, in the morning, after it's been in contact for an extended period of time, say overnight, then of course there will

tend to be a much higher concentration of lead in the water in those first early samples.

I use the term "sample", although obviously, if you are filling the kettle, you don't refer to it as a sample.

Q. A drawing.

A. Yes, the first-drawn water.

During the day, the concentration will vary, because it will have variable amounts of time that it's in contact with the lead. So it --

Q. Depending on how long before the last switching on of the tap that you next use it; right?

A. Absolutely. If somebody is in the house all day using the tap at intervals, you will tend to have a lower overall level of lead, because the volume of water that's gone through is much greater in relation to the surface area of the lead that's there.

If you go out in the morning, having taken your first-draw sample and used the water early on, and come back eight or nine hours later, then you are back into the position of a first-draw water.

So it's very difficult. Because of the variation in the way that different people will use the system, you simply cannot come up with a single sample that will reflect the individual exposure. So it's a different

approach that's required, and that is that you are controlling the amount of lead that's in the system. Hong Kong has tried to do that by specifying that you do not use leaded solder, you do not use high-lead copper alloy fittings. So that would reduce. If you meet those plumbing requirements, you have solved the problem.

In terms of then taking samples, it's a case of identifying whether -- verifying whether that has been the case. So you are looking for a worst-case sample, in other words a period when the water has been in contact with the internal distribution for an extended period of time and that will tell you whether or not you have elevated -- and I use "elevated" with inverted commas, forgetting the 10 micrograms per litre; it could be whatever you want -- it will tell you that there is elevated, over normal or over expected, lead. That is very good evidence that you have lead in the system that should not be there.

So it's a different set of circumstances to saying, well, we want to assess the health risk. If you want to assess the health risk, then that requires a much more comprehensive study of exposure, of the way that people use the water, of the different concentrations at different times, and that's quite an intensive process,

not easy to do, and it doesn't actually provide you with very much of a solution, because at the end of the day, if you provide advice to people that they should flush their systems, but you don't do anything about the lead in the system and they do -- previously have had elevated lead -- in my experience, with time, people start to revert back to --

Q. Old habits?

A. Yes, because it's convenience. It's potentially quite onerous on people, unless you have some automatic system in there.

So it's a way of identifying where you have a problem, and then allowing you to identify the solutions to that problem. I wouldn't particularly specify those solutions at this time, because those solutions will depend on the circumstances that you are in.

In the UK or in the USA, for example, if they identify with their first-draw samples that you are -- a certain proportion of the properties are above the threshold concentration, 10 in the UK and 15 in the United States, then it is incumbent on the water supplier, who has responsibility to the tap for the quality of the water, or some responsibility for the quality of the water -- it's incumbent on them to

provide information to the consumers, because consumers have control over the piping that's in their dwelling, or it could be the landlord or the building manager or whatever. But they may need to actually adjust the plumbosolvency, the ability of the water to dissolve lead. And in the UK, most of the water suppliers in certain areas will actually add orthophosphate, and that orthophosphate actually reduces the lead solubility.

So that's a central action that's taken in that way.

In Hong Kong, you have a rather different situation, because we believe -- I use the term "we believe" carefully, because I think the amount of hard data we've got is limited -- would indicate that most of the buildings don't have lead.

Q. Should not have lead?

A. Well, the evidence that we have is that, yes, they shouldn't have lead. I think that needs to be confirmed. But that shouldn't be there.

So, actually, you have a number of individual buildings which have -- and because of the size of these housing blocks in Hong Kong, that complicates matters -- in which you've got lead.

Now, the solution, under those circumstances, I think needs to be thought about very, very carefully, because there are costs and benefits, and there will be

potential disruption to the tenants, there's the potential for changes in what happens when the tenancy changes and what advice and so on. So there's an awful lot of complicating factors, so it needs to be thought about very carefully.

So there are various possibilities. One wouldn't necessarily suggest that you need to treat all of the water supplied to Hong Kong with orthophosphate. On the other hand, I think I would want to know a little bit more about the potential levels of lead in other parts -- in other buildings in Hong Kong, and I don't know what data there is to be able to tell us about that. It's not a criticism of the WSD, but the WSD did not have responsibility to the tap. The problem was that, as far as I could see, nobody had responsibility to the tap, in terms of water quality. So the Housing Department for public housing had responsibility for the quality of the plumbing and the materials used, but nobody actually had responsibility for the water quality, which is slightly different.

Q. From plumbing materials?

A. Yes.

Q. Even though one may have an effect on the other?

A. Absolutely. It's unfortunate that that is the case, but it has occurred elsewhere, and other situations do

arise.

In Scotland, the reason that it was picked up was because that responsibility lies with the water supplier, and they do sampling, and they then will, in the case of the systems in Scotland, because there's a lot of lead around, they actually dose orthophosphate, and that makes a difference.

Q. But in Scotland, if I understand correctly, the problem arose simply because somebody started having symptoms, otherwise -- it's not as if someone in the course of routine spotted it?

A. They would have picked that up in due course, by routine sampling.

Q. Right.

A. Because routine sampling requires that they sample a proportion randomly through the --

Q. Because of the statutory regime in Scotland or the regulatory regime?

A. Which is very similar to the regime in England and Wales.

Q. But which does not exist in Hong Kong, where the supplier, the WSD, does not have any coercive power to march in or to require --

A. Right, and there is no overall body or person that has an overall responsibility for water quality and can

bring together the different groups and co-ordinate the approach to maintaining drinking water quality.

Q. Can I return to a point that you made earlier, about detecting the presence of lead in water. You mentioned that finding out or discovering that there is lead in water could have, I think, two lines of significance. One is in relation to compliance or non-compliance with WHO provisional guideline value. Whether or not that guideline value should be regarded as health-based or whatever, we will leave that to one side. One significance is WHO guideline value related.

The other line of relevance is independent of WHO, and it's simply presence of lead in the plumbing system.

A. Correct.

Q. I want to explore that a little bit, because in Hong Kong, you know because of, as you mentioned, the existence of the relevant waterworks regulatory regime, statute and regulations, you are not supposed to use leaded solder, you are not supposed to use any fittings which would leach lead in any significant way.

A. Correct.

Q. So what you are saying, this second line of significance or relevance, independent of the WHO -- forget about 10 --

A. Yes.

Q. -- is that if you find any significant amount of lead, even though it may be 5 or 9.9 micrograms, which you can drink for 70 years without dying, it still tells you that there is some breach --

A. Absolutely.

Q. -- in the relevant standard, so you shouldn't celebrate and open champagne?

A. No, it's an indication that you actually have a failure of part of your regulatory process.

Q. Yes.

A. The regulatory process that says we should not have lead in the system because we don't allow it. Strictly speaking, Hong Kong should have had the ideal set of circumstances. They had licensed plumbers, they had plumbing training, there's a lot that goes into training plumbers. They also had the statutes that say you are not allowed to install -- use leaded solder and you are not allowed to use high-lead copper alloy fittings, and we know that in Hong Kong, back in the 1930s, we stopped the use of lead piping.

So the situation should have been absolutely wonderful for Hong Kong, and I am saddened by the fact that this has happened, because it really -- I suspect it arises because, for so long, there hasn't been a problem, that people take their eye off the ball.

In terms of the WSD not having responsibility to the tap, part of that, reading between the lines of the first meetings of the Advisory Committee on Water Quality, way back, there was a feeling that we have in place the processes that will prevent the contamination in the first place, so we don't need to worry about it. That is always a little bit of a concern, because the sampling process for water samples just provides you with a verification that the other parts of the system are working properly, because it's easy to say it's very easy to do all these things and it's easy to criticise everybody and say, "They should have done this", "They should have done that", but in truth this is a small part of the construction of very significant buildings, and I'm sure that Housing Department, for example, were quite rightly concerned that the first priority was that the buildings didn't fall down and kill everybody in them, and that is right and proper.

So it's making sure that each bit has its appropriate level of verification that the standards are being met, and that's the building standards, the plumbing standards.

So it's a complex situation. It's not one that I would feel at this stage is one for throwing lots of blame around, but I think it's one that says that the

authorities involved have got to recognise where there is a problem, and get together to do something about it and make sure it doesn't happen again.

Q. Because I asked Mr Chan Kin Man, the chief chemist, questions along similar lines, that the fact that whatever samples you use, flushed or unflushed, you see 9.9 or 9, so you don't breach the WHO, but it still means there's lead in the system?

A. Absolutely. It is telling you something.

Q. And someone breached the British Standard, obviously?

A. Yes. It is telling you that the system is not as it should be.

Q. Right. Obviously, health may well come first and people may, as a matter of first priority, make sure that they deal with cases of breach of the WHO. But what you are saying is that irrespective of WHO, this phenomenon of buildings where materials obviously contain more lead than they should contain under the British Standards is something that the authorities should pick up?

A. Yes, and we will talk about Water Safety Plans later on.

Q. Yes.

A. And a key part of Water Safety Plans is you prevent things going wrong in the first place. Hong Kong had in place the provisions to do precisely that, to prevent lead getting into the system, and that is right and

proper. That is the correct way to go about it and is a good example. But you've got to make sure that that works and you've got to verify that it's working.

Q. Yes. I mean, I asked Mr Chan. Obviously Mr Chan deals with technical and scientific matters, he's not a decision-maker, so he wasn't able to assist us as to what the WSD has been doing in terms of, not health, but enforcing the relevant legislation containing compliance with the British Standards.

What we knew is that they acted to discipline certain, but not all, the licensed plumbers responsible for some of the estates, maybe the more high-profile ones, where we know as a fact that there are other estates, even unaffected estates, with let's say 8 or 9 micrograms, which still plainly breach British Standard, but nothing is done about that?

A. Absolutely.

Q. And there's a sense of grievance by some licensed plumbers that they were being used simply politically, to show to the world, "Look, we have done something", but it's not even-handed. What do you say about that?

A. I think that's exactly right, and I think the point --

Q. Not that what they have done is right, but the comment is right, that it's not being even-handed; the grievance is justified?

A. Yes, that comment is correct. I think that's a perfectly justified comment. It's important that it's recognised.

There was a misunderstanding of what the WHO Guideline meant, for a start, and that underpinned a number of the decisions. The guideline value is no longer a health-based guideline value, and therefore the nature of the guideline has changed. That doesn't mean that lead is actually that much more toxic than it was before. It's exactly as toxic. It's just that we recognise that it's preferable to reduce the level of lead as low as we possibly can.

We have done that in certain other areas. I noticed in the newspaper today there was concern over lead occurring in organic vegetables in Hong Kong.

Q. Yes, just this morning in the news.

A. Yes. That is all part of the overall policy position in Hong Kong. Hong Kong had already taken a policy position on lead in water, by putting in place no-lead pipes, way back, and saying that you can't have lead solder and you can't have high-lead copper alloy fittings. So they had taken the policy decisions at that stage.

The fact that that policy has not been pursued appropriately or has fallen down, or whatever term that

you wish to use, means that you then have a different situation and you've got to try and put that right. The WHO Guideline is not going to help you to do that, because it's not an excuse to be able to say, "Okay, we'll allow the water to fill up and we'll have lead polluting up to the guideline value" --

Q. 9.9.

A. -- and we are okay. That's not what it's about and that is not appropriate.

Q. Thank you.

Paragraph 21 of your report:

"It is not possible to identify a threshold for the adverse effects of lead so there should ideally be no measurable lead in drinking water. WHO recognises that this is not practical because there will be many existing systems with lead service connections or lead pipe from a time when the adverse effects of lead were not fully recognised. It is not possible to get to average concentrations well below the provisional guideline value in such systems just by treating the water to reduce plumbosolvency (the tendency of the water to dissolve lead) by such means as dosing orthophosphate. It is not intended that meeting the guideline value should be an excuse to install new lead, which best practice dictates should not happen, hence

the strictures on lead solder and copper alloy fittings in Hong Kong."

This really encapsulates what you have just said on the spot; right?

A. That's correct.

Q. "Meeting the guideline value is not a means of protecting health, it is a means of reducing exposure while further actions can be taken to remove lead from the systems and to achieve as low a level of lead exposure from drinking water as possible. The situation in the new Hong Kong public housing developments is different to other older systems since the use of lead solder and 'high lead' copper alloy fittings is not allowed and there should be no lead in the system except traces that arise from copper alloy fittings that meet the requirements for low lead. The object of sampling water at consumers' taps in this case should be to identify where lead solder may have been used."

A. Yes.

Q. That should be a separate exercise from getting into the WHO?

A. Yes. The exercise is to verify that the regulations that you have in place are being met.

Q. We have heard quite a lot about other systems; the American Lead and Copper Rule.

A. Yes.

Q. Or Canadian systems.

A. Yes.

Q. And each system is different, obviously.

A. Absolutely.

Q. The wording is different, the concepts are different. Sometimes different acronyms, MAC or what have you. But the fundamental point, would you agree, is inherently, in many other systems, they can't get away from having leaded pipes and they've got to work with what's in existence; right?

A. Absolutely. The problem with so many other systems is that historically we have a significant amount of lead present in the system. That is very different to a new system, where you know that you shouldn't be adding in lead. So they have to have a system where they are saying, "Okay, we need to get the lead down as low as possible." If you look at the European Union, for example, the 10 as a standard, 10 micrograms per litre, only was adopted just over a year ago. Prior to that, it was 25 micrograms per litre. But it said, "By such and such a time, the standard will change to 10." That gives you so many years to get cracking and do something about it. But it recognises --

Q. In fact the change shows that it can't be health-based,

because if it's health-based -- unless health research shows that somehow the tolerance --

A. That's not quite correct. We are going to come to that a little bit later on.

Q. Yes.

A. But it shows that in adapting to particular circumstances in Europe, it would have been very difficult, with the wide range of older properties and systems, to be able to immediately say, "We are going to get down below that."

So the standards were set in order to provide an achievable level, in stages, so continuous improvement. And continuous improvement actually is also one of the cornerstones of the Drinking-water Guidelines from the WHO, and it says several times that continuous improvement should be the way forward.

One of the reasons for that is that we know in a number of countries, if you set an extremely tight standard, the countries will simply give up and not even try to meet it, because it's just so difficult and they don't have the resources, they are not going to do anything about it.

What the WHO doesn't want is, with significant health contaminants, you don't want countries abandoning the idea. You want them to do something. If you can do

something, you actually start to achieve.

If I can use another example that's away from lead, because that gets very complicated: arsenic. The guideline value for arsenic is a health-based guideline value of 10 micrograms per litre. Well, it's a sort of health-based guideline. Again, there's an extent of, "Well, it's as good as we are going to be able to do", because arsenic is a natural contaminant; removing it is difficult. There are lots of small suppliers which have very limited resources.

In Bangladesh, and a number of other countries, they have set their standard at 50 micrograms per litre.

Q. Five-zero?

A. Five-zero, not 10.

We had a lot of people from the US and Europe saying, "They should have a much tighter standard of 10", and all that would do is mean that more systems failed the standard. So what you are doing is increasing failure and measuring failure. You are not encouraging them towards success.

So the 50 means that they are doing something. They can get to 50 in an awful lot of the systems. And you are actually improving the situation. So in Europe, with the 25, getting down to 25 was actually an improvement for an awful lot of the systems, where we

know that there were places where there were 50 micrograms per litre and above as the normal level of exposure. So you are doing something.

In Hong Kong, that would not apply, because your starting point is completely different. Your starting point is effectively a clean sheet. You are in a very, very strong position. And therefore the 10 is not really relevant in that respect. Hong Kong should be aiming at better than the 10, because they can do that, and they should be able to do that very, very easily.

The guidelines suggest, emphasise, that countries should adapt the guidelines for their own purposes, in their own circumstances. In some cases, such as Bangladesh, with arsenic, they have taken a decision that they will accept a greater level of risk, because they need to be able to do something about this much wider area -- they are exposed to very high levels and we see cancer and all sorts of things. So they have accepted that and are doing something about it.

Equally, if you don't have a problem, it is perfectly reasonable and laudable to set a standard at a lower value than the guideline value, because that's what you can achieve, and you should not be allowing the water to degrade. In other words, when you achieve a good standard, you should be maintaining that good

standard and not allowing it to deteriorate.

Q. Now, we know that in Hong Kong, historically -- in Hong Kong, there is no statute or no law stipulating water quality, as we know. This idea of complying with the WHO went way back to a pledge by the relevant -- I think by the Water Supplies Department, that we would pledge that we would comply with this 10 microgram value.

A. Yes.

Q. I'm playing the devil's advocate. If pushed, the WSD could well say, "Well, we'll pledge it and we have met our pledge", but what you are saying is we should revisit the pledge?

A. Absolutely. My position is that the --

Q. You can't just set the wrong goal and say, "I'm complying with the goal", because you're saying that the goal is wrong in the first place?

A. The WHO make it very clear that they are not keen on -- in fact they are quite against the member states just copying the guideline values into their standards, or even not having standards and just saying, "We are meeting all the numbers."

The approach which has changed since 2004 actually reflected concern about that. We knew it was happening.

Q. Concern about people just copying?

A. Yes. In fact, we knew that in some cases, what was happening -- we tried to take out the list of guideline values from the back. There's an appendix with a list of guideline values and we tried to take that out but there was protest from a lot of member states about that.

Q. Why?

A. We knew that people were photocopying it and that were their standards, and the rest of this document, with all this information, was just being ignored.

Q. Human nature, they want numbers, they want --

A. Yes. If I can have a little dig, a lot of this is to do with the lawyers.

It's very difficult. Water quality doesn't operate that way. You need to think about the particular circumstances. There are many contaminants that are not in the guidelines. We have emerging contaminants, and we will come back to that a little bit later.

So actually just using the list is a wrong premise, and at that time, that pledge, which predates the third edition of the guidelines --

Q. The pledge was made in the mid-90s, 1994-1995, the Water Services Department pledge.

A. Yes, it predates the third edition of the guidelines.

Q. It came out shortly after the 1993 version.

A. Yes. We understand there was a misunderstanding in a lot of countries, not just in Hong Kong but in many other countries as well, about that, and we tried to do something.

Unfortunately, in having made that sort of stand, there was an unwillingness, in a number of member states, to change to the system that we've got, because in terms -- if you do have standards and compliance, which you don't have in Hong Kong, it starts to get a bit more complicated in assessing whether you meet the standards or not.

I'm currently going through this process of discussion in Europe. We are revising, or proposing revision, for the European Drinking Water Directive; 28 member states. Basically, what the legal people in the Commission want is something where they can say "Pass", "Fail", "Pass", "Fail", "Pass", "Fail", "Pass", "Fail". That's simple, straightforward.

But life is not that simple, and if we really -- it states that the Drinking Water Directive is about public health, the guidelines are about public health, and if we really are serious about public health, then we have to accept that it isn't quite that straightforward and we might need to take a different approach and a different way of looking at it.

That's got advantages and disadvantages. We know that if -- the way that the guidelines for chemicals, which are different from the microbiology from pathogens -- the guidelines for chemicals, in most cases -- you've got to be a little bit -- you can't make total generalisations -- in most cases, those guidelines are set with a significant margin of safety. So if you exceed the guideline value, it doesn't necessarily mean you are actually going to have a problem. In fact for many of them you certainly won't have a problem, unless you've got very high levels for a long period of time. There are one or two others where that is not the case. For lead, obviously, that's one of them. Nitrate -- we know that nitrate, again, is about bottle-fed infants. Nitrate is a bit more complicated, but if we leave the complicated bit out -- "blue baby syndrome", methaemoglobinaemia, occurs, and the margin of safety is a factor of 2, thereabouts, roughly, whereas with something like antimony, the margin of safety is about 100 to 1,000, below the no-effect level.

So you have a very significant margin of safety. Others, you have a much smaller margin of safety. So actually understanding what is in your water and the concentrations, and the conclusions that you take and the actions that are taken, are very important. That

allows for member states, if they have a problem, particularly, say, arsenic, with Bangladesh, which you can't control, it's in the groundwater, it's naturally occurring, then you have to accept that it's actually quite difficult for them to deal with, and you have to allow some flexibility.

So one approach is derogations, for example, that you set standards and you have derogations. We have those in Europe. The derogation that says if you are above the standard and it's very difficult to deal with, then you have a period when you can exceed that. You have checked to make sure that level is not going to cause significant health effects. You can be at that level for a fixed period of time, while you actually start to do something about it.

In the case of Hong Kong, you have discovered that you have a problem. Now, the 10 in this case, as far as I'm concerned, is irrelevant. You have lead in systems, and you have -- you can't fix it overnight. This is just not going to happen. So it's a step-wise approach to dealing with it.

The first step is understanding the scale of the problem. The second step is identifying the range of solutions that are possible. And the short-term solutions -- one the short-term solution is in place,

people are either not using the water or are flushing, or a combination of different systems, to reduce their exposure. That's correct. That's the right way to do it.

The next stage is to decide for a longer-term solution, because the flushing process, et cetera, providing bottled water, really is not an ideal long-term, lifetime solution.

So Hong Kong has set out in the right direction. It's doing the right things. We are now at the point where we are debating about how big is the problem, how do we find out how big the problem is, and how do we take decisions about the long-term solutions.

The reason that there is a debate is because there are costs involved, and the various parties do not want to expend greater amounts of money than they need to, though I have to say that the impression that I've got, in talking to a whole range of the parties, when I was here last time, is that there is a willingness to address the problem. There is a recognition that there's a problem. That's admitted.

That's the first step. If nobody admits there's a problem, you've really got difficulties. They admit there's a problem, and now it's a case of finding the best way forward.

Does that help?

Q. It does. It actually covers a good deal of the ground later on in the report, but I will come back to that in due course.

Paragraph 22:

"If the lead concentration in the water after an extended period of contact is less than 10 micrograms per litre then it is reasonable to assume that the concentration will always be less than 10 micrograms per litre and there is unlikely to be significant lead in the system. The study carried out by Professor Lee on behalf of the Commission of Inquiry was designed to determine how the time the water flows will impact on the concentrations of lead in a range of domestic systems in the public housing developments and to inform the development of a suitable sampling protocol. It also provides supporting data regarding the presence of lead in significant concentrations in the public housing developments.

23. In the interim report issued by myself and Professor Lee we used the term fully flushed in the context of lead in domestic plumbing between the meter and the tap indicating that the system is likely to be flushed after 5 minutes and the water sampled would be from the down pipe from the fresh water storage tank

with a minimal contact time with the plumbing.

24. Mr Chan in his fourth statement states that samples taken after a period of stagnation cannot be considered representative of the average concentration of lead at the tap to which the consumer is exposed on a routine basis. This is correct but neither can flushed samples. This is dealt with above in more detail in paragraphs 2 and 3. Mr Chan also makes a statement in paragraph 11 of his fourth statement regarding compliance with the WHO guidelines, or rather the guideline values. This is a misunderstanding of the guideline value for lead and I have dealt with this in more detail in paragraph 21 of this report.

25. Under the circumstances described above, the most probable cause of the lead exceeding 10 micrograms per litre in flushed samples is particles of lead compounds mobilised by the flushing process from the deposits downsteam of the joints containing lead solder."

Now, pausing here, if you used what is called first-draw sample --

A. Yes.

Q. -- and it contains lead, then the conclusion could very well be the lead comes from lead leached into the system through a long period of stagnation --

A. Yes.

Q. -- overnight, and fair enough, if your system has lead, it would leach into the water. Whereas if you use flushed sample --

A. Yes.

Q. -- in theory, you flush it for two or five minutes, basically you wash the inside service --

A. Yes.

Q. -- that bit of pipe, at least once, so in theory, even if there otherwise is lead leached into the water after stagnation, that lead, in theory, would have been flushed out --

A. Absolutely.

Q. -- during the water -- from the five minutes?

A. Yes.

Q. And yet we find still significant lead in even flushed samples.

A. Yes.

Q. So this paragraph, paragraph 25, is your attempt to suggest why, despite this flushing, which in theory would have gotten rid of lead, still there is exceedance?

A. This is a suggested solution to the reason that those high levels occurred. And I discussed this with the members of the task force, and they were -- we couldn't

see any other reason why that would occur. So I think they would concur with my opinion. It is based purely on the fact that we have deposits, we have flushed samples, which should have no lead in, or very low lead, because of the lack of contact. So there's got to be a reason for those high levels, and the most likely cause is particles that have been disturbed in the flushing process.

Q. That is not leaching; right?

A. That's not leaching.

Q. Leaching simply means lead somehow through chemical reaction gets dissolved and seeps bit by bit into the water, in layman's terms?

A. Absolutely. It's obviously associated with leaching, in that the leaching gives rise to the particles, but it's not going to be directly from leaching, it's from these particles, and even in the first-draw samples you may find particles.

Q. Yes, yes. So basically again, just to visualise in my layman's mind, this basically means there could be particles stuck to the walls of the pipes, or the solder. Basically the whole thing gets dislodged through the flushing process?

A. Microscopic particles, you wouldn't see them, but they will have enough lead in them to be able to be detected

when you do the analysis, and Prof Lee said yesterday that part of the process is an acid digestion and so on and that's what's going to happen. So you will dissolve those particles.

CHAIRMAN: Would this also explain some of the odd readings?

A. Yes, it could well do. I can't say that that's definitely the case. I can say that it's the best solution that I can come up with at the moment, and I would welcome anyone else coming up with a suggestion that would help in that direction.

One of the other points -- I would just like to make the point at this stage, before we go any further -- because you are talking about 9.9, 10, and so on -- the analytical method will have variation around it. So you may take the same sample, and you can measure it ten times, and you won't get exactly the same result ten times. There will be variation around it.

So if you have 11 micrograms per litre, that doesn't necessarily mean that you are out of compliance. If you have 9 micrograms per litre, it doesn't say you are in compliance.

So you have to be a little bit careful about the interpretation of those. That's just an aside, really, for awareness. As I say, the 10 is, in Hong Kong, largely irrelevant.

MR SHIEH: Thank you. I move on. Paragraph 26, "WSD Task Force":

"The investigations of the Task Force into the effects of stagnation and flushing of water in pipework on lead concentrations are helpful in making a preliminary assessment of the impact of the intermittent use of water by consumers on the average exposure to lead in water over time, ie the effect of the normal use of water from the drinking water tap on lead concentrations. The Task Force commissioned studies showed that the concentration of lead in affected systems increasing significantly with the period of stagnation in the pipes but that the concentration fell very quickly with a relatively short flushing time due to the short lengths of pipe involved. While much of the water consumed would be expected to have contained low lead concentrations, concentrations in the initial quantities of water drawn after standing for extended periods would be expected to contain much higher concentrations of lead as would water drawn from the hot water supply. The quantity of lead ingested would depend on individual habits. This is demonstrated by the evidence given by four residents who described their patterns of use of water for drinking and cooking and who fall into two categories, those who flush the

water for a period in the morning and those who use first draw water. However, this evidence does not provide sufficient information to estimate the potential for exposure to lead contaminated water through the day following varying periods of standing time."

The third line from the top, "The quantity of lead ingested would depend on individual habits" -- by "individual habits", basically you are referring to the patterns of use, at what point in time of the day they basically draw water from the tap?

A. Yes, and the pattern of how they do it. Certainly in the past there will have been people who will have got up in the morning, they fill the kettle, they put the kettle on to heat the water, and then they will go and do other things, getting washed and so on. I'm very familiar with this, because this is exactly what I do at home, and I know lots of other people do that.

A lot depends on whether they are using that water for drinking a small quantity or whether they are using that initial draw of water for filling up flasks or bottles or whatever for use right through the day.

Q. Or give to their kids to bring to school or to me to bring to work?

A. Absolutely, or making up, as I mentioned yesterday, baby's bottles that you then put into the fridge.

So there are an awful lot of different things that individuals do that can impact on the pattern of exposure. Some will flush. Some will not. Certainly the evidence at the moment, from the new study that's been commissioned by the WSD, from Black & Veatch, about patterns of consumption is that since the lead problem has been made so much of, people are generally, not always but generally, flushing first thing in the morning. As I indicated yesterday, my concern is that over time, people will revert back to other habits, because it is not -- it is inconvenient to do that, and in Hong Kong, too, you have a mixed message. One is save water and the other is waste water. Those two -- you know, people smile, but this is genuinely a problem. We have it all over the world. That is a message which is not very comfortable. Which is it? Are we saving water or are we wasting water? The idea that you fill up a bowl with cold water that you use over the day is a little bit idealistic, because it's an incredibly inconvenient thing to do.

Q. The answer by the WSD is that you don't waste the initial water because you can save it for washing and other stuff.

A. Saving it requires quite a lot of effort --

Q. And people to remember?

A. Yes. They have to remember, they have to remember to use it when they actually do the washing, otherwise it will just get poured away, and they have to be able to have water -- that if they want to use hot water, for example, they are not going to use cold water that's stored.

So there are a number of constraints around it. As a short-term measure, that's fine. As a longer-term measure, it requires consideration.

Q. There is a theory that's been put forward that a flushed sample would provide a representative sample of the average quality of drinking water that would be consumed by somebody during the day. Now, first of all, is there any such concept as how to calculate or which sample is likely to represent "the average" sample, the quality of drinking water?

A. In terms of most of the parameters that one is measuring in drinking water and for drinking water quality, that would be the case. But for parameters that are influenced by the internal plumbing system, or from the point where the supply comes into a particular building or property, to the tap, that is not the case, and it is demonstrably not the case. The WSD-led task force clearly demonstrated that -- and one of the big conclusions was that the level of lead depended on the

amount of time that the lead was in contact with the leaded material. So if you flush it, by definition you reduce the contact time to virtually nil. And if you do that, then you will not get a reflection of normal use, just as, to be fair, a first-draw sample is not necessarily going to give you a reflection of the actual exposure in normal use.

But since we have a situation with lead in particular where we do not have a health-based guideline, we are not looking at exposure that meets the guideline value. What we are looking for is to minimise the level of exposure.

Q. Paragraph 27:

"The study by Professor Lee has provided significant data that assists both in assessing the extent of lead contamination and the short to medium term means of ameliorating the problem. This is the most comprehensive study carried out to date and allows a number of important conclusions to be drawn. Firstly, the extent of contamination is significantly greater and more widespread than was indicated by the WSD/HD data, primarily because the sampling method was designed to detect the presence of lead in the system. Secondly, a relatively short flushing period will generally reduce the lead in the drinking water drawn from the tap to

a low level, although the necessary flushing period required does vary. It would be helpful to make a more detailed study of the patterns of stagnation and use throughout the day in order to formulate the best advice to consumers as to how to manage lead concentrations in their domestic systems. Thirdly, the study provides some evidence that there may be passivation (reaction of lead at the surface forming coatings of lead carbonates, hydroxides and phosphates) of the exposed lead surfaces over time in the older systems resulting in a lower level of leaching. However, changes in the water system can destabilise these layers and this has caused problems elsewhere, eg USA. Fourthly, the study shows that the problem is complex and that care will be required in designing a sampling protocol that is suitable for verifying that lead has not been used in new developments. This is important for the quality assurance procedures to be adopted in the future."

There is a reference in the third point to passivation.

A. Yes.

Q. And:

"... over time ... the exposed lead surfaces resulting in a lower level of leaching. However changes in the water system can destabilise ... has caused

problems elsewhere, eg USA."

Is that the oblique reference to Flint that you made?

A. It is indeed.

Q. It is now no longer oblique.

A. Yes. What they did was change their source, and the consequence was that the lead in their system was destabilised and they suddenly started to get very high levels. It's happened elsewhere. It happened in Washington, DC, with their system. They changed their disinfection, or the residual disinfection in their system, from free chlorine to chloramine, and again they destabilised -- and they were using phosphates, so even the phosphates can be destabilised if you are not careful.

So the process is one that -- it's a great one and it's really useful, but you have to be careful how you handle it over time.

Q. "Task Force Recommendations":

"28. I am generally in agreement with the recommendations of the Task Force.

29. In the case of recommendation a(ii), I would stipulate that samples for heavy metals should not be based on flushed samples but that a suitable sampling regime should be adopted that will reflect a reasonable

worst case for the leaching of heavy metals. In addition I would recommend adding copper, antimony and zinc to the list of metals for a limited period until sufficient data are collected to show exactly which metals are leached from the system. Copper can leach from copper piping used in internal plumbing systems and is known to cause acute gastric irritation when concentrations exceed about 2 micrograms per litre, which is the WHO guideline value. Copper is usually only a problem in new copper plumbing systems after extended periods of standing although other circumstances can give rise to high copper concentrations. Antimony is seen in samples at the tap in Europe and although concentrations are relatively low (5 micrograms per litre or less) it would be prudent to collect some information on concentrations at the tap in Hong Kong. Zinc may be released from galvanised pipes and although it is not a concern for health it can cause problems with acceptability at concentrations above about 3 milligrams per litre. If antimony, zinc, cadmium and probably chromium are subsequently shown not to be an issue in Hong Kong, then they could be dropped from the monitoring suite of parameters influenced by leaching from distribution systems. However, it would be prudent to maintain the full suite for initial

samples taken from new buildings to ensure there are no unexpected sources."

Paragraph 30, "The WHO Provisional Guideline Value for Lead":

"The WHO guideline value of 10 micrograms per litre was originally based on a provisional tolerable weekly intake (PTWI) of 25 micrograms of lead per kilogram of body weight in infants and children on the basis that lead is a cumulative poison and there should be no accumulation of body burden of lead. The guideline value was derived by assuming a 5 kilogram formula-fed infant, considered to be the most sensitive subgroup of the population, drinking 0.75 litres per day and assuming 50 per cent of the PTWI came from water. The PTWI was developed by the WHO/FAO Joint Committee on Food Additives and Contaminants (JECFA) in 1986. This guideline value was adopted in the second edition of the Guidelines in 1993 ..."

Now, we have looked at that yesterday, I'm not going to turn it up again.

"... but was designated as provisional in the fourth edition in 2011 ..."

Again, we have seen the derivation in that table yesterday, I'm not going to go to it again.

"... on the basis of the JECFA re-evaluation of the

PTWI in 2011. In that re-evaluation JECFA concluded that there is currently no measurable threshold for effects on childhood IQ and learning or on systolic blood pressure. The previously established PTWI was withdrawn and it was not considered possible to establish a new PTWI that would be considered protective of health. The reason for WHO retaining the existing guideline value was that it is extremely difficult to achieve a lower concentration in systems by central conditioning, such as phosphate dosing. This consideration is based on systems with a significant existing amount of lead but it presumes that no lead will be introduced into new systems that should be effectively lead-free."

I guess you would say that this last sentence would apply to Hong Kong?

A. Absolutely.

Q. Can I ask you to look at bundle A1, tab 17. That's the background document. This is something that we have not looked at yesterday.

It's A1, tab 17. This is actually the background document for the development of the WHO Guidelines. Are you familiar with this document, this background document?

A. Yes.

Q. This is obviously a different document from the actual WHO Guidelines, but this is a precursor; this explains the background for how the 2011 document came about?

A. Yes. These documents are prepared, and they are considered by the Guidelines Committee, in the process of development the guideline value and also as a basis for the summary statement that is present in the Guidelines.

Q. So one would expect some similarity between what's set out here, in this background document --

A. Yes.

Q. -- and what's eventually in the 2011 document?

A. Yes.

Q. Because if you look at page 422, there's a heading, "Provisional guideline value"; do you see that, at the bottom?

A. Yes. The pages are sticking together.

Q. Page 422, the bottom right-hand corner?

A. Yes.

Q. "Provisional guideline value":

"The evidence for the carcinogenicity of lead in humans" -- that's the tendency to cause cancer?

A. Yes.

Q. "... is inconclusive because of the limited number of studies, the small cohort sizes and the failure to take

adequate account of potential confounding variables. Lead has therefore been placed in group 2B of the IARC classification, namely possible human carcinogen (evidence inadequate in humans, sufficient in animals). However, inorganic lead compounds have been placed in group 2A, namely probable human carcinogen.

As there is evidence from human studies that adverse effects other than cancer may occur at very low lead levels and that a guideline thus derived would also be protective for carcinogenic effects, it is considered appropriate to derive the guideline using the TDI approach."

Forgive me, what's the TDI approach?

A. Tolerable daily intake.

Q. "In 1986, JECFA established a provisional tolerable weekly intake (PTWI) of 25 micrograms of lead per kilogram of body weight (equivalent to 3.5 micrograms per kilogram per day) for infants and children, which took account of the fact that lead is a cumulative poison, so that any increase in the body burden of lead should be avoided. The PTWI was based on metabolic studies in infants showing that a mean daily intake of 3-4 micrograms per kilogram of body weight was not associated with an increase in blood lead levels or in the body burden of lead, whereas an intake of

5 micrograms per kilogram of body weight or more resulted in lead retention. This PTWI was reconfirmed by JECFA in 1993 and extended to all age groups.

In the second and third editions of the Guidelines, a guideline value of 0.01 milligrams per litre was derived on the assumption of 50 per cent allocation ..."

This paragraph is familiar. I think this paragraph was eventually repeated in substance in 2011?

A. Absolutely.

Q. "JECFA re-evaluated lead in 2010, finding that exposure to lead is associated with a wide range of effects, including various neurodevelopmental effects, mortality (mainly due to cardiovascular diseases), impaired renal function, hypertension, impaired fertility and adverse pregnancy outcomes. Impaired neurodevelopment in children is generally associated with lower blood lead concentrations than the other effects, the weight of evidence is greater for neurodevelopmental effects than for other health effects and the results across studies are more consistent than those for other effects. For adults, the adverse effect associated with lowest blood lead concentrations for which the weight of evidence is greatest and most consistent is lead-associated increase in systolic blood pressure. JECFA concluded that the effects on neurodevelopment and systolic blood pressure

provided the appropriate bases for dose-response analyses.

Based on the dose-response analyses, JECFA estimated that the previously established PTWI of 25 micrograms per kilogram of body weight is associated with a decrease of at least 3 IQ points ..."

This discovery of IQ effects I think are also carried over to the 2011 document.

A. Yes.

Q. "Because the dose-response analyses do not provide any indication" -- that also I think has been carried over.

The last sentence:

"JECFA re-affirmed that because of the neurodevelopmental effects, fetuses, infants and children are the subgroups that are most sensitive to lead.

There remain uncertainties associated with the epidemiology, which relate to very low blood lead levels and end-points that are affected by many factors. Nevertheless, because lead exposure arises from a range of sources, of which water is frequently a minor one, and as it is extremely difficult to achieve a concentration lower than 10 micrograms per litre by central conditioning, such as phosphate dosing, the guideline value is maintained at 10 micrograms per litre

but is designated as provisional on the basis of treatment performance and analytical achievability."

The next page contained, I think, a familiar passage about lead being exceptional, et cetera.

A. Yes.

Q. Then we move on to another topic, being Legionella, but before we do that, I want to revisit a topic with you, and that is about the ISO document, concerning sampling mechanism.

May I ask you to look at bundle C2, the ISO document. C2, tab 19.

There are two references to a certain phrase that I wish to draw to your attention. One is under 6.1 at page 1538. Under 6.1, "General", the second line:

"In general, sampling to ascertain the quality of the water delivered to a building, or to ascertain whether the quality of water delivered within a building is possibly altered by the service network within the building, should not be carried out without thorough cleaning and flushing of the sampling points."

Next, over the page, at 1539, under the heading "Faucets", seven lines from the top:

"If the quality of the water as supplied to premises is to be checked, then the faucets should be cleaned and flushed at a uniform rate for 2 minutes to 3 minutes or

longer ..."

Now, remember I asked you about the significance of two minutes to three minutes and you gave an answer.

A. (Nodded head).

Q. The point that I now want to ask you to focus on is the reference, in this sentence, to "as applied to the premises".

A. Yes.

Q. The previous page, third line from the top, under "General" -- second line, "delivered to a building".

Now, there are these references to a building, to premises.

A. Yes.

Q. And people have been asking questions or looking at these with a microscope and saying, "It says to a building, a block, premises or a block or is it a unit?" How would you look at these references? Does "premises" refer to a flat in a public estate or does it refer to a country house in England?

A. This is a document that's prepared for very general advice. A building is a structure to which water is being delivered. If one is taking an extreme position, a small hut could be a premises, or it could be a public housing block, or it could be a stately home in England.

Q. Downton Abbey, yes.

A. Any of it, so you cannot look -- try and overinterpret what it's trying to say. It is really very, very basic advice. To an extent, it's the same with the Guidelines for Drinking-water Quality. They are providing advice for the world. Therefore, you cannot try and interpret them to say that they are giving specific advice to one particular place. It's the same with the ISO standard. It needs to be thought about in relation to the context.

So a building is a building is a building, in this term. It could be a small building, it could be a big building; it could be a private building, it could be a public building.

Q. Thank you. Can I move on to Legionella, page 101 of bundle V1. Paragraph 31:

"Legionella are heterotrophic bacteria that are found in a wide range of aquatic environments."

Pausing here, that would include a water tank?

A. They are all around us in the environment. They like damp, wet conditions, but they are all around. They are fundamentally soil bacteria.

Q. So a water tank not thoroughly cleaned or not regularly cleaned?

A. You would not be surprised to find them there.

Q. "They are all considered to be potential pathogens for man. Legionella pneumophila is the cause of

Legionellosis, a severe form of pneumonia, and Pontiac fever, which is milder and usually self limiting with flu-like symptoms. The route of transmission is almost invariably by inhalation of infected droplets of water that carry organisms. Legionella are unusual for water-borne pathogens in the route of infection and the fact that they grow readily in biofilms and sediments at temperatures between about 25 degrees Celsius and 50 degrees Celsius. They can and do infect water systems in buildings, mostly associated with biofilms and frequently in association with free living amoebae, where these are present."

So a water tank --

A. A water tank.

Q. -- in a subtropical country, where it's moist and wet, would be a welcome habitat for them?

A. It can be an ideal habitat for them, unless that tank is properly managed.

Q. "32. The best approach to prevention is considered to be management of water in buildings and in this case water in the hot and possibly cold water distribution systems in buildings. Disinfection and temperature control are normally the way this is managed but it should be noted that monochloramine is a more effective disinfectant in this regard than free chlorine, probably

because it is more effective at penetrating biofilms.

33. There is a clear potential for the growth of Legionella sp in apartment blocks in Hong Kong and this requires a suitable building management plan to be formulated and properly executed. Such a plan should also include advice to tenants regarding regularly cleaning items, such as shower heads, that can generate aerosols and in which biofilms can thrive. The recommendations from the WA that tanks in housing blocks should be cleaned every 3 months is to be welcomed but it would be best to develop a comprehensive strategy for managing the internal fresh water supply in large buildings to prevent Legionella.

Description of the WHO Guidelines for Drinking Water Quality as the International Norm.

34. The [WHO] develops Guidelines for Drinking Water Quality which are revised on a regular basis. The current edition is the fourth and was published in 2011. The Guidelines for Drinking Water Quality were first published in 1984 and superseded by the International Standards for Drinking Water. The change from Standards to Guidelines was in recognition that the WHO Guidelines had no legal force and there was a need for member states to develop their own legally enforceable drinking water standards taking into account local requirements

and local circumstances. WHO do not encourage member states to simply adopt the guideline values as standards without due consideration of the local situation."

35. The Guidelines have evolved over time and in 2004 introduced the concept of the Guidelines as a framework for safe drinking water. It was recognised that assuring safe drinking water requires more than simply measuring microbial indicators and standards for individual chemicals in the water as supplied (often termed end of pipe monitoring). The concept of water safety plans was introduced in order to encourage a proactive preventive approach to managing risks to drinking water from the catchment to the point at which consumers receive their drinking water, frequently referred to as the souce to tap approach."

Over the page:

"36. Water Safety Plans ... require a system assessment from catchment to tap, identifying hazards, assessing risks from those hazards, establishing mitigation measures and ensuring that the measures are working. It also includes monitoring and surveillance, usually by an independent authority or regulator. There are recommended supporting activities such as ensuring that materials in contact with drinking water do not cause degradation of the quality of the supply or

introduce new risks to health. The Guidelines are supported by a range of documents including a Water Safety Plan Manual and documents such as Water Safety in Distribution Systems and Water Safety in Buildings and Health Aspects of Plumbing. The Guidelines emphasise the need for close stakeholder liaison with different groups who have responsibility for different parts of the water supply or who have influence on the water supply.

37. The Guidelines are regarded as the scientific point of departure for the development of National Standards providing guidance on microbiological, chemical and radiological quality and on acceptability to consumers. The guideline values for chemical contaminants provide a basis for assessing the risks to health from drinking water but WHO indicates that local circumstances should always be taken into account in setting national standards and recommend that individual guideline values should be considered in the appropriate context. In this respect, and as mentioned above, the statement that 'A guideline value (for a chemical constituent) normally (my emphasis) represents the concentration of a constituent that does not result in any significant risk to health over a lifetime of consumption' should be treated with caution because it

does not mean that contamination can be allowed to increase to the guideline value."

We have seen this passage before.

"In addition some guideline values for chemicals are designated provisional and may be set at a higher value than would be the case for a strictly health-based value because of practical considerations. It is appropriate to try and achieve as low a concentration of a contaminant as possible within the constraints of cost and practicality. WHO has introduced the concept of health-based values for a number of potential contaminants rather than formal guideline values. This approach will, for example, include pesticides to discourage simply copying the list of guideline values into national standards."

Can you explain to us this idea of creating this concept called health-based value, in contradistinction with formal guideline values and what pesticides have to do with it?

A. Each guideline value starts off with a health-based value. So you have a health-based value that relates to protecting public health. It may be modified in terms of the guideline value, taking into account practicality, et cetera. That happened with lead.

Pesticides, there's a wide range of pesticides and

there's a long list of pesticides considered in the guidelines, and member states would like guidance on even more pesticides. But different pesticides are used in different circumstances, and they are not necessarily present all the time.

So if you put guideline values and just copy them in this long list without proper thought, you finish up potentially monitoring -- if you are going to take the guidelines seriously as standards -- for substances which are either unlikely to be there, or you monitor when you know this they are not going to be there, rather than when they are there, and the resources expended are quite significant, and it can be misleading to say, "We monitor for these, and therefore the water is safe", if you are sampling when you know this they are not going to be there is a little disingenuous.

So we know this can happen, and often it comes from ignorance, because you can't expect everybody to be experts in these sorts of areas, and we have taken a decision --

Q. "We" as in WHO, the committee or the group responsible for --

A. In WHO, we in the committee and with the WHO, have taken a decision that we will start to move the pesticides, and even new pesticides, for example, concerned, it will

just have a health-based value and it will not therefore be in the same list of guideline values.

Q. But would they be in a separate list? Because human nature being human nature, as long as they see a list, whether you call them health-based or whatever, they copy?

A. It will be a less obvious way. We haven't decided how exactly that's going to happen. But it will be designed to reduce the temptation just to photocopy everything and put them in the list.

Q. Put them in a text, force them to read, rather than put them in a table?

A. We have tried that, and it works to an extent, but what tends to happen is they completely miss them altogether, and they may be things that are important.

It sounds funny but you have to understand that there are a lot of member states whose resources are very limited. I was helping Afghanistan with their drinking water standards, and you talk about the implications of monitoring, et cetera. Well, there are places they can't monitor because if they send people out to take samples, they get killed. That's pretty serious.

So there's a very wide range of different circumstances around the world, and we understand that

in some countries the resources simply aren't there, because they have other things that are high priority, and in those countries, largely what we see is you focus on the microbiological quality of the water. In countries like Hong Kong, we are very, very fortunate, because we have generally very good resources. We have a sophisticated water treatment, and we understand a lot about what is going on, so we can actually handle things in a different way.

So we ought to be thinking about what we are doing much more.

Q. Over the page 104, at paragraph 38 --

CHAIRMAN: Before you go on, perhaps it's time for a cup coffee. Thank you. Let's take a 20-minute break.

(11.18 am)

(A short adjournment)

(11.43 am)

MR SHIEH: Mr Fawell, may we now continue, at page 104:

"38. Chemicals present in water can vary significantly between water sources, and because water supplies vary significantly in size and resources, the Guidelines emphasise the need to be selective and to prioritise chemicals so that the most important for the country or local region are considered for inclusion in national standards and monitoring programmes. The most

important parameters should be identified during the hazards and risk assessment phases of the Water Safety Plans. Monitoring programmes for chemical contaminants should be designed to provide the greatest focus on those parameters that are likely to be present in significant concentrations. Sampling points should reflect whether the parameter is likely to change between the treatment works and the tap. Those substances that either change in distribution such as trihalomethanes or are introduced from materials in the distribution system, such as lead, should be monitored close to or at the tap to reflect the worst case. Sampling frequency should reflect the variability of the concentration of a parameter over time. However, WHO emphasises that the Guidelines do not cover all possible chemical contaminants and other contaminants identified as a risk under the Water Safety Plan may need to be considered.

39. The International Organisation for Standardisation ... also develops standards that may contribute to the process of assuring drinking water quality. These standards provide guidance in the field of water quality, including definition of terms, sampling of waters, measurement and reporting of water characteristics, including numerous standards relating

to analytical methods, but it specifically excludes standards on the limits of acceptability for water quality.

40. As part of the process of developing Water Safety Plans it is important to identify hazards, which are pathogenic microorganisms or chemicals, including radionuclides, which are of possible concern for health or which could render drinking water unacceptable to consumers. In the process of understanding the water supply it is also considered important to identify hazardous events. These are circumstances in which the probability of a hazard reaching consumers at concentrations of concern is increased. Examples would be heavy rainfall resulting in a significant increase in raw water turbidity or the number of pathogens in raw water, a failure in a treatment process, a sudden drop in mains pressure allowing ingress of contamination, the installation of inappropriate materials such as lead solder or cross connections between drinking water systems and salt water or waste-water systems.

41. In each case when deciding the preventive or mitigation measures necessary it is usually appropriate to consider the possible risks associated with a particular hazard, taking into account existing barriers and mitigation procedures such as water

treatment. In this case it is important to consider the likelihood of a hazard reaching the consumer and the severity of the outcome. While this may be related to health, such as disease caused by pathogens, it may also be related to the effects on consumer acceptance of the water or the probability of exceeding a standard or guideline value. This process allows prioritisation of those hazards that are of greatest concern and for which management steps are the most important. It also allows prioritisation of monitoring for chemicals so that the focus is on the most important. Normally managing the risks begins in the catchment but much of Hong Kong's water comes from catchments outside the control of the Hong Kong authorities. Even when this is the case some understanding of the probable hazards in the catchment and their risks is still necessary for establishing the appropriate barriers by blending sources or in treatment and the ability of those barriers to meet the challenges when they are at their greatest. These hazards may or may not be covered by guideline values."

Pausing here, you mention "much of Hong Kong's water comes from catchments outside the control of the Hong Kong authorities." Now, as we know, in Hong Kong drinking water comes from reservoirs, rainwater, but also from Dongjiang, water supplied from the mainland.

So by "catchments outside the control of the Hong Kong authorities", you are referring to water supplied from Dongjiang?

A. Yes, the catchments of the Dongjiang River.

Q. Right. So when you talk about "understanding of the probable hazards in the catchment and their risks is still necessary", are you talking about a theoretical case? I mean there --

A. Yes.

Q. -- is a need to understand what may or could come, rather than what something you have actually observed.

A. Absolutely.

Q. Because as far as we are aware, the testing is up to -- the water tank on the rooftop doesn't actually show any lead.

A. No, it's understanding what might be present and, to an extent, why it might be present.

In respect to that, I know the WSD has meetings with the authorities on the mainland, the pollution control authorities on the mainland. Having a systematic approach to asking the questions and having those discussions I think is an important part of the process. It's logical.

We know that there are contaminants of emerging concern. Some of them we are seeing because we now have

analytical methods that allow us to be able to detect them at the low concentrations that they are present in, and I'm absolutely sure that the authorities on the mainland are also considering these contaminants.

So discussions would continue because it makes sense for both sides to be exchanging that information.

Q. At least asking questions?

A. Yes. It doesn't necessarily mean that there's a problem. One would hope that there isn't. But it's important to be able to determine whether there's likely to be a problem.

And in terms of emerging contaminants, everybody is facing the issue all over the world. Anybody who's dealing particularly with surface water and particularly a river, which may have a significant number of inputs into it, are looking at these emerging contaminants. It's true in Europe, it's true in the United States, it's true in Singapore, in other parts, wherever.

So this is just a common-sense, sensible approach.

Q. I was about to say, stripped of all the geographical connotations, what you are really saying is that if the bulk of your water comes from something outside of your control --

A. Yes.

Q. -- even if you don't actually see it as a contaminant

which is causing problems, you should keep asking questions and raising concerns --

A. Yes.

Q. -- and wait for any answers that come?

A. This is the sensible thing to do.

Q. Paragraph 42:

"There is a clear difference between the ways in which the risks from pathogens are considered compared to the ways in which chemical contaminants are considered. Pathogens pose an acute risk, ie a single exposure through ingestion of water containing pathogens can lead to disease in susceptible individuals. Even after exposure had stopped, if infection has taken place the disease will develop. This is not the case with most chemicals for which extended exposure at a sufficiently high concentration would be required to cause adverse effects on health and those effects might not be obvious. The exposure period may be for weeks to months in the case of a chemical like lead, to years in the case of a chemical such as arsenic. For many chemicals there is no direct evidence that they do cause adverse health effects through consumption of drinking water but there is indirect evidence that they can cause harm if exposure is great enough. The guideline values for chemicals are developed to provide a benchmark

against which to judge concentrations of concern and there is usually a significant margin of safety built into these guideline values."

This is the point you mentioned earlier, basically the buffer.

A. Yes.

Q. So for those materials, the fact that you exceed the value doesn't mean that you are unsafe?

A. That's right.

Q. "There are exceptions and lead is one of those since the provisional lead guideline is not based directly on health but on what can be achieved by treatment without removal of all lead in the system.

43. Pathogens can take the form of bacteria, viruses or protozoa, such as cryptosporidium" -- I hope I've got that right.

A. Yes.

Q. "... but these cannot be easily measured and so the absence of indicator of faecal contamination in 100 millilitres of water is used, ie [E.coli] or Enterococci. Meeting the guideline values for microbiological quality does not, on its own, assure microbiological safety. They are indicators of the potential for faecal pathogens to be present by rely on very small samples in relation to the total amount of

water supplied. By the time results are available the water will most probably have reached the consumer. The numbers of pathogens can be highly variable in space and time and a single exposure can lead to disease, particularly since the infective dose can be very small. As a consequence the approach to assuring safe drinking water is also to monitor operational parameters such as turbidity and free chlorine to ensure that barriers such as treatment processes are operating at their optimum at all times with a rapid response to correct the system when the operational parameters start to indicate that the processes are becoming less than optimum.

44. Other microbial indicators are used, such as total coliforms or plate counts of heterotrophic bacteria. These are not indicators of the presence of pathogens but can be general indicators of ingress into the distribution system, a change in the system or deterioration in water quality. In certain cases a sharp increase in plate counts can be an indicator of the presence of opportunistic pathogenic bacteria such as Pseudomonas aeruginosa which can grow in distribution or in water systems in buildings.

45. The control measures outlined above should start in the catchment with the prevention or amelioration of contamination of the source. Where this

is not possible or inadequate, water treatment processes may be installed and monitored to ensure that they continue to work efficiently. Prevention of contamination of the drinking water in distribution requires that the system is properly maintained and operated. This would include prevention of ingress of contaminated water into service reservoirs and distribution, and management procedures to operate the distribution system to minimise risks, for example operating valves to minimise surges. Control measures also include preventing contamination from materials and chemicals in contact with drinking water.

46. The Guidelines recommend that chemicals and materials in contact with drinking water should be of an appropriate quality to prevent contamination of water by chemicals leaching in significant quantities from the materials, ie that cause or contribute to a failure of a standard or guideline value. However, it should be borne in mind that concentrations of chemicals should always be kept as low as is feasible within the constraints of cost and resources. While there is no formal international approval scheme for materials in contact with drinking water, there are a number of approval systems in place in different countries and these can form the basis of assuring the suitability of

chemicals and materials more widely, for example NSF International in North America and Regulation 31 of the Water Supply (Water Quality) Regulations 2000 managed by the Drinking Water Inspectorate in the UK."

Now, NSF International is not a governmental body in the US? It's a kind of test and certifying organisation?

A. Yes. It was set up as a way of the government not having to cover that itself. So the government take NSF as being the appropriate means of certifying the quality of materials.

Now, NSF, strictly speaking, is supposed to be a not for profit organisation, and I pick my terms very carefully there, as it actually makes a tonne of money, because they do the right things and they are very successful at doing it, and they provide a service in many parts of the world. So they effectively are the equivalent of the government-run system in the UK.

Q. They test, not water, but suitability of materials?

A. That's right, yes.

Q. "The European Union is also discussing the establishment of an EU-wide scheme. There are also systems to ensure that materials used in buildings do not result in contamination or deterioration of the quality of supply, for example the Water Regulations Advisory Scheme in the

UK. All of these schemes require that materials and/or fittings are submitted for testing to demonstrate that they will not result in contamination of the water."

So it would mean, for example, that if somebody actually wants to draw up a list of approved components for use in, say, construction in the plumbing system, or if somebody wants to try a newly developed brand or a new specification for a particular component, they want to make sure that this is safe, they would be able to have an organisation to submit the materials?

A. Absolutely.

Q. And for them to tell them, "This is safe, this is not safe"?

A. They can show that they meet the appropriate -- I hesitate the use the word "standards" -- the appropriate levels of safety, in other words leaching any chemicals, growing microorganisms, because that's also a check, the ability of a material to support the growth of microorganisms, whether it causes taste and odour in contact with water, and whether it actually works. WRAS and NSF test taps and things like that, to make sure they actually do what they are supposed to do, in terms of quality.

Q. Fittings, taps and valves, the kinds of things that are routinely used?

A. Routinely used. So there are lists of materials, valves, fittings and so on that are approved, but then you can check that, and that could be used and in fact Hong Kong uses the British Standards system. And you could submit new materials for approval.

Q. "NSF also carries out inspections of factories and all require some re-testing at various intervals to demonstrate that the quality has not changed. NSF has their own testing laboratories but the UK Regulation 31 allows the testing to be carried out by accredited laboratories. In all cases, any change in the formulation of materials or in manufacturing practice must be notified and if necessary re-testing will be required to retain approval. By specifying the use of approved materials, such as those meeting specified British Standards, Hong Kong has in place the fundamental structure to take advantage of other approval systems without the cost and difficulties associated with establishing a separate scheme."

So the way Hong Kong did it was, instead of having its own equivalent of NSF, they say British Standards. So whoever is responsible for developing British Standards, if I have the relevant document showing that this meets BS, then we rely on it?

A. I think Hong Kong needs to consider whether that is

sufficient and whether actually to provide the flexibility, they may want to incorporate approvals by other systems, such as NSF and Regulation 21, because it takes quite a long time for a British Standard to be developed.

Q. To catch up?

A. Yes.

Q. "The problem has been the implementation of the existing arrangement for listing acceptable (approved) products and ensuring that the lists are both current and easily accessible. The introduction of a modern website that categorises different materials and fittings in accordance with their purpose and where they are used with a listing of approved products would be helpful, easy to use and encourage submission of locally manufactured materials and fittings to one of the designated approval procedures. The site would also be a useful way of explaining why using approved products is important. Currently this process is the responsibility of the WSD/WA but it is essential that the process and the requirement are taken seriously. However, no system will be truly effective unless there is enforcement of the rules."

47. The Housing Authority specify in their contractual arrangements that low lead copper alloy

fittings and lead-free solder should be used. However, there also needs to be an active process by which checks are made that the requirements are being met. This is the responsibility of the HA but, because there appeared to be a lack of understanding of the importance of the specification, clear allocation of this supervisory task does not seem to have taken place. The HA must understand and act upon the contractual requirements for construction and not just assume that because it is in the contract it will happen. If staff in the HA are unaware or unsure why a contractual requirement is included then this should be rectified before the contract is let. The proposals from HA and discussions with senior HA staff during my visit show that the HA do now understand the problem and are taking steps to correct the situation. The HA Review Committee have made a number of appropriate and constructive suggestions to improve this situation. However, significant responsibility also lies with the main contractor to ensure that both it and its subcontractors fulfil the requirements of the contract. In this respect, licensed plumbers also have a key role in ensuring that their plumbing workforce has been properly trained and comply with the specifications for the materials to be used. Part of the tender process should

also be a demonstration that quality assurance procedures are in place and are sufficiently robust to deliver the requirements of the contract in all areas."

Now, pausing here -- you have been talking about the building contract aspect of the matter, because you mention the HA and the main contractor.

A. Yes.

Q. Insofar as the Housing Authority is concerned, going straight to the point, you know -- are you aware of evidence in this case that when building materials are delivered by suppliers to the construction site, there is a standard form in existence for people on the site to tick off or check whether or not --

A. Yes.

Q. -- the materials being delivered comply with the relevant requirements?

Can I show you that form at bundle B15.1, tab 337, page 37641.

This is a form called 4210. It's a standard form by the Housing Authority. It's a checklist that people tick off when materials are delivered to site, and it gives a whole list of materials that are supposed to be checked. We have spent lots of time exploring how this actually happened. They don't actually do on-the-spot physical checking; very often they rely on documents.

But in any event, soldering material is not here.

So this is the kind of opportunity which, if the Housing Authority wanted to enforce any particular contractual requirement --

A. Absolutely.

Q. -- they would be able to include it?

A. Yes, they would.

Q. But the reason given for not including it -- we have heard a lot about this phrase lack of understanding or lack of recognition of the problem -- but another reason that permeates the whole hearing is that these are soldering materials. They don't cause the building to collapse. Once used, they melt; they disappear. These are regarded to be consumables, sundry items. In an ideal world, you monitor everything, but within the constraints of time and effort, you need to allocate your resources, and therefore sundry items, you just assume people would comply with the rules?

A. Yes, which makes me wonder why there was a clear requirement in the contract that unleaded solder should be used and that copper alloy fittings of an appropriate quality should be used, if you are not going to check that. It would imply that the problem has been, and as was stated by a number of the Housing Authority staff, they just were not aware that lead could be a problem

for drinking water quality.

I am absolutely convinced, from my discussions with a number of them, that if they had known, lead would have been -- the lead solder and other items would have been looked at much more closely.

So understanding -- I emphasised that to an extent yesterday -- I believe that knowing and understanding why things are there is really very important, because then people understand exactly why they should be taking them seriously.

Q. In the middle -- I continue -- "In this case" -- sorry, before I go on, you mentioned that, "licensed plumbers also have a key role in ensuring their plumbing work was ..." Now, licensed plumbers are within the jurisdiction of the Water Supplies Department and Water Authority. You are aware of evidence in this case that licensed plumbers carry on their task in all shapes and forms?

A. Yes.

Q. We have heard evidence that some licensed plumbers own their own business.

A. Yes.

Q. Some licensed plumbers are employees.

A. Yes.

Q. Some licensed plumbers basically regard themselves as

signing documents. They charge a fee for signing documents --

A. Yes.

Q. -- for individual projects. Is that how this charging a fee and signing documents approach --

A. I would be a bit concerned. I would see, from my perspective, and from what I've seen in other parts of the world, that being a licensed plumber should carry -- its basically a professional qualification and should carry with it professional -- standards of professional conduct. Acting as somebody who merely signs documents without knowing what they are necessarily signing would, in my view, not be fulfilling the professional standards that they should be meeting.

It is unfortunate, because I think that the licensed plumber system that you have -- the potential for it in Hong Kong is really very, very good. The licensed plumber is potentially a fulcrum for the drinking water quality, the materials and the installation of good materials in buildings. That should be a huge advantage, because I perfectly understand that for all of the other groups, including the WSD, this is actually fairly small beer as far as a major project is concerned, and having somebody whose role is key in that area is actually potentially a huge benefit.

I am concerned at one or two of the things that I have heard, that the status of the licensed plumber is less than it ought to be, but I think that this is a professional qualification that, with proper professional standards of conduct, should lead to Hong Kong having one of the best systems in the world.

Q. Even afforded a higher status, rather than regarded as the lowly labourer?

A. Yes.

CHAIRMAN: Instead of elevating the status of the licensed plumber, do you think it's a better practice actually to take away the licensed plumber's responsibilities and put that onto, say, a building services engineer, specialising, say, in water plumbing work?

A. That would depend on the training, specific training and qualification, and continued training, that could be provided for that water services engineer.

The advantage of a licensed plumber is that it's plumbing. A building services engineer -- there are advantages in going in that direction, because they have a much broader background, but they need to have the specific training, et cetera, for the water side of things and the plumbing side of things.

That can happen. It does mean that that's another thing that the building services engineer has got to

deal with, and that's fine, but you have to have a way of making sure that they stay up-to-date and that they are maintaining their professional integrity -- "integrity" is the wrong word -- but meeting the professional behaviour that they should have for that.

It's an interesting question. I think you could go both ways. Certainly that is an approach that's been used in some other countries. There are advantages and disadvantages to each system. If you have a licensed plumber, they have to be able to liaise closely with the building services engineer, and at a later stage, when you actually have a building and it's occupied, then having a building manager who has available a building services engineer who understands these things is important.

That is where having the building services engineer approach could have advantages, because it's a continuing involvement.

CHAIRMAN: Why I ask is because we understand the historical reason for having licensed plumbers.

A. Yes.

CHAIRMAN: But in Hong Kong, in a city like Hong Kong, where we are talking about multi-storey buildings, where you can have, say, 3,000 households within a building, that seems to me -- you know, the scale of work goes beyond

a normal licensed plumber's responsibilities.

A. Yes. I understand that. And I think it requires some proper sitting down and working out what would be the best to go forward for Hong Kong, and I agree completely.

I have to say, I haven't come across building projects like the ones that I have seen, the public housing projects. These are very, very large, and quite complex in their operation. The approach to their design is pretty well unique, and the way that they are operated is, I believe, pretty well unique.

So it needs careful thought. I commented on this on the basis that you have a licensed plumber system. If that is to be retained, then I think that you need to strengthen, or it needs to be strengthened and improved, because it does provide a way forward; but equally it may be that that system changes and the licensed plumber is really responsible for supervising technically qualified people on the ground, rather than a broader responsibility for the quality of materials, et cetera.

They would still need to understand about materials. They would still need to understand why all the materials were important.

So it's a case of a balance of finding the best way forward for Hong Kong, and I can't comment -- well,

I can comment, but I can't decide for Hong Kong. I think Hong Kong has to decide the best for itself. I think it's got the basis to be able to do -- to go either way and do well with either system.

CHAIRMAN: Thank you.

MR SHIEH: I read on, two-thirds down the page on 108:

"In this case, none of the responsibility parties had carried out the basic checks. It would seem that it is particularly unfortunate that the licensed plumbers who should have been fully aware of the potential for using the wrong kind of solder, which is both cheaper and easier to use, did not ensure that installation of plumbing met all the specifications of the contract. Once the labels have been removed and solder cut into strips, it is difficult to identify leaded solder from unleaded. The suggestion by HA that it may be appropriate to have central purchasing of items such as unleaded solder has considerable merit. However, if there are circumstances in which leaded solder can be used on non-potable systems then appropriate steps will need to be taken to ensure the unleaded and leaded solders are kept apart and the two cannot get mixed up. Effectively the responsibility for monitoring what is actually being used, both unleaded solder and low lead copper alloy fittings, lies with the main contractor and

the licensed plumber(s). The HA has a higher level supervisory role but this role is key in the early stages of a contract ensuring that the main contractor or its subcontractors are proposing to use appropriate approved materials and are aware of their responsibility to ensure that there is no deviation during construction."

Now, in this whole paragraph, you have been looking at it from the building contract perspective, so the HA, contractors, et cetera. But there is also a role to be played by the WSD, because even though the WSD does not formally feature in the chain of building contracts, as the supplier of water to all buildings, if you want water to be connected, you've got to approach the WSD, and in the necessary procedure leading to connection, paperwork is generated, checks are done.

So there is a role to be played by WSD, even though albeit outside of the context of enforcing a contract; do you agree?

A. I agree. I think that there is an issue surrounding the way that that is presented at the moment. WSD do not formally have, yet, responsibility for the water quality as a consequence of the materials that are installed. It's not actually their responsibility --

Q. In terms of water quality?

A. Yes. So there is a gap there. And in fact they take samples at the curtilage, they check the water to make sure that if there's any backflow -- and that's a serious possibility with these very tall buildings; the back-pressures will be significant --

Q. Which can't be helped by having valves?

A. Well, you make sure that they're there and your backflow prevention devices are good enough, and they are checking that, and they are checking that there is no backflow, there's no contamination from -- particularly from the saline system, because you don't want this getting back into your public water supply.

There therefore needs to be -- and they have some responsibility for checking that the plumbing is fitted in the right way. I think the way that it's developed, it's a little bit like topsy, it's grown, and the time has come where sitting down and actually redefining the role of WSD in these circumstances, along with the others, and determining who has responsibility for what and making sure that it is set up so that they co-ordinate between the different groups -- I think that time has come, because I have sympathy with the WSD in that it's not entirely clear for them, and that makes life difficult.

Q. But in terms of water quality, of course there's no

statute --

A. That doesn't help.

Q. -- or a city standard, and there's no clear statutory force or requirement --

A. Yes.

Q. -- that, "thou shalt take care of water quality" by this standard?

A. Yes.

Q. But in terms of building materials, the relevant requirement is compliance with British standard is contained in the very Ordinance about waterworks?

A. Yes.

Q. So if one wants a window for the Water Supplies Department to come in, to be able to do something, some checking, which impacts on water quality, through their responsibility of administering compliance with not the building contract --

A. No, no.

Q. -- but the water legislation --

A. This would provide --

Q. -- would be an opportunity?

A. It would be an opportunity, but again, I think it needs to be properly phrased and defined, as with the responsibilities in terms of materials approval and listing of materials. I think all of this needs to be

more clearly defined now.

We have reached the stage where, as with every system, it's unavoidable that eventually a system gets a little bit blurred, and this is a very, very timely opportunity for WSD, the Housing Authority and others to have much more clarity and, as I have said later on, I think working together to pull information into one place would be very beneficial.

It is a little diffuse, as it stands at the moment. I found considerable difficulty finding things on some of the websites, and so on, and you are looking in lots of different places. So this is an opportunity for Hong Kong to actually put that right and to co-ordinate things and actually pull them together.

Q. It's a familiar phenomenon in public administration -- very often, one single topic, different facets are dealt with by different departments, and different departments only look at that little bit which concerns them, but nobody looks at pulling all the strands together and says, "Look, water quality", it cuts across numerous departments. That's a rather familiar aspect of administration all over the world, right?

A. It's very familiar to me in lots and lots of circumstances, and it isn't just public administration; it happens with private systems as well.

Q. In any bureaucracy?

A. Yes. It's a fact of life. That's what happens, because bureaucracy doesn't necessarily -- it's not usually designed to be flexible, and that's partly the point of it, but it does have to be sufficiently flexible to adapt to change.

Q. And human nature is such that everyone lives in their comfort zone, they are very good at doing that little thing they are doing, but they --

A. Usually, the way things operate is that those who are comfortable with operating a system like that gravitate into that system, and those that are more comfortable with being flexible and doing other things gravitate into those other areas.

Q. Or become professors?

A. I could argue with that. I don't think that's necessarily true!

Q. You mention lists and checkings. Can I ask you to look at -- I wouldn't say the equivalent -- but a list which exists in relation to water supply. It's not a list, it's an annex. It's WWO46, in B15.1, at page 37626. It's actually 37627.

A. Yes.

Q. To cut through the myriad of complications, when somebody tries to get water connected to a newly

constructed building, they've got to go through a whole host of filling in forms and all that. One of the forms which kick-starts the process is WWO46.

One part is to be completed by the licensed plumber, and this is an annex, and you are supposed to include pipes and fittings intended to be installed. Do you see page 37627? It's not a checklist in the same way as 6210, in the Housing Authority context. It's basically a list for you to fill in, country of origin, et cetera, and category of compliance.

If you look at the notes, over the page at 37628, note number 7 -- oh, I was told that 37627 -- the annex that you are looking at, is it 37626 or 37627?

A. It's page 37627 and 37626 is a form.

Q. I see. 37626 is a form, so 37627 is the notes?

A. Yes.

Q. I see. I was looking at another version. So 37626 is the form; right?

A. Yes.

Q. 37627 are the notes.

If you look at note number 7 --

A. Yes.

Q. -- it says:

"All pipes used/intended to be used are required to be reported in the annex. For fittings, only draw-off

taps, stop valves, gate valves, ball valves and combination fittings need to be reported. A directory of pipes and fittings approved by the Water Authority can be found in [a particular website]. For pipes and fittings not yet approved ... submission of details and samples of such pipes and fittings listed in the annex may be required."

Then there is listed out a whole host of relevant British Standards applicable for pipes and fittings, those that need to be submitted, they help up by setting out the relevant British Standard, but the problem here is that solder not listed as being required to be included in --

A. I'm sure that's exactly the same sort of situation that happened in Scotland, that it tends to be forgotten about, because it is, as you said, a consumable. It's used and then, unless it's done very, very badly, it's out of sight and therefore out of mind, and that is a problem, because it actually is quite an important part of the process, because it can have such an impact on the water quality with regard to lead concentrations.

Q. And there is a BS, but people don't understand why the BS is there?

A. Absolutely.

Q. In the same way as in the housing context, people know

you are not supposed to use certain things, but if they don't understand why, they would simply --

A. I think this sort of listing is not very informative. It encourages a tick-box approach, rather than a thinking approach: "Why are we doing this; why is it important?" Somebody, somewhere, needs at some stage to be incorporating, "Why are we doing it; why is it important; why do we have to make sure that this is right?"

And if there isn't a good reason, then they have to address why it's there in the first place. In the case of solder, the question is, "Why is it not there?", and the difficulty with things like that is -- "Why is it not there?" -- if you don't see it, you have to know quite a bit about it, to identify that there is something missing.

So that is then an important part of the process. There are a lot of forms that I see and I just get nervous when there are lots of forms because it's easy for things to become --

Q. Standardised?

A. Absolutely. You just --

Q. The mind gets numb because you ... (demonstrating).

A. So many forms, you fill them in, you sign them. I've been there myself, not with plumbing but with other

things.

Q. Tax -- filling in a tax form -- no?

A. I get somebody else to do that!

Q. Thank you, Professor. Over the page, at page 109:

"Effectively the responsibility for monitoring what is actually being used, both unleaded solder and low lead copper alloy fittings, lies with the main contractor ..."

I have read this. Paragraph 48:

"The Benchmarking Study of Overseas Regulations and Practices on Management and Control of Inside Plumbing Services identifies a number of schemes along with different practices regarding licensing and certification of plumbers. I broadly agree with the conclusions from that study but I have reservations regarding reliance on testing post installation. Hong Kong has procedures in place to ensure that inappropriate materials are not installed, at least in public housing and these procedures should be simplified and strengthened. There should be consequences for licensed plumbers, who do not properly fulfil their responsibilities with regard to using craft trained plumbers who will carry out much of the actual work, eg removal of licence or suspension of licence with a requirement for re-examination and demonstration of

competence over a suitable period, reflecting the severity of the breach of conditions, before the licence could be restored. There should also be a requirement for all licensed plumbers to attend periodic short courses to ensure that their knowledge is up to date. Hong Kong has one of the few national public certification and training schemes for plumbers (Scotland also established such a scheme in 2002) but it is essential that the system is not undermined by not being properly and rigorously applied. It is important that all individuals in plumbing, including those trained practically through apprenticeships and similar schemes, understand the reasons why certain materials should not be used and why system design is important."

Now, the Benchmarking Study, can I ask you to have a brief look. It's bundle C19.6, tab 143.

A. Yes.

Q. Certain conclusions are set out. First of all, can you look at the first page of this Benchmarking Study. How did you come across this Benchmarking Study? It was done obviously before the saga, the excessive lead in water saga -- after, sorry, yes. How did you come across it?

A. It was brought to my attention as one of the documents in the bundles.

Q. Certain conclusions were put forward at the end of this report, and can I ask you to look at page 14452.

A. Yes.

Q. Under the heading "Conclusion", 8.1.3, there are numerous bullet points. I think in one of them there is a suggestion of testing water post-installation. Is that the part that you are commenting about?

A. Yes.

Q. Is that the fourth bullet point?

A. Yes.

Q. "In Hong Kong, after the July 2015 incident of excess lead found in drinking water, the WA has responded by taking additional measures of testing water samples ... before turning on the water supply to newly completed buildings. The measures are cost-effective to reduce the chance of non-compliance with the waterworks requirements."

Now, the reason why you have reservations about reliance on testing post-installation is because if you have a system of controlling the source, ie controlling the materials --

A. Yes.

Q. -- which could well contaminate the water, you would suggest that it's actually more worthwhile trying to strengthen that part of control?

A. I would say that would be much more cost-effective. If you find you have a problem, it's rather late, and the costs of fixing that will be much greater. Therefore, it makes sense, in cost-effective terms, to prevent it happening in the first place.

Q. That is also the stance taken by the Water Supplies Department --

A. Yes, I would agree.

Q. -- in actually not testing for lead as one of the parameters tested, because the view taken was that it's not resource-friendly, it's not a proper use of resources, to test at the end; it's far better to tackle the problem at the beginning?

A. Yes. I have commented in various places in my report, but not specifically on WSD's position, but in fact that measurement afterwards -- this is a very final assessment, just to make sure that nothing has slipped through. So really it's a one sample but it's not to be an appropriate one.

Now, how you achieve that, with the sort of complex buildings, that is a different question, and there it would require a considerable amount of thought, and there may be other ways of dealing with it.

I think that WSD's position is correct, and I fully support that. I think that prevention is always better

than trying to fix it after it's gone wrong.

Q. As long as prevention is properly done?

A. Absolutely. You have to make sure that the preventive system is working properly and that you have a very high -- you have enough checks in there and enough verification that it's working at each stage, in order to make sure that you don't need to do any extensive testing.

Q. Paragraph 49:

"Construction and maintenance of water supply systems not only requires that the correct materials are used, it also requires that under the Water Safety Plans there are appropriate procedures in place to ensure that the safety and quality of the drinking water is not compromised by the design of the system. Similarly it is essential that management procedures are in place for maintenance. Not only is it necessary that procedures are in place for construction and maintenance but training is required to make sure that the reasons for the procedures, eg lead is hazardous to health and dead ends result in deterioration of quality because of microbial growth, are fully understood. This also applies to maintenance procedures because understanding why procedures are necessary is an important step in ensuring that they are taken seriously, eg growth of

Legionella."

Just a very small point -- what are dead ends?

A. When you design a system, there is in certain circumstances, both in changing an existing system, and occasionally in building a new system, just in case we need to take an extension off here, we take a tap and we have a capped off end here (demonstrating). So you have a piece of pipe that is fundamentally not delivering water anywhere; it just sits there. We know that -- it happens a lot in hospitals, unfortunately, where it's really serious and we know that under those circumstances you can get serious deterioration of the microbiological quality of the water within those dead ends, because there's no flow, so there's no penetration of any disinfectant or anything like that. They are very difficult to manage because you can't just put a plug of a disinfectant through; it's not going to have any impact on it. But they will leak out an inoculation, an inoculum, of microorganisms into the main system.

We have seen or I've seen with others a number of circumstances where that has led to serious deterioration, and in some cases problems for health, within the system.

So that sort of design, and understanding why that's

there -- we had long discussions with plumbers in Scottish hospitals as to why this was, and to start with they couldn't understand what the problem was. "We are going to make it easier for the future" -- but in fact you are making it worse. Then they understood and they stopped doing it.

Q. In relation to this problem that you mention, dead ends and -- you don't actually see any abundance of that in Hong Kong; right?

A. I've not seen any particular signs of it. I'm aware that it's an important issue, or can be an important issue. We have only looked at these particular systems. I would hope that this Inquiry will inform the general approach to building quality, or water systems in buildings in Hong Kong for the future.

Q. Paragraph 50:

"Maintenance of systems is emphasised under water safety plans including preventive maintenance and regular planned maintenance of important equipment and fittings. Maintenance is particularly important in the water treatment works and the distribution system but it is also important in the water infrastructure in buildings, for example the requirement now proposed by WSD for disinfection and cleaning of systems every 3 months.

51. There are currently no formal international standards for inspection and monitoring of water supplies or for the building and construction of water systems although there are a number of areas in which guidance is available, either through WHO documents that support the Guidelines or through other networks such as the International Water Association Operation and Maintenance Network. The reason for this is that inspection and monitoring needs to be tailored to specific circumstances and requirements which vary significantly around the world.

52. Management procedures are a key part of Water Safety Plans. They are vital in ensuring that water supplies are capable of delivering safe drinking water and continue to do so. In the fourth edition of the WHO Guidelines it is stated that 'a Water Safety Plan comprises, as a minimum, three key components that are the responsibility of the drinking water supplier in order to ensure that drinking water is safe. These are a system assessment, effective operational monitoring and management and communication'. Management and communication are key parts of any process to assure quality. Management procedures that are clearly laid out and understood underpin the delivery of safe water from source to tap. In addition the Guidelines state

'effective management implies definition of actions to be taken during normal operational conditions, of actions to be taken in specific 'incident' situations where a loss of control of the system may occur and of procedures to be followed in unforeseen (emergency) situations. Management procedures should be documented alongside system assessment, monitoring plans, supporting programmes and communication required to ensure safe operation of the system'. Supporting programmes would include systems for ensuring that only appropriate materials are used both in terms of approval and ensuring that only approved materials and chemicals that meet the appropriate quality criteria are used.

53. The documented management procedures should ensure that when any part of the system has a problem that problem is rectified in due time to prevent any unnecessary risk to consumers. Systems must be capable of responding quickly at any time because water is supplied for 24 hours per day and 7 days per week. This also means that staff must be properly trained and understand the limits of their authority to take decisions, however decisions should be delegated to the lowest appropriate level to ensure rapid response. It is also important that there is an appropriate on-call support system that is properly staffed and able to

function at any time.

Plumbing materials and their installation.

54. The development of detailed Water Safety Plans that include buildings is difficult because of the variations in building design and ownership. However, one of the key areas that can be included is the approval of plumbing materials to ensure that only those that do not cause an unacceptable deterioration of the water quality are used. Lists of approved products need to be up to date and readily available and stakeholders such as construction companies, plumbers and suppliers of plumbing material need to [be] made aware of the requirements and why those requirements are in place. The WHO document entitled Water Safety in Buildings mentions the use of inappropriate materials and specifically mentions lead in this context. Lead is also specifically mentioned as a potential hazard in the drinking water system in buildings and as a chemical that can leach from materials used in pipework with particular mention of solder. These mentions of lead in the context of building construction reinforce the statements regarding lead in the Guidelines for Drinking Water Quality. In terms of installation, requirements such as not leaving dead ends in systems should be made clear to architects, construction companies and plumbers

along with their responsibilities with regard to ensuring safe water. The WHO document Water Safety in Buildings states 'This should include minimising sources of hazards (eg stagnant water, long branch pipes and dead legs), as well as enabling access for monitoring and maintenance'."

You mention here a WHO document entitled Water Safety in Buildings. Can we take a look at that. A2, tab 35. It starts at page 1066.

A. Yes.

Q. It starts at page 1066, but the operative part that you cited is page 1083. "Introduction".

A. Yes.

Q. "Outbreaks have been associated with both microbial and chemical contamination."

The first bullet point:

"Direct contamination through faults in water systems or leaching from inappropriate materials or corrosion eg copper, lead, nickel, cadmium)."

The other mention is at page 1089, under "Hazard identification and risk assessment", and then:

"Chemicals from external environmental, industrial and agricultural sources can enter the water-supply system. In addition, chemical hazards can be introduced from treatment processes, leached from unsuitable

materials, or released from corrosion of pipework and fittings (eg copper, lead, cadmium and nickel) used in plumbing systems."

Now, you mentioned at the beginning of this paragraph one of the key areas to be included, that can be included, is the approval of plumbing materials to ensure that those do not cause unacceptable deterioration are used and a list of approved products needs to be up to date.

Now, we have seen in Hong Kong, for WWO046, the Water Authority document, they don't require you to put into the annex your soldering material.

A. Yes.

Q. In relation to 6210, the form of the Housing Authority, likewise, it doesn't actually require on site staff to check soldering material.

Now -- and you have cited the Water Safety in Buildings, which mentions on the face of it that lead leached from soldering material is a potential hazard.

But in real life, in your experience, in the jurisdictions that you've had experience of, how many of them actually put pen to paper and actually have a system whereby there's actually a checklist of approved soldering materials, or people are mandatorily required to actually check the specs of soldering

material?

A. I can't tell you exactly how many, obviously, but it generally is introduced after there's been an incident such as there has been in Hong Kong.

Q. I was about to say obviously in Wales and Scotland, they weren't aware of it --

A. Absolutely.

Q. -- and something blew up and then they started doing lots of things?

A. There are many assumptions, because solder is a relatively small component, and a lot of the people putting these documents together don't have particular expertise in actually doing soldering, which is --

Q. When you say "these documents", you mean the list, checklists or whatever?

A. Yes, checklists or whatever, because there is a tendency not to involve stakeholders and get their comments. This is why --

Q. But stakeholders don't know here, in Hong Kong.

A. Arguably, through the process, having seen and looked at some of the training requirements for, for example, plumbers, for the licensed plumbers, it does say that the reasons why lead should not be used is mentioned in the training.

Q. The VTC that you have seen?

A. Yes. Now, obviously I can't tell you whether that actually happens or it's just one of these things that's in the course and gets flipped past, but it should be picked up there.

So Hong Kong should be in a good position. Now, in Scotland, the licensed plumbers have to be licensed, and they will know. I know that in England and Wales, there is the International Plumbing Council and the Institute of Plumbing Qualifications, and there people can volunteer to get themselves properly qualified.

Building, construction, you are not necessarily required to have somebody who has got that certification, because our governments -- and I use that as any persuasion over a century -- have consistently wanted to allow there to be some flexibility in this. They don't regard or apparently don't regard health from drinking water in the same regard as, say, gas fitting, presumably because an explosion hits the headlines rather more readily than something you can't actually see or detect in the water unless you have specialised detection equipment.

So it depends on it being operated properly. The position in Hong Kong is that you have in place something that ought to operate properly. And it's potentially a very, very good system.

Q. Thank you. Page 112:

"My opinion on the introduction of water safety plans by WSD."

I'm going back to the experts' bundle, V1. I'm returning to V1.

A. It's okay. I turned two pages back. Sorry.

Q. "My opinion on the introduction of Water Safety Plans by WSD", paragraph 55 of your report:

"WSD has adopted the concept of Water Safety Plans and it is to be expected that these will be developed further in the future. It is difficult to give a comprehensive opinion regarding WSD's development and implementation of WSPs from the documents available and from the short time available to discuss the plans with WSD staff. The following comments reflect the information available from the documents submitted.

56. WSD's understanding of WSPs would be enhanced by consultation with organisations in other countries that are also actively involved in the process of developing and implementing WSPs. There appears to be some complacency about water quality and the approach appears to be top down with no clear indication of how the Water Safety Plan teams work, which is an important part of the process. How well external stakeholders are engaged is also unclear but the involvement of other

stakeholders is key in ensuring full understanding of what WSPs are and their role in assuring safe drinking water."

How did you get the impression that there appears to be some complacency about water quality?

A. The WSD website, and numerous people I spoke to, kept saying, "Hong Kong water is the best in the world" and this seemed to be a mantra. I have come across it elsewhere, in other countries, "Our water is the best in the world", and when you challenge that, it comes back as, "Our water is the best in the world", and I understand pride in water supply.

But, for example, the water has got high lead in some of the buildings. There is a problem with lead. And I would regard that as being a bit of -- it's recognising that there's a potential for problems. When I hear phrases like "Our water is best in the world", I wonder how closely people are prepared to look and support that, and how well it is verified. It's a natural position to get to, and it's something that occurs over time. There is an element of unwillingness to admit that there could be problems. We see it in many, many places. I have had a number of issues with the approach of the water companies in the United Kingdom, who say, "We do" --

Q. Their water is the best in the world?

A. "We do thousands and thousands of tests, and 99.9 per cent of these tests meet the required standards." Then I look and see, and a significant proportion of these tests that they are carrying out are looking for things that were never going to be there in the first place, so the 99.9 per cent doesn't mean anything; it's meaningless.

It's part of the problem of the pressure on particularly water suppliers. Everybody is very quick to criticise if the water has a problem. My position is that if a water supplier identifies and admits to a problem and deals with it, I'm a lot more comfortable than if they deny that there are any problems.

I feel that in general we have to be rather better, and I would look at the media in this respect as well, because the media are very quick to say it's a failure when in fact it's not. Actually, it's a success, that they have spotted there's a problem and they are fixing it.

Q. Thank you. Can I move on to page 113, paragraph 57:

"It appears that there may not be clear understanding of the purpose of health-based targets for pathogens: for example in the WSP general plan it states that the 'absence of thermo-tolerant coliforms and

E.coli in 100 millilitres of treated water is taken as the performance target in ensuring the microbiological quality of treated water'. While performance targets are an important part of WSPs, one of the reasons for establishing WSPs is that simply monitoring for faecal indicators is inadequate for ensuring the supply of safe water and so this would not be a suitable performance target. The target would be a removal target for pathogens by treatment processes. Hong Kong has well established multi-barrier treatment in place and performance targets would relate to operational parameters that reflect the efficiency of treatment such as filtration and disinfection."

So the message you are trying to bring out is that it's a good thing to have performance targets, but simply priding yourself with absence of coliforms and E.coli is setting actually the wrong parameters as being your performance targets?

A. Absolutely, and I think that reflects a historic position, that having incorporated the guidelines -- we work to the guidelines and we have a list of parameters that we check against. This is about the old system of end of point monitoring, and was exactly the opposite of what was intended in developing water safety parameters.

So it takes time, and it takes time to get a change

in mindset, to looking at this in a different way.

This is an important one, because the microbiological quality can change very, very rapidly in raw water, and the challenge to the drinking water can be significant and very rapid. So understanding what that challenge is and having in place performance targets that relate to the treatment -- you can only take a very small number of samples to actually look for the faecal indicators, and those faecal indicators might not be adequate against some of the pathogens. For example, if you chlorinate, chlorine doesn't kill cryptosporidium, so what you do is effectively kill the indicative parameter and leave the pathogen and there have been outbreaks as a consequence of misunderstanding that.

So part of the Water Safety Plan approach is to make sure that you have -- again, it's like making sure that your prevention of materials works -- it's making sure that your preventive steps are adequate and that they are working at their optimum all of the time.

So in this case the performance targets are how much do we need to remove and if our system -- if we are confident our system is good enough, then what performance targets are in, say, the turbidity coming through the filters, what are they; what are the

boundaries? When the turbidity starts to rise, at which point do we switch in and say, "We've got to modify the system and make sure it's working properly, to bring it back down into spec".

Q. Thank you.

"58. While the overall structure and purpose of WSPs appears to be understood and the WSPs as presented form a very good starting point there are areas that would repay closer examination.

59. It is not clear how the WSPs were prepared but the General Plan implies they were prepared by one department for others. In fact the WSPs were prepared under the auspices of a WSP team ..."

When you say "one department", you mean one division in the Water Supplies Department?

A. Yes.

Q. "... with representatives from various sections to ensure that it reflects actual practice and has the commitment of the different sections. The situation in Hong Kong is complex and so an overarching team that links into external stakeholders on a day-to-day basis and ensures consistency would be appropriate. This would be supported by small teams associated with each supply train. In terms of distribution this would be much more of a common plan but there would be a clear

need to have a proper schematic, preferably using GIS with the associated data on materials, condition and flows in the different sections. There would also need to be records for the position and status of valves, procedures for opening and closing valves and planning maintenance, such as periodically operating valves to ensure that they are still fully operational and flushing mains. Consideration of the operation and maintenance of service reservoirs is also important. As indicated above it is difficult to determine to what extent this is the case due to the lack of time to specifically study the WSPs with WSD staff.

60. For the future it would be beneficial to have a more systemic understanding of the possible hazards and risks from the Dongjiang River in particular, because it is such an important source. This would also apply to the catchments, with less reliance on lists of chemicals that may or may not be there and so may or may not be adequately monitored."

Now, this is another place where the Dongjiang River is mentioned, and this harps back to paragraph 41 of your report earlier.

A. Yes.

Q. So what you are saying is you don't actually see evidence that there's any problem about Dongjiang water

containing lead or whatever.

A. Not at all.

Q. But you are sounding the need to be alert to the unknown?

A. Yes, it's understanding, because things change. It's a surface water, it's a river, and rivers and surface waters are vulnerable to all sort of contaminants. Understanding a bit more about it, and continuing -- that continuing understanding. You don't look at it and say, "Okay, we have looked at that, that's the end", because things change, and it's part of that process of making sure that you've got in place systematic procedures so that you will have regular meetings, you will ask a series of questions, you will understand. You will exchange information, and both sides learn and grow as a consequence.

MR SHIEH: Thank you.

I wonder whether it is an appropriate time to have a break.

CHAIRMAN: Let's take the lunch break and resume at 2.30 in the afternoon.

(1.04 pm)

(The luncheon adjournment)

(2.31 pm)

MR SHIEH: Good afternoon, Mr Fawell. I will continue with

your expert report at page 114 of the bundle, paragraph 61:

"The approach to water treatment is sound but the extent that continuous monitoring technology is used to support operational monitoring technology is less clear. This is an important step to assuring safe water.

62. Distribution system management plans do not appear to be so well developed. It is not clear how the distribution system, including service reservoirs, is managed to minimise the risks of contamination, for example management of operations to open or close valves to prevent surges, which are followed by pressure drops and the extent to which pressure falls after a burst will affect the wider distribution system.

63. There is mention of water distribution systems in buildings as a responsibility of the Customer Services Branch but this can only be achieved by appropriate collaboration with other agencies such as the [Housing Department]. Paragraph 3.8 of the minutes of the First Working Group Meeting on the Development and Implementation of Water Safety Plan for WSD held on 28 February 2005 indicates that WSD does have indirect control of systems in private premises after the connection points but it is unclear what actions were put in place to extend [Water Safety Plans] to

buildings, possibly through another agency."

If we look at that part of the minutes, at bundle C21, tab 179. The minutes start at 18998, but the actual passage appears at 19000. Could you find that?

A. Yes, indeed.

Q. If we can just look at the cover, the first page, just to see what it is -- it is 28 February 2005, and there are various people attending. We can recollect -- because these are all in surnames but we may just be able to guess who various people are or may be -- perhaps it is something -- yes, Mr Chan Kin Man may be there, because one can see "Mr KM Chan" and Mr CM Lam, maybe it's Lam Ching Man, maybe. Anyway, a group of Water Supplies Department officers.

If we look at 19000, at 3.8:

"E/PU asked whether the [Water Safety Plan] would include systems within private premises. The chairman responded that the consumer service issue would be covered in the master plan and the Water Science Division would cover the monitoring of indirect supply. SE/NTW(1) supplemented that WSD had indirect control of the systems after the connection points under Waterworks Ordinance."

That's the part that you have in mind?

A. Yes.

Q. Have you explored with anyone during any of your visits to the Water Supplies Department as to what kind of indirect control they might claim to be able to exercise?

A. That wasn't possible when I was here last time. I had actually found this piece of information in one of the bundles after I had visited Hong Kong.

Q. Right.

A. So I haven't had any direct contact with them. It was interesting because we did actually talk about the difficulties of establishing a Water Safety Plan covering buildings, and there was some uncertainty amongst the staff that I talked to about how that could be achieved in a sensible way, and I certainly didn't make light of the fact that it is difficult, when I talked to them. But we did talk about the need for collaboration with other stakeholders and other departments.

How that was taken, I have no way of knowing at the moment. Really, the time frame was so short that it was very difficult to get down to any good, detailed discussion on these issues. We were covering so much in such a short space of time.

Q. Perhaps all is not lost, because I can recognise perhaps

Chau Sai Wai and Lam Ching Man; these are both names on the minutes, assuming the initials correlate to these two individuals. They will be testifying, so we will have a chance of exploring with them what kind of indirect control that the WSD may well be able to think about. They may be thinking about control of the plumbing materials, or whatever, through the licensed plumber.

A. Yes. That may well be the case. That seems to be --

Q. Or maybe, during an emergency, they may be able to insist on access. We don't know; we can ask.

A. It doesn't say an awful lot in that paragraph. It's fairly limited.

Q. Continuing --

CHAIRMAN: Can I go back to paragraph 61, because I do not quite understand what exactly you mean that the "continuous monitoring technology" -- it is less clear. In what respect?

A. I am not sure to what extent they are using continuous monitoring of parameters such as turbidity, how extensive that is, and how it is linked into actually measuring the position -- for example, with turbidity. Measuring when the turbidity level starts to increase, at what point they would then start to make changes to the treatment process, to bring it back into process.

Continuous monitoring technology is now much more readily available and is coming down in price, and obviously being able to monitor parameters continuously is a huge advantage, rather than taking individual samples, because you literally get a continuous picture of the situation. It's being introduced very widely and I've been involved with a couple of companies who are looking to improve control of their treatment process and using continuous monitoring for that.

MR SHIEH: You have been to the Sha Tin treatment plant?

A. Yes.

Q. You know there is some kind of continuous monitoring programme?

A. Yes.

Q. So you are not saying that they are not utilising it --

A. No.

Q. -- but you are saying you don't know to what extent they have fine-tuned the system, what kinds of parameters, what kinds of changes they are calibrated to?

A. Yes, how well they are taking advantage of that in relation to Water Safety Plans, and I'm not sure -- there just wasn't time to really find out, explore it properly, because it was a very short visit -- exactly where their continuous monitoring is placed. If you've got filters in parallel, have you got a turbidity meter

on each filter, and so on.

So it's quite a complex area and it takes a little bit of time, and within the time frame available --

Q. So you are not saying you have observed something deficient?

A. No.

Q. You are saying it's a good start but you should pay attention to optimising the use or making the best use out of such systems?

A. Absolutely, and on these, Chairman, I understood -- we had obviously some discussions with WSD staff -- but what I have tried to do here is to help them, to highlight various things that they can go back and look at it and say, "Okay, we are comfortable that we have done all the things we should" or, "We have looked at it, and yes, we should be doing a little bit more."

Q. I am looking back and reading paragraph 63, page 114 of the bundle:

"This is important since WSD do not take responsibility for water quality beyond the supply point into a building. In addition, responsibility for continuing water quality and maintenance associated with water quality, for example Legionella control, lies with the building manager and individual householders or tenants. WSD have previously taken samples from the

buildings before the systems are approved for use but this has been to ensure that there is no danger of back flow contaminating the public water supply and the parameters considered were limited to those that could be indicators of the potential for such contamination. Since the identification of the lead problem the proposal is to take samples at representative sampling points for several metals, but the objective of such sampling needs to be carefully considered and clearly stated. In particular, sampling needs to reflect a worst case in order to identify hazards and to determine whether further investigation is required to determine the risks and interventions. In the case of lead, the presence of elevated lead above 5 micrograms per litre, and possibly less, in a suitable sample indicates a failure of the procedures intended to prevent there being any excess lead in the system. It is important that there is someone responsible for water quality and monitoring water quality at the tap within buildings. Following the source to tap principle of [Water Safety Plans], WSD would be best placed to do this."

Returning to the bottom of the previous page, "the objective of such sampling needs to be carefully considered", and then you mentioned worst-case scenario,

identify hazards, et cetera, et cetera. Do I take it to mean that you've got to, in terms of lead, say to yourself, "Am I trying to find lead so as to satisfy the WHO only, or am I trying to identify lead not just for merely satisfying the guideline value but for something" --

A. Absolutely.

Q. -- "deeper"; I use this word advisedly.

A. It's not about compliance with a guideline value. It could be compliance with a standard in Hong Kong, if there were standards. But it is not about compliance with a guideline value; it's about the compliance with the requirements to use the correct materials, or not use the incorrect materials.

Q. Or you can define the objective as meaning detecting possible excess lead, to indicate breach of a relevant British Standard or whatever?

A. Yes.

Q. Because the whole point of using British Standards would be that they don't want excess lead in the system?

A. Yes.

CHAIRMAN: So, with the addition of the four heavy metals, four parameters, are you saying that if the WSD continued to adopt the same sampling procedure, that sampling procedure is still regarded as unsatisfactory,

because the objective -- because we are not talking about complying with the WHO Guidelines; we are in fact trying to investigate the presence of, say, the four heavy metals?

A. Yes, absolutely. It would not be particularly appropriate. It's important that under these circumstances, we are looking at a complex building, so we are only taking a few samples relating to the whole building, and therefore what we are looking for are indicators of an issue that might need further investigation. You can't thoroughly investigate just by complying with the guidelines.

MR SHIEH: Jumping ahead, let's look at the latest testing protocol -- well, testing criteria. You dealt with it later, but now that Mr Chairman has raised it, and since it also relates to this paragraph, let's look at bundle C5, tab 60. That's circular No. 1 of -- sorry, bundle C5, tab 60. It's circular No. 1 of 2015. Do you see that?

A. Yes.

Q. It's 13 July 2015, circular No. 1 of 2015.

One point that has struck me, actually, ever since the beginning of this case is that it has taken up to July to issue the very first circular letter in 2015, but it may mean that no news is good news prior to that.

I don't know.

But WSD circular letter No. 1/2015, "Prohibition of Using Leaded Solder at Fresh Water Inside Services and New Parameters for Testing of Water Sample":

"Water Supplies Department is responsible for the enforcement of the Waterworks Ordinance and Regulations. We therefore [are] highly concern[ed] with the quality of water supplied in inside services. In accordance with the 'Waterworks Ordinance', it is the responsibility of the licensed plumbers to construct and install inside service and to ensure the materials of water pipes and fittings installed/to be installed are in compliance with the requirements and/or standards stipulated in Waterworks Regulations. Any person who contravenes ... shall be guilty of an offence ...

I [would] like to remind you that the requirement of using lead-free solders for copper pipes at fresh water inside service is specified in the standard as stipulated in the Waterworks Regulations. For all applications for new water supply (for example part I of form No. WWO46) submitted on or after 13 July 2015, if soldering is used in the connection between water pipes, a supporting document of lead-free grade soft solder or filler metal used in soldering, brazing and/or welding construction methods is required."

They do require some kind of documentation --

A. Yes.

Q. -- showing lead-free solder, but after the event. We have looked at WWO046 earlier, the pre-existing version which excluded solder.

Anyway, more pertinently:

"In light of the recent cases of lead level of water samples found in the inside service exceeding the acceptance criteria ..."

I take that "acceptance criteria" as being 10 micrograms?

A. I think that's fairly clear from this document.

Q. "... further to WSD circular letter No. 2/2012, we add new parameters for testing of water samples. The four additional test parameters and the acceptance criteria are as follows".

Then lead, in terms of micrograms per litre, it's set at 10, the WHO provisional value.

A. Guideline value.

Q. "Should you have any [queries], please contact our engineer Mr Ken Chan ..."

Then we look at a later circular letter at page 4072, which you can find a few pages later, annex -- it's actually page 4072.

A. Yes.

Q. 28 August:

"In response to recent feedback from the industry concerning WSD circular letter No. 1/2015, a guideline for water sampling in newly installed fresh water inside service for testing is attached at annex. This guideline aims at standardising the number and location of water samples to be taken. The related sampling procedure and cleaning procedure for sampling bottles to be complied with are available in WSD's webpage ...

Separately, during inspection of the inside service, non-destructive tests on solder joint samples selected by our representatives will need to be carried out. A guideline for solder joint sampling and testing is also attached at the same annex."

In your paragraph 63, you mention that you need a worst case in order to identify hazards; in the case of lead, you would suggest that the presence of lead above 5 micrograms per litre, albeit below guideline value, you say here would indicate a failure of the procedures intended to prevent there being excess lead.

So, basically, your preferred objective would not be compliance? Your preferred objective --

A. Would be identification of the presence of unusual amounts of lead.

Q. Yes. So, to repeat the obvious, if it is said in answer

to what you say, "But we've complied with the WHO", your answer would be --

A. You haven't complied with WHO. The WHO Guidelines value is there as an indicator, as a minimum, as to what you would achieve, and the guideline value actually states that there is no health-based value, therefore you should be achieving as low as you reasonably can.

Q. Paragraph 64 -- so apart from this comment about WSD adopting 10 as the limit -- I mean, you have commented on adopting 10 micrograms as the limit -- and I think Mr Chairman also raised a separate issue, whereby you may say that the new regime may not be entirely satisfactory, and that is if they stick to their sampling protocol using flushed samples --

A. Yes.

Q. -- then that would not be entirely helpful?

A. It would not be entirely helpful. It might well lead to missing contamination that was arising from the materials that shouldn't be there.

Q. At the risk of stating the obvious, if there is a breach of British Standard, which should not happen, and which is what the WSD should be monitoring, there would be expected to be lead leached into the water in the first draw, which may or may not exceed 10 micrograms, but that's neither here nor there; yes?

A. Yes, that's correct.

Q. It may be 9 in the first draw. It may drop to 1 in the flushed sample.

A. Absolutely.

Q. If you do a flushed sample and stick to 10, you would blissfully say to yourself, "I open a bottle of champagne and celebrate" when in fact there's no cause for celebration?

A. That is correct. No, it is misleading in terms of the conclusions that one might draw.

Q. If you set yourself the wrong question, you get the wrong answer?

A. Correct. You have to have the right question in order to get the right answer.

Q. Paragraph 64:

"While the [Water Safety Plans] developed by [Water Supplies Department] broadly cover the recommended steps in a water safety plan, with the reservations indicated above, the WSPs would benefit from an external audit because this can help to identify improvements that are not readily obvious to those who are closely involved. It not clear how ..."

Well, it may be stating the obvious, but the more deeply immersed in a system you are, the more likely you are to miss out on flaws?

A. It's like any system, that a fresh pair of eyes will often see things that you don't see as important yourself.

Q. It's like giving a draft for someone to proof-read?

A. Yes.

Q. If you see a draft continuously --

A. Absolutely. I have been involved in doing some assessments of particularly water treatment works but also Water Safety Plans associated right through the system, and you ask questions that are considered to be the normal situation for them. They are so used to it, it's not seen as out of the ordinary. And when you ask, "What happens if ...", then the penny drops and people start to react, "Ah, yes, we hadn't thought of that."

One example which clearly wouldn't apply to Hong Kong was in Northern Ireland, where we had a fairly remote water treatment works, a very important water treatment works, and we visited and we said, "What happens in bad weather, in snow, because you have quite a steep slope up to the treatment works?" They hadn't thought of that. So would they be able to get vehicles in, if they needed chemical deliveries or anything like that? Well, they hadn't thought of that. So then they put in place an appropriate modification to their Water Safety Plan, to make sure that in the event of snow,

they were able to get vehicles in.

Q. So they did not need an incident --

A. No.

Q. -- to prompt them?

A. No. Somebody else was able to ask the question before it happened.

Q. "It is not clear how extensively staff have been trained in the development of the plans and how closely involved the operators of the various stages of the supply chain have been. The water treatment sections of the WSPs are the most extensively described. My visits to two water treatment plants and conversations with senior supervisory staff indicate that there is a good understanding of the overall requirements. However, WSPs are also about continuous improvement and it is important that the need for improvement is properly and openly discussed and recognised.

65. The monitoring regimes need to be re-assessed and modified to meet the contaminants known to be likely to be present and the points and frequency of sampling adapted to reflect behaviour, presence and concentration. This is referred to as risk-based monitoring and is intended to target resources where they will deliver the greatest benefit.

66. The regulatory and monitoring regime prior to

the excess lead in drinking water incident should have prevented the incident occurring if it had been fully implemented. The failure of implementation was largely due to a lack of understanding of the importance for health of lead and other potential contaminants from the internal distribution system. However, the clearly stated requirement that only unleaded solder must be used should have raised questions as to why this was sufficiently important to merit a specific mention. It would appear that no one had specific responsibility regarding water quality at the tap. This was not helped by WSD's responsibility for water quality ending at the point at which water enters the building and the fact that the HD has no clear mandate in this respect."

"In this respect" -- you mean in respect of water quality?

A. Quality at the tap, yes.

Q. "All depended on meeting the requirement for materials set out by the WA. That a similar situation has occurred elsewhere in the world indicates that unless explicit steps are in place to cover water quality in buildings then what are seen as relatively minor items may be overlooked, particularly when the consequences are not visible.

67. Subsequent to the discovery of the lead in

water incident a number of steps have been taken to heighten awareness and to improve the final monitoring step."

Then you refer to the two circular letters that we have just looked at.

"[They] reiterate the requirement not to use lead solder but do not mention the concern for health. The circular letter adds four metals to the analysis of samples already required but does not add anything about the need to take separate samples with an appropriate sampling protocol to maximise the detection of metals. I would suggest the addition of copper, antimony and zinc to the list of parameters, at least in the short-term, to gather data on concentrations. This has been discussed above in paragraph 29 but the lack of data on metals from plumbing needs to be rectified. However, both the WSD and HD have shown that they are aware of the need to tighten up the supervisory measures at all stages to ensure that drinking water quality in buildings, particularly public housing blocks, is maintained.

68. There is a need to produce guidance for building managers on the continuing maintenance of water systems in buildings to minimise the risk of Legionella.

69. The approaches to monitoring the quality of

water at the tap in buildings, particularly apartment blocks, proposed by the Task Force have significant merit for newly built or refurbished properties. These ought to provide a final check on materials being used, in particular lead solder. The use of hand held x-ray fluorescence spectrometers to check soldered joints for lead would be highly beneficial in ensuring that lead solder has not been used (non-destructive testing). The sampling of water at the tap for heavy metals would be in addition to sampling for the eight parameters to protect the public supply in the event of back flow because the sampling protocol would need to be different to ensure detecting these contaminants, eg first draw of sufficient quantity or fixed stagnation time. In addition it would be useful to add copper, antimony and zinc to the list of metals for the reasons outlined in paragraphs 29 and 67. Cadmium is unlikely to be present unless lower quality galvanised pipes is present or fittings are used that do not meet the relevant [BS]. Similarly zinc is unlikely to be present unless galvanised pipe is present. Chromium does not appear to leach in significant concentrations from chromium plating. The surface area for chromium in taps in contact with the water will be small but nickel does leach from the nickel base plating onto which the

chromium is plated. However, the volume in the taps is very small and will be cleared in a very short flush. This is important because there is significant nickel in the water as supplied. Copper from copper piping is not likely to reach concentrations of more than a few hundreds of micrograms per litre, unless there is significant corrosion combined with extended standing time when concentrations can increase significantly but this needs to be confirmed. Copper can cause acute gastric irritation when concentrations exceed about 2 milligrams per litre, which is the basis for the WHO Guidelines value. One difficulty with such sampling is determining how many apartments to take samples from if the pattern of lead solder use is not consistent and this will not be known until a significant problem is encountered. It would, therefore, seem appropriate to choose a manageable number of apartments at random depending on the resources that HD and WSD are able to commit.

70. What remains uncertain is to what extent lead has been used in plumbing in other buildings in Hong Kong in the past. To determine this would require an investigative study that could be achieved by random sampling using a suitable sampling protocol but this approach would need to be considered carefully in order

to make sure that it was cost-effective.

71. In relation to additional microbiological parameters that could be useful to include, Enterococci are used in a number of countries. How much information these would add as faecal indicators, along with or instead of E.coli, is under consideration by a number of authorities, including WHO. Enterococci tend to survive longer in the environment than E.coli and are more resistant to chlorine although the numbers in human faecal matter are fewer than E.coli."

What are Enterococci?

A. Enterococci are microorganisms which are found in the gut of humans, the same as Escherichia coli, E.coli, and they are excreted in faecal matter. They are used as an indicator of the presence of faecal matter.

We use Enterococci particularly in relation to bathing waters, particularly marine bathing waters, where they are probably better than E.coli as they survive better in the marine environment. We are looking at the possibility and determining how Enterococci, how much they will benefit adding them to the list of faecal indicators. In the EC Drinking Water Directive, they have both Enterococci and E.coli. So there should be a lot of data there that will help us to tell whether adding Enterococci actually adds benefit.

But Hong Kong should be aware of that fact because it could be of interest in relation to the particular supplies here.

Q. Paragraph 72:

"The Review Committee have made comments and recommendations to the HD following the excess lead in water incident. The primary recommendation is that existing procedures should be tightened up and I fully agree with this recommendation. I would strongly support their recommendations regarding education and training to raise awareness of the importance of using lead-free soldering and the consequences of using inappropriate plumbing materials. There is value in establishing a Review Committee because it means that the messages with regard to lead and the potential for what appear to be relatively minor plumbing components to have a significant impact on drinking water quality will be more widely disseminated.

73. However, their view that the incidence of excess lead in water is very low cannot be substantiated by the data because of the sampling protocol requirement for flushed samples. They also show that there is a general misunderstanding as to what the WHO provisional guideline value is intended to achieve and that the provisional guideline value is a health-based

standard, which it is not.

74. It is my opinion that there is a need for formal drinking water standards and a regulatory structure for drinking water for Hong Kong to ensure that there is co-ordination of all matters relating to drinking water quality. The standards would incorporate WHO Guidelines in the manner recommended by WHO and focus on the most important contaminants. This would also allow external examination of the WSPs and provide an external stimulus to encourage more focused risk-based monitoring of raw and treated drinking water. The regulatory structure could be quite small but would provide independent oversight of drinking water quality."

So it's like an audit, like you mentioned earlier?

A. Yes.

Q. "75. In the UK and many other countries there is an independent regulator for drinking water quality. The formal structure varies but the regulator reviews and assesses the performance of the water supplier(s) with regard to the quality of the water supplied. In the case of the UK there are three regulators, one for England and Wales and one each for Northern Ireland and Scotland. The model for Northern Ireland and Scotland is more relevant for Hong Kong as there is a single

water supplier and the supplier is in public ownership. The regulator assesses compliance with drinking water standards and also determines the risks, in consultation with health professionals, associated with parameters that are found in drinking water or drinking water sources but are not included in the standards, eg PFOS. The regulator also agrees the sampling programme and audits the analysis and the results for quality and agrees any remedial steps or improvements. In the UK the three regulators also audit water safety plans, providing a beneficial second view. The inspector has complete and open access to the data and operations of the water supplier. It is, however, important that any regulatory structure is appropriate for Hong Kong's particular circumstances."

As a complete layperson in this area, one point that immediately came to my mind is that: is it efficient, an efficient use of resources, to create one regulator to have oversight of one water supplier? Does it justify their existence? One supplier keeps producing or supplying water, and the regulator, their daily work is to go to work and monitor the Water Supplies Department.

A. Yes, but I think the evidence from the UK, from Northern Ireland and Scotland, and to an extent what's happened

with the lead in water problem here, actually shows how that is important. In Scotland and Northern Ireland, there have been significant improvements in water quality and the way that the supplier operates, because of the presence of the regulator.

So the regulator provides an independent check and balance, and also an independent overview. It's always difficult. Water quality is very, very important. It is public health, and that's why it is different to other types of utility and other types of supply. Electricity tends to be the same quality whatever, it's all electricity, and the same with gas. Water is not that way, and there are issues in drinking water that can affect public health.

Within a supplier, within a company, it is always possible to become stale or complacent or the same people are going through the motions. That's inevitable. I don't care which organisation you are in; it is inevitable that a certain amount of that will creep in.

Because it is public health, that is very, very undesirable, and a regulator, it doesn't have to be a major operation, but a regulator provides an external check to make sure that that is not happening, and that if it is happening it can be put right and that the

water quality does not suffer.

Q. Paragraph 76:

"I believe that it would be appropriate for WSD to consider creating the position of water quality manager who would report to the director and who would have the role of overseeing drinking water quality data and activities from all parts of the organisation. This role would also involve evaluation of the particular trends in water quality data and working to assist operational sections to work towards gradual improvement, which is a key part of the WHO framework for safe drinking water. Hong Kong will undoubtedly face significant challenges to its drinking water supplies in the future and a water quality manager would be a positive step to looking towards the future."

So overseeing drinking water quality data and activities from all parts -- so from getting to know the result of water sampling to studying the effect of soldering materials --

A. Yes.

Q. -- on water from construction stage until tap?

A. Indeed.

Q. All aspects of building which impact on water quality?

A. Yes, asking the questions, making sure that when the data are there, that the correct response is in place.

I have recommended this in other places, within water suppliers, and it proves to be very valuable.

Operations, it's very difficult, because there's a lot of pressure on the operations staff to deliver the daily quota. They've got to have the water in there, they've got to meet the standards, and so on. There is always a danger that the operational staff will be prepared to rationalise a piece of information which is going to be really inconvenient. It is no accident that many of the incidents occur, water quality problem incidents, on a Friday afternoon or the afternoon just before a holiday starts, because people's minds are on trying to get the work finished, to get things done, and there is a potential to rationalise inconvenient information.

That is human, and thank goodness we have humans actually doing the work because they have brains and they can think. Having a step in there, another check, that allows that to be considered and dealt with is important.

An example in one company was that they had a finding of E.coli. It came up as a positive, and the response from the -- it was going to be really, really difficult, because there was a lot of pressure on the water supply at the time. The operations people's

reaction was, "There's a free chlorine residual, it's got to be a mistake at the laboratory." I was asked to step in to look at this, and in fact what had happened was there had been a rainstorm, there had been an increase in turbidity in the raw water. That turbidity was really on the limit of what the water treatment works could cope with, and almost certainly the finding was due to a particle that had come through, and the organisms, the E.coli, was masked within that particle and protected from the free chlorine.

So there actually was an issue. It wasn't something that they had to stop, but they did have to do something to improve their treatment, to bring it back within spec. And that is a role we recommended with that particular organisation, that they have a water quality manager, and that water quality manager had the ability to overrule operations on that sort of circumstance, so that it would be -- they wouldn't say, "We are going to go ahead and stop the supply" or anything, but it would be, "We have a think about this; we stop and we think and we consider all the data, and it may be inconvenient but this is public health and we need to make sure we get it right."

Q. Paragraph 77:

"While I understand the need for and importance of

bureaucracy, many of the policies and procedures seem to be fragmented between various documents. I also understand that this gradually happens in many organisations as changes are made but it would be beneficial to consolidate and streamline all documents, particularly as changes are incorporated over time to make the documents easier to access and more transparent to ensure that the chance of misunderstanding and using out of date procedures is minimised."

So does this apply to contract documents or circulars or --

A. I think right across the board. It's one of those facts --

Q. Things grow along the timeline and they get cut and pasted?

A. Absolutely, yes, and you have to have steps that say, "Okay, we've really got to consolidate everything at this stage or intervals in order to ensure that things don't get lost", and there's always a tendency for lots of circulars and memos and so on, and the story within that starts to become fragmented, and once it becomes fragmented then there is a real danger of misunderstanding and misuse.

And organisations understand this. It's just not always high on the priority to actually do it, but it is

rather more important than sometimes they would admit to.

Everybody very short-staffed, everybody is very busy. I understand that. I know the feeling very well, but there are certain things that need to be done because in the end it's going to make your life a lot easier.

Q. "78. While HA has now started to allocate a specific quality assurance role with regard to drinking water, I find the statements that the HA were unaware of the issue of lead rather difficult to understand in view of the HA's specific requirement for using unleaded solder and low lead fittings. This implies that little thought was being applied to the contract. Rather, standard terms were being applied without understanding the reason for their inclusion. It will be important that the new quality assurance regime is proactive in preventing the unauthorised use of materials by a process of simple inquiry. The water sampling provides retrospective verification but this will only be reliable if a suitable sampling method is adopted to maximise the chance of finding unwanted heavy metals. It is also clear that because the WSD did not take any responsibility for water at the tap and had not formally delegated that authority, no one took that

responsibility. It is not, therefore, entirely surprising that the current situation occurred. I would anticipate that the HA and the WA will now be aware and will ensure that quality assurance checks are properly carried out. Ultimately, water quality assurance to prevent things going wrong will depend on individuals carrying out their responsibilities and in this, I would include licensed plumbers and main contractors.

A central purchasing arrangement for unleaded solder and possibly for low lead copper alloy fittings would assist this greatly but thought should be applied to any other components of the plumbing system from which quality problems could arise, eg taps and copper piping.

Summary of conclusions.

79. The WSD led Task Force has carried out a thorough investigation of the affected systems using appropriate methodology.

80. The reason for the exceedance of the provisional WHO Guidelines value for lead in drinking water in public housing was primarily due to the use of lead solder for joints in copper pipes contrary to the clearly stated requirements for plumbing materials in Hong Kong.

81. The sampling protocol used to take samples of drinking water at consumers' taps for lead was not

designed to detect the presence of lead in the plumbing systems in apartments and so may underestimate the scale of contamination; this was confirmed by Professor Lee's study. A suitable sampling protocol should be developed to address this problem.

82. The WHO provisional guideline value is based on practicality and is not a health-based value because it is not currently possible to determine a suitable threshold for the adverse effects of lead. It is based on the premise that no new lead materials will be installed.

83. It would be valuable to investigate whether other metals that can arise from distribution are likely to be present in drinking water at the tap in Hong Kong, these include nickel, chromium, cadmium, copper, antimony and zinc. Those that are shown to be present should be included in the suite of metals to be measured in tap samples along with lead.

84. The possibility of Legionella bacteria growing in the internal fresh water systems of housing developments in Hong Kong has been demonstrated. There is a need to develop suitable management strategies to be implemented by building managers and consumers to minimise the risk of Legionella.

85. WSD has implemented Water Safety Plans, which

are a key part of ensuring the ability of water systems to supply safe drinking water as recommended by WHO. While it is difficult to judge how well this has been done from the documents provided and the short time available for discussions with WSD on this topic, the work on Water Safety Plans would benefit from an external view and external audit.

86. There is a gap in the Water Safety Plans because they do not cover the supply to the tap. Even if WSD do not take responsibility beyond the point at which water is delivered to a building, it is important that someone has clear overall responsibility for water quality in buildings.

87. WSD should develop a risk-based strategy for monitoring contaminants and to improve the approach to operational monitoring to ensure that systems are always operating at their optimum.

88. It is not clear how systematically the hazards from the Dongjiang River have been characterised, particularly with regard to chemicals that are not listed in the WHO Guidelines. For the future it would be beneficial to address this issue as far as possible since it is a key water source. This does not mean that the source is unsafe but it is important to be aware of emerging issues.

89. Systems are in place for regulation and monitoring of plumbing installations but these need to be properly implemented by inspection rather than just documentation. Licensed plumbers must take responsibility for trade trained plumbers who they employ or are subcontractors and ensure that they follow the requirements to ensure plumbing that is safe.

90. Hong Kong has the elements of a system to ensure that only suitable materials are used in contact with drinking water either in the public supply or in the distribution systems within buildings. This is based on other international approval systems. While there is no need for Hong Kong to develop its own approval system, it should specify more clearly the requirements for acceptance using other international approvals and which international approval systems can be accepted.

91. Hong Kong should develop formal drinking water standards based on the WHO Guidelines but adapted to its own needs.

92. Hong Kong would benefit from the establishment of an independent regulator who would provide a means of reassuring the public about the quality of drinking water in Hong Kong and would provide a means of ensuring that quality is integrated from source to tap. The

regulator would also be responsible for auditing Water Safety Plans and for ensuring that drinking water standards are sufficiently up to date in conjunction with other departments.

93. WSD should consider creating the post of water quality manager, independent of operations, to report to the director and to act as a first contact point with the regulator.

94. In responding to this incident HD and particularly WSD have issued a series of documents and memoranda over several months. At no point can I find a desire for the two departments to work together to develop a single document with the input of other stakeholders, which would effectively be a manual covering the installation of plumbing in buildings in Hong Kong. The result is that, to date, there is a fragmented response, when a co-ordinated response would ensure that all of the key information was in one place and would be much more effective in preventing future problems without excessive effort.

95. It is important that now that a problem with the installation of lead solder in new public housing developments has been identified, the scale of the problem should be properly assessed and actions identified and implemented to rectify the situation and

to protect consumers from lead in their drinking water."

Then there is your expert's declaration and your signature at page 126.

So you confirm the views that you have expressed in this report and what you have said in the box as being your opinion --

A. Yes.

Q. -- you put to the Commission?

Thank you very much. Other counsel may have questions for you, so sit tight and wait.

Cross-examination by DR WONG

(All questions of Prof Fawell in English)

DR WONG: Good afternoon, Prof Fawell. I am from the WSD, the Water Supplies Department.

In paragraph 6 of your report --

A. Paragraph 6?

Q. Yes -- you refer to a document issued by Health Protection Scotland in 2012.

A. Yes.

Q. That is in bundle A1 at page 148. Are you by any chance related to the production of this document?

A. No.

Q. Were you a participant?

A. No. I was not involved in that.

Q. This document is dated March 2012, entitled "Public

health action in response to detecting high levels of lead in drinking-water"?

A. Yes.

Q. If we go to page 152, the foreword --

A. Yes.

Q. -- at paragraph 3, it says:

"The document was produced by a sub-group of the CPHM (HP) Working Group. The recommendations are based on published evidence and expert opinion on best practice."

If we jump to the next paragraph:

"Evidence was reviewed following identification via searches of on-line published medical literature databases for material on exposure to lead in drinking-water (especially involving children, pregnant women and incidents involving schools) supplemented by supporting literature to cover evidence gaps."

So this is a rather considered and well-researched document; right?

A. Yes, but from the health point of view. It was a health document.

Q. Yes, from a health point of view, precisely.

A. Yes.

Q. And the members of the CPHM are set out there, three members, at the bottom of the page.

A. Yes.

Q. I suppose you know some of them?

A. I know Colin Ramsay very well.

Q. This document -- if you go to the next page, 154 -- in Scotland, in 2012, for the first time they introduced what is called a prescribed concentration value, PCV, you see in the middle of the page?

A. Yes, I do.

Q. Right, "compliant source of drinking water". In other words, in 2012, Scotland decided to adopt a prescribed concentration value, and for lead, that's 10 micrograms per litre. That is the WHO standard; correct? You know that?

A. Yes. Yes.

Q. Then if we turn to the next page, at page 155, if we go down to the middle of the page, the fifth paragraph from the top, "Until 2011 ..."

A. Yes.

Q. "... the WHO specified a guideline value ... of 10 micrograms of lead per litre as an acceptable lifetime exposure threshold for drinking water, based on a provisional tolerable weekly intake (PTWI) that would be protective against adverse health effects. In 2011, JECFA ... re-assessed evidence of health effects associated with very low level lead exposure and

withdrew their PTWI on the basis that they no longer consider that there is a safe level of lead exposure (no tolerable threshold dose). WHO noted this development but recognised that in practical terms, achieving lead levels of less than 10 micrograms ... may be technically very difficult. WHO have not therefore withdrawn their GV but designated it as 'provisional'."

You have already told us this many times?

A. Yes.

Q. If we then go down to the next paragraph:

"Lead levels in drinking water should not exceed the PCV. In practice, lead levels are unlikely to be reported to HPTs unless the PCV is exceed. In Scotland, the current regulatory limit (PCV) will fall from 25 micrograms to 10 micrograms on 25 December [Christmas Day] 2013."

Right? The next paragraph:

"Detection of a single water sample result that exceeds the PCV need not automatically result in precipitate action. A measured and systematic approach is essential to the assessment of the risks in each situation. Minor or short duration exceedances of a PCV are unlikely to present a serious threat to health even in the more susceptible groups. A balanced approach to dealing with each situation is therefore required."

Prof Fawell, I suppose you agree with this comment?

A. Yes. It's more or less what I said yesterday.

Q. Yes. Discussing the issue of whether, after the withdrawal of PTWI, the value, the provisional guideline value, of the WHO still has a health-based significance -- if I may invite to you go to appendix 6 of this document, at page 186.

CHAIRMAN: Can you repeat your question, please?

DR WONG: Yes. Prof Fawell, in assessing that question as to whether after the withdrawal of the PTWI value, the provisional guideline value of the WHO still has a health-based value; right?

CHAIRMAN: Ask simple questions. A simple question, please.

DR WONG: Actually, I haven't asked the question yet.

CHAIRMAN: I do not want to hear long preambles because I cannot understand long preambles.

DR WONG: Okay. Short.

Professor, if we go to page 186, which is appendix 6, the second paragraph, which says:

"Despite the lack of an accepted 'safe' threshold for lead in drinking water, intensive clinical investigation is not automatically justified in all situations. It is still necessary to decide whether an individual's exposure is such that investigation of blood lead levels is likely to be appropriate. It is

unlikely that blood lead levels will be significantly elevated (above 10 micrograms per litre) at exposure levels below the previous (JECFA) PTWI (25 micrograms) ... or the WHO GV for lead."

A US study used the EPA integrated exposure uptake biokinetic model for lead in children to predict blood levels after exposure to lead in school drinking water. This study calculated worst-case scenario blood lead levels for 5-6-year-old schoolchildren, based on the 90th percentile lead levels in school drinking water samples. Assumptions were that children consumed 50 per cent of their water supply from school and that 25 per cent of this was from standing samples and 75 per cent from running samples. The study report that, assuming exposure to lead levels in school drinking water of up to 49 ppb (standing water) and 7 ppb (running water), then no children (aged 5-6 years) are likely to have resultant blood lead levels that would exceed CDC guideline of 10 micrograms per decilitre for blood lead ..."

Then if we jump to the last paragraph on the page, it says:

"JECFA formerly suggested a provisional tolerable weekly intake (PTWI) of 25 micrograms per kg body weight/week as outlined above. This remains

a reasonable pragmatic level against which to compare individual exposure when deciding if blood lead levels are necessary. Up to half this intake is allowed from drinking water exposure."

So, Professor, although there is withdrawal of the PTWI level, ie 25 micrograms per kg of body weight, assume from this document that it appears that the study shows that that level is still a reasonably pragmatic level, as far as health is concerned; would you agree with that?

A. It depends on the circumstances. If you are faced with a position where you have significant areas of existing lead through lead piping, which would be very difficult to deal with, then this is a pragmatic approach to saying how far you need to investigate individuals.

What they are saying is: this is the point where we would not actually take blood lead levels, not that we are prepared to walk away from it. That's rather different.

So it's talking about whether they are going to actually take samples of blood lead, which has a number of risks associated with it because it's invasive.

That's fine, but it does not change -- my understanding is that you're challenging the WHO Guidelines.

Q. No, no, I'm not trying to --

A. Challenging the decision of the PTWI.

CHAIRMAN: I think he is, in a way, challenging the WHO's decision. In particular, he is challenging that the provisional guideline value is still a health risk based value.

A. But we quite clearly stated in the guidelines, more or less in words of one syllable, that it is not a health-based guideline value. The provisional tolerable weekly intake has been withdrawn. Therefore, there is no health basis to the guideline value. And it quite clearly states that it's there for practical purposes.

I don't quite understand what you are trying to achieve, but if you could rephrase your question, that might help.

DR WONG: Professor, what I am trying to say is that despite the withdrawal of PTWI value, guideline value, the 10 micrograms per litre WHO Guideline was adopted by a number of countries, including Scotland in 2012, as a guideline, as a health-based guideline. Do you agree?

A. No, it was not adopted as a health-based guideline. It was adopted as a decision basis, as to whether you would take certain actions with regard to the population, if they were exposed. It's saying that if it's below

10 micrograms per litre in the water, you would not take blood samples from the population, which is a completely different set of circumstances. It's not saying that the 10 micrograms per litre is a health-based value. It's saying that the risks associated with exposure to that, and below that, are decreasing, as I said yesterday, to the point where you would not want to make physical interventions in terms of blood lead sampling.

That could be really worrying for the population, if you suddenly go in and say, "We have lead present, it's below the WHO Guidelines value, the practical guideline value, but we are going to do a major intervention in sampling blood leads in a whole range of the population." That would be quite worrying for people. I certainly would be very uncomfortable with that.

Q. I'm not saying -- I need to make clear that the WSD is not saying we are satisfied with achieving 10, being the level that we say we would celebrate or congratulate ourselves, when we reach 10, because you have actually inspected, visited the water treatment centres in Hong Kong, and the water in Hong Kong, the lead content is actually very low, 0.00-something; right?

But what I'm just trying to --

CHAIRMAN: Can you slow down, because I cannot follow your questions.

DR WONG: What I am trying to understand is this. There are a number of countries, like Scotland, New Zealand, Australia, Canada, even the UK, have adopted the 10 micrograms per litre as a basis for compliance --

A. Compliance is a completely different issue to whether it's a health-based value. They are two totally different questions.

I understand what you are trying to say, but compliance with a standard is very different from a compliance with a health-based standard.

Q. Can you educate us: if it is not health-based, the 10 micrograms per litre, from all these countries -- if it is not health-based --

CHAIRMAN: What do you mean by saying "from all the other countries"?

DR WONG: I mean, for example, Australia, New Zealand --

CHAIRMAN: Are you saying that in the case of Australia, Australia adopts the 10 micrograms as a health-based risk criteria?

DR WONG: No, I am saying that they adopt it as a compliance --

CHAIRMAN: If you are saying that Australia adopts the 10 micrograms as a drinking water guideline value, I can accept that.

DR WONG: Yes. Chairman, I'm saying that. I'm saying that.

CHAIRMAN: So you have to be careful about your question, especially in science terms.

DR WONG: Yes.

For example, in Canada -- you were here yesterday when I was asking Prof Lee -- I referred to a document by Health Canada, they established a maximum acceptable concentration. That's the term they use; right?

A. Correct.

Q. What is the reference value, if it is not health-based, for these countries?

A. It can be practicality, and the WHO have clearly stated in the guideline that it's based on practicality, what can be achieved, and what can be achieved one in country is often very different to what can be achieved in another country.

In Hong Kong, you are in the position where you ought to be able to achieve considerably less than 10 micrograms per litre, because your starting point is extremely low lead levels. It is not a situation where you can say, "Okay, other people have got 10 micrograms per litre, and so we can allow lead to be contributed to the water supply to take it up to 10 micrograms per litre and we will be okay." That would be unethical.

Q. That doesn't undergo (?) any responsible, I agree with that. I just want to understand that Health Canada --

CHAIRMAN: I'm so sorry, can we go back to this Scottish paper at page 155. I think the Scottish paper actually explains quite clearly, in particular in paragraph 5 -- I think you have also read out that part as well:

"Until 2011, the WHO specified a guideline value of 10 micrograms of lead per litre as an acceptable lifetime exposure threshold for drinking water, based on a provisional tolerable weekly intake that would be protective against adverse health effects. In 2011, JECFA (Joint Expert Committee on Food Additives) re-assessed evidence of health effects associated with very low level lead exposure and withdrew their PTWI on the basis that they no longer consider that there is a safe level of lead exposure (no tolerable threshold dose). WHO noted this development but recognised that in practical terms, achieving lead levels of less than 10 micrograms may be technically very difficult. WHO have not therefore withdrawn their GV but designated it as 'provisional'."

So it seems to me it's crystal clear.

DR WONG: Chairman, I did read this paragraph.

CHAIRMAN: Exactly. And you say that 10 micrograms now is still a health-risk-based figure? That's simply incorrect.

A. Chairman, if I could assist, if you look at page 186,

appendix 6, the first two paragraphs, before the bit about the US study, actually explains it rather well.

DR WONG: Yes.

A. It explains that this is about measuring what you do if there has been exposure in an individual.

So, if there's been exposure, it acknowledges that there's no accepted threshold for the health effects of lead, but it acknowledges that you may need to act because there will still be exposure.

What they are saying is that if you need to take an intervention, they are saying it is still necessary to decide whether an individual's exposure is such that investigation of blood lead levels is likely to be appropriate.

What they are saying is that you don't want to do that unless it's necessary.

So it's actually got nothing to do with whether the water meets 10 micrograms per litre or not. It's about the decision on an individual exposure as to what interventions you need to do and whether you need to actually start looking at blood lead, in which case you might be thinking about treatment of the individual for reducing that blood lead.

The water issue is actually a separate issue. The other point here is that although water has been used as

the basis, they are not just talking about water as a contributor to blood lead. In Scotland, there are lots of old properties, and there's old lead paint. There's a tendency, with gentrification of some of these areas, that young families move in, there's improvement of the property, they try and do things properly, so they sand down the old paint. The result is you get a lot of dust that contains very high levels of lead, and individuals, in children, particularly, hand-to-mouth activity results in a much higher intake of that lead. That was the problem with the leaded petrol.

What this is about is the interventions that they make with the individuals. It still remains that there is no health-based standard, guideline or whatever, for lead in drinking water.

Q. I see. So the fact that the last paragraph on this page, where it says that although the withdrawn JECFA standard "remains a reasonable pragmatic level against which to compare individual exposure", that does not make the 10 microgram --

A. No. It says it's a sensible level where you decide whether you are going to make an intervention, whether you are going to actually take invasive samples of an individual.

In many of these cases, this is going to be children, and not unreasonably, doctors are very cautious about taking blood samples from children, particularly small children. And that's right and proper. This is an ethical approach. This is about recognising the fact that we still have lead in our environment. It's undesirable. We need to get as low as possible. But where there has been exposure, you need to decide what you are going to do, and they are advising medical practitioners not to panic and not to start taking invasive samples when it's not necessary, because that in itself is stressful and causes problems for potential patients.

Q. But can we say that it is still a health -- if not health-based, health-related or health action level?

A. It's not a health action level. It's an intervention action level.

Q. Intervention action level?

A. In other words, it's the action level at which point they decide: are they going to take blood samples or not? And taking blood samples is actually quite a big decision.

So it's actually got nothing to do with it being a health value. It's an action level, an intervention level.

Q. Thank you, Professor.

Can I invite you to go to bundle V, page 63, Prof Bellinger's report. Prof Fawell, if you go down to the last paragraph on this page, on page 63, paragraph (5), Prof Bellinger commented on:

"The adequacy and suitability of the acceptance criteria laid down by the Water Supplies Department for heavy metals and, if necessary, to make recommendations."

The acceptance criteria, Mr Shieh has already referred you to in the circular, and I am not going to read out the entire paragraph. Can you read this paragraph and see whether you agree with Prof Bellinger's comments?

CHAIRMAN: You ask a vague question, and the answer given is a vague one.

DR WONG: Okay.

CHAIRMAN: Let me tell you, you score zero points in my court.

DR WONG: Chairman, in that case, can I break it down into small questions?

CHAIRMAN: Please.

A. I can answer this, Chairman.

CHAIRMAN: In particular -- I am sure you can answer it -- it's the second sentence that I think Mr Wong tries to

focus on:

"They are either more protective or equally as protective of human health than are guidelines for these metals in drinking water established by authoritative bodies such as the World Health Organization and the [USEPA]."

A. Absolutely, but the first one, the lead one, is not designed to protect health. It's "as protective". Of course it's "as protective". It may not be as protective as it ought to be. But it's "as protective". It's not a very well-phrased question.

DR WONG: Can I refer you to the Canadian -- Health Canada's guideline, which is bundle C19.6, page 14592.

A. You mean the 1992 document?

Q. Yes.

A. The one that predates the 1993 guideline?

Q. Yes. Prof Fawell, if you go to page 14601.

A. Yes.

Q. There's a rationale at the bottom of the page.

A. Yes.

Q. I'm sure you are also familiar with this document. There are two bold paragraphs at the right-hand column, which says:

"... the MAC for lead is based on chronic effects, it is intended to apply to average concentrations in

water consumed for extended periods; short-term consumption of water containing lead at concentrations above the MAC does not necessarily pose undue risk to health."

Then it talks about:

"In order to minimise exposure to lead introduced into drinking water from plumbing systems, it is also recommended that only the cold water supply be used, after an appropriate period of flushing to rid the system of standing water, for analytical sampling, drinking, beverage preparation and cooking."

Now, does the withdrawal of the PTWI change any comments here?

A. Yes. I know that Health Canada are in the process of reconsidering this document in the light of the change in the PTWI. I am in close contact with Health Canada, and in fact I acted as a peer reviewer for this particular document, and I also acted as an arbiter between Health Canada and some of the provinces. In Canada, they have guidelines produced by the federal state, and they are implemented as standards by the provinces, and I acted as an arbiter between some of the provinces who were uncomfortable with having to go as low as 10, because it was going to be very difficult, and the central government ...

Q. Thank you, Prof Fawell.

After the withdrawal of the PTWI, your evidence is that the WHO standard is no longer health-based; right?

A. That's correct.

Q. Then if you may educate us --

CHAIRMAN: Sorry?

DR WONG: If you may educate us, for those countries like Scotland, who after withdrawal still legislate the 10 micrograms, the WHO provisional guideline --

A. Yes.

Q. -- what are they trying to achieve?

A. They are trying to set -- as I explained earlier on, they are trying to set a practical level. That's the minimum that you should achieve.

Q. Yes.

A. Then the next stage is to get below that, but in a practical way, it is very, very difficult, because they are starting from a rather different position to somewhere like Hong Kong. Because of that, they have to take a stepped approach, which is why in Europe you have 25 micrograms per litre down to 10 micrograms per litre. The next stage will be to determine how far we need to go.

One of my tasks for next week is to start to look at the new directive for drinking water in Europe and to

look in particular at lead and what is possible and what is not possible. We are not always able to make all of the standards health-based. Standards have to take into account a whole range of different factors. My recommendation in Hong Kong would be that a standard for lead, a reasonable standard for lead, would be 5 micrograms per litre, because you should be able to achieve that very, very easily.

The standards are not set as a basis for saying, "We can increase the amount of lead", in this case, if you had a regulatory situation with the lead solder, illegal use of lead in systems, to allow that illegal use to continue.

Q. We all agree with all of those. Let's assume that, because in 1994 the WSD, on its own initiation, pledged that the water supplied in Hong Kong would at least, minimum, meet the WHO provisional guideline value of 10.

Now, we can discuss whether it's 5 or 4 or 6 in the future.

A. But you don't have standards. It's not a standard. There is no force to it at all. It's a vague convenience, effectively. And the way that you've described it to me is that you would use it as a convenience so that you could say, "Actually, if we have got around about 10 micrograms per litre, despite

the fact that this has been due to effectively illegal activity, that's okay, we can ignore it." That doesn't make any sense to me at all.

Q. That's not my mindset and that's not what I intended, the message. What I am trying to say is before this incident -- before this incident --

A. Yes.

Q. -- in 1994, the Water Supplies Department voluntarily pledged to 10. We can discuss about that at some other stage, but it's a matter, a topic we can look at into the future. We can bring it down to 5 or 3 or even 2; the lower the better.

A. At that time, 10 was considered to be a reasonable value.

Q. But at the moment this Inquiry about excessive lead -- the reason why we have the title "excessive lead", when you say something is in excess, then you have your benchmark to say in excess of what, and at the moment the benchmark that we are talking about is 10, as far as the pledge in Hong Kong. We can revise that, of course.

A. That's not quite correct. It's a value which says in Hong Kong, when we found above 10, it triggers that we have a problem, and that's what it showed, that there was a problem.

When you've investigated that problem, it is more

extensive. But what you can't do is use that value as a health value, to say, "We are going to have above the level of lead that we ought to have, in order for convenience."

Initially, at the time that this came in, because it's happened such a relatively short time after the 2004 guidelines were introduced, it is not unreasonable that you were saying, "Okay, we're looking at that", but you weren't monitoring on a regular basis. It was by sheer chance that this was actually discovered.

So what you are saying doesn't make a lot of sense to me, I'm afraid, sorry.

Q. What I am trying to say, Professor, is that let's assume that the 10 micrograms is not health-based; right?

A. Yes.

Q. That it's just a compliance standard, a reference value that various countries set, not for health-based but as a practical step for them to achieve a quality of drinking water as far as lead is concerned; right?

A. Yes.

Q. Working from that basis, for example, in Scotland they say 10, and in Canada they also say 10, and Australia says 10 and New Zealand 10.

A. Yes.

Q. Now, having set that benchmark, if one were to find out

whether the benchmark has been met, one has to adopt some measures to find out whether that benchmark has been met; right?

A. Yes, but that requires that you have in place a monitoring system in order to do that. Hong Kong did not have in place a monitoring system. That was not in place. There was no monitoring at the tap. There was no systematic sampling at the tap to demonstrate whether or not you were meeting a benchmark of 10 micrograms per litre.

The whole basis of these other countries is that they have an established monitoring system at the tap. It's designed that if you find in a significant number of properties, in the zone, that you are above the 10, then you have to take certain actions.

But in Hong Kong it was by accident that you found out. There was no monitoring programme. So the benchmark really isn't particularly relevant. Up to that point, WSD were looking at lead effectively in raw water, and there certainly was no problem with lead in raw water. The levels were very, very low.

Q. Professor, perhaps let me supplement you with the information: as far as monitoring is concerned, the WSD does have monitoring over the consumers' taps, randomly on the consumers' taps in the community.

A. Can I stop and clarify -- what approach was that using? What sort of sampling regime did they use for that?

Q. They have two regimes. There's the evidence from Mr Chan, the chief chemist, that says that they affixed consumer taps and they also random-sampled.

A. But were they flushed samples or unflushed samples?

Q. They are also flushed samples.

A. Right.

CHAIRMAN: Essentially, they go to shopping malls, community centres, where, say, the residents would not be disturbed and samples then would be taken from those taps, say at a public toilet within a shopping mall, at particular public housing estates and so on and so forth.

A. And they are flushed?

CHAIRMAN: They are flushed, using the same method as they are adopting now.

A. I don't want to be brutal but that's not very helpful.

DR WONG: Prof Fawell, can I move on very briefly --

CHAIRMAN: Before you move on, shall we take a ten-minute break?

DR WONG: Yes.

(3.57 pm)

(A short adjournment)

(4.15 pm)

DR WONG: Prof Fawell, I was asking you, in relation to let's say intervention level -- let's use a neutral term, intervention level --

A. Yes, yes. That's good.

Q. 10 micrograms. Now, your evidence at paragraph 3 of your statement -- you said:

"There are no internationally agreed sampling protocols that can truly reflect the average consumption of lead from drinking water ..."

Page 5, paragraph 3.

A. Yes.

Q. Your evidence is that or your expert knowledge is that insofar as intervention level is concerned -- we want to find out the intervention level -- your evidence is that there are no internationally agreed sampling protocols that can truly reflect average consumption of lead from drinking water and which are reasonably practical to apply.

And you mention about the composite proportional sampling method in your evidence.

A. Yes.

Q. That's a research tool; right?

A. Yes.

Q. Impractical to adopt so far as general sampling is concerned?

A. You simply couldn't do that as a general sampling.

Q. I will speak louder. You simply couldn't adopt that sampling protocol?

A. No.

Q. But you would agree that the intervention level is an average consumption of lead level; right?

A. Not necessarily. It depends on, as a standard, what you are going to choose. It could be a first-draw sample, and that is the situation in, say, the UK, where their intervention level is 10, but in a first-draw sample, that is done to inform whether the company, the water supplier, actually treats the water to reduce plumbosolvency.

So there are a number of possibilities around that. It's not straightforward.

Q. Of course there are variations. It depends on, when you adopt the intervention level, what you are trying to achieve?

A. Absolutely.

Q. The purpose. If you are trying to achieve the 10 micrograms as an action level, for example, in the USA the action level is 15, then that's different, then you might use first draw because you want to test whether the intervention level as an action level has been achieved or not; right?

A. Yes.

Q. But as far as the WHO provisional guidelines are concerned, putting aside whether it's 70 years' continuous consumption or not, but that level of 10 is actually an average lifetime consumption value, not a one-off; that's quite clear, right?

A. No, it isn't, because it's not health-based, therefore exposure is irrelevant. It is a value that is intended that you should not exceed. You should be achieving that as a minimum, because of the practicalities. In other words, okay, it could be for as long as whatever, but it's about actually -- it's got nothing to do with exposure. It's got to do with trying to reduce the level of lead in water.

So I understand where you are coming from, but it's not actually associated with that. So the intervention level, in terms of drinking water and what you would do in Hong Kong -- Hong Kong is free to choose whatever value that it decides -- but that intervention level then needs to relate to a type of sampling that will be meaningful, and also actions that will follow.

That creates a certain amount of difficulty in Hong Kong because Hong Kong, quite reasonably, and for very good scientific reasons, is not very keen on dosing orthophosphate through the entire system. So you are

then asking a different -- what's the intervention? Well, you are looking at an intervention that relates to specific properties where lead has been installed, when it shouldn't have been installed. So in certain respects it's a way of retrospectively checking whether the appropriate Ordinances have been followed.

Q. For example, the intervention level in Scotland, we have just seen, is 10; right? For them -- let's see if my knowledge is correct, and in fact it's in the document -- in order to check whether the intervention level, 10 in Scotland, is achieved, the first sampling technique they use is a random sampling?

A. Yes.

Q. So they don't resort to first-draw technique first?

A. Yes, they do first-draw, but it's random. It's random daytime sampling. They take --

Q. Yes, random daytime sampling?

A. Yes, from a number of -- they just take the first draw and random daytime sampling, and that reflects -- overall, that will give you a feel for the range of lead levels over the day, and it will tell you whether you have plumbosolvency, whether you need to intervene and start to take action by dosing phosphate, which generally they will have to do.

Q. And in Scotland, if the first random sampling exceeds

10, the intervention level, then what they did was that they would do stagnation sampling and then do an overnight sample, and having done a composite sampling, then decide what to do; that is the sampling protocol in Scotland?

A. If you find a problem, that is the protocol that is -- it's not proposed by the regulator or the water supplier. This is proposed by the health authorities, when they are trying to investigate a health problem.

You have to remember, in Scotland, there is a history of very high lead in water, and that goes back to the early 19th century, and there were actually cases of frank lead poisoning from water in Scotland at one stage, very, very high levels of lead, very aggressive waters, and so on.

So it's a very different set of circumstances, and what they are doing is they want to investigate what a more overall exposure would be, so they can decide whether they are going to go in and start actually treating people for high lead exposure.

That's different to a water supplier. I hope that you would not -- I hope that's clear, and I hope that would not create a position where the WSD had to start running around taking blood samples.

Q. No, no, no.

For other countries, for example like Canada, Australia, New Zealand, which adopted an intervention level of 10 micrograms, their sampling protocol, as far as benchmarking, whether that intervention level has been breached, as far as you know, they all adopt a flushed sample; right? They all adopt a flushed sample, in order to check whether the intervention level has been breached? Canada, Australia --

A. A fresh sample?

Q. A flushed sample.

A. Generally, they don't, or they will flush and then they will take a stagnation sample, because what they don't want to do is to miss the potential for lead exposure from the plumbing system.

So mostly they will -- or they will take a first draw and they will flush.

For their other assessment -- in other words, the flushed sample relates to the water as supplied, is there lead in it or whatever you are looking at, and what they want to know is what the level is in the plumbing.

Q. Actually, the position in Canada, Australia and New Zealand is set out in the fourth witness statement of Chan Kin Man. I assume you have read this statement; right? The sampling protocol in Canada, New Zealand,

Australia and Japan are set out in the witness statement of Chan Kin Man.

A. Yes, we indicated that.

Q. You have read it, right?

A. Yes, yes.

Q. In your report you have not said --

A. I didn't repeat that in the report, no.

Q. You have not commented on that in your report?

A. No, I commented on it in the preliminary report. I didn't think it was necessary to repeat that in my individual report.

Q. Okay. I understand that your approach, following from paragraph 3, is that because it was impossible or impractical to adopt or to find a sampling method which would truly reflect the average consumption of lead; therefore, the approach that you adopt is to actually find out the maximum amount?

A. The approach is to identify -- because lead is so different to other contaminants -- there are some other ones that come from the distribution, the plumbing -- but because that type is so different, you are actually looking to identify the presence of lead.

So there are two stages. The first stage is to identify, "Do I have lead present in this system?", and the second then is investigation --

Q. Of course.

A. -- to determine what are the levels under different circumstances and so on. A single sample is not going to be particularly informative in terms of risk assessment.

Q. Yes. In fact you say even first-draw is not accepted?

A. No, no, none of them. Of course it can't be, because it would vary from person to person and different times of the day and so on. So it's a very difficult thing to do, and you have to be very clear what you want to achieve by the sample.

Q. What you want to achieve by the sample -- the question to be asked and the purpose to be achieved by the sampling is the key, isn't it? What you are trying to say is that if the purpose is to ask, first, whether lead exists in the plumbing system --

A. Yes.

Q. -- "yes" or "no"; second, what is the quantum, what is the amount that exists in the system, and whether these models chart the quantum variation over time; right? And third, having found out whether it exists and how much, then one can decide what are the solutions or the reactions, responses to the problem.

A. Yes.

Q. That is the thinking behind your report; correct?

A. Yes.

Q. And that is the guiding philosophy for the design of any sampling protocol; right?

A. Yes.

Q. But if we are talking about a different purpose, the purpose is actually to find out -- try one's best to reflect the true average consumption of lead, which is the average consumption of lead, ie the intervention level as set out in WHO level. Then one's sampling protocol might be different. Do you agree with that, or do you say --

A. Can you clarify what you mean by "intervention level" in this context?

Q. When I say "intervention level", I mean the adoption of the 10 micrograms per litre as the lead content in drinking water.

CHAIRMAN: Your question is too long. By the time it finishes, we are all lost. Can you simplify your question, please?

A. I think the premise is flawed. The 10 micrograms per litre, average or not, as an intervention level, that's not really -- it's an intervention level in places like the UK, because of the amount of existing lead, and it says -- at that point we know that we can get down that far -- if we've gone above that, then (a) we need to

modify the intervention that we are doing, if we are doing one, or (b) we've got to start improving things, and that may mean improving --

CHAIRMAN: I understand that part of the question, if it is a question. In fact, it is a statement more than a question. But what I do not understand is the bit that you mention about the average consumption. That bit, you know, I do not understand at all. So can you formulate your question properly?

DR WONG: What I was asking was, paragraph 3 of Prof Fawell's report, where it says:

"... sampling protocols that can truly reflect average consumption of lead from drinking water ... "

In paragraph 3; right?

A. Yes.

Q. Let's assume that for the purpose of Hong Kong's context, we bring down the intervention level to 5, as you suggest?

A. Right, yes.

Q. In paragraph 3.

COMMISSIONER LAI: Which particular line?

DR WONG: Paragraph 3, the first line:

"There are no internationally agreed sampling protocols that can truly reflect average consumption of lead from drinking water ..."

A. Yes.

Q. Professor, let's assume we bring down the intervention level from 10 to 5.

A. Yes.

Q. If we have to find out whether the level has been breached, ie the bench mark, whether we satisfy the threshold of 5 micrograms per litre --

A. Right. That would indicate that you had lead in the system.

CHAIRMAN: So what's your question?

DR WONG: In order to find out that answer, one's sampling protocol would be a bit different to the one which is identified --

CHAIRMAN: Let me ask you this, Prof Fawell. In order to find that, say, 5 milligrams, what, in your opinion, would you do? What sort of sampling protocol would you adopt, in order to find out?

A. I would adopt either first-draw sample at sufficient quantity, about a litre, or I would adopt the Japanese system which is you flush it and then leave it for a fixed period of time and then take that litre sample, or a larger sample; whatever is convenient and is appropriate.

So that's the approach that I would take.

DR WONG: But the approach is in order to find out not the

maximum level of lead content in drinking water, right, at any one time, whether it's first-draw, 1 litre, or flushing for five minutes and then for stagnation; the purpose is actually not to find out the maximum level of lead at any one point of time?

A. It's to identify whether lead is in the system at levels that it shouldn't be. So in Hong Kong lead levels should be very, very low, and what you are trying to identify is: has lead been used inappropriately in the system at some stage.

So that stage is merely identifying that you have an issue. You may then want to investigate, arguably should investigate, further to see what the source of that lead is, why it's there, and so on.

Then there is a third stage, and that third stage involves the medical authorities, where they will look and determine whether that exposure is such that you really have to be very concerned about health of individuals who are exposed to that.

So it's a three-stage process. Often the third stage will simply be a discussion and advice that relates to flushing the system, to minimise the amount of lead that they are exposed to.

CHAIRMAN: So, in short, as you say, there's no sampling protocol to determine the average lead, say, intake of

any resident?

A. No.

CHAIRMAN: Because, in order to do that, you have to do it scientifically?

A. Yes, which would be very difficult --

CHAIRMAN: And costly?

A. Yes, and you couldn't do it routinely.

CHAIRMAN: That's right. So therefore you try to ascertain the maximum level, the first-draw sample?

A. Yes.

CHAIRMAN: Thank you.

DR WONG: Prof Fawell, I will ask one more question on this topic. You say you would also adopt the Japanese model of flushing for five minutes.

A. That's potentially.

Q. And then for stagnation for a period. Why do you consider it necessary to flush for five minutes and then stagnation?

A. The idea of that -- when the task force did their investigation, they looked at exactly this. The amount of time that you've got, that the lead is in contact with the water, if you know that and you know the rate, you then can work out the rate of dissolution. It just happens to give you a more standardised approach to different circumstances.

When you have a situation that you have in Japan, in the UK, in the US, where you've got lots and lots of existing lead, then it's a case of coming up with an approach that will allow you to identify when you have to do something. In Japan, once again, it's a case of generally people will dose orthophosphate into the main supply at the treatment works.

CHAIRMAN: So in Japan they actually use lead pipes still in existence?

A. It's used in areas where there are earthquakes, because lead pipe fractures less readily than some of the other pipes.

CHAIRMAN: I see.

A. And clearly there you have a balance of risks. Do you have water or no water, or do you have some lead in it, and it can be dealt with by -- if you orthophosphate dose, you can limit the amount of lead dissolution.

They used to use -- at one stage, lead pipes were specifically required in Chicago because of the danger of earthquakes and earth tremors.

DR WONG: Okay. I will move to another topic.

In paragraph 6, you also mentioned the two incidents --

A. Paragraph?

Q. Paragraph 6 of your report.

A. Yes.

Q. You also mention two incidents, one in Scotland, one in Wales; right?

The incident that happened in Scotland actually happened in 1999.

A. It did.

Q. Do you know whether after the happening of that incident in England and Wales, which are right next to Scotland, have the water regulation authority, the DWI, adopted any improvement measures as far as lead is concerned?

A. Yes. The requirements were that you should not be using leaded solder for potable water systems, and if there was lead discovered, high lead discovered, that was not associated with leaded solder but was associated with historical lead in the system, then you would treat the water with orthophosphate in order to reduce the plumbosolvency of that water.

The incidents in Scotland and in Wales, the reason that they attracted so much attention, was that by then, both Scotland, and England and Wales, basically the UK, had made the use of leaded solder in potable water systems illegal. So what they were identifying was illegal use of solder.

There was considerable concern because the concern was that plumbers had used that because it was cheaper.

Q. The incident happened in 1999, in Scotland, and then England and Wales adopted certain reactive measures to that?

A. Yes.

Q. Why is it that in 2007, Wales had another incident on lead? Do you know why?

A. Because they didn't have in place the system in Hong Kong that says we check before the building is built that these should not be used, and although it was illegal to use leaded solder, leaded solder is available, and because it's available, there are always people who will ignore the system, and of course at that stage there was no licensed plumber equivalent in England and Wales.

So there were issues over the types of plumbers that were used and the type of work that was being done, and to an extent you get what you pay for, so if you get poor quality workmen then they tend to do poor quality work.

Q. Thank you. Back to the paper on the public health action in Scotland. If I may invite you to go to another passage. Page 159.

A. So we are back in --

Q. A1.

A. Sorry, Chairman, I'm running out of space.

CHAIRMAN: A1, page 159.

A. Thank you.

We've got that.

Q. 4.2.1, under the heading "Further investigation", the last paragraph says:

"Ideally, sampling of drinking water would be carried out by a local EHO in support of an HPT public health intervention. However, each situation will differ and responsibility for taking (and paying for) samples may have to be negotiated. In general terms for public mains water supplies, SW is responsible for the water quality only up to the property boundary. Beyond the property boundary, responsibility for the water quality (and the system) lies with the property owner."

A. That's correct.

Q. So in Scotland there's a very clear delineation of responsibility; is that right?

A. Yes. It's changing because now, in England and Wales, and I think in Scotland, they have extended the responsibility to the tap.

Q. Yes.

A. So that creates a certain amount of difficulties.

But what they are saying -- this is basically saying that when you find a property that has got lead in it, which would have been identified almost certainly by the

water company doing its tap sampling and doing the random day-times, then the next stage is one where you've got to determine are you going to be taking samples that are not paid for, that are not covered by the water supplier, and what actually happens is that they usually will pay the water supplier to do the sampling, because they are the experts.

So this is the health intervention people.

Q. In fact actually, there is a diagram at page 173 which makes the delineation of responsibility clear. At page 173 there's a diagram.

A. Yes.

Q. It says the communication pipe, the stopcock or meter.

A. Yes.

Q. And there is a bold broken line, "Scottish Water's responsibility" then at last soft dotted line, which is "owner's responsibility" so there's a very clear delineation of responsibility; right?

A. Yes. So the communication pipe up to the stopcock is Scottish Water's responsibility. So if that's lead, they have to replace that.

CHAIRMAN: But what about after that?

A. After that, they will inform --

CHAIRMAN: The owner?

A. -- the owner of the house, and this is obviously very

different to Hong Kong because this is an individual dwelling and not a very large ...

CHAIRMAN: So what happens is that then Scottish Water would go into the house, the building, and then they take the sample, at the owner's cost, and analyse the water, and if the water sample comes back with, say, a positive result --

A. Usually, they would be looking -- if the owner is paying for it, they are usually looking for an assessment of just how big a risk. So there, they are looking at more samples, to determine how big an exposure and how they can handle that. Can they deal with it by flushing, is it worthwhile, or do they need to think about replacement?

CHAIRMAN: But, in the case of Scotland, the residents can actually seek the advice of Scottish Water?

A. Oh yes.

CHAIRMAN: And Scottish Water can then come and collect samples and then inform the residents the result and then give them positive advice as to how to remedy the situation?

A. That's right. Scottish Water, if they did find a high lead in the random daytime samples, would automatically inform the householder that they had found high lead, and they would also investigate whether there was a lead

service connection, which is their responsibility.

CHAIRMAN: If say the household owner suspects there is an exceedance of lead, and informs the Scottish Water, can the Scottish Water refuse to come and do the test and analysis?

A. It's a slightly grey area. From personal experience, they would not do that. If there was a reasonable -- if there was reasonable -- if it was somebody who, say, just for the sake of saying it, there was no supporting evidence, then they may well get the health authority to go and see them rather than the water supplier, or the water supplier would make a visit and then assess whether there was lead present, lead piping present.

But mostly they would say, "Yes, we'll do that."

COMMISSIONER LAI: May I know that, say when Scottish Water come to do the testing, would they test also other chemicals and materials in addition to lead?

A. That would be unusual. They might have a look.

COMMISSIONER LAI: Just check that --

A. For example, one of the standard tests is you look at the piping that's running up to the tap and check whether that's lead. Sometimes that means scraping paint off, but obviously if you have leaded pipe, it's pretty straightforward.

In terms of lead-soldered joints, that's a little

bit more difficult, because obviously it's not so obvious. If you have easily-accessible soldered joints, then they would certainly be likely to look at those, and they will check whether that's likely to be lead, not with a measurement or anything but just by some qualitative technique.

COMMISSIONER LAI: Okay.

DR WONG: Professor Fawell, actually this delineation of responsibility is very similar to Hong Kong's regime --

A. Yes.

Q. -- where, especially -- it was copied from Scotland or England many years ago; right? So there is actually quite a clear delineation of responsibility, of where the WSD's responsibility comes into.

So when you say there is no clear delegation of responsibility from the WSD to --

A. It's not quite the same. I'm sorry, it is not quite the same.

Q. Please.

A. Because in Scotland, they are talking about the dwellings, and they actually go in and sample at the taps in the dwellings, and they have access. They have power of access to those buildings, in order to take those samples. You don't have quite the same access in Hong Kong. So it's more difficult --

Q. More difficult.

A. -- for the Water Supplies Department to be able to check these things.

I understand that initially, WSD were not unhappy about not having the responsibility to the tap because there would be significant --

CHAIRMAN: I'm so sorry, can you repeat your last sentence, because it seems that's quite contrary to my view.

A. The Water Supplies Department had agreed that their responsibility would stop at the curtilage, the boundary.

CHAIRMAN: Yes.

A. In Scotland, whether or not their responsibility stops there, they also have a responsibility to take samples at the tap --

CHAIRMAN: Yes.

A. -- to look for lead, et cetera.

CHAIRMAN: Right.

A. I can't find anywhere that that responsibility actually formally exists in Hong Kong, for WSD.

CHAIRMAN: That I agree, yes, because the Scottish Water, they are also -- they are concerned about the quality of the water at your tap.

A. Oh, yes. Yes.

CHAIRMAN: In between the meter and the tap, of course

that's your responsibility, the owner's responsibility.

A. Yes.

CHAIRMAN: But they still care about the water coming out of the tap.

A. Absolutely, and there are difficulties there sometimes, because, for example, on the microbiological sampling, you do find positives at the tap, but they then go back and re-sample to show whether the supply is actually safe. If it is then they will inform the householder that they've problem.

CHAIRMAN: Whereas the difference in Hong Kong is that the Water Supplies Department do not care what comes out of your tap.

A. I wouldn't put it quite like that. But I'm not in the same position as you, chairman.

DR WONG: Chairman, I have to disagree with that. We do care but the question is, the --

CHAIRMAN: You see, from the evidence I have heard so far, that's the impression I get: "Our responsibility stops at the connection point; beyond that, none of our business."

DR WONG: Chairman, I have to put a marker here, that's not quite --

CHAIRMAN: Thank you. Yes, noted. Carry on, please.

DR WONG: You were referred earlier to the document in

relation to the WSP, and that's paragraph 3.8 -- I'm not going to drag up that document again -- about indirectly extending the WSPs -- indirectly, concerning about the taps, and you say you don't know the reason as to why the WSPs, the Water Safety Plans, attempt to extend to the consumer tap. That's your evidence; right? You have read paragraph 3.8, but you don't know -- you don't have sufficient time to discuss with the staff of the WSD in relation to the reason for indirectly --

A. That's partly true. I understand why the Water Safety Plan in this case has not been extended. But the proper practice for a Water Safety Plan, under those circumstances, is to start discussing with other stakeholders.

The Housing Department would be one stakeholder. There are other properties, of course, private properties, and so on, where you may have to involve other stakeholders. But a good starting point would be with the public housing, and you would discuss with the Housing Department how you could develop and extend the Water Safety Plan to managing the water in the public housing blocks, because that, strictly speaking, is the responsibility of the Housing Department, as the landlord.

You, not you personally, WSD should be the experts

in this area. They should be largely the water quality experts, and they should be in a position to advise the Housing Department. This is a team process between the two. What is different in Hong Kong is the scale of the public housing developments, which, having visited for the first time, really took my breath away. These are remarkable buildings, and it's a remarkable achievement to have built them, and to have got them plumbed and so on. It's a shame that it's been let down a little bit on the way.

But having said that, there is a requirement. We have identified that there is an issue or possible issue with Legionella. So that's one of the things. So the management -- so the Water Safety Plan would be something that would result in a building management plan, the water management within buildings.

And in the UK, when I worked with a colleague to develop an advisory document to the water suppliers on the adoption of Water Safety Plans -- we had a catchment management plan, we had a water treatment management plan, a distribution management plan and we had a customer liaison plan, and that customer liaison plan was equivalent to a building management plan. In some cases, the approach was to work with building managers, in order to develop a building management plan. In

other cases where you have private households, as is shown in the illustration in the Scottish Water, where you have an individual property, there it was to develop a process for actually informing consumers and educating consumers about managing their own water.

So it is made a little bit more complex in Hong Kong, but I see more of a relationship between WSD and HD, but clearly the compartmentalisation requires some effort to overcome, because both sides have knowledge and responsibility. WSD are responsible because they are supposed to be the experts on water quality, and they know about Water Safety Plans, and HD as the landlords have responsibility for making sure those plans are implemented, but both sides would be involved, with potentially some other stakeholders, in developing that part of the Water Safety Plan.

Q. You say, in paragraph 54:

"The development of detailed [WSPs] that include buildings is difficult because ..."

A. Hang on.

Q. Paragraph 54 of your witness statement.

A. It takes me a minute or two to get there. Thank you. "Plumbing and" --

Q. Yes. You say:

"The development of detailed [WSPs] that include

buildings is difficult because of the variations in building design and ownership."

As far as your experience is concerned, confining it to the UK, are there any WSPs extended to buildings in the UK?

A. Yes, there is a building management plan that's available to water suppliers, to help them -- to help landlords and other building managers. But it is not the responsibility of the water supplier to develop a plan for a building, but they would be involved in it.

So it's not so dissimilar to what it ought to be in Hong Kong.

Q. And in fact, the DWI, as far as you know, was not -- in fact were not involved in the development of Water Safety Plans?

Let me ask you, did the --

A. DWI do audit --

Q. Were the DWI involved in the design and implementation of Water Safety Plans for buildings?

A. Yes. DWI were involved in the WHO Water Quality in Buildings document, very much so.

Q. Yes, but as far as implementation -- the design, yes, but insofar as the implementation or the carrying out --

A. Well, to an extent, they are, because they have a great say in what happens with, let's say, lead at the tap,

and so on. So they are involved, and as I said, it's difficult, because of the jurisdictions, and so on. But they do get involved and they are seen as the experts, as a regulator, in the field, and other groups would often defer to them.

I attend a regular meeting of one of the water suppliers, when they have -- the local health authorities come and they send the various representatives, and the environmental health officers, and they will present their experience, but DWI are there because they have responsibility for overall water quality and they will advise as to what needs to be done in buildings.

So there is a considerable amount of liaison between the various parties.

CHAIRMAN: Because they are also concerned with the water quality coming out from the tap in the individual house, in any individual household.

A. Yes, absolutely.

CHAIRMAN: So in that respect, the situation in, say, England is not the same as in Hong Kong, so you are pretty much comparing an apple to an orange?

A. Yes. There is no regulator in Hong Kong, et cetera. That makes a big difference. It's one of the reasons that I recommended that a regulator would be beneficial,

because the danger is you get fragmentation and you actually need somebody that helps, is a focus for pulling everything together. That helps both the Housing Department and the Water Supplies Department.

DR WONG: Can I move to another topic? In relation to the benchmarking --

CHAIRMAN: Is it going to be long, your next topic? Because it's now 5 o'clock.

DR WONG: Okay. Then tomorrow.

CHAIRMAN: So shall we adjourn the hearing to tomorrow, 9.30 in the morning. Thank you.

(4.58 pm)

(The hearing adjourned until 9.30 am the following day)

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