Scottish Hospitals Inquiry

Witness Statement of

Stewart McKechnie

Professional background

1. I am Stewart McKechnie. My address for the purposes of this inquiry is c/o BTO Solicitors LLP, 48 St Vincent Street Glasgow G2 5HS. I am employed at TÜV SÜD Ltd as a principal engineer. I previously had the title of "director," which is an engineering title within TÜV SÜD Wallace Whittle. The term "director," just to make clear, was used more as a seniority term, rather than inferring that I was a full director and registered in Companies House. The company Wallace Whittle, at the time of the RHCYP/DCN project, were owned by TÜV SÜD, but they have since had a management buyout. At the point of where TÜV SÜD and Wallace Whittle parted company, I elected to remain with TÜV SÜD to assist them with various legacy engineering issues that were ongoing at that time. Although TÜV SÜD are a huge company they do not really have the same type of engineering expertise as Wallace Whittle, who were the only building services engineers that they had.

2. I have been qualified as an engineer now for about 40 plus years, working within mechanical and electrical engineering, however my specialism lies more towards the mechanical side. I had my first spell with Wallace Whittle a number of years ago before I then did a brief spell with another company called Donald Smith. I was invited to re- join Wallace Whittle, where I remained and progressed up the ladder to director. During that time, I have worked on a vast range of different types of projects as Wallace Whittle cover quite a broad spectrum, from commercial buildings, offices, data centres, to more government work where I worked on schools and universities, also a number of shopping/retail centres such as Buchanan Galleries and Princes Square, Glasgow and St. James, Edinburgh. My work within healthcare settings has been varied as well, working on Orkney Hospital; Craig Dunain Hospital, Inverness; Aberdeen Royal; Queen Elizabeth University Hospital, Glasgow; Golden Jubilee Hospital, Clydebank, and Ailsa Hospital in Ayr. There will be

others but I cannot recollect them at this time. I have covered a wide range, not specialising in one particular area, so gaining a wide range of experience across construction sectors.

Overview

3. In this statement I will address the undernoted themes:

The Environmental Matrix
(EM) The Procurement
Process
EM within Reviewable Design Data
(RDD) Room Data Sheets
Air Movement Report for Single Bedrooms

The Environmental Matrix

4. I joined the RHCYP/DCN project in or around November 2012 when Wallace Whittle were subcontracted by Multiplex to work on the mechanical and electrical (M&E) provision. My involvement began at the pre-qualifying stage, as soon as Multiplex invited Wallace Whittle to join their bid team. As part of the bid process, in around March 2013, we received, via Multiplex, the Invitation to Participate in Dialogue (ITPD) volumes of information. Included within the Board Construction Requirements (BCRs) ***(A33405670, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsections A, B and C Excerpt pages 1 to 149[1], A41179262, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsection D Excerpt pages 360 to 780[2])*** was the Environmental Matrix (EM). My interpretation of the inclusion of the EM at that time was that it was mandated conditions the client was providing to us and formed part of their brief and would replace the Activity Database Sheets (ADB). In essence, the EM was to replace the ADB process as the briefing tool for the project. We were familiar with the use of EMs and this decision did not strike me as a surprising one. The idea of having all the building services

[1] Bundle 5 - Contract Documents, Item 3, P192
[2] Bundle 5 - Contract Documents, Item 4, P341

engineering information in one document makes sense from a practical point of view, in that it brings everything we need into the one place and saves having to extract it from, or cross refer to, other documents.

5. My understanding was that if the EM had been duly developed along with the client then that specified their desired performances for the building services at the hospital. If changes needed to be made to the EM, then it was my expectation that you would have to re-engage with the client and whatever department the relevant section of the EM covered before you would be able to make any change. I did not see it as a document that could be changed based upon my own interpretation of the ITPD documents[3] and BCRs ***(A33405670, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsections A, B and C Excerpt pages 1 to 149[4], A41179262, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsection D Excerpt pages 360 to 780[5])***. The ITPD documents state that they need to be complied with (e.g. at paras 5.3 and 6.14) and that the BCRs ***(A33405670, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsections A, B and C Excerpt pages 1 to 149[6], A41179262, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsection D Excerpt pages 360 to 780[7])*** are mandatory (e.g. at para 2.5) and the EM is listed as part of the BCRs ***(A33405670, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsections A, B and C Excerpt pages 1 to 149[8], A41179262, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsection D Excerpt pages 360 to 780[9])***.

6. The Inquiry has asked whether I was aware of the Chief Executive Letter 19 (2010) ***(A37215536, CEL 2010 - Letter to Chief Executives, 'A Policy on Design Assurance for NHS Scotland 2010 Revision' (2) dated 2 June***

[3] Bundle 2 - Reference Design and Invitation to Participate in Dialogue (ITPD) Documents
[4] Bundle 5 - Contract Documents, Item 3, P192
[5] Bundle 5 - Contract Documents, Item 4, P341
[6] Bundle 5 - Contract Documents, Item 3, P192
[7] Bundle 5 - Contract Documents, Item 4, P341
[8] Bundle 5 - Contract Documents, Item 3, P192
[9] Bundle 5 - Contract Documents, Item 4, P341

2010[10]). I was not aware of the published guidance at that time. However, the ADB process would normally be led by the architect as lead designer and supported by the building services engineers. We adopted the client briefed EM as it was stated as being part of the BCRs ***(A33405670, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsections A, B and C Excerpt pages 1 to 149[11], A41179262, Schedule Part 6: Construction matters, section 3 (Board's Construction Requirements), Subsection D Excerpt pages 360 to 780[12])*** and any subsequent revision would have been driven by client comment.

7. The RHCYP/DCN project was slightly different from other hospital projects that I have worked on as a number of years had been spent working on its reference design, which was provided to tenderers. I was more familiar in engaging directly with end users from inception rather than being brought in when this process had already taken place. The other hospital projects I had been involved in would have been more along the lines of being involved in the various dialogue sessions with clinicians, engineering, and Facilities Management representatives. This concept of working as a subcontractor for Multiplex was a slightly different way of working, although we had experience of it in Glasgow because we had been involved in there, our involvement was more peripheral. Understanding a bit more about what happened in Edinburgh, I think it was probably reasonably unique. They had a design team in place for quite a lengthy period and had progressed the design to a much more advanced stage than you would normally have when you were starting off an initial tender.

8. I was quite surprised at the level of queries that arose on the EM, because, if you view it as a client's brief, we felt we had interpreted the ITPD documents[13] in that way. The resultant review process seemed out of kilter with a client's brief, because we were put in a position of trying to answer questions on their own briefing, which seemed a bit odd at the time. This became the main focus of our attention on the EM, the contractual lifespan of it was not really a

[10] Bundle 1 - Published Guidance, Item 6, P553
[11] Bundle 5 - Contract Documents, Item 3, P192
[12] Bundle 5 - Contract Documents, Item 4, P341
[13] Bundle 2 - Reference Design and Invitation to Participate in Dialogue (ITPD) Documents

concern, as we kept it going for as long as the client wanted to keep it going. It was never a conscious thing that said, “Oh this will be over,” or, “This will drop off at a particular stage.”

9. Once the bidder IHSL and Multiplex had ownership of the EM then we were instructed to take it on board, not to revamp it. We had no involvement with the EM prior to the appointment of the preferred bidder. There is some subtlety, because you would not normally take a client's brief on as your own document, so I saw it as a duty, if you like, to add to it. As the architectural design progressed, we discovered that some of the rooms on the EM were not listed, although they did appear on the initial Schedule of Accommodation (SoA), which meant augmenting the EM to cover the entire building. Any further revising or updates should have been done at the preferred bidder stage when the architects would feed in on things that may not have been already included: that would have been where any changes should have taken place. This, for instance, would allow for new previously unbriefed rooms to be introduced into the EM and we could then include building services design criteria for approval by the NHSL and their Technical Advisors. However, I would not expect given values for accommodation included in the original briefing to subsequently be altered. The EM as issued included a table of comments, which we took on board, some of which were tidying up and some were criticisms, which I felt should have been tidied up in the Hulley & Kirkwood version of the EM before being passed to us. It should have been a definitive document in my opinion. I do not recall any specific request for us to review any iteration of the EM for compliance with published guidance. From memory, we and the rest of the design team were asked to send an e-mail confirming that the solutions proposed complied with the client’s brief.

10. The Inquiry has asked me why the term HDU was removed from the EM. The EM covers approximately 2500 plus rooms, and it also has a supplement called the Room Function Reference sheet (RFRS) ***(A32623039, Environmental Matrix dated 4 September 2014[14]),*** which has about 50 entries on it. The RFRS listed all the common room types and the environmental conditions for each of those rooms, which allowed the population of most of the 2500 plus rooms. I do not

[14] Bundle 4 - Environmental Matrix, Item 1, P4

think that the term Room Function is a good phrase because it does not provide a description of what is actually happening within that room, it is purely environmental, providing the air changes, lighting levels, sound levels and that kind of information. There was no reference whatsoever to whatever clinical procedure was being conducted in that room. Hulley & Kirkwood prepared the original RFRS as part of the EM and the room functions came from their initial documents which were presumably agreed with NHSL.

11. Within the EM table the first column had the RFRS code, so for example, if we were looking at a toilet it could get picked up and put into each of the individual ward areas so that each toilet in that building was engineered to the same standard. By doing this you reduce the chances of someone making an error, where having to start off from scratch with 2,500 rooms and populate them all individually, carries more risk. That concept was picked up from the initial Hulley & Kirkwood EM, which we then applied.

12. There was a line on the RFRS with “HDU” and it gave 10 air changes, I cannot recall if it gave 10 pascals, but it gave it a definition. Once we got the architectural plans, we did a cross-reference of every room to ensure that every room had been covered on that SoA. I have a chronology report where the term “HDU” was used with a description. In my experience the term HDU denotes “High Dependency Unit,” and this could be a unit or a room, not necessarily a global description of a department. When we reviewed the EM and RFRS, there was only one room that had the term HDU on it, so I believe it got caught as part of the tidying up exercise and removed as it then made the RFRS a bit more manageable. I am uncomfortable about the way it is being depicted as if we were trying to do something underhand, however there is no engineering benefit in reducing the level of servicing in any building. If a member of my team puts in the wrong amount of air and it needs addressed then that could cost me. The onus is on us to go a bit further or to make sure that we have complied with the client’s brief as much as we can. There is not a formal review of key areas against the briefing parameters but all of our designs were subject to RDD which involved review by NHSL and their technical advisors. There was also a further specific review of all four bed ward areas, again with NHSL and their advisors, during the construction phase.

13. Prior to commencing work on the RHCYP/DCN I was familiar with environmental matrices being used as a development briefing tool but do not recall there being many used on projects on which I had worked. My own experience, prior to that, was of projects which adopted the ADB and Room Data Sheet (RDS) style briefing tools. Environmental matrices have since become a more common tool and Wallace Whittle have assisted in preparing them for example in the Golden Jubilee Hospital and for some of the newer hospitals in Aberdeen. It was a practical tool, because in the old days, prior to environmental matrices, you would use the RDS or ADB sheets; the two terms seem to get intertwined now. As an engineer, you would have to go through and extract from each RDS the environmental conditions, essentially making up your own EM for you to progress the design, because obviously you do not design a hospital one room at a time. During design you have to link the rooms, you have to link the systems, so the EM provides a summary of the room requirements for environmental conditions. The ADB process is normally architect led, however, my understanding is that the ADB product is not necessarily up to date with current guidance, so it acts as a starting template but requires client specific input to arrive at a bespoke solution.

14. During the procurement phase it was noted on the general notes from the Hulley and Kirkwood version of the EM that it would be replacing ADB sheets, it specifically states that the EM was produced in lieu of ADB sheets. This was the first version of the EM we saw. Wallace Whittle adopted this as it was a useful tool with all of the information gathered in one place, which allowed the engineering designs to develop quicker than they would have if you had been given a whole pile of ADB sheets.

15. The Inquiry has asked me if I noticed discrepancies in the EM in relation to air change rates within critical care areas. It is an interesting question, because I am aware that there has been a lot of commentary and people expressing opinions on the air change rates that have been listed, however I am not necessarily convinced that all those opinions have interpreted it correctly. My position is that the EM produced by TUV SUD captured the applicable requirements from the Guidance section in the EM. There were particular rooms in the Critical Care area that required the 10 air changes and 10Pa

pressure, which were given 10 air changes and 10 Pa and they were given 10 air changes and 10 Pa on the EM. Some of the other areas did not have the 10 and I believe there are some questions to be asked on the interpretation there. As best I can recall, the guidance specified 10 air changes and 10 Pa pressure for the isolation rooms in the Critical Care area and these were designed accordingly.

16. I would also say that whilst I keep reading about specific air changes, which relates to the part of SHTM 03-01 ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[15])*** that is being referenced, it is not simply about air changes, it is also about air pressure, which appears to be missing from a lot of the previous reviews. The air pressure is a huge part of the servicing of an area because it affects the structure, the ceilings, lighting, it affects a lot of other aspects. I honestly do not think it is quite correct to simplify the issue and say that it is just about air changes and believe that would need a bit more investigation.

17. Within the EM dated 31 October 2014 the Inquiry have queried the air change rates of HDU, which were listed not as recommended 10 air changes per hour but four air changes per hour. My take on this was that within the PICU area there was only one room which had the HDU prefix, which asked for and received 10 air changes. I am obviously aware that as we go through the commentary on the most recent EM, there are comments about RFRS and that at a point in time the term HDU was removed. This was done as part of a tidying up exercise. Wallace Whittle have produced a separate report with a chronology of the information we received and the information which we issued, which included environmental matrices, along with comments on that.

18. Up to financial close, the only area I can recall being discussed in detail within the EM was the four air changes for the single-bed rooms. Following on from financial close there was detailed discussion late in the day about the four-bedded bays. There was a huge amount of work done on the four-bedded

[15] Bundle 1 Published Guidance, Item 3, P149

bays, including the four-bedded bays within the Critical Care area, at the point where the hospital decided not to open, and there was criticism of the 10 air changes and 10 Pa pressure on the Critical Care areas in general. We had dialogue with NHSL, HFS and produced a detailed report of our understanding of what the briefing was for the Critical Care areas, which was subsequently released quite early on to the Inquiry. The purpose of this Report was that it was requested by HFS to be issued to them along with a similar Report requested from NHSL, both to set out our opinions: the intent being to allow HFS to then reach a conclusion on what if anything required rectification. We duly issued our Report but have never seen sight of NHSL's version nor commentary from HFS. We have also prepared a further Report on this subject in which we list a review of all relevant documentation which may be of assistance to the Inquiry and which we would append along with our earlier Report to this statement.

19. During the period up until the financial close, there was some commentary raised on the question of the four air changes and, more importantly, it was on the resulting pressure within the bedrooms. We prepared an Air Movement report ***(A34225453, Wallace Whittle - Air movement Report for Single Bedrooms (draft) - 12 January 2015[16]),*** and I gave a presentation to NHSL and explained what the end result was going to be if we kept with the four air changes supply and the ten air changes in the en-suite. I was trying to help the client understand what the pressure was going to be with their briefed ventilation rates. I explained to them that when you open a window, you then have variable conditions depending on the circumstances, air pressure can come in, you can get a draught in through the window, or air can spill out if it is a still day, which then becomes a variable. Their concerns were only relayed back to us after financial close, where they wanted the air pressures to be negative or balanced. The engineering solution to that was to increase the bathroom extraction, so that the amount of air that was getting supplied in was equal to the amount of air that was getting extracted.

20. I believe that NHSL were going to internally review what we had explained to

[16] Bundle 8 - Scoring & Correspondence Regarding Issues, Item 15, P66

them and make a decision as to what they wanted or that they were going to come back and revise their brief. Some people were talking about the possibility of patients with an infectious disease walking along the corridor, which could flow into the single bed areas. From an engineering perspective, the whole question of vulnerable or infectious people is generally viewed as those who should be accommodated within the isolation rooms. With isolation rooms, you protect not only the people on the corridor, but you protect the person in the isolation room, because you create this air lock where air cannot spill from the patient out into the corridor and cannot, conversely, flow from the corridor to the patient. Logically if you have a particularly vulnerable person, you want to keep them in an environment that is in as steady a state as it can possibly be, and you do that by an isolation room and having that pressure. The same could be applied to neutropenic patients, as they have a low immune system then my understanding would be that they would be placed within isolation rooms.

21. In my opinion it should have fallen to NHSL's technical advisor to explain what the implications of what they were asking for were, but that was not the way the process rolled out, so we did the presentation and got their comments back. They told us that they wanted a balanced system within the rooms, so that it was neither positive nor negative going to the corridors and we gave them that. We increased the extract rate in the bathrooms to balance the same amount of four air changes that were put in by the supply and gave them that balance.

22. As we moved closer to financial close the EM was included as Reviewable Design Data (RDD) ***(A32435789, Schedule Part 6: Construction matters, section 5 Reviewable Design Data[17]).*** In my view, the environmental parameters could not be regarded as agreed at financial close given that the EM was classified as RDD. The EM was basically the client's brief so, in my opinion, this would not normally be a post appointment negotiation factor. My own opinion of that was that I could not see how you could put a client's brief in as RDD, the implications of leaving that unresolved could be quite significant in

[17] Bundle 5 - Contract Documents, Item 7, P767

a building and I certainly had no experience of that happening before. The one item that ran right through was the attention to the pressure in the rooms, and following quite quickly after financial close, my memory is that HAI-SCRIBE came back with their concerns over the low level of pressure in the rooms. The purpose of HAI-SCRIBE is to review the potential risks of airborne infections within the hospital and give advice on how to avoid them. Wallace Whittle had no other involvement with them other than to discuss the air pressure on ward ventilation.

23. The whole issue of the four air changes to the single bedrooms seemed to go away after our presentation. It was the air pressure that then became the issue not the air changes. With NHSL apparently choosing to keep some of the design issues going over the line, we did not see a conclusion on them until quite later on.

24. If we had noted discrepancies in the EM, which did not accord with the SHTM, we would have flagged them up. I was aware of the need to comply with SHTM03-01 ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[18])***. In my view, the EM did accord with SHTM03-01 ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[19])*** and the rationale for this is included within my report of 15 July 2019 (Review of Ventilation Provisions for (B1) PICU and HDU Departments). In my opinion, the way in which we designed the Critical Care Unit was in compliance with the requirements of the EM in terms of the isolation areas. My interpretation of the guidance was that the requirement for 10 air changes and 10 Pa

[18] Bundle 1 Published Guidance, Item 3, P149
[19] Bundle 1 Published Guidance, Item 3, P149

applied to the isolation areas only. As such, any apparent inconsistency between the EM and SHTM03-01 ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[20])*** can be reconciled and the two are not setting different environmental parameters. The key issue that we did notice was in the four air changes and the mixed- mode solution using openable windows, plus the four air changes. This was prior to the discussions with HAI-SCRIBE about the air pressures. The whole concept of the four air changes did not really feel discordant to us, particularly on wards, as the SHTM is a guidance document. They are not mandatory, and there are various notes on the SHTM where, for example, they state their preference is natural ventilation. There is a detailed description of mixed-mode ventilation, and they have a requirement for a minimum fresh air load of 10 litres per second per person. The four air changes in the wards, within a single bedroom, equates to about 50 litres per second which is the equivalent of the recommended air flow supply for five people.

25. If we are looking at a single bedroom, you are then thinking that allowing for five people seems more than sufficient to cover that fresh air load. The only area we did note, but which came out in later discussion, was the ensuites, where the SHTM-03-01 ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[21])*** stipulates three air changes for bathrooms, yet Hulley and Kirkwood had gone for 10. In discussion with NHSL, we suggested to them that 10 for a single bedroom was probably a sensible allowance for the purposes of people's dignity. If you are in a single bedroom and unwell three air changes are a particularly low turnover rate, so it could be quite unpleasant. However, 10 air changes is more akin to commercial hotel-type levels, so we could see the logic in what they were saying.

26. There was also a lot of energy consumption information where Hulley and Kirkwood had based a lot of their energy predictions on four air changes. In retrospect I think there should have been derogations included in the briefing

[20] Bundle 1 Published Guidance, Item 3, P149
[21] Bundle 1 Published Guidance, Item 3, P149

pack to us, which would have explained the choice. However, at that point, our interpretation was that this was an engineering brief we were being given and we could not fault the four air changes on an engineering level. It is not unusual for air changes to be taken at a reduced rate particularly if you have to take energy consumption into consideration as I know that this has happened in other hospitals as well. It was not seen by Wallace Whittle as an unusual step and it did not appear to be a mistake, in as much as the rest of the documentation provided for the reference design supported and reiterated that four air changes were to be used.

27. The inclusion of the four air changes in the EM by Hulley and Kirkwood was not an issue as they had also provided their own predictions on the energy uses for the hospital, and in those predictions, they had reiterated the use of four air changes. The process requires you to compute how much energy the hospital would utilise on heating the air, or cooling the air, and it was my understanding that four air changes would work as part of mixed-mode ventilation, which is what the client wanted from review of the brief.

28. If you are using SHTM as the reference for a bedroom, then it allows for 100 per cent natural ventilation, however natural ventilation, from an engineering perspective, can never give you a guaranteed air change rate. There are far too many variables such as temperature, wind direction, wind strength. The concept of natural ventilation and its limitations for the prescribed air change rates is all detailed in the SHTM. The guidance documentation points you in the direction if you wish to go down the natural ventilation route, however it is quite difficult to do 100 per cent in a bedroom because you have to provide an openable area of I think one-thirtieth of the floor area. In hospitals, for security reasons, you have a restriction on the opening size of a window, which I believe is 100 millimetres, so to get one-thirtieth of the floor area room with windows, where you may only have one external wall, will require a lot of windows, although some people have used openable ventilators as opposed to openable windows, using a louver- type device. However, despite these restrictions it is not unusual for bedrooms within a hospital to be naturally ventilated, just like a room within a house.

29. I am aware that there were latterly concerns raised in regard to the four-

bedded rooms within the Critical Care Unit (CCU), we referred to these rooms as wards. The layout of one of these rooms has a corridor running through it with double doors either side of it. I did not see anything special on the Critical Care four-bed wards in terms of the layouts, or architectural solutions, which would have suggested to me as an engineer that these were technically different from the other four-bed wards. This decision was not one made in isolation and we, as engineers, would be not be qualified to make any decision on a clinical matter. Service provisions for critical care four bed wards were reviewed by the client both during the RDD process and as part of a further review of that specific aspect. In this ward you had to walk through a corridor to get to the other side of it, so you had two doors, and I remember saying, when the solution was being reviewed at the end of the contract "Look, if we pressurise this, how do you stop the pressure getting lost every time somebody opens a door? And what happens if both doors are open? The pressure goes away. at what point does this pressure become dispensable?" There followed various discussions on it, and I do recall someone suggesting that we could fit lights saying enter or do not enter, and I distinctly remember questioning the practicality of that. If an alarm goes off and the crash team runs in, they are not going to stop because there is a red light over the top of the door. I felt the ward was set up to me as it should have been, allowing staff to keep observations on the patients and the four-bed wards allowed for that.

30. I believe there is disconnect in the way that the Inquiry is looking at the ventilation issues within Critical Care, as I think they appear to have dropped the 10 pascals requirement, and I think that should get reviewed. As an engineer, if it were only 10 air changes, we would just increase the air volume, but you have to query that and ask why you would put in 10 air changes. The SHTM guidance ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[22])*** is that you ventilate for two main reasons, with ventilation primarily, there to reduce body odours and to provide air for people to breathe, which is where the 10 litres per second per person comes in. However, when we start as engineers looking at air pressures, you realise that you have to put a significant amount of air into the room. For example, a large

[22] Bundle 1 Published Guidance, Item 3, P149

amount of air is put into operating theatres, about 25 air changes, and that is because we heavily pressurize that room, and we let the air flow from there into other areas.

31. From my recollection the four-bed areas did come under scrutiny but not until well after financial close and Wallace Whittle produced a report on every single four-bed ward and what the air balance was within them, whether it was positive or negative, The difference with the four-bed wards to single wards is that generally they had less extraction, as they would have a common bathroom area. So, again, there was a discussion about what the air balance was in terms of pressure, not of air changes, but of pressure and what we could do to balance these areas again.

32. These concerns over the four bed wards were raised by NHSL, however not really after financial close but during Construction, when there was a full review of all the four- bedded areas carried out by Wallace Whittle and NHSL. During this review we were looking at the pressure regime within the rooms, however when I say pressure, it is not a defined pressure rather a notional pressure. As a hospital engineer providing pressure you are putting more air into a room than you extract out, so there's notionally a bit more pressure within the room, or vice versa, you extract a more, so there's more of a nominal air flow into the room, with the exception of specific critical areas, such as isolation rooms, theatre areas etc, where there will be a defined pressure requirement, and we design the systems to that defined level, In order to achieve that, the architecture needs to reflect that need as well, so you would need air locks or lobbies and different finishes so that you retain that pressure. There are specific, numerated pressures and the 10 pascals within CCU, in my opinion, expresses that as a defined pressure that you should achieve, which we have in the isolation rooms. We did not note any discrepancies but during the design we had referred certain aspects back to NHSL where we felt the guidance had to be clarified. The pressure aspect is absolutely critical when looking at rooms as you have to have a solid box to maintain pressure. Every building leaks, but to maintain specific pressure you usually have to go a bit further sealing your finishes.

33. One issue I recall was over a small room within the CCU, where they had an

air lobby with a gowning area where we provided 10 air changes. There was a similar room, but it did not have the gowning lobby and it did not seem to fit the criteria of an isolation room, but we felt that it should be an isolation room, so we referred this back to NHSL for clarification. They advised us that our interpretation of it was correct, and we duly put in 10 air changes and 10 pascals. During our involvement in the project if we saw something which did not really accord with our understanding, we certainly queried it, and of course all of our designs were put through RDD. Everything that we did, be it water, drainage, ventilation, heating, all of those were up for comment and were commented on by NHSL and their technical advisers. We received comments and we also addressed those comments until we got to a level of approval that the design was aligned with what they were looking for. We were providing the engineering solutions and if there was some other clinical need or whatever that was outside of our terms of reference or experience, then we would raise that with Multiplex.

34. During the project Wallace Whittle were sub-contracted by Multiplex, we were working directly for them and in that relationship, we relied on Multiplex for direction. I am aware that there were meetings with IHSL and NHSL, but there were very few of them that Wallace Whittle would have been involved in, any outcomes would be fed back to ourselves. Our direct route, if looking to raise any issues was through the RDD process, where after financial close, we would be speaking with Mott MacDonald and NHSL on our designs. There were no communication lines with clinicians and Wallace Whittle and if there were any discussion with them then it likely happened through NHSL or IHSL meetings.

The Procurement Process

35. The BCRs state that there must be compliance with the EM, however it also states that there must be compliance with guidance, which included the SHTM 03-01 ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[23])***. The Inquiry has asked me if I saw any issues for

[23] Bundle 1 Published Guidance, Item 3, P149

conflict with this. The SHTM is not always definitive, it is guidance and can provide you with different solutions. At no time did I feel there was any particular aspect where any of the solutions being applied did not fall within the guidance framework. No one within the team was coming up with their own bespoke solution and to the best of my knowledge we were complying with the SHTM guidance ***(A33662259, Scottish Health Technical Memorandum 03-01, Ventilation for healthcare premises, Part A v2.0 - Design and validation dated February 2014[24])***.

36. There was a lot of collaborative working during the project, but I can only speak for Wallace Whittle's relationship with the architects, structural engineers and other team members, within which everyone worked together well. We were not involved with NHSL/IHSL but had regular dealings with NHSL's advisors Mott MacDonald, as they were leading the RDD process. Occasionally it would get a bit fraught with them, particularly on the EM, where I felt they were unfamiliar as they had not prepared the documents. We had no dialogue with the EM authors, Hulley & Kirkwood, so it became a bit frustrating when the client had been apparently asking for something and then wanted it changed.

37. It was apparent that the date for financial close would slip and at the time we just accepted it. I think all of us were assuming that it was going to happen, and it was just a case of when it was going to happen. I do not recall it being a huge concern to us at the time because the actual detail of getting down to the detailed design follows on afterwards, and that is where our remit begins, when various engineers know what is required and we can begin doing the detailed design works.

EM within Reviewable Design Data (RDD)

38. As highlighted in para 15 above I felt the inclusion of the EM within the RDD ***(A32435789, Schedule Part 6: Construction matters, section 5 Reviewable Design Data[25])*** was an unusual step as this was part of the client's brief. With Multiplex or IHSL accepting that this was now a variable, I saw potentially a lot of implications from that. If, for example, it was decided that NHSL wanted to

[24] Bundle 1 Published Guidance, Item 3, P149
[25] Bundle 5 - Contract Documents, Item 7, P767

double the amount of air change rates for any particular area, it would have design and commercial implications. Wallace Whittle did not have any commercial incentive to provide people with a cut-to-the-bone solution, but if someone is looking to put six air changes into bedrooms for example, then the implications of that are that the supply air systems increase by 50 per cent. This results in the distribution system for that air increasing by circa 50 per cent, the main plant which is providing that air increasing by 50 per cent and the energy consumption increasing by 50 per cent. We also then have to look at the extraction side and how you then extract that air, so potentially you have to install another extraction system. From an engineering perspective, I am quite happy to do that as long as I have clarity on what is required, but there is a commercial angle to that, which will see greater spend and a substantial increase in your operational energy, which is going to be for the lifetime of the building. As an engineer it is apparent that is not a logical solution, but if that was what the client wanted then fine, but they would need to understand the implications.

39. As we reached financial close, I did not realise that the EM had been included within the RDD ***(A32435789, Schedule Part 6: Construction matters, section 5 Reviewable Design Data[26])*** package, I thought it was just our detail design solutions. This meant that the design solutions would be sitting in limbo, because until you have got the design brief sorted, there was only so far we could go with the actual design of the systems themselves, so it was not a good thing for us as designers. I thought it was unusual, however might have missed the discussions somewhere in amongst all the dialogue, and maybe if I had spotted it thought, "We'll just go with the flow here." I was not really bothered about any financial implications, more concerned over the engineering requirements, as I needed to brief my engineers on how they progressed the solutions, and prepare the drawings so we could get to the point of installation.

40. I recall being told by Multiplex that they had made the decision to put the building services all as RDD ***(A32435789, Schedule Part 6: Construction matters, section 5 Reviewable Design Data[27])***. That was not an unusual circumstance, given that engineering had only been progressed to a particular

[26] Bundle 5 - Contract Documents, Item 7, P767
[27] Bundle 5 - Contract Documents, Item 7, P767

point and it still had to be detailed and finalised, so having the client involved in that was a positive. It would allow us to get to a point where we could get the client to buy-in to proposed solutions and if there are issues, have meaningful discussion and reach an agreement on those going forward, as opposed to spending an lot of time going down the wrong path. However, with the EM that seemed to have v there to be fundamental changes to a client's brief during the course of the contract as the contract has to have a defined baseline. If that baseline has to alter post award, my experience is that normal practice would be that the client would have to instruct an alteration, because that alteration could have impact on a number of things, such as time, cost, and energy.

41. The environmental matrix now appears to have been in its infancy, but there was an expectation that it would become defined at financial close and form part of the client's brief. It is no different from a commercial application or any other building, as it is not unusual in other commercial developments to have a guiding engineer on the client side helping the client express what their intentions are. To have the EM added to the RDD ***(A32435789, Schedule Part 6: Construction matters, section 5 Reviewable Design Data[28])*** was not a decision we made and looking back I think it was potentially a dangerous thing to do, from a commercial aspect, bearing in mind that all the energy calculations were a big part of the tendering and the development of the building. Whilst environmental parameters were important, we could not lose sight that sitting parallel with that was energy efficiency and ensuring that the building ran as efficiently as it possibly could. The client would not be satisfied with a building that was going to be overly expensive to run, so it is all linked.

Room Data Sheets

42. The responsibility for the production of the RDS ***(A32505840, Schedule Part 6: Construction matters, section 6 (Room Data Sheets), Appendix 1 RDS Pack[29]),*** fell to the Architects, HML, working for IHSL as this process does not tend to be engineering led. The architect would normally lead the production of the sheets, they would only come and ask us for information to help them input data on the RDS ***(A32505840, Schedule Part 6: Construction matters,***

[28] Bundle 5 - Contract Documents, Item 7, P767
[29] Bundle 5 - Contract Documents, Item 8, P882

section 6 (Room Data Sheets), Appendix 1 RDS Pack[30]). In circumstances such as these, where there existed an EM, I would expect the architect to take the information from the EM directly and there would not be a specific requirement for an engineer to review. If the RDS sheets ***(A32505840, Schedule Part 6: Construction matters, section 6 (Room Data Sheets), Appendix 1 RDS Pack[31])*** had been produced by NHSL as part of the ITPD/BCRs, I would have expected the environmental conditions section of the RDS ***(A32623049, Schedule Part 6: Construction matters, section 6 (Room Data Sheets), Appendix 2 Environmental Matrix[32])*** to align with the EM. The EM only covers a portion of what's required to prepare a full RDS ***(A32505840, Schedule Part 6: Construction matters, section 6 (Room Data Sheets), Appendix 1 RDS Pack[33])***. I note that there is a focus on the environmental conditions portion of RDS but my understanding is that RDS ***(A32623049, Schedule Part 6: Construction matters, section 6 (Room Data Sheets), Appendix 2 Environmental Matrix[34])*** should also be providing a briefing to other designers and contractors, supplying additional construction information not included within the EM.

43. On other hospital contracts, I am aware that we have assisted in helping the client produce RDS sheets ***(A32505840, Schedule Part 6: Construction matters, section 6 (Room Data Sheets), Appendix 1 RDS Pack[35])*** along with the architect, however, did not see an absence of the RDS as unusual on the RHCYP/DCN project as we already had the EM. We needed the information for all the rooms to be able to compile the engineering solutions and to be able to size them up properly and do all design activities that we do. That information was absolutely key for us and the cornerstone of our designs. In the event that there were any obvious inconsistencies between RDS ***(A32623049, Schedule Part 6: Construction matters, section 6 (Room Data Sheets), Appendix 2 Environmental Matrix[36])*** and the EM, the process would have been to escalate the matter to Multiplex. We would not have made a judgement call on

[30] Bundle 5 - Contract Documents, Item 8, P882
[31] Bundle 5 - Contract Documents, Item 8, P882
[32] Bundle 5 - Contract Documents, Item 9, P1454
[33] Bundle 5 - Contract Documents, Item 8, P882
[34] Bundle 5 - Contract Documents, Item 9, P1454
[35] Bundle 5 - Contract Documents, Item 8, P882
[36] Bundle 5 - Contract Documents, Item 9, P1454

which took precedent but would seek clarification from our client.

44. I know from hindsight and from reading some of the information that there was a desire to have 100 per cent of RDS, but I believe there was an agreement reached that this would be for particular rooms. As above, our involvement in relation to RDS was limited to advising the Architect if it seemed to us there was any relevant information missing. We are able to assist with the ADB process, but we did not lead it, so it would only be if someone came to me or the team about a room datasheet, we would have an input at that point.

45. I believe that the facts stated in this witness statement are true. I understand that this statement may form part of the evidence before the Inquiry and be published on the Inquiry's website.