

**Scottish Hospitals Inquiry**  
**Witness Statement of**  
**Paul Winning**

**Witness Details**

1. My name is Paul Winning

**Qualifications**

2. I am a Chartered Engineer with a BEng Honours in Building Design Engineering and a member of the Chartered Institute of Building Services Engineers (CIBSE)

**Previous Roles and Experience**

3. In September 1998 I started working for Hoare Lea based in Bristol. After about 6 years I moved to work for Hulley and Kirkwood, also in Bristol, where I stayed for another 3 or 4 years before moving back to Scotland in December 2006. I worked for Hulley & Kirkwood until 2007, with Buro Happold until 2009 and returned to Hulley & Kirkwood until December 2015. I moved to Hoare Lea in January 2016 to set up their Glasgow Office..
4. In that time, I have worked in a number of different areas within the construction industry including health, offices, education, science and custodial centres. One of Hoare Lea's major sectors is in healthcare and I have been involved in various projects including Dumfries and Galloway hospital, Queen Elizabeth in Birmingham and the Queen Elizabeth University Hospital, Glasgow. As a result, I have built up quite a bit of experience dealing in acute hospitals projects.

## Current Role

5. I am currently the Director for the Glasgow office of Hoare Lea.

## Initial Approach / Involvement

6. We had worked in the past with Dave Keenan, who (at the time of this project) was a Director at Imtech Engineering, and we had built up a good working relationship with him. In December 2019 one of the funders (Dalmore) from the RHCYP project approached Dave indicating they were looking for a team to look at the critical care ventilation and requested his assistance. Dave then approached Hoare Lea and asked if we could help as he knew that he could trust us and that we had the necessary expertise. We, in turn, had to create a practice profile, for NHS Lothian and Dalmore, to show we had the expertise, knowledge and the resource to do the work.
7. Imtech agreed the contractual terms. There were various drafts of the contract which after various exchanges and amendments, was agreed (**A47237743 – Consultant Agreement between IMTECH Engineering Services Central Limited and Hoare Lee LLP dated 24 February 2020 - Bundle 13, Vol 8 – Page 2232**). Meanwhile while that was going on we started doing the initial briefing of the project and the initial concept design.
8. We were aware of the ongoing problems with ventilation as it was reported in the press but we didn't know the specifics. We did have an internal discussion within Hoare Lea as to whether we would carry out the work, as we knew there would be potentially a lot of politics and publicity, but we decided to proceed. We are a firm with culture of problem solving rather than getting into the politics of who why and what. We were appointed to establish the facts and use the findings to help us resolve the issues that complied with the regulations and ensure the hospital opened.
9. We had a number of workshops with NHS Lothian in order to obtain the design information for the hospital, which proved quite difficult due to the

online platforms that were being used for various stages of the project. This meant we had to spend time sifting through all the information to try and understand it. The hospital was originally designed in Revit (i.e.BIM), and there were 3D coordinated plans which we were able to utilise. It became clear that the main issue with ventilation was that the air changes within the Critical Care bedrooms was designed for four air changes per hour as opposed to the SHTM requirements (**A32354071 – SHTM 03-01 Principal Differences between SHTM and HTM -03-01 dated 20 October 2011 – Bundle 5 – Topic 5 The Works Under Supplementary Agreement 1 (SA2) – Page 1504**) of 10 air changes per hour.

10. There were a number of implications of trying to achieve the 10 air change compliance.. If you put in 10 air changes an hour as opposed to four air changes, its more than double the amount of air you're having to supply and extract. The knock-on effects of this was significant in that the existing ductwork infrastructure was too small, the air handling units weren't big enough, which resulted in plant space issues. Routes had to be found to bring in new and bigger duct work. We had to explain to the The more air flowing down a duct, the faster it goes. The faster it goes, the more noise it creates, which meant it had to be resized.
11. In the initial stages we had to establish what the requirements were and what the NHS and HFS (Health Facilities Scotland) would accept. For instance, ideally you would want an air handling unit to be located within the building, so that any maintenance could take place inside. However, it became clear that there was insufficient space within the building so we looked outside to locate some of the air handling units.

### **Original Air Handling Units / Ventilation System**

12. It was quite clear that the original air handling units were not designed to deliver 10 air changes per hour. We discovered from the documentation that we had collated at the early stages that the design was based on four air changes, so, the system was commissioned to that. All the commissioning

records were based on four air changes. The environmental matrix **(A39032317 – RHCYP+DCN Environmental Matrix Rev 12 – Bundle 5 – Topic 5 The Works Under Supplementary Agreement (SA2) – Page 1446)** that the original design team worked from was based on four air changes; the air handling unit drawings and associated technical documentation were all design to deliver four air changes. All the documentation (design and commissioning) confirmed the ventilation systems were based on and delivered four air changes.

13. IOM were the independent testers who were instructed to examine and verify the system. They were to look at the requirements and determine whether the original design complied with the original brief (i.e. four air changes). IOM then identified that for the critical care areas the requirements should have been ten air changes and not four. It was at this point that the system was discovered to be non-compliant with SHTM 03-01 **(A32354071 – SHTM 03-01 Principal Differences between SHTM and HTM -03-01 dated 20 October 2011 – Bundle 5 – Topic 5 The Works Under Supplementary Agreement 1 (SA2) – Page 1504)**.
14. A high value change notice (High Value 107) **(A34957602 – Appendix 4 – HVC 107 – Paediatric Critical Care and Haemonc Ventilation\_SIGNED AND ISSUED\_05\_12\_19 (3)(127055780.1 – Bundle 3 – The Works Under Supplementary Agreement 2 (SA2) – Page 1146)** completed by NHS Lothian and signed by Brian Currie on 5 December 2019, was provided to set out what was required order to achieve the 10 air changes per hour. It included a requirement to design and install a ventilation system to deliver 10 ac/hr at +10 Pa pressure to nine specified rooms in the paediatric critical care department and fourteen specified rooms in the haematology and oncology department. Our thoughts were “Did we have to get bigger ductwork into the hospital, did we have to strip out all the existing ductwork and put new in, or could we re-use elements of it?”
15. Initially we thought we might need to strip all of the supply and extract ductwork out and start again but realized that we could re-use elements of it. We made the decision, after looking at the plant space, ceiling void space,

and coordination, that re-using what was there would be beneficial. We therefore tried to use the existing air handling units to supply some of the non-critical care rooms, and designed new air handling units that was eventually located outside the building, dedicated to serve the isolation rooms requiring 10 air changes per hour.

16. From a co-ordination point of view, the ductwork was the first thing that we installed in the ceiling voids; below that was the electrical containment, then the pipe work, including the medical gases. This was a huge additional piece of work because to work on the ventilation system meant completely overhauling or tinkering with other MEP systems.
17. There was also a control issue with the cooling and heating of certain rooms, because each individual room was to be heated to either 18 or 28 degrees. This meant working closely with NHS Lothian, and the head clinicians, to establish how we could do this.
18. The bedrooms contained radiant panels. These were all removed as that aspect didn't comply with SHTM (**A32354071 – SHTM 03-01 Principal Differences between SHTM and HTM -03-01 dated 20 October 2011 – Bundle 5 – Topic 5 The Works Under Supplementary Agreement 1 (SA2) – Page 1504**), and the heating control was basically achieved via the supply air temperature. If 28 degrees in a room was required, approximately 33 degree air into that room would be required to offset any kind of heat losses in the winter, just to control that room to 28 degrees. It was all clinically driven with the clinicians specifying that that's what they needed for certain types of patients.
19. All this is contained in our Stage 4 report. (**A35683157 – Hoare Lea Final Report REP-2727164-08-SV-20200313-Stage 4 Report- Rev 07 dated 20 December 2020 – Bundle 3 – The Works Under Supplementary AGREEMENT (SA2) – Page 1440**)

## **Remedial Works Carried Out**

20. As we were engaged by Imtech, we were part of their team, so we were heavily involved in the design and the installation decisions that were being made. It can be difficult when you're working off drawings to understand if the design is achievable. We did investigation works and decided that all the ceilings had to come down as a starting point. Then we looked at our proposed design and decided what was practically achievable, and what could be used and what couldn't.
21. We carried out a structural assessment to make sure that the roof could take the extra load involved in accommodating the new plant. We did ductwork pressure tests because the ductwork had to be a certain classification and capable of the higher pressure.
22. This information is all contained within the completion criteria document. It provides all the documentation we had for the project. Appendix 1 is the Stage 4 design information, which contains everything in the Stage 4 report and all the appendices that go with it. There was a compliance tracker, RFI's, commissioning methodology, commissioning information, the sign off, building control and planning. This all had to be finalised for the client before sign off.
23. We also drafted various down-taking drawings. These are colour coded. The red sections show everything that we removed. New and existing designs, again colour coded, shows our designs for levels two and level four. Our scope from NHS Lothian was to change from four changes to 10 changes, and the positive 10 pascals for these rooms.
24. The existing ventilation plant rooms were located within the hospital, but there was insufficient space for us to utilise. There was an external energy centre which contained all the boilers, the CHP, medical gases, HV and LV. The ventilation plant rooms were on level two and level four where we looked at reusing the existing air handling units. However, we came to the conclusion

that we weren't capable of delivering all the additional air that we needed. Therefore, we replaced the existing air handling unit, utilized some of the existing ductwork, then stripped out and rejigged a lot of other areas of the ductwork.

25. There were two elements to this project. The Critical Care bedrooms with the air change issues and also the isolation rooms which, in addition to air change issues, also posed questions regarding the resilience of the systems serving those rooms.
  
26. The way the system was designed originally was with one air handling unit served four different isolation rooms. This design was criticised on the basis that if the air handling unit went down, for maintenance or because it broke down for example, you then had an issue that those isolation rooms wouldn't have enough air to keep sufficient positive pressure. I wouldn't say that design was wrong or non-compliant, but the implications of having that design made it difficult to achieve the requirements and created a clinical risk. After consultation with NHS Lothian, we decided to design individual air handling units, i.e. small air handling units, one of which served each of the isolation rooms. That also meant that you could have specific temperature control of different rooms. You could have one isolation room being shut down for maintenance purposes and it wouldn't affect the other three. That was another big piece of work that we included and this was part of High Value Change 107 (**A34957602 – Appendix 4 – HVC 107 – Paediatric Critical Care and Haemonc Ventilation\_SIGNED AND ISSUED\_05\_12\_19 (3)(127055780.1 – Bundle 3 – The Works Under Supplementary Agreement (SA2) – Page 1146**). Although individual air handling units were not specified, we were to comply with the SHTM requirements, and our technical opinion was the best way to achieve that was a design in which an individual air handling unit supplied each of the isolation rooms.
  
27. The critical care rooms were heated by radiant panels, which we didn't think was right as there was no real temperature control with this type of system (i.e. to heat from 18 degrees to 28 degrees). We therefore included additional

heater batteries to make sure that each room could be controlled at a different temperature, by heating or cooling the air going into each room. The central air handling unit can do this if all the rooms had to be the same temperature, but if you needed one room at 23 degrees and another at 18 degrees then you needed to control the temperature of the air supplied to each bedroom. Each bedroom would have its own heater battery, which is basically just a coil in the ductwork. If a room required to be heated to 28 degrees, and it was 18 degree air in the duct, that coil would heat it up to 28 and it would be delivered into the room at 28 degrees.

28. Each air handling unit is bespoke because the air volume is specific to the building that you are designing. The cooling and heating loads are specific to the building and to the environment that you are trying to create.
29. A company called Daikin built the new air handling units. We have kept the technical information for the old air handling units and likewise for the new ones. We also have the technical drawings and we carried out a 3D reality photographic Matterport survey which is a kind of reality 360 degree survey so you can see a before and after images (you can also walk through the plantrooms).
30. The new units were marginally taller, wider and longer. They were tested within the factory then disassembled into small sections, a fan section and a filter section, then rebuilt on site. There were double doors into the plant room, so we had taken a site measure to see what was the biggest element that we could get safely through the doors. There was then another performance test on site to make sure it still delivered what it did in the factory.
31. The initial location for the new air handling unit was going to be within the Paru Garden. This created another issue as the Paru Garden was an outdoor garden space and the clinicians were against having a big air handling unit sitting in their nice garden potentially affecting its use by the patients.
32. It was eventually located on the first floor of the energy centre, which was extended so that all the new air handling units were contained within this and



was surrounded with a louvered screen so you couldn't visually see it. There was some ductwork across the sunken courtyard but we created a link bridge, which we turned into a bandstand, that made it more of a feature of the garden. We involved the Edinburgh Childrens charity and we got musical instruments and things like that to make it more of an interactive space for the patients. Using our in-house specialist lighting team, we assessed the perceived brightness of the space and eventually painted the wall in the ground floor bedroom accommodation that brightened it up and gave it a little bit of a lift.

33. There were two existing air handling units. One served the critical care on level three and the other served level one. Originally we were going to put one in the Paru garden but it was too big and again there was a problem when it came to maintenance access. We therefore decided to go back and replace that unit to deliver the 10 air changes and to also make necessary changes to the distribution rather than having something outside the building. It was only the isolation rooms that had the new air handling units located outside.
34. Most of the ductwork did not require to be changed but some had to be modified to allow resilience to the system if all four went down. This was done by having a structural engineer and contractor drill through the fourth floor plant area into the isolation room and reconnect onto the existing duct work.
35. Because we were increasing the heating to the air handling units, as they were bigger and delivering more air, their heating coils also had to be made bigger (i.e. larger load). Therefore, the heating pump also had to be larger to deliver the heat from the boilers to the heater battery.
36. All contractors working on any installation, be that ductwork or pipework, all complied with our workmanship specification issue sheet **(A35681002 – 20201221 – Hoare Lea Stage 4 Rev06 Specification Issue Sheet 20<sup>th</sup> Dec 2020– Bundle 3 – The Works Under Supplementary Agreement (SA2) – Page 1439)**. This was more to do with quality and made sure that we were all using the necessary fixings and fittings.

37. We were also conscious, at the time, that when you are not using the cold water system you may have bacterial growth which could result in a Legionella risk. This was a live hospital, so creating dead legs had to be avoided. Our design managed to incorporate and retain the existing cold water system without modifying the pipework in any way.

### **Commissioning / Testing and Validation**

38. Before everything was signed off, a number of commissioning activities were carried out to verify that all the critical care bedrooms achieved 10 air changes. We also needed to confirm that we had achieved a positive pressure of 10 pascals between the room and corridor. This is actually quite difficult to do because if you have got lots of rooms with their excess air going into the corridors, you need to then remove that excess air when doors start opening and closing. This affects the pressure cascade, as we call it, and needs to be a very settled system.

39. We checked the pressure rating of the rooms, then we set the pressure of the ventilation, then we had to measure the air volumes and the air change rates going into the rooms to verify the 10 air changes.. If you have measured the volume of a room, and that volume gets replaced every hour, one can then measure the air in litres per second. SHTM requirements **(A32354071 – SHTM 03-01 Principal Differences between SHTM and HTM -03-01 dated 20 October 2011 – Bundle 5 – Topic 5 The Works Under Supplementary Agreement 1 (SA2) – Page 1504)** are based on air changes whereas most of the commissioning activities are based on a flow rate which is litres per second.

40. We were involved in all the commissioning checks and signed it off as designers. The NSE 4 supervisors, Watermans, also verified it and signed it off, then the independent tester, Arcadis, signed it off. IOM then did the final audit and fully signed it off.

## **Declaration**

41. 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.