SCOTTISH HOSPITALS INQUIRY

Hearings Commencing
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Stephen Maddocks

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10:00

THE CHAIR: Good morning, everyone. Now, Mr MacGregor, we have Mr Maddocks this morning.

MR MACGREGOR: Mr Maddocks, yes.

MR MADDOCKS: Good morning.

THE CHAIR: Good morning, Mr Maddocks. As you understand, you are about to be asked some questions by Mr MacGregor, who I think you have had the opportunity, at least, of saying hello to this morning and may have met previously. Can I ask you whether you will take the oath?

MR MADDOCKS: Yes, I'm happy to.

Mr Stephen Maddocks

(Sworn)

THE CHAIR: Thank you very much, Mr Maddocks. Now, we plan probably to take a coffee break at about 11.30 a.m. We will see how the evidence goes, but if, for any reason before then or after then, you want to take a break, just give me an indication and we can take a break at any time that you wish to, but there will definitely be a coffee break in the middle of the morning.

THE WITNESS: Thank you.

THE CHAIR: Mr MacGregor.

Questioned by Mr MacGregor

Q Thank you. Good morning, Mr Maddocks. Can you tell the Inquiry your full name, please?

A Stephen John Maddocks.

Q Have you provided a report to the Inquiry dated 10 April 2022?

A I have.

Q That will be found in bundle 6, at pages 51 to 96. Does that report cover healthcare ventilation, both principles and practice?

A Yes, it does.

Q The content of the report will form part of your evidence to the Inquiry and I am also going to ask you some questions today. If you do want to refer to your report at any point, please do let me know.

A Thank you.

Q If I could begin by asking you about your experience, which is section 1 of your report, at page 55 of bundle 6. You explain in your report that you are a Chartered Building Services Engineer. How many years of industry experience do you have, Mr Maddocks?

A 40-plus. I started in the industry when I was 16, in 1981.

Q And you are currently a member of the Chartered Institute of Business Service Engineers, is that

correct?

A Building Services Engineers.

Q You are a Chartered Engineer?

A Yes, I am.

Q You are also a fellow of the Institute of Healthcare Engineering and Estate Management?

A Yes, I am.

Q You mention that you started your career working in 1981. What company were you working for?

A It was called DSSR, Donald Smith Seymour and Rooley. They were a private consulting engineer.

Q What did your work for DSSR involve?

A I started as an apprentice learning the basics of building services design. I started in the public health department of drainage, then moved into the mechanical engineering department looking at ventilation, heating, hot and cold water systems.

Q Mr Maddocks, could I possibly ask you to keep your voice up a little? It is my fault. I am just having a slight problem hearing. That would be appreciated.

A Yes, no problem. I'll get a bit closer.

THE CHAIR: Closer to the microphone might help and I am hard of hearing anyway, so I am very appreciative of people who speak up.

Q Am I right in thinking that in your time with DSSR you worked in what you refer to in your report as "Exemplar Nucleus Hospital design packs"?

A Yes, I helped collate the packs of technical information for what was the Department of Health's nucleus design concept.

Q Can you just explain to the Inquiry, what was the nucleus design pack?

A It was a predefined layout of a department in a hospital, based on what was called a "cruciform template" and the idea was that designs were predefined for various departments within a hospital – accident and emergency, operating theatres, wards – and the design was supposed to be rolled out across the country, so that if a particular region wanted a design, they could just pick a file off the shelf and say, "That's the A&E department, that's the ward department" and they would build a hospital using standard, predefined layouts.

Q So standardised designs with, presumably, a hard copy folder with information?

A It was all hard copy folders in those days, yes.

Q If you needed to build a specific part of a hospital, you had an example that you could go to?

A You had an example that was-- the design had been costed, it had set the benchmarks for affordability within the NHS and was deemed to be the most efficient and appropriate design at that time.

Q Is the nucleus design pack still used?

A Not that I'm aware of.

Q Is there an equivalent?

A There are standardised rooms, not floor plates. So, there's a desire to produce standard rooms – a single bedroom, a standard en suite, clean utility, etc. It's possibly maybe a dozen, I can think of, that have been standardised to allow economies of scale and uniform practice across the NHS.

Q So, although the concept has been updated, there is still the general principle that there is standardised information that can be called upon if required in hospitals?

A Yes, very much so.

Q Thank you. Just returning to your career, am I right in thinking that you moved from DSSR to Hoare Lea?

A Yes, in 1989.

Q And whenever you were at Hoare Lea, what types of work were you engaged in?

A Predominantly healthcare, projects at Blackpool, Lancaster, Salford.

Q So you mention Blackpool, Lancaster and Salford. Can you just explain, what type of projects are they?

A All three schemes were all nucleus related developments, so they followed the nucleus related layout. I designed ventilation systems and steam distribution systems and medical gas systems on each of those three projects. I spent about ten years on the Blackpool Victoria site doing various enabling works followed by the major development.

Q So the time that you are at Hoare Lea you are involved in the development of designs for hospital ventilation systems?

A Yes.

Q Then in 1992, you went to work for the NHS as a capital projects officer at Trafford General Hospital?

A That's correct.

Q So can you explain, what were you doing in the NHS as a capital projects officer at Trafford General

Hospital?

A I was charged with developing new schemes and implementing them. Whereas a capital projects officer looks at new development, an operational officer looks at the day-to-day management of the estate, the operations of it. So they look after the trade staff who maintain the buildings. My role was to implement new schemes.

Q Just so I am understanding, you would have the capital projects officer, but you would also have an estates officer, is that correct?

A Well, there's an estates officer, capital, and an estates officer, operational. They are two different roles and mine was purely just to deal with new development.

Q And what would the other role that you talked about be?

A They would just operationally-- they would look after the day-to-day maintenance of the buildings, whether it be building work, electrical work or mechanical work.

Q So one effectively involved in new capital project, one in the maintenance of the facilities?

A Yes, I was new capital.

Q How long did you spend working at Trafford General Hospital?

A I was there for two years.

Q Then you tell us in your report that you returned to Hoare Lea thereafter.

A Yes.

Q Okay. Again, when you returned to Hoare Lea, what type of projects were you working on?

A I continued with healthcare all the way through to leaving that firm in 2002. It was all I did predominantly for the remaining eight and a half years.

Q You give some examples within your report. So, you mention work that you did at Wigan Royal Albert Edward Infirmary; Royal Manchester Children's Hospital; Blackburn Queen Park Hospital; Evelina Children's Hospital; Bishop Auckland Hospital; Wharfedale Hospital; North Wales Cancer Treatment Centre. Can you just tell us, in broad terms, for those types of projects, what work are you doing?

A I was responsible for delivering the building services aspects of them. Some of them I did all the detailed design. As I moved through my career at Hoare Lea, I was managing them. North Wales Cancer Treatment Centre, I managed that project from start on site all the way through to handover. Blackpool

Victoria, I was involved in the design all the way through design process, tendering, construction and handover of that building.

Q Would that include involvement in the design and implementation of the hospital ventilation system?

A Yes.

Q You tell us after your time at Hoare Lea, you move to BDP.

A Building Design Partnership, yes

Q What type of work were you undertaking there?

A Healthcare again, predominantly healthcare. There were other schemes that I did get involved with, but my role was really to develop other projects, other healthcare schemes.

Q You tell us within your report that you were working for them on a range of PFI hospital projects.

A Yes.

Q Can you just explain to the Inquiry, what do you mean by "a PFI hospital project"?

A The Private Finance Initiative was an initiative developed in the 90s whereby there's two streams of funding for a project and it's either capital funding that comes from government, or local government, or

from investors, which is the private finance element. So you developed a scheme, a client wanted a new hospital and quite a long process of generating funding from the financial markets, investors markets in particular.

The Bishop Auckland Hospital that I was involved with was-- the money was raised through a bond sale on the financial markets, which is a bit beyond my expertise to understand but that was what was called a "triple-A rated bond". So, they went to the finance markets to raise the capital that was then to build the hospital. The NHS trust then pay rent for the use of that hospital for a defined period – 25, 30, 35 years – so the investor gets his return over a longer period of time. So things like pension funds get invested in that.

Q Just so I am understanding you, there are effectively two types of funding for new hospitals. You can have capital funding which would come direct from central government----

A Correct.

Q -- or you can have what you refer to as "PFI", which is effectively private capital coming in, whereby there will be a return provided to investors.

A That was then. I don't believe there's been a current PFI in healthcare for some time. It was stopped around 2014. We were involved in a PFI for a small primary care centre and it was one of the last PFIs. The government moved away from that model of development.

Q You mention during your time with BDP that you worked on PFI schemes, including Burnley General Hospital and Hexham General Hospital, is that correct?

A That's correct, yes.

Q Then within your report, it details that from 2008 onwards, you joined Cundall?

A Yes, that's correct.

Q Can you just explain, what has your role been within Cundall since 2008?

A I'm a partner. I'm the health sector leader, so my role is to try and win new work in the healthcare market in the UK and overseas. I run projects, I provide a point of contact for technical reference. So, as an example, my colleagues in Australia were wanting some assistance on a project so I've had a few very early morning conference calls, giving them advice on technical aspects of the project, as well as market intelligence.

I'm a partner within the business, so I have all the responsibilities about the management of the business, but one of my roles is the health sector leader.

Q Would that include having input into design projects for healthcare ventilation?

A Yes. As you move up the positions within a company, I tend to do less of the detailed day-to-day calculation work, but I will always sit with a project and develop the concept and do the initial, early design work and then as a scheme develops, then I have a team of engineers who will do the detailed design.

Q In addition to your work with Cundalls on the design side and as a partner, have you also been engaged by partners as an expert witness in litigations?

A On a few projects, yes. Not many, a few.

Q What types of projects were they?

A I've been asked to look at defect issues on PFI hospitals. I've been asked to look at condition surveys on a PFI hospital. I am trying to think. Yes, those are the ones that I can recall straight off the top of my head.

Q That is providing expert reports on engineering issues?

A Yes, similar to what I've done today.

Q Thank you. Now, within section 1 of your report, you also tell us that you sit on the CIBSE Healthcare Committee. So, firstly, what is CIBSE?

A CIBSE is the Chartered Institute of Building Services Engineers. It's a chartered body that grants chartered engineer status when people satisfy their entry criteria for being a full member, which I am.

Q What is their healthcare committee? What is its remit?

A CIBSE covers all manner of sectors for building services engineers – it might be healthcare offices, retail, leisure facilities – and they have a number of groups that are focused on developing and being a focal point for experts. So, I was asked to join the committee last year. I'm now the secretary of the committee, and I'm helping write a design guide for engineers to learn how to design hospitals.

Q Why are you writing that design guide?

A Because there isn't a comprehensive guide that exists to cover it all. From a building services perspective, there's no real-- it's a way of gathering all the expertise around

before too many of us retire. People can use an online tool to seek guidance, find the pitfalls that occur on projects.

Q So, just so I am understanding you, at the minute there are various people that work in this space, but what you are telling the Inquiry, there is not one single guide someone could pick up where all the principles are written down?

A There are a number of guides available; there is the HTMs, HBNs, which I'm sure we will come on to, as the NHS publish, but there's not many other design tools available. Certainly, from a detail of ventilation design, you have the NHS HTMs which give you the principles and some of the data, but the design guide that we're going to write – that we are in the process of writing – is how you interpret those and what systems you might put in a building. So, it's the next level of detail from the NHS publications.

Q Thank you. If I could ask you within your report to look on, please, to section 2, which is on page 56, whereby you outline project design process and drivers. So, if a client comes to you and they want a new ventilation system for a hospital, have you really set out the design process

on page 56?

A Yes, very much so. It depends what stage the client will come to you at. Sometimes I've been involved pre-design. Sometimes a client has an idea of what they already want and will ask you to implement it. A lot of the projects I've been involved with, they are really a much higher level, a strategic case I've been involved in. So, in other words, when you look at a scheme to decide what size a hospital might be, I've been involved in that stage, but all aspects of it, it's not just ventilation. I look at all aspects of the engineering services.

Q So, in terms of the four stages that you have set out there, is there any standard entry point where a health trust or a health board would get external advisers in?

A I would say the pre-design stage. They would generally not have the level of resource within their organisation to advise them of the specialist requirements of a hospital at pre-design stage. So, at pre-design stage, a strategic case, we would look at a site: "Is that site suitable for a hospital? Is there a sufficient infrastructure? Is there sufficient power, gas, water, etc.? What size of plant area will we need? Clinical accommodation?" So, all that is pre-designed – that's at strategic level. So, we can offer advice at that stage and then as the project moves forward through the design process, we input at the various RIBA stages – the Royal Institute of British Architecture design stages. There's pre-defined stages. Rather than just starting a scheme and ending at going to tender, you go through key gateways.

Q We will come on and look at each of those stages in a moment, but if you could help me, you mention within your report the term "reference design". What is a reference design?

A A reference design would be a concept design that defines how many wards, how many operating theatres, what departments are likely to be in a hospital. You would typically get a reference design done at RIBA stage 1 and it's a simple building block diagram of how areas relate to one another. That proves that that building will fit on that site and have sufficient space around it for car parks, utilities and so on.

Q Are you familiar with the term "exemplar design"?

A I've heard of it, yes.

Q What is your understanding of an exemplar design?

A I would say an exemplar

design would be one that is based on something like the nucleus related templates. So that's an exemplar design. It works. An exemplar design for a specific hospital would be-- I think the term “reference” and “exemplar” are very similar. It would be the exemplar design for this hospital, with this accommodation, sitting on this site. This is what is the, I suppose, the benchmark that if you are going out to competitive tender to redesign that you would use that and say, “Well, we know that we, as the public sector, can build that exemplar design for that amount of money, on that site.”

Q You mention it in terms of reference design, that it would take the design up to what you refer to as “RIBA stage 1”.

A Yes.

Q What do you mean by “RIBA stage 1”?

A It's an early concept layout to prove that you can-- you develop the design based on the brief from the clinical body, the client body; you would then cost that job and use cost methodology to prove the budget and the scheme is affordable before you move forward into a more detailed, brief analysis.

Q So if we could return then to page 56 of your report, you

begin by setting out the pre-design stage, you say that you look at the site location, local issues, the Schedule of Proposed Departments, and then you say, “A simple building diagram Reference Design may be developed to support the funding application.” Do you see that?

A Yes.

Q So that would effectively be the first stage of the project?

A It's the first stage of a project that would seek initial concept review with the local planning authority – will they accept that building? – and also, as part of the NHS approvals process, you would have to do a RIBA stage 1 to get approval to move to the next stage. It's a relatively quick process. You pay a fee for it, but you're not committing to professional fees and the design fees for something further down the line, because there's no point starting a scheme if it’s not affordable, it won't fit on the site and it doesn't seek approval. So you do it in a stage process to get, as I say, gateway sign-off.

Q So in terms of, for example, the Schedule of Proposed Departments, what level of specification is going to be provided at the pre-design stage?

A At that stage, it would

simply be how many-- in simple terminology, how many beds are required, how many operating theatres, what specialist departments are required, are there-- is there a staff canteen required, is there a commercial kitchen required? Laundry, mortuary, pharmacy – all the departments that could make up a district general hospital, you would-- the clinical team and usually the NHS trust or health board would set out what the clinical objective of that hospital is and say, “We want these departments in our building.” You could then look up and say, “Well, what are those standard areas from databases”, and that helps to build your outline business case.

Q Is that information being provided by the client, the health trust or the health board?

A Typically, yes, with support from medical health planners, if they didn't have that resource in-house or----

Q What do you mean by a medical planner?

A A medical planner is a company or person who has experience in developing capital projects. Some organisations, NHS organisations, have those people in-house, and some employ professional

consultants to provide that service for them. They’re experienced consultants who know that before-- It becomes into the whole health economics as to how many people does that area serve and how much funding is available. But, again, that's outside my area of expertise. I know people who do that for a day job. So they will assess the size of the hospital. Does the local health economy support that size of hospital?

Q So, at this stage, would any engineering details be specified?

A Outline-- Possibly not. You would use experience to say, “Based on this level of accommodation and this square meterage, you need this amount of plant area, potentially this number of air handling units and this power supply to serve that site, this size water tank.” That's the sort of stuff that I tend to do very early on before the detailed design gets underway.

Q So issues such as air changes per hour or pressure requirements for individual spaces, would that level of detail be provided at this stage?

A No. You might consider whether a building is going to be mechanically ventilated or naturally ventilated at that stage, but that's still a

little bit early at that stage.

Q So you then move on to what you refer to as stage 2, the design stage. You say that you would "consider if any areas can be naturally ventilated or require mechanical ventilation, Plant room Locations to optimise ductwork". So what are you meaning by the "design" stage?

A Again, it's the next stage of design. It's not the finalised design that positions grilles in the room like you see in this room here today. It's the primary systems that will impact on the building, so the primary duct runs which push air around the building, primary electrical containment systems that provide power around the building. So the big pieces of kit in a big area and what-- where they will be located in relation to, say, operating theatres. There's a key one with operating theatres is they are very intensive in terms of the ventilation area, so you want to position a plant room that serves an operating theatre very close together, so you then sit with the architect and the health planning team. Because when you look at the relationships of a department, clinically you want people to travel as little distance from point A to point B. So the architect will lay out the relationship of the departments that

serves the best clinical delivery, and then we, as engineers, will look at how we can service that area from an engineering perspective.

Q Just so I am clear, who is developing this design? Is it the architects and the engineers or would it be the health board and the health trust?

A At that stage, it would be the architects and the engineers with input from the health board.

Q Would an authorising engineer be involved at this stage?

A Traditionally, no. But, really, as of the last 12 months, yes.

Q Why do you say, "Yes, as of the last 12 months"?

A The particular Health Technical Memoranda for Ventilation, 03-01, was revised last year and it has required, or now requires, a group called the Ventilation Safety Group. That comprises of the authorising engineer whose role-- I know he's given evidence – he would see this job all the way through. You would want to see the estates professionals who are going to look after the building, clinical team, the infection control team, who may have a particular desire to see something within a building. Local practice and policy might change the way you want to

ventilate somewhere.

Q So you are saying in the last 12 months, when the Ventilation Safety Group concepts come in, you would have a lot of input from the Ventilation Safety Group, including the authorising engineer. But, before that, am I correct in understanding that you would not traditionally have had input from an authorising engineer?

A Not from an authorising engineer.

Q What about input from clinical teams?

A You would always seek clinical input from the very start of a project. The clinical users, the nursing staff-- I've written the room data sheets for a scheme and I sat down with the clinical staff, the actual-- you know, nursing staff, the surgeons. A scheme I did at Trafford General, when I was at the engineer there, I sat down with the surgeons to establish what did they want out of a theatre. They wanted an ultra-clean theatre and they wanted some extra things, so you'd sit down and consult with them.

Q Again, you have told us that the pre-design stage, that would take you up to what you called RIBA stage 1. How detailed is this design going to be at stage 2?

A It's more developed.

That's when you start to put locks on a drawing with plant arrangements and potential ductwork runs, pipework runs, cable runs. No sizes on yet, no detail, but just a-- conceptually of how you'd get ventilation ductwork from a plant room somewhere down to a department.

Q At this stage, would you have levels of detail such as air changes per hour and pressure regimes?

A They may have been produced as part of the room data sheet process. We can talk about that if you want in terms of-- about the room datasheet, but----

Q We will come on to room data sheets, but if we could just focus, before we do, just on what level of detail you would be at this stage of the design.

A You'd use experience, you'd use what exists in the Health Technical Memoranda to inform that decision-making process. Unless you were aware of something in the brief that required something completely different, then you would use experience of what's already in existence.

Q So just to make sure I am understanding, you have the brief, get it to RIBA stage 1, you then take it

on and build in slightly more detail at that stage, and am I correct in thinking that you may or may not have levels of detail such as air changes per hour or pressure regimes?

A Correct.

Q Now, you mentioned a concept called room data sheets. What do you mean by room data sheets?

A A room data sheet is the requirement for that particular space. It will cover the physical characteristics of the space, what the walls are going to be made from, what the flooring is going to be. So you'd say the flooring, in this-- If you take this space as an example, it's got carpeted floor, it's got lay-in ceilings, it's got white walls with a certain permeance of paint, the room is a certain size, it's a certain height, and you would also see on some room data sheets the number of people that are in there and what the room is going to be used for, and also what its relationship is to other rooms because sometimes you get rooms that need to be next to one another in a hospital for patient flow and clinical use.

You then get another element of the room data sheet which gives you the environmental criteria: what light level will be required, what air change rate, what temperature, whether the room is positive or negative in terms of airflow, fire detection. What is the noise criteria for the room? So what room-- You know, if it's a bedroom, you want it very quiet. If it's an operating theatre, it can be a bit noisier. Then another level of detail goes down to how many sockets are in the room, how many data points, how many cabinets are in the room, and it defines who puts those into the contract. So there's a definition in the column, which is called Group 1, 2 and 3. So a Group 1 item would be an electrical socket, so the contractor will price for that and he will install that. A Group 2 item might be an IT screen that gets supplied by the client, but the contractor installs it. A Group 3 item might be just something like a litter bin that gets purchased by the trust and put into the space, or the chairs that you see, something that can be just wheeled in at a later date and moved around.

Q We will come on and look at an example of a room data sheet later, but, just so I am understanding you at the minute, it sounds, from what you have said, that the room data is highly prescriptive in terms of the level of detail it provides, is that correct?

A Correct.

Q So it would be providing the size of the room, is that correct?

A It would.

Q It would be providing the ventilation requirements, such as air changes per hour and pressure regimes?

A Yes.

Q At what stage is that coming in? Because we have got pre-design, we talked about the reference design starting then, and then we are into the design stage where you have got the concept, but how do the room data sheets slot in? At what stage are they made up?

A You can generate that level of information at day one. There are different levels of detail that you can draw down from. There's a number of proprietary products where you can pull this data from. It is what's regarded as best practice, it's what's affordable, it's what normal clinical practice has, from experience, used to define that room.

Q So you could either do that at the pre-design stage or when you move into stage 2 in the actual design stage itself?

A Yeah, it just depends how much-- It's not that difficult to-- Once you've generated a schedule-- The schedule of accommodation at

stage 1 defines the departments that are in the facility, and you can then just go onto a department and click, “I'll have that many bedrooms,” and you just generate a sheet. It's not that difficult. You can generate it all at one point.

Q Who would generate it?

A Either the NHS trust, the architect or the medical health planner. It depends who is asked to do that. Some trusts have a team experienced in capital development who can do that work for you.

Q Now, the next stage that you mention on page 50----

THE CHAIR: Sorry, my fault, it is just getting that answer. The question was who would generate the room data sheet, and you said it might be the trust, it might be the architect, and the third one was?

A The medical planner.

Q The?

A The medical health planner.

THE CHAIR: Thank you. Sorry, Mr MacGregor.

MR MACGREGOR: Thank you, my Lord. So, if we could look back to page 56 of your reports, you have got the pre-design, the design stage. Am I right in thinking by the time you are at the design stage, you have to have,

effectively, both the concept and the room data sheets, is that correct?

A Yes, and that would form another key gateway to sign off and say, “Yes, that's what we want to build.” So you've gone through the funding application process where you have just-- is, “Will this building fit on this site?”, you then go to the next level of detail and cost checks, and then that would get approved through a key gateway before you then go into the detailed design.

Q When you say the “detailed design”, when does the design phase finish and when do you move to the construction phase?

A Once the-- You’ve then-- From establishing the rooms and the detail, you then start to spend a period of time calculating the pipe sizes, the cable sizes, the duct sizes, the architectural details. So the whole design team have then a series of tasks to develop that design to a point that a contractor can price it.

Q For a contractor to price it, do you need both concept design, room data sheets and what you are referring to as the more detailed design?

A Yes. You can get different-- It's all about accuracy of price. You could approach a

contractor at stage 1 and you would have a price certainty with a plus or minus percentage of accuracy. The more detail you can put down on paper, the more accurate the price becomes.

Q So would you have to have that design process that you have just told the Inquiry about completed before you could effectively move to the construction phase?

A Ideally, yes. There are situations where you might not have developed that design to that level of detail, but the programme pressure means you have to start construction before that level of detail. In other words, the pipe sizes, you might not have got that secured. You may have got 80 per cent of the design complete to get a cost certainty to appoint a contractor, but then there is a risk associated. But the contractor would generally price that into his offer, price the risk of the design not being completed.

Q Going on your experience, is that something that you would recommend the client does?

A No, not in my opinion.

Q Why not?

A Because at this moment in time, with the way the market is and the way prices are fluctuating, it just

carries a lot of risk that-- As of today, you know, inflation price risk is huge in the industry, shortage of materials is huge in the industry, and those are inflating prices beyond what might normally be affordable, say, 18 months ago.

Q Is it too basic to say that if you did not have the design fixed, you do not know what will be built?

A There is-- Well, if the contract documents set the parameter, set the rules as to what you will have, then that is a degree of protection for you as the client. You know, if your specification says you shall have X, then you expect to get that. The size of the pipe that goes to something is less important, but there is still a risk to pricing.

Q Just before we move into the construction phase itself, if a health board or a health trust was going out to do a competitive tendering exercise, it was going to conduct a procurement exercise, what level of design would you expect to be completed before that procurement exercise started?

A It depends on the contract that you're going to engage with. Traditional-- As we call them, traditional contracts, you would expect the design to be very well advanced before it's priced. If the time pressures

are such that you might just take that risk and not have the pipe sizes on, you would go to tender and you might go through a design and build contract, such that the design-- the completion of the design is undertaken by the contractor.

Q Would you expect room data sheets to be in place before a procurement exercise was conducted?

A Yes.

Q Why do you say that?

A If you want a degree of cost certainty-- Because of the way the room data sheets work with the amount of detail that's in them, you're telling a contractor, “That is what I expect. That is the employer's requirement.” Instead of just saying, “Give me a hospital with 200 beds and five operating theatres, please,” you're telling them the level of detail that they expect to price.

Q So returning then to page 56, you go on to tell us about the construction phase. What do you mean by construction?

A Turning the drawn information into reality, the ductwork, the pipes, the walls, such that a contractor can programme works and decide the priority of what he has to build first and what contractors he will need to bring on board to implement

that design from a 2D drawing into a reality.

Q Would that be done before or after a contract was completed?

A How do you mean, sorry?

Q With a contractor.

A The design would be complete before you would go to-- or degree-- to what extent you agree before you go to the contractor, and then you call on the contractor's skill and experience to inform the whole construction process and programme.

Q Thank you. So the next stage that you outline on page 56 is what you refer to as "handover", and then you outline a process called "commissioning". What is commissioning?

A Commissioning is setting to work of all the dynamic systems in the building. You can't just turn a fan on and expect the air to get from the plant room down to the apartments in the correct volume. So you're basically turning things on and making sure that water flows where you want the water to flow, air flows where you want it to flow to and is the correct temperature.

Q Then you mention a concept over the page, on page 57 of

the bundle, of validation. What's validation and how does it differ from commissioning?

A Commissioning is undertaken by the contractor. As part of his brief and as part of his tender, he will be asked to commission the systems and prove that they meet the design requirements. In other words, if a room, such as we are in today, has got X many litres per second, he will be required to demonstrate that. Validation is an independent third-party proof that he's done what he said he's done, and certain areas of a hospital require validation for legal purposes and for third-party verification. As an example, a pharmacy that produces drugs is controlled by the Medicines Health Regulatory Agency. They will go in and validate a pharmacy to prove that that pharmacy meets their guidance. So that's another set of guidance documents that the design has to be considered. So validation is really a third party verification of a system or facility.

Q With commissioning, the contractor is proving that the ventilation system, for example, works. Correct?

A He's basically-- The contractor is proving that everything

that was on the design drawings has been installed and works in accordance with the design intent.

Q Then validation is a check by an independent third party.

A Correct.

Q Who would actually do that, that validation process? Is there a specific individual that would carry that out?

A It may be overseen by the authorising engineer. He may do that work or want to inspect the records of the contractor and ask for spot checks on things. How he does it is really up to him. If he starts to do inspections and find there's lots of errors, then he will basically go back and start all over again, but if he gets comfort that the main key criteria, the main air-handling unit air volume, is matching the design intent, he may say that that is sufficient as far as validation is concerned. It might be that he has to go back and check every single valve. In a pharmacy, as an example, you have to check everything to get the Medicines Health Regulatory Agency stamp to say-- because a pharmacy produces drugs that are being given to a patient, there's a lot greater surety requirement that that building has been built to the correct standards – or that facility,

rather.

Q Thank you. If I could ask you to look on page 57, please. Just below figure 1, there's a note. Do you see that note beginning "Commissioning is the setting..."?

A Yep.

Q Okay. So you say:

> "Commissioning is the setting to work of all engineering systems that move air and water around a building and is vital to ensure the systems perform as intended by the designer. Air and water-based systems need to be set-up to ensure correct flow rates are delivered to ensure air change rates are achieved or heating is available…"

Now, whenever you say: "air change rates are achieved", what are you talking about? Are you talking about contractual specification, or would there be checks against wider guidance?

A It would be-- You would look at-- The engineer will have taken the air change rates for a space, converted that to an air volume, and then designed the distribution system in the room to get that air into the space. So, if you look in this room here, you've got these swirl diffusers. The design drawing will show how

many litres per second of air are required from that grille. So the commissioning process is you put a device up there to measure that performance and prove that that will go to that place. One of the things with fluids is they only take the path of least resistance. So if you-- The duct that serves this room is at that far end, you might find all the air goes out through those grilles, so there's no air distribution at this end. So you have to balance where the air goes, and that's what the commissioning engineers do, and they prove it by measuring the air volumes. There are devices within the ductwork that push the air or ensure the air is delivered equally as you intend it to.

Q The Inquiry heard evidence from Mr Andrew Poplett, who's an authorising engineer, and his evidence was, at the validation stage, the authorising engineer would check not just the contractual specification but would also check for compliance with guidance such as the Health Technical Memorandum.

A Yes.

Q Is that your understanding of what happens in practice?

A Yes, it may well be. He would look to see as to what were the

contract documents, what was the air change rate. He may do his own independent verification, look at what a particular room was intended to be; he may do his own calculations to do that.

Q Just to be clear, would that be checked against both the contractual specification and guidance such as Health Technical Memoranda?

A Yeah. With an experienced authorising engineer, he would say so, yes. He would look at that and say, "Well, why is that at that specification? That doesn't meet--" He might say that "That doesn't meet the HTM. Why has that occurred?"

Q What would you expect an authorising engineer to do in that scenario if there was a disconnect between the contractual specification and what's specified within a Health Technical Memorandum?

A He would flag it up as a non-conformance or noncompliance and why, just to seek the question "Why is this-- Why does this not meet the HTM?"

Q As he's an independent party, who is he flagging that up to?

A He would be employed by the NHS trust body that has commissioned the hospital, so he provides an independent verification.

Q Still within page 57 of your report, just above the bullet points, you say:

> "Throughout the above stages there are many competing interests that have to be resolved that can only be resolved by dialogue with all parties."

Then you list a number of parties, so architects, structural engineers. You also mention an infection prevention and control. What do you mean by infection prevention and control within the NHS?

A Every hospital has an infection control officer who's-- That person may be of a nursing background – generally they're of a nursing background – and they will implement policies on a site to control infections. They will have policies for handwashing, for washing mattresses. They may have technical requirements that they've developed from their own experience. They may have policies in place that say they want to be able to examine something. So it's what-- Some of the policies are all to do with sort of clinical nursing practices, but they may have an impact on the built environment. There's not many-- in fact, I know of only one nurse that's an infection control nurse that's a built environment specialist as well, there's not many of them about, but some trusts might insist on certain things.

Q Just to be clear, the procedures that you're talking about here, is that the procedures that existed up to 2021 because, after 2021, you would now have the Ventilation Safety Group that started here?

A Correct. I would always ask if I was taking-- all the way up through my career, as I started to ask clients for briefs, I would always ask, "Is there any infection control policy that is local to this trust that might impact on the engineering design?"

Q In terms of those changes, so the individuals listed there that would be involved as opposed to those individuals plus the Ventilation Safety Group, what system do you think?

A I think the creation of the Ventilation Safety Group has been a-- it's followed the principle of a Water Safety Group, which was something that was developed a few years ago to look after the water systems in a hospital. So the actual Ventilation Safety Group is a really useful team of individuals to agree a design.

Q Why?

A There are some times where you might choose to change a

design for local reasons. There might be issues with the-- trust might want to-- they have a different maintenance protocol that they want to implement in-- and that would influence and feed into the Ventilation Safety Group.

Q At this section of your report, you mention a number of key considerations in relation to ventilation. So obviously architectural issues, engineering issues, infection prevention and control. Would you agree that energy efficiency would also be an important consideration in many cases?

A Energy efficiency tends to be governed by building regulations and statutory requirements. So you have to comply with those before you really comply with the HTMs because you have to get building regulation compliance before you're-- the building sign-off.

Q Would such issues have to be factored into the ventilation design?

A Yes, they would.

Q Can I ask you to look to section 2.2 of your report, please, which is on page 58. You introduce here the Scottish Capital Investment Manual, and you list various stages: initial agreement, outline business case, full business case and so on. Can you just summarise what each of those stages is?

A These are key gateway sign-offs that the NHS has in terms of its investment process. So, like we said earlier, you wouldn't start with a concept design and go all the way through without some checks and balances through the process. There's a time period for all these tasks to take place. So it's making sure that you are going to build a hospital that meets the clinical need for the area. You're then going to make sure that it's going to be at the right size that still meets the budget. So you start off with an accuracy of a budget; for argument's sake, let's say it's 30 per cent accurate; as you go through these key design stages, the level of detail increases and the cost certainty decreases. So instead of being plus or minus 30 per cent or plus 30 per cent, you would be down to, say, 10 per cent. So you're getting more and more accurate and, as you do that, you obviously are expending more money because of the design service involved to get to that stage. If you'd suddenly started with a desire to build a hospital of X wards, X operating-- Y operating theatres, and then you went all the way through to the end and suddenly found you couldn't afford it, once you'd

tendered it, you've wasted an awful lot of money. So there are key gateways, and these are allied to the line underneath-- are the RIBA industry standard stages, so preparation and brief, concept design, developed design, technical design. You would normally go to tender at the end of a technical design process, but if you're doing a design and build, you might go out at the end of a developed design – but, again, you carry a risk commercially as to what that price from a contractor would be.

Q Just thinking back to the four-stage design, beginning with pre-design and moving onto design, at the initial agreement stage, what level would the design be at?

A I would say at the initial agreement stage, you're talking possibly just schedule of accommodation with area.

Q Then, once we move forward into the outline business case, by the outline business case, what stage would you expect----

A You would be----

Q -- the design to be at?

A -- doing drawings at a 1 to 200 scale, which showed the interrelationships of the departments, where the wards are in relation to an ICU, and just the functional shape of

the building should be defined during the outline business case.

Q Would the room data sheets be completed by that point?

A They could be. The outline detail in terms of the departmental areas, the level of detail in terms of air change rates, you wouldn't need to know that at that stage – that really comes-- The level of detail that is on a room data sheet in terms of lux levels, noise levels, that really steps in at developed design stage.

Q The developed design stage would be somewhere between outline business case and final business case, is that correct?

A Correct.

Q So, if we look within the outline business case, these just still within figure 2, you'll see that you have various boxes. So, below concept, you've got "Operational Commissioning", and at the bottom of that box you've got "Late OBC", so is that late in the outline business case? Within outline business case, there's then a large box with "Operational Commissioning", do you see that?

A Yes.

Q Then within that, just above the third-last bullet point, it says "Late Outline Business Case, Review

Concept Design, Outline Equipping Strategy, Outline Commissioning Masterplan".

A Yeah, this is where you engage with the NHS team, client body, the project board – call it what you will. So the NHS body should be setting up or should have set up a project team, usually comprising a project director, a representative of the estate staff, representative of the operational staff, to develop the brief. That team will then have to look at those particular aspects. They will need to look at appointing a commissioning manager and some of the tasks that they, as the client, will need to consider to help them get what they want at the end of the project.

Q Then, if you look at the box below that which is called "Technical Commissioning", we see the second bullet point there, "Review Guidance & Standards". What does that mean?

A Really, just for the team to-- the NHS team to understand what they're going to get, and that's the chance for them to say, "Actually, we've found this doesn't work on this site. This is not what we've developed in terms of custom and practice from a maintenance perspective."

Q In terms of guidance and standards, would that be touching on things like Health Technical Memoranda----

A Yes, it would.

Q -- or Scottish Health Technical Memoranda?

A Yeah. An example of this is that, one aspect of the HTMs relating to single-bed isolation rooms, there are certain organisations do not concur with the standard, they have a slightly different standard; that's where they would say, "We don't want you to use that element of the HTM. We want you to use this document."

Q Then if we see, within that, still Technical Commissioning, it says: "Late Outline Business Case, Review Concept Design, Agree key Derogation list". What does that mean, "Agree key Derogation list"?

A If there is an element of the HTM-- and this is one of the new things that's occurred with the-- certainly with HTM 03-01-- If there is an element of HTM 03-01 that is deemed not suitable for that project, then you would now be required to prepare a list of derogations. An example might be the construction quality of the air-handling unit; the trust may prefer the interior to be made of X, whereas the HTM has a list of what it should be. So if you-- if the estate

staff or the client body agrees that there is a derogation, that should now be listed on a schedule.

Q If you're thinking of not complying with guidance such as Scottish Health Technical Memoranda, you would be expecting that to be identified at the outline business case stage.

A If there was a key change at outline business case, yes, you might look, as it develops further down the line, to change that.

Q If we then look on to the next stage, which is the Full Business Case, and within the second main box there, "Technical Commissioning", see the third bullet point "Review Derogations…" See that?

A Yes.

Q Could you just explain what's meant there by "Review Derogations"?

A Well, that's when you-- a derogation from a standard may have been selected, as the word says, record the risks, so you then need to do a risk assessment on why has that change occurred and what are the risks that-- You know, someone may have agreed something at one stage and then not really thoroughly thought through the risk associated with that change; it might be something or

nothing, it might be quite important.

Q In terms of this diagram that you've provided, "Initial Agreement, Outline Business Case, Full Business Case", if there had to be a procurement exercise done, what point would that be done in terms of those three stages?

A It depends on how you're going to procure. If it was a full, detailed design using a traditional model, you would go at the end of stage 4. If you're going through design and build, you might go out at the end of stage 3, developed design – but you've developed a much greater development of the room relationships, and then you are using the contractor's skill and expertise to build that more quickly – using perhaps offsite manufacturing as an idea. They would bring that to the table at that stage.

Q Am I understanding correctly, you would do the outline business case, the procurement exercise, and then that would all be signed off in the final business case before the contract's concluded, is that correct?

A Yes, and that's part of the NHS approval process that you cannot generally appoint a contractor until full business case has been approved.

Q In terms of any agreed derogations, is that being done by a health board before or after the contractor is becoming involved through the procurement exercise?

A It-- Well, it should be signed off before the contract is in place. It might have been agreed with the health board or the client. A contractor may propose a derogation as part of his tender exercise, and that derogation would get added to the derogation list – again, so that the client is clear that he is not getting a fully potentially compliant hospital. If there's been a-- the derogation's agreed, then the contractor builds to that, then it's compliant with what the derogation says.

Q We can move on within your report, please, to page 59 whereby you outline issues such as time, cost, and quality. On page 59, just below "Time", at letter "B", talking about the funding arrangement, you say: "PFI funded schemes have a higher degree of urgency from a cost viewpoint as financial investors will want a faster return on investment." Can you just explain in a bit more detail what you mean by that?

A A funding partner, a financial house, will basically loan the money to build the hospital. As soon as the hospital is handed over, they start to get a return on that investment. So, the longer the hospital takes to build, the longer it will be before they start to see a revenue stream. In my experience, it's as simple as that: they will want to see it built as quickly as they can, so they get their-- the client moves in and they start paying the rent.

Q Is it an over-simplification to say a pressure to get to a point where the money starts to flow?

A I don't think it's an over-simplification, there is a pressure. There is a practical limit as to actually how fast you can build something. Concrete takes so long to set, it takes so long to install certain things and test them. Some of it you can do it just by putting lots of labour on, but there are still some practical boundaries, if you will, to limit them, how much you can build and how fast.

Q There could be private money that's going in, both potentially capital and debt, with interest running-- interest payments, is that correct?

A Potentially. That's beyond my area of expertise, I'm afraid. When you start talking equity and debt, I get confused, I'm afraid.

Q Again, just going back to my understanding of what you've told

the Inquiry, though, that the money wouldn't be paid by the health board until they get the facility handed over.

A With a PFI-funded option, that's correct. That's my interpretation, yes.

Q If I could ask you to look within your report, please, to section 3 which is on page 62. You set out, at 3.1 onwards, the various types of hospitals, so primary care, secondary or acute, tertiary or specialist care. Then from 3.12 onwards, you begin to talk in slightly more detail about nucleus design. You say, towards the bottom of the final paragraph, three lines up from the bottom, with the nucleus design there was "a lever arch file with concepts layout and room data sheets being pre-defined." See that?

A Yes.

Q Is that really what you've told us you were working on earlier in your career----

A Yes.

Q -- in terms of the nucleus pack?

A The nucleus pack, as I say, I can distinctly recall a whole series of purple lever arch files, and you said, "If you want an A&E, you can pull the lever arch file off." You know, this was in the days of pre-digital, so it was-- you had a paper print showing you what the drawing was going to look like for an A&E.

Q So, effectively from 1975 onwards, you had a degree of standardisation in terms of the approach towards hospital design?

A Yes, and I think, as I said in my report, there were all the concepts that were developed on ward layouts: the Nightingale from the 1800s; the post-war racetrack; Nuffield wards; Falkirk wards. I have not dealt with a Nuffield or Falkirk. I've dealt with plenty of Nightingales, many of which are still operational today.

Q You mention within your report at page 63, that nucleus design fell out of favour. Why did it fall out of favour?

A In my experience, it was because-- I understand that it didn't meet certain changes in nursing practices. The layouts were-- clinical nursing practices were changing and in a nucleus ward you had a couple of seven-bed wards. There was a desire to reduce the number of beds in a ward to four and more single beds. The nucleus footprint didn't lend itself to that. It was a change.

I think there was an architectural imperative at the time that they were just boring and they didn't fit on certain sites because they were designed for

two or three storeys at most. A lot of new hospitals can be typically six storeys and they're more inner city based as well because of transport links for members of the public to get there. So, there was a whole change in emphasis.

Q The Inquiry has heard evidence that there has been a greater drive towards single bedrooms within hospitals. Is that correct?

A Yes, very much so.

Q Is your experience that there are still some multi-bed wards within new hospitals?

A I've not done one for a while. We've just completed a project in the last 12 months where we've done two major developments at a site and we've delivered approximately 400 single bedrooms. The only multi-bed areas are recovery bays or intensive care units or critical care units. The general medical, or surgical, delivery is done through single bedrooms these days.

Q The Inquiry heard evidence from Ms Mackenzie, a former chief nurse for Acute and Community Children's Services with NHS Lothian, and her evidence is that there is a move towards nearly 100 percent single beds unless there is a clinical justification. One example of a clinical justification she provided the Inquiry was, for example, within a children's hospital. That children can have social isolation if they are on their own. It can be more difficult, in terms of alerting staff if they are ill, so she said there could be a clinical justification for a departure from 100 percent single bedrooms. Would that be your experience as well?

A Yes, very much so. There was a desire from an initiative called “The Patient Experience” to give people some privacy and dignity. If you're in a bed bay with seven other patients and one's in a degree of pain and screaming out through the night, then it disturbs the other six patients. There's also an operational issue that if one of those patients becomes very ill, they can spread sickness and a diarrhoea and vomiting bug around the other seven, six patients. So, suddenly you've got seven patients who are very poorly, whereas if you've got lots of single beds, you can just isolate that one room and deal with it.

Q Thank you. I want to move on now and look in a bit more detail at some of the guidance that we’ve touched upon. The first document that I want to look at, please, is Scottish Health Technical Memorandum 00, which is in bundle 1,

at page 333. So, this is document "SHTM 00 Best Practice Guidance for Healthcare Engineering, Policies and Principles". Have you got a familiarity of working with Health Technical Memoranda and Scottish Health Technical Memoranda?

A The Scottish ones are very similar to the English ones. I am more familiar with the English ones.

Q So, within the series of either the HTMs or the SHTMs, what is either HTM or SHTM 00? What is its purpose?

A It's really the whole structure of the process and documents that you need to go and refer to. I tend to go and look straight at the detailed technical ones for medical gases, water or ventilation. This sets the framework for which the documents have come out. They were renumbered, have been renumbered twice, so it's just the structure of the way the whole guidance documentation works.

Q Within that document – we will come on and look at it – but at various points it is described as "general guidance" and then at other points it is described as "comprehensive guidance". What is your understanding of the level of guidance it provides?

A It is just a level of detail. If you look at the below, it just tells you the principles that you should adopt about plant resilience and general issues you should consider as part of-- It's not a document I read every project because I always work straight through the detail. So, it's more aimed at people who've not got a great deal of experience, in my view, that can inform them of where to look and look at the detail. I tend to look straight at the detail.

Q If I could ask you to look, please, to page 340. Do you see that it sets out, on page 340, the scope of the document? So, it says:

> "Scottish Health Technical Memorandum 00, and the series it supports, provides comprehensive specialist advice and guidance on the design, installation and effective operation of a healthcare facility from an engineering technology perspective. While it is not intended to cover every possible scenario, for example the concept of hospital at home … the standards and principles it advocates may be appropriate to follow in all locations where healthcare is provided."

Do you see that?

A Yes, I do.

Q Is that your understanding of what these documents do?

A Yes. I think the opening line of that is, "This document gives best practice advice", is the key one for me.

Q It continues then, under the next bold heading, the aim of the guidance:

> "The aim of Scottish Health Technical Memorandum 00 is to ensure that everyone concerned with the management, design, procurement and use of the healthcare facility understands the requirements of the specialist, critical building and engineering technology involved."

Do you see that?

A Yes, I do.

Q So, again, is this just a guide written by engineers for engineers, or does it have a wider audience?

A I think it has a wider audience because some of the elements within the HTMs are for the operational staff. It's also telling other members of the design team why we do what we do. We have certain requirements to comply.

Q Then if we look to the

final main paragraph, beginning, "Only by having a knowledge", do you see that?

A Yes.

Q So:

> "Only by having a knowledge of these requirements can the healthcare organisation's Board and senior managers understand their duty of care to provide safe, efficient, effective and reliable systems which are critical in supporting direct patient care. When this understanding is achieved, it is expected that (in line with integrated governance proposals) appropriate governance arrangements would be put in place, supported by access to suitably qualified staff to provide this 'informed client' role, which reflect these responsibilities."

Do you see that?

A Yes, I do.

Q Do you see the reference to the term "informed client"? Thinking back to the design process that you talked about, in terms of the pre-design, the design, do you deal with informed clients or really is control just ceded to the architects and the engineers?

A No. The client generally

is an informed client. They may have different levels of experience of procuring capital projects, but generally the clients I've worked with are informed. They know the level of information and their own skill and at what point they need to pass down to design engineers or architects to develop that skill.

Q If I could ask you to look on, please, to page 341 of the Scottish Health Technical Memorandum 00, to the bottom of the page, "Recommendations". Do you see that?

A Yes.

Q On page 341, the bottom section, "Recommendations".

A Yes.

Q "Scottish Health Technical Memorandum 00 recommends that Boards and Chief Executives, as accountable officers, use the guidance and references provided…" Then over the page, on page 342, "…when planning and designing new healthcare facilities or undertaking refurbishments". Do you see that?

A Yes, I do.

Q And is that your experience in the industry of what actually happens?

A Yes. Hospital trusts tend

to set up a project board, and that project board is then responsible for delivering that facility, and make key decisions and bring the relevant stakeholders into a team. So, whether it be a clinical team, surgical team or a medical team, they will pull together the specialists from each department to help inform the designers.

Q That is being planned and designed in line with the Health Technical Memoranda or the Scottish Health Technical Memoranda?

A Yes.

Q Just for completeness, at the bottom of page 342, we see the guidance going on:

> "Once NHS Boards and Chief Executives have embraced the principles set out within this document and taken the necessary actions, their duty of care responsibilities are more likely to be fulfilled, as will their ability to maintain public confidence in the NHS at local level."

Do you see that?

A That's correct. Yes, I see that.

Q If I can ask you to look on, please, to page 344 of the Scottish Health Technical Memorandum, to paragraph 1.11 "Guidance". Do you

see that?

A I do.

Q Page 344, paragraph 1.11:

> "Scottish Health Technical Memoranda Guidance provides a best-practice framework which aims to raise awareness and provide the confidence for strong management."

Do you see that?

A I do.

Q So again, is that the same formulation you use? That it is best practice?

A I believe that they are the best practice.

Q Is it mandatory though, to comply with the guidance?

A That's a difficult one, so actually is it mandatory? I don't know if the word actually "mandatory" exists. It didn't in the old versions. The new version of HTM 03-01 uses what's called "modal verbs", so it defines what the word should-- because there's many situations where arguments have occurred between whether something "should", "must" or "will". So they've now defined that in HTM 03-01 to offer what is guidance and what is mandatory. An example being that a certain component of an air handling unit had to be a glass trap on a cooling core, so you could see-- and that was a mandated requirement. There are other options and elements that others could give an option for; there are certain elements that would be mandated.

THE CHAIR: Your reference to the use of modal verbs, was that an innovation in the 2021 version of the HTM or----?

A Correct. Yes, it's in HTM 03-01. I don't believe it's in any others, but it came out in HTM 03-01 because of these different engineers would have different views on things, so they used modal verbs to really define and be more prescriptive.

MR MACGREGOR: Regardless of the precise legal status of Health Technical Memoranda and Scottish Health Technical Memoranda, if a client came to you seeking a design for a ventilation system for a new hospital, would you expect to be able to achieve full compliance with the Health Technical Memoranda or the Scottish Health Technical Memoranda?

A Yes, I would.

Q So would your expectations be that there would be any derogations at the design stage?

A If the client wanted to derogate, he would tell you. Otherwise you'd take it that-- the HTMs are the

gospel, your Bible to work to, instruction manual. They are regarded as the most comprehensive and they are used by many European and overseas countries as the gold standard. So they are based on years of experience from operational people, from health facilities, health trust boards who feed into the whole process to modify them and update them.

Q The next document that I would like you to have a look at, please, Mr Maddocks, is the Scottish Health Technical Memorandum 2025, which is in bundle 1, page 28, please, "Scottish Health Technical Memorandum 2025, Design Considerations, Ventilation in Health Care Premises". Again, you have explained within your report that there were various developments through what you refer to as "DV4" and then there was Health Technical Memorandum 2025 and Scottish Health Technical Memorandum 2025. Then there was the re-numbering from 2007 onwards where it became Health Technical Memorandum and Scottish Health Technical Memorandum 03-01. So, if we think back to the point that we are dealing with, with 2025, what was the purpose of this document?

A This was really an

enhancement on previous guidance, bringing together operational experience and started to become more applicable to other areas. The original design guide that was referenced as "DV4" was purely for operating theatres. 2025 started to expand it to other areas within a hospital and then as HTM 03-01 has been updated, they've started to define more detail. This is like an evolution of the design standards through a period of time.

Q So, effectively, technical principles and guidance for ventilation systems being set out?

A Yes.

Q If I could ask you to look on, please, to page 41, to table 2.1. So, on page 41, table 2.1, "Typical internal design conditions" and then, below that in brackets, there is a statement, "Refer to Activity DataBase for specific details". So this is within the Scottish Health Technical Memoranda. It is referring the reader to what is referred to as an "Activity DataBase" to get more specific details. What is your understanding of that reference?

A The Activity DataBase is what generates the room data sheet. So it's a database of various departments, rooms and that will cover

the information. You go onto the database to look for the rooms in particular. The HTM only lists eight rooms. Obviously, there are many more room descriptions within a hospital, within departments, so you would expect if the information isn't on that table for the room you're looking at, you would then go and look at the room data sheet and hopefully it would be in that room data sheet.

Q Okay. Now, you have told us about the old nucleus design where you had lots of purple folders. Physically, what is the Activity DataBase? Is it more lever arch folders or is it something different?

A It was, at the time, just in lever arch folders. It's now, obviously, an online database and a piece of software that you can interrogate, adjust or just generate the standard exemplar spaces.

Q Again, what level of detail would you see within the Activity DataBase?

A Every detail that you would need to develop the design for a space: temperature; humidity; lighting levels; pressure regime, which is on that table; everything that you would need to inform your design as an engineer.

Q So the Scottish guidance is effectively saying, "For the real detail, go and look at the Activity DataBase"?

A Correct.

Q If we can, then, still within SHTM 2025, if we could look onto page 46, please, to paragraph 2.52:

> "Specific requirements for individual spaces and departments are included in the Scottish Hospital Planning Notes (SHPN), Health Building Notes (HBN) and Activity Data Base (ADB) A-Sheets."

Do you see that?

A Yes.

Q So if we see references to "Activity DataBase", "ADB" or "A-sheets", is that all relating back to the Activity DataBase?

A To the room data sheets, yes.

Q Just to be absolutely clear, you would have a room data sheet, which is a physical screenshot or a piece of paper, but it would be populated from the Activity DataBase?

A Yes. I put examples in appendix 1 of my report of the level of detail that they cover.

Q Thank you. We will come on to that in a moment. Thank you. Then still, just for completeness,

within SHTM 2025, if you look to page 222, please. This is section 3 "Minimum standards". Which says:

> "New ventilation systems should be designed, installed, their performance validated and handed over to the standards set out in the relevant sections of this SHTM, Health Building Notes, Scottish Hospital Planning Notes and associated activity data sheets."

Do you see that?

A Yes.

Q Again, is that in line with your understanding of industry practice in terms of how a ventilation system would be created?

A Yes.

THE CHAIR: Sorry, my fault, Mr MacGregor. Could you just give me that page reference again?

MR MACGREGOR: Yes. So, it is page 222----

THE CHAIR: Thank you.

MR MACGREGOR: -- and it is paragraph 3.1. The next set of standards I would like to look at, please, is in bundle 1 at page 618, which is Scottish Health Technical Memoranda 03-01, "Ventilation for healthcare premises, Part A – Design and validation." So we have now moved on, in terms of the development, from 2025 to 03-01. Were these guides split into Part A and Part B?

A Yes.

Q So what did Part A show?

A A is really for the design engineer to review. It's for the operational management of a ventilation system, so that tells the operational team the tasks that they are required to do on a quarterly, monthly, twice-yearly basis. How they can look after the system, basically.

Q If I could ask you to look on to page 624, please, which is the Preface, "About Scottish Health Technical Memoranda". Does it then really set out what this technical guidance is for?

A Yes.

Q So we see:

> "Engineering Scottish Health Technical Memoranda (SHTMs) give comprehensive advice and guidance and the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.
>
> The focus of Scottish Health Technical Memorandum guidance remains on healthcare-specific elements of standards,

policies and up-to-date established best practice."

So, again, is that in line with your understanding? You used that reference to best practice earlier in your evidence.

A That's your starting point.

Q

"They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle.

Healthcare providers have a duty of care to ensure that appropriate engineering governance arrangements are in place and are managed effectively. The Engineering Scottish Health Technical Memoranda series provides best practice engineering standards and policy to enable management of this duty of care."

Then, if we skip the next paragraph, there is a paragraph beginning:

"Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities."

Do you have any observations on that phrase?

A No. Again, it is the established protocols, procedures that have been experienced over time. There's a lot of hindsight that's gone into these documents from operational teams where NHS trusts and estates officers have fed back information. The authors of these guides are people from a variety of backgrounds, and it's just lessons learnt as well.

Q Would you agree with the reference to it being directed at ensuring "the safe operation of healthcare facilities"?

A Yes.

Q It continues in the next sentence:

"Scottish Health Technical Memorandum guidance is the main source of specific healthcare-related guidance for estates and facilities professionals."

Do you agree with that statement?

A Yes, I do.

Q Again, it then says: "The core suite of eight subject areas provides access to guidance, which," and then in the second bullet point, "encapsulates the latest standards and best practice in healthcare engineering."

A Yes, I agree with that.

Q If I could ask you to look

on to page 629, please, paragraph 1.17 on page 629, which says:

> "Increased health risks to patients will occur if the more specialised ventilation systems installed to supply high quality air to operating departments do not achieve and maintain the required standards. The link between post-operative infection and theatre air quality has been well established. Plants serving conventional operating departments, for instance, will be required to ensure the separation of areas within the suite by maintaining a specific direction of air flow between rooms, even when doors are opened. They will also maintain the selected operating department environment conditions regardless of changes in the outside air conditions or activities within the space."

Then it goes on to deal with ultra-clean operating theatres. Now, that is just an example for operating theatres, there are other examples, but is that really what this is directed at in terms of what needs to be complied with?

A Absolutely. It's informing an engineer or design engineer of the importance of following the procedure

that's laid out in the manual, following the calculation methodology and process, and that particular aspect of an operating theatre has been studied many times over to establish those design principles and they really haven't changed in-- since the 1960s.

Q Then if we look on to page 633, please, paragraph 1.35 on page 633:

> "The guidance contained in this SHTM should be applied in full to new installations and major refurbishments of existing installations."

Do you agree with that?

A Yes, I do.

Q Then if we look to paragraph 1.37:

> "In assessing the need for more specialised ventilation and the standards desired for patient care, managers will need to be guided by their medical colleagues and by information published by Health Facilities Scotland."

Do you see that?

A Yes.

Q Do you agree with that?

A Yes. If there is something-- If there's a new medical procedure being undertaken, say, a development, then the client needs to

explain to an engineer or the design consultant what that process is so that you can come up with an agreed strategy to deal with that uniqueness.

Q If I could ask you to look on, please, to page 646 to the bottom paragraph, paragraph 2.60. So page 646, paragraph 2.60:

> "Specific requirements for individual spaces and departments are included in the Health Building Notes (HBNs) and Activity DataBase (ADB) A-sheets, or Scottish Health Planning Notes (SHPNs)."

Are you surprised by any of those references?

A No.

Q Why would you expect to see all those references?

A It's reinforcing that the Activity DataBase provides the level of detail required to develop a design.

MR MACGREGOR: Lord Brodie, I am conscious that it is half past eleven. I am moving on to a slightly different area now within the guidance.

THE CHAIR: Right. If that is a convenient moment to break, that is what we will do. So we will take a coffee break, Mr Maddocks, and sit again at about quarter to twelve.

THE WITNESS: Okay. Thank you.

(Short break)

THE CHAIR: Thank you. Mr MacGregor.

MR MACGREGOR: Thank you, my Lord. Mr Maddocks, if I could ask you to have your report in front of you again, please. So it is in bundle 6 at page 65, please, and I am going to ask you to look at a passage at paragraph 3.3.1. You begin in the first sentence, setting out the brief, and then you say:

> "This should also include any specific engineering requirements including compliance with the relevant Scottish Health Building Notes (SHBN's) and Scottish Health Technical Memorandum's (SHTM's). This is often generated by the client (HFS Scotland or Health Board) in conjunction with a Clinical Health Planner …"

Can I just ask why have you included "Health Facilities Scotland or Health Board" in brackets?

A Sometimes they may have the team or the experience to prepare the room data sheet. Some organisations do have people within their team or they may second in a specialist to do that work for them.

Q It is just that, really, the Inquiry understands that Health Facilities Scotland is a body that provides technical advice and assistance to NHS boards, and that would include setting up framework agreements, for example. However, the board may be responsible for individual contracts in terms of building a hospital. Would you agree with that?

A Yes.

Q Then you say just towards the bottom of paragraph 3.3.1, three lines up from the bottom:

> "A brief should still contain the core physical requirements such as bed numbers (surgical or medical), number of operating theatres, specialist departments. Etc and the corresponding Room Data Sheets that provide the level of detail for department and spaces …"

Do you see that?

A Yes.

Q So, again, am I right in thinking you said earlier in your evidence that the room data sheets could be really produced at any point, but in an ideal scenario they would be produced right at the start?

A Yes.

Q Would they be a good way of confirming a client's ventilation requirements for dealing with issues such as odour emissions or removal of potential pathogens?

A Yes, and if there's any variances that are specific for that development, then you could flag it up at that stage.

Q If I can ask you to look on, please, within your report to page 89, top right-hand corner. At page 88, you start with Appendix A, which is "Example Room Data Sheets", but if we could pick matters up on page 89, please. So on page 89, we see, top-left hand corner, "ADB, List of Departments". What is this that we are looking at?

A This is an extract from the current Activity DataBase software – I contacted the manufacturers and agents for this product – and these are the departments that exist in the current Activity DataBase software package. These are based on the available Health Building Notes. You see the number on the left-hand side, the code. So those are codes that reference across to the Health Building Notes and they just detail what size department or what the departments are that they have. So you can see, about a third of the way down the page, you've got, "Adult in-patient facilities, 24-bed, 50% single-bed

rooms" or "83% single-bed rooms" or "100% single-bed rooms". So if you wanted a 100 per cent single-bed room ward, you would click on that 04-01C and it would tell you what rooms are in that department.

Q So if you opened up the Activity DataBase program, is this one of the menus that you would see?

A Yes. I've not used it for a while, but when I used it 20 years ago-- The process hasn't changed that much. It's just updating in accordance with the dates that you see on the right-hand side.

Q And this is giving you, first off, specific spaces that you can then click on?

A Yes, and it'll tell you what area that is. So, again, if you start at the very strategic development, you would look down this list and say, "Right, I've got so many 100 per cent single-bedroom wards. They are whatever area it is that's developed," and then you work down through that process.

Q You gave examples, but just perhaps another one. If we look approximately halfway down the page on the left-hand side, we will see "04-02", and then just in from that, "Critical care units".

A Yes.

Q So what is that referring to?

A It's a higher level of care provided for patients who are perhaps injured from an accident and they need more-- closer nursing care.

Q So specific areas within a hospital?

A Specific areas for specific functional needs, yes.

Q If we then look over the page on onto page 90, again, just as another example, approximately six entries up from the bottom, we see each "HBN 23, Hospital accommodation for children and young people".

A Yes.

Q Again, so that would be an area that you could click on within the menu?

A Yes, and you'd get a different level of accommodation within a children's ward. You would have play areas, as an example that immediately springs to mind, which you wouldn't have in an adult acute ward.

Q So if we then look over the page onto page 91, this time we have "ADB, List of Rooms". What is this showing us?

A This is rooms that are coded-- This one is, unfortunately, for

a mental health unit, which is what the manufacturer gave me. So these are standardised codes that you can key in and it will give you the more detailed information which follows on from these.

Q So, for example, if you wanted a single bedroom, you would look to the second entry, “BO512, Single Bedroom: mental health,” and then click on that?

A Yes, and that would tell you what size the room would be and what you need in that room. But, again, if you look to the right-hand side, the area schedule that I talked about earlier, that just demonstrates that a mental health single bedroom is 12 square meters, but an accessible one, i.e. one with somebody with a wheelchair, needs to be 14.5 square metres. So, again, it's that level of area schedule that's important.

Q If we then look on to it to page 93, please. So we have selected the area of the hospital, selected the specific space – what happens next?

A You then-- The activities are-- The activities, personnel, planning relationships and space data are the typical example-- exemplar designs from the Health Building Note. So it tells you what the room is going to be used for, “Patient may undress in

vicinity of a bed, receive therapeutic care,” etc., it tells you as a designer how many people to allow in that space, “1 x Patient and up to 2 x Staff,” so you can ergonomically design that space and allow for those people, it should have access to an en-suite facility, and then there are some design notes and you can edit those design notes and add them if there's anything specific that you want to make project-specific.

Q Just so that I am understanding things: whenever we are talking about an Activity DataBase, an ADB or a room data sheet, is this the physical document that we are talking about?

A This is a room data sheet. Activity DataBase is the backbone behind it all. This is the room data sheet that you would use to go into a room. You’d take this as an example and you’d say, “Right, have I got 12 square metres? Is it 2.7 metres high? Are this many people working in that room?”

Q And there would be one of these sheets for every space in the hospital?

A Yes.

Q You see at the top “Room Data Sheet,” it then gives the project, the department room, the

room number, sets out the activities, and then just above the notes, we see the space area. So you would have the area in metres squared and the height of the room?

A Correct.

Q What do we see in the notes section? What would be set out there?

A They're just pointers to the designer and to clarify with the user what their interpretation or their planned use of that room will be. So the last bullet point there, it says, "Where there is a significant risk of assault or self harm all furniture and fittings are required to be robust, anti-ligature," etc. So that's just really telling the designer that, based on the Health Building Note which generates these-- The information in the Health Building Note describes the space. This is an actual description in detail of what that space is going to be used for, that specific space. So a Health Building Note will describe the department and how it's used. The room data sheet will say specifically that space, what is required. I say that as an example for that particular one.

Q Thank you. If we look over the page onto page 94, is this still part of the room data sheet?

A It is still part of the room

data sheet. The room data sheet is four components. Sorry, I was just checking. So the first part is the room data sheet itself: "This is the room, this is what we're going to do in the room." Then the second page which we have is the Room Environmental Data sheet. This is the data that the engineer will look at to design the facility. So if you look at the top, you have "Temperature and Ventilation". It tells you what the permissible temperature range will be, and that's between winter and summer, what the heating design temperature is for winter, the minimum air changes – six – ventilation type, it says "S/E/N", which is supply, extract or neutral or natural, the pressure relative to the adjoining space – negative – the supplier air final filter class, so that's the-- telling you, for this particular space-- So G4 is not the highest level of cleanliness, but it's the-- Filter grades have changed but, for simplicity, that's a fairly average level of cleanliness because a single bedroom in a mental health is not a really intensely surgical space.

Q Is this automatically populated or does there have to be manual entry?

A It's automatically populated based on the Health

Building and Health Technical Memoranda. You can edit it if you want to.

Q So when you establish your room data sheet, it is going to self-populate with a minimum air change and a pressure regime for a specific space, drawing the information from Health Technical Memoranda and Health Building Notes?

A As long as that space exists within the database, the information is there. If you got a new concept that we talked about earlier, a new form of clinical delivery, you might have to fill that in based on that process.

Q If it's a space that wasn't recognized within a Health Building Note or a Health Technical Memoranda, would it simply be a blank sheet that's generated?

A Correct.

Q That would have to be manually----

A You'd have to be-- manually inputted, yes.

THE CHAIR: When we talk about manually editing, am I to think of the designer having drawn down either template of an identifiable space or a blank space, he's able to edit the digital document and then, if he saves that information, that is available either

to describe the project to other people or for the designer to have a point of reference to go back to? I mean, I'm trying to imagine how this might be used. You've identified that room datasheets can be edited. Once edited, do I understand that the information is then-- can be held on it digitally and then referred to by anyone who needs to refer it?

A On that project, yes.

Q Yes. So there is the possibility of using-- well, possibility, maybe probability, of using a number of room datasheets as a digital way of describing a particular project.

A Yes, there would be a whole suite of these documents, depending on the rooms. So you get a schedule of rooms, and then each one of those rooms would have four accompanying sheets.

Q Thank you. Sorry, Mr MacGregor.

MR MACGREGOR: Again, if we could just look onto page 95, which, again, I understand you've already told us that this information would be provided in the room datasheet, so detail on walls, floor coverings, ceilings, door sets, windows, etc. Is that correct?

A Yes. Yeah, so the environmental datasheet is the

engineer's point of reference, the room design character is the architect or interior designer's point of reference.

Q Then over the page onto page 96, we see a raft of information, including right down to mirrors that would be wall mounted and various sockets. What are we seeing on page 96?

A These are the components that would be installed in the room. So these codes that you see are universally accepted codes, so if you're purchasing-- If I go to the grouping on the right-hand side, so group 1, 2 and 3, as I mentioned earlier: group 1 is what's installed by the building contractor; group 2 is generally supplied by the client and installed by the contractor; and group 3 is supplied by the client. So "BED051" is a standard description of a bed for use in that facility. An electric hoist bed might be a "BED052". What you can do, because it's an electronic database, you can quite easily group codes by "How many beds are they?" So you can go and produce these and then just say, "Right, how many BED051s have I got in this facility?" You can then go and get those costed to purchase, so the client can use this form to purchase his group 3 equipment or his group 2 equipment.

These codes are universal, so an OUT005 is a socket outlet switch, single; that will be the same in any healthcare facility. That code is the same across acute care, mental health care, anything that uses the Activity DataBase.

Q Just to be clear, how routine is the use of room datasheets----

A It's essential on every project. The actual tool that's used may be different. I'm familiar with the ADB system; I know of one other called "Codebook". I know different government bodies use different tools and they are difficult to work with in my opinion. I could mention one, but it's a-- it becomes unwieldy. With a spreadsheet that's got hundreds of cells and hundreds of rows, you can only review it on a computer. I'm a bit old fashioned and I prefer a piece of paper in my hand that I can actually, you know, tick these off and give to an engineer.

Q Have you ever worked in a project where room datasheets weren't prepared?

A I can't think of one.

Q You've told us that there's different types of programmes that you can use in terms of not just the Activity DataBase, but there's

competitors that effectively generate something that's very similar and still called a room datasheet. Are you aware of there being any standard substitute if you weren't using a room datasheet approach?

A So the only other one I've seen is an Excel spreadsheet in Department for Education projects, and they have a different methodology – a similar methodology of a standard classroom, but they use an Excel spreadsheet, and it's very difficult to work with, in my opinion.

Q Have you ever heard of that approach being adopted within the healthcare sector?

A My experience revolves around using-- I've written room datasheets for the children's hospital I referred to earlier and, again, it was old school; we had eight lever arch files with eight different departments, and we generated these, and we found it was the easiest way to get the client and the users engaged because, as engineers and architects, we understand what a drawing looks like. It's a bit difficult for a clinical team who aren't used to looking at this level of information to actually explain to them what they're going to get in that space.

Q Have you ever heard of the term an environmental matrix?

A I have heard the term. I would imagine-- Yes, I've heard it not specifically in healthcare circles, but is a term that's used for, I would say, an Excel spreadsheet-based system.

Q So your understanding of an environmental matrix would be a simple spreadsheet-based system?

A A tabulated form of everything that you see on the room environmental datasheet. So you'd have the room description, say, on the left-hand side, and then different columns with all these categories that you see on this form. It would just be a spreadsheet version of that page.

Q Have you ever been involved in a healthcare ventilation project where that approach has been adopted?

A Not that I can recall.

Q Is that an approach that you would recommend to a client?

A Probably not.

Q Why not?

A The ADB system or its equivalent is, as we've discussed earlier, the best practice, and I think if you try and produce something in Excel, it could lead to misunderstanding. This replicates what's in the Health Building Notes, the Health Technical Memoranda. For me, it's a simplified approach. You

know, you can just say to an engineer, “Right, just read those room datasheets and go through every space”. An engineer may choose to put them into an Excel spreadsheet for calculation purposes, which is what you would ordinarily do; you'd put the room volume and then you can amend things, but in terms of the client's brief to the engineer, I just find these a lot easier to use.

Q If you were involved in a PFI project for example, and there had been a procedure started to use room datasheets, and then a decision was taken to cease using room datasheets, who would you expect to make that decision?

A I would say the client, the client body, because the room datasheet is the client's brief of what they want.

Q What information would the client need to take a decision like that?

A I mean, I would expect them to still comply or still follow the tables. You know, the criteria that's on this table is essential for any engineer looking at the room environmental datasheet. You need this information to complete the design process. If you don't have this information, you can't complete the design process. You

then start to have to make assumptions and interpret the Health Technical Memoranda which leads to a fallout.

Q Thank you. If I could ask you to have your report in front of you again, please, so bundle 6, page 66, and to look to paragraph 3.32. So you again address room datasheets, then in the second line, page 66, paragraph 3.32, you describe them as “most critical design element” and you've put that in bold and underlined it. Why have you done that?

A In my experience and my opinion, it is the only way for the client to inform the design team of what they really want. It's like going for a car and asking for a list of all the extras, that's what you want, you write it into a contract and that's what you get. Historically, it's been proven to work. Most of the industry understand it, NHS purchasing authorities understand it, and it's just an easy, established practice, in my opinion.

Q Again, in your experience, do those requirements, the requirements set out within the room datasheet, do they need to be set out before the contractor really work out what it is they need to build?

A Yes.

Q So would you be

expecting a completed room datasheet to be provided by a client to a contractor?

A Client or his advisors, yes.

Q Before or after conclusion of the contract?

A Oh, before. You often find that the independent certifier will look at the room datasheets after a building's-- or at near completion, and use that as a check to ensure that the contractor has delivered what was in the brief, particularly with regard to PFI where you start construction perhaps before things have been finalised.

Q If I could ask you to look over the page, please, to page 67 of your report. Two paragraphs above 3.3, there's a paragraph beginning: "The (RDS) are best described as…" Do you see that?

A Yes.

Q So, you state: "The (RDS) are best described as an informed 'starter for 10' based on best practice design, operational experience and functionality." What do you mean by the phrase "starter for 10"?

A It's to inform a design or a clinical team of what they're going to get. Some clinical teams will maybe get involved in one major capital development in their entire medical career, so they don't really understand what they want. They know how to deliver clinical care, but they don't necessarily understand everything that goes behind the scenes or behind the fabric of a building. So this is where the experience of the health building though-- which you can tell them "This is what you're going to get in a room." You can either go through the lists of the components with them or, with digital technology and virtual reality, you can-- the Activity DataBase will actually now generate, and other products will generate the three-dimensional drawing of a space that you could go and look into and put a virtual headset on and say, "Oh, actually that's where the sockets are going. That's where the bed's going." Because most-- As I say, the project team should be experienced at delivering capital schemes, but the clinical staff are unlikely to have delivered-- so it's an easy way of telling them what they're going to get in their facility.

Q At a practical level, if there was going to be a derogation from using room data sheets or a derogation from complying with Scottish Health Technical Memoranda, before 2021, how would you expect

that to be documented?

A By amendment to the room data sheet. Excuse me. So if you've gone through the drawings, you would look at them and, as an example, you might look in a particular bedspace and there are six socket outlets there. You say, "Well, those are for these pieces of medical equipment", and that clinical team will say, "Actually, well, we use a different set of processes and we need more electrical sockets, so can we have eight instead of six, please?" It gets to that level of detail because obviously more sockets is more money.

Q Would you expect a schedule of derogations to be provided?

A I suppose ideally, yes, you could do, but the fact that it's been agreed and signed on a room data sheet as having been amended and saved, then that's sufficient. You would only necessarily need to derogate if you are doing less than what's in the guidance.

Q I'd like to ask you to look at a few NHS design quality policies, please. Can we begin by looking in bundle 3, volume one, at page 114, please?

THE CHAIR: Thank you.

Q Bundle 3, volume one, page 114, in the top left-hand corner. It's a document issued by the Scottish Executive, do you see that?

A Yes.

Q 23 October 2006, and it's called "A POLICY ON DESIGN QUALITY FOR NHS SCOTLAND".

> "This letter provides colleagues with a statement of the Department's Policy on Design Quality for NHS Scotland… Associated with the policy is an Annex of policy guidance… which should be reflected in the Design Action Plans and related operational policies of NHS Scotland bodies..."

So this is effectively guidance from government going out to engineers.

A Yes.

Q Then we see the background, paragraph 3:

> "The attached policy statement reflects consultation with colleagues and the Scottish Executive, NHS Scotland and Architecture and Design Scotland. It provides a concise definition of policy along with details of mandatory requirements which must be complied with by NHS Scotland

Bodies, although the Department recognises that requirements may not be directly applicable to the day-to-day operations of those Special Health Boards which are not actively engaged in the procurement of new healthcare premises and refurbishments to existing healthcare premises."

Do you see that?

A I do.

Q It's effectively a direction from government to NHS bodies. We can then look on to page 117, please. You see the policy itself, a policy on design quality for NHS Scotland, from 2006 – do you see that?

A Yes.

Q Then if we look on page 125, we see a series of mandatory requirements. Can I ask you to look at paragraph 5, please? Page 125, paragraph 5:

"All NHS Scotland Bodies engaged in the procurement of both new-build and refurbishment of healthcare buildings must use and properly utilise the English Department of Health's Activity DataBase (ADB) as an appropriate tool for briefing, design and commissioning. If deemed inappropriate for a particular project and an alternative tool or approach is used, the responsibility is placed upon the NHS Scotland Body to demonstrate that the alternative is of equal quality and value in its application."

Do you see that?

A I do.

Q Are you surprised that that was a direction issued by the government to NHS bodies?

A It's clear. As I said, in my career, I've always used-- when I'm working on NHS projects, I've always used room data sheet systems, so that's actually sort of black and white.

Q In terms of your experience, is that simply what should happen in the industry anyway?

A Yes.

Q Then if we can look on to page 132, please. At the bottom, do we see a section: "Activity DataBase"?

A Yes.

Q

"Activity DataBase… is the briefing, design & commissioning tool for both new-build and refurbishment of healthcare buildings. It is a briefing and design package with an integrated textual and graphical database, an

interface with AutoCAD and an extensive graphical library - the complete tool for briefing and design of the healthcare environment."

Is that your understanding and experience of what ADB is?

A Yes.

Q It continues:

"ADB is produced by the Department of Health in England and is endorsed for use in Scotland by the Scottish Executive Health Department as the preferred briefing and design system for NHS Scotland. It has been developed to assist in the construction, briefing development, design and alteration of healthcare facilities. In 2005, the Scottish Executive Health Department, in association with the NHS Scotland Property and Environment Forum (now Health Facilities Scotland) launched an initiative to support NHS Boards in the implementation of ADB throughout NHS Scotland…"

Do you see that?

A Yes, I do.

Q Then in the next paragraph:

"Spaces designed using ADB data automatically comply with English planning guidance (such as Health Building Notes (HBNs) and Health Technical memoranda (HTMs) as ADB forms an integral part of the English guidance publication process. Whilst Scottish users can create their own project-specific briefs and designs using ADB's extensive library of integrated graphics and text which includes room data sheets, room layouts and departmental room schedules, extreme care should be taken to ensure that such data generated by the package are consistent and compliant with Scottish-specific guidance such as Scottish Health Planning Notes, Scottish Hospital Planning Notes (SHPNs) and Scottish Health Technical Memoranda (SHTMs) as published by Health Facilities Scotland."

Do you see that?

A Yes, I do.

Q So, again, is that consistent with your understanding that there is no Scottish-specific

Activity DataBase sheet?

A Correct.

Q The next document that I would ask you to look at, please, is in bundle 4, page 99. Bundle 4, page 99.

THE CHAIR: Thank you.

Q Again, top right-hand corner. It is a document issued by the Scottish Government, this time on 2 June 2010 called "A POLICY ON DESIGN QUALITY FOR NHS SCOTLAND: 2010 REVISION". Again, on the right-hand side, it is addressed to, for action, chief executives of NHS boards and chief executives of special health boards. If we look to paragraph 3, it says:

> "This CEL and the attached policy statement supersedes NHS HDL(2006)58. This CEL also provides information on Design Assessment within the SGHD CIG Business Case process."

Then if we can look it to page 102, please. This is another document: "A policy on design quality for NHS Scotland", this time 2010. So, page 102. If we would look on to page 113, please. Page 112 sets out mandatory requirements, and if we look on to Mandatory Requirement 7 on page 113, which states:

> "All NHS Scotland Bodies engaged in the procurement of both new-build and refurbishment of healthcare buildings must use and properly utilise the English Department of Health's Activity DataBase (ADB) as an appropriate tool for briefing, design and commissioning. [If deemed inappropriate for a particular project and an alternative tool or approach is used, the responsibility is placed upon the NHS Scotland Body to demonstrate that the alternative is of equal quality and value in its application.]"

Do you see that?

A I do.

Q So essentially a restatement of what had already been set out in the 2006 policy.

A It's reinforcing the need to use that product or an equivalent product.

Q Then look on, please, to page 136. I will not read all of that out, but if I could just ask you to take a moment to familiarise yourself with the paragraphs that are set out there, please, Mr Maddocks. Have you had an opportunity to----

A To Scan through it? Yes.

Q Effectively, is that just a restatement of what we've already seen from the 2006 policy in terms of what Activity DataBases are and the need to be specific if you are in Scotland because Scottish Health Technical Memoranda might not be identical to English Health Technical Memoranda?

A Correct.

Q There is a reference there in terms of the asterisks at the bottom to something called "Space for Health Web resource". Does that mean anything to you?

A I've not heard of that reference before.

Q If I could ask you to return to your report, please. Still within bundle 6, page 68, please. In approximately the middle of that page, page 68, there is a paragraph beginning: "A client body procuring…", do you see that?

A Yes.

Q So you say:

> "A client body procuring a hospital (for example an NHS Trust) must develop a Project Brief for a new hospital that should ordinarily specify that the design and build is in compliance with HBN's and HTM's (SHBN's/SHTM's) (unless a list of derogations was agreed at the time a contract is agreed)."

Do you see that?

A I do.

Q So, again, can you just explain what you mean by a list of derogations?

A If you wanted to vary the design from what's prescribed within the SHTMs, SHBNs then you should have to write that.

Q How would that be done? Would there be a formal process that had to be followed?

A There would have been an agreement between contractor and client. An example may be that the bedrooms are going to be bigger or smaller than the prescribed area. For whatever reason, if there's a change from the brief, then that needs to be recorded as a contractual vary--contractual derogation.

Q Just if we leave the contractual issues to one side, if we are thinking before 2021, when the Ventilation Safety Group (inaudible), is there a standardised procedure or is it very much an ad hoc arrangement?

A I would say it's an ad hoc basis. There's no prescribed form that I'm aware of. You would develop it on a project by project basis.

Q If we then return to that paragraph within page 68, you go onto say:

> "If there was only reference to Statutory Compliance, then in terms of ventilation only The Building (Scotland) Regulations 2004 (the "2004 Regulations") and the Scottish Technical Handbook (Scottish equivalent of the "Approved Documents" issued in England in terms of The Building Regulations 2010) would apply.

And then you set out Regulation 9, Schedule 5 which states: "Every building must be designed proctored in such a way. Ventilation is provided that the air quality inside the building is not a threat to the building or the health of the occupants." Do you see that?

A I do.

Q So is that your understanding of the base legal obligation for any health trust or health board?

A Yes.

Q Can you just explain to the Inquiry what are the Scottish Technical Handbook and Approved Document F in England?

A They are the building regulations, requirements for buildings of all types to comply in-- and be built to a satisfactory construction standard.

Q So, effectively, is the Scottish Health Memoranda(?), Scottish Technical Handbook, and Approved Document F-- are they giving guidance in terms of how you would comply with general legal standards?

A They set the standard that you should do something to. I wouldn't say they necessarily offer guidance.

Q In terms of the Scottish Technical Handbook, is there any references to Scottish Health Technical Memoranda or Scottish Health Building Notes within that?

A I haven't found that.

Q What about within the Approved Document in England?

A There is reference in part F. If you go to the next page, there's an extract from the England Building Regulations 2010.

Q So if we look to page 69, Figure F, is that an extract from the Approved Document, part F?

A Yes, it is.

Q Okay. So what do we see in terms of the box at the bottom, the reference to health buildings, nonsurgical and hospitals?

A That's directing people to go and look at those design standards in order to develop the design of a building that would comply with building regulation requirements.

Q Okay. I just want to make sure I am understanding this. In England, you have got the Building Regulations 2010 that sets a general standard for, effectively, a safe space.

A Yes.

Q Then you have Approved Document F which gives you guidance in terms of how you would comply with that standard.

A Correct.

Q It specifically mentions there, we see at the bottom, for healthcare buildings, nonsurgical, there is CIBSE guidance. What is that?

A Chartered Institute of Building Services Engineers Guide.

Q We then have NHS Activity DataBase. What is that?

A That's the Activity DataBase that we've been talking about with regard to room data sheet generation.

Q Then you have got Health Technical Memoranda HTM 03-01.

A Yes.

Q Then below that, again, for hospitals, you have got CIBSE guidance. What is CIBSE Guide B2 Ventilation and ductwork?

A It's a particular document that tells you the detailed design parameters for a ventilation system used by engineering colleagues and ourselves just to look at design conditions, velocities to design ductwork in real detail, engineering parameters.

Q Then you have got the NHS Activity DataBase again, and you have got Health Technical Memoranda HTM 03-01 by the Department of Health. Could I ask you, within your report, to look on to section 5, please, which begins on page 71, but if we perhaps pick matters up on page 72, paragraph 5.2.1? In the first main paragraph of 5.2.1, in the final sentence you mention a Dr O. Lidwell published some 130 technical papers on ventilation principles. What is your understanding of the work that Dr Lidwell did?

A As I understand it, he was a research specialist who looked at improving the ventilation conditions in operating theatres initially, which is what he did. I haven't read his reports. It's one that informed-- the informed guidance document I've made a reference to before.

Q So, is it fair, from what you have said there, that you know about the generality of what Dr Lidwell did, but you do not know about the specifics?

A Correct, yes.

Q If I can ask you to look, please, within your report at page 77 first. So, bundle 6, page 77. What do we see on page 77?

A This is a table – appendix 2 – of the recommended air change rates in many departments within a hospital. We made reference earlier to HTM 2025, which had maybe eight spaces. This version of HTM 03-01 from 2007 increased the number of spaces covered by the guidance document. So, again, you can see ventilation rates, air change rates, the pressure regime, filtration specification, noise and temperature bands. If there is any further documentation, you would need to go and review to complete your design.

Q Within your report, you have recreated appendix 2 from HTM 03-01 so you have got the general ward, which has got six air changes an hour?

A Six air changes an hour, yes.

Q Then what is the dash next to “pressure”?

A That means there's no need to have a negative or positive pressure in that space.

Q Then, again, still within page 77, if we look down we see “infectious diseases isolation room” “air change 10”, and then we see “negative five” for pressure. What does that mean?

A That's five Pascals pressure, so that basically air is being drawn into that space from surrounding areas.

Q Then if we keep working down, we see “critical care areas”, again, we have got 10 air changes an hour and this time it has got “plus ten”. What does that mean?

A So, again, that space is positive because those patients are at risk and you want to positively pressurise that space. So you would push air into the space and you would, at commissioning stage, measure the pressure differential. If you take this room as an example, from this room and the room outside, you would be able to see a pressure differential of ten Pascals on a gauge.

Q Then, still working down within appendix 2, we have got the operating theatre that says it is “25” for pressure. What is that?

A Again, 25 air changes

an hour in the general theatre and 25 Pascals. So, there are calculation procedures later on in the HTM to show you how to-- so it's what's called a “pressure cascade”. So the operating theatre is the cleanest space, at 25 Pascals, then the spaces that surround it are generally less. There is a slight nuance with a lay-up prep which is where you bring the surgical instruments onto the trolley that the surgeon might use and if it's a certain type of preparation room, as it's called, the lay-up prep’s a slightly higher pressure because you're bringing sterile equipment onto a trolley that will then be handed to the surgeon.

Q So, if we then look within your report, this time on page 78. This time you have recreated appendix 1 from SHTM 03-01, Part A. Again, could you just explain, what is this that we are looking at?

A It's the same as appendix 2 in the English HTM. They are identical with one exception of the communal toilet air change rate, which is slightly different.

Q So, if we look down for things like we have already looked at, “general ward, infectious diseases, isolation, medical care…”, we are effectively seeing the same values that we see in the Health Technical Memorandum.

A Yes.

Q For both of those tables that we have looked at, do you know how the various values, both for air changes and pressure, are calculated or composed?

A No. It's one of those that may have come through an academic study or it's a discussion that's made whilst the documents have been recorded, starting with the principle that the operating theatre is the cleanest space.

Q Again, just to be clear, if we take the general ward as an example, you cannot explain why that says six air changes in an hour, as opposed to seven or five?

A Not without researching any academic papers to come up with that figure.

Q Have these rates become standard within the industry?

A Yes, they have.

Q Have you discussed those over the years with architects, engineers, infection prevention and control officers?

A I have discussed them with engineers as to say, “Why is that?” and they’ve just gone, “I don't know, just design it to that figure.”

Q Having worked within the industry for over 40 years, are you aware of anybody suggesting that these rates are far too high?

A No.

Q Or anybody suggesting that they are far too low?

A No, they've worked. They're proven. Again, as I said earlier, the HTMs have been developed with working practice and procedures and found to be satisfactory.

Q The Inquiry has heard evidence that, effectively, these rates are based on discussion and compromise between a range of disciplines, including engineering, microbiology and infection prevention and control. Do you know if that is correct?

A I don't know where those discussions-- but it would make sense because you wouldn't want to ventilate the whole hospital at 25 hour changes an hour, because it would be astronomically expensive to build and to operate.

Q Are you able to assist the Inquiry in relation to any deviation from the figures in these tables, when any deviation would get to a level that it simply was not safe for a patient in a space?

A No, I wouldn't, I'm afraid. That's something I would push to the academic sector for input.

Q Are you familiar with the concept of natural and mechanical ventilation?

A Yes, I am.

Q Can you just explain what is your understanding of natural ventilation?

A Natural ventilation is ventilating a space by means of opening windows or other ventilation devices in a room to get air circulating across a space.

Q In contrast, then, what is mechanical ventilation?

A Mechanical is when you seal a room and you use supply and extract air, that is treated and filtered, to ventilate the space. You bring fresh air in via mechanical means, whereas with natural you bring it by buoyancy effect, temperature and wind.

Q Can you use natural ventilation in certain areas of a hospital?

A Yes, you can. It tends to be limited to non-clinical spaces so meeting rooms, office space, waiting areas.

Q If I could ask you to look within bundle 1 to page 618 – this is going back into SHTM 03-01 – and to

look at paragraph 2.3. So, page 639, paragraph 2.3. Do you see a statement there, "As the motivating influences…"?

A Page 639?

Q 639. Bundle 1, page 639. Do we have that, Mr Maddocks?

A Yes, we do.

Q Paragraph 2.3:

> "As the motivating influences of natural ventilation are variable, it is almost impossible to maintain consistent flow rates and ensure that minimum ventilation rates will be achieved at all times. This variability is normally acceptable for general areas including office accommodation, general wards, staff areas, libraries rooms, dining rooms and similar areas which should, where possible, be provided with opening windows of a design that facilitates natural ventilation."

Do you see that?

A Yes, I do.

Q Do you agree with that statement?

A Generally, yes.

Q You say, "Generally, yes". That sounds qualified.

A I think there's a confusion on line four where it says, "The variability is normally acceptable for general areas, including office accommodation, general wards…" is a conflict with the appendix 2 table, which says six air changes, so there's a bit of a discrepancy there that you would ordinarily discuss at briefing stage.

THE CHAIR: Sorry, can you give me that again, Mr Maddocks? So, you draw our attention to line four and the reference to a general ward?

A Yes. It says there that natural ventilation, variability is normally acceptable if you're naturally ventilating. The table at appendix 1, the first line is, "General ward, six air changes an hour…". So that's telling me it's mechanical and yet that's saying natural's acceptable, so that's an anomaly that you have to agree with your client early on.

MR MACGREGOR: If I could then ask you please, within bundle 1, if we can look to the Scottish Health Technical Memorandum 03-01 Interim Version – Additional Guidance related to COVID 19 to be Added in an Update in 2022. So, that begins in bundle 1 at page 802, but the section I wish to draw your attention to, Mr Maddocks, is at paragraph 5.6 on page 837. So page 837, paragraph 5.6. So, this is

the most recent Scottish guidance that has been issued. It says at 5.6:

> "With natural ventilation is almost impossible to maintain consistent flow rates and ensure that minimum ventilation rates will be achieved at all times. However, this variability is normally acceptable in non-clinical spaces such as office accommodation, staff areas, library/seminar rooms, dining rooms, and some clinical areas such as level 0 and level 1 care spaces and waiting and consulting rooms where risk airborne infections is likely to be low. The design must still aim to achieve agreed limits for room temperatures and, for clinical areas, achieve the desired room air change rate with "thermos-convective" effect (at peak room temperature coincident with summer external design temperature). Where it is essential to achieve a minimum ventilation rate at all times, mixed mode or mechanical methods will be needed."

Do you see that?

A I do.

Q What is the reference to "level 0 and [level] 1 care spaces"?

A I can't recall. I will have to go back and look at the definitions within the beginning of the HTM.

Q There will be a definition somewhere within the SHTM?

A Yes, I just can't recall off the top of my head, but it's interesting that the reference to general ward areas is removed. That paragraph is almost identical to the previous one with the general ward areas removed.

Q Again, do you have any other observations on that formulation?

A No, I've not seen that document before, so I'm looking-- it will be interesting to read it afterwards, I'm afraid.

Q Having looked at what is said there, does it indicate that if the purpose of a room, or a ward, is not to control the spread of infection from an infectious person towards a particularly vulnerable person, then the flow rate is not going to be particularly important?

A I would say so, yes. I think what it means, without looking at the definition of what the 0 and 1 is, just reading that paragraph, it is saying that they are not the highest levels of clinical care. What it's telling you that

you can't let the temperature in the space get too uncontrolled.

Q The next issue that I want to ask you about is the issue of pressure, which we have touched upon. You have addressed it in terms of positive pressure and in terms of negative pressure. Just remind me, please, when we are dealing with positive pressure, what are we trying to do in a hospital?

A You're trying to protect a space, or a person, mainly the space. So if it's an operating theatre with a patient who's got an open wound, you want that space to be clean so that's a high pressure. It cascades down through the surrounding areas. If you've got a ward with a patient who is at risk, say a person who has undergone chemotherapy, so their immune system is compromised, you want them to be in a safe space, so that space would be positively pressurised.

Q Then in terms of the converse, what would negative pressure be?

A If you've got a patient with a transmissible illness – let's take a common one, measles – you want that person to be not presenting a risk to the remaining ward area. So that room would be under negative

pressure.

Q So if you had, for example, if I use the term a neutropenic patient?

A Yes.

Q What is a neutropenic patient?

A I think it's to do with blood counts. I tend to try and take it into-- I've got a table in my report to try and break it down to less medical terminology for simple engineers to understand.

Q In terms of a neutropenic patient, is there a specific pressure regime that they should----?

A Yes, there are. There are pressure regimes written within appendix 1 of SHTM. It's about a third of the way down. So that's a patient whose blood cell count is compromised and therefore could be open to this infection, so it says “neutropenic patient, supply, air change rate ten, positive pressure of ten Pascals” for that space.
That patient is at risk rather than a patient who is risky.

Q Can you comment on what the potential consequences could be for a neutropenic patient if they were in the wrong pressure area of a hospital?

A They're put at risk.

Depending on what the area is that is surrounding them, they could be put at significant risk from gaining further infection and where their body is weak.

Q If I can ask you, still within your report, to look to section 7, please, which is Ventilation System Components at page 85. You have included within your report a diagram of a standard operating theatre?

A Yes.

Q This is a diagram that the Inquiry has looked out with a couple of other witnesses so if I could perhaps just check my basic understanding of the system would work. In the top left-hand corner, bundle 6, page 85. The top left-hand corner, you would have the air intake?

A Correct.

Q That should be from some form of clean space?

A It's from outside, drawing fresh air in from the atmosphere to the building.

Q And then you have got the attenuator that basically reduces noise?

A Correct.

Q You have then got your primary filter that takes any coarse agents out of the air.

A On the diagram you have a fog coil before that. This goes

back to a number of years ago when filters, if they got wet, they could freeze and block airflow so the fog coil was designed to preheat the air, so on a winter's day from, say, minus 10 outside, it would heat the air up to a plus 3 or plus 5 to protect the primary filter. The primary filter is basically a coarse filter, very thin. If you liken it to a face mask, one face mask is the primary filter.

Q Then we have got the supply fan that is drawing the air in?

A Yes.

Q Then we have got the run-around coil, cooling coil and eliminator, and the heater battery. Are they effectively heating, tempering and then cooling the air and making sure that you make the best energy efficient means that you can?

A Yes, they heat it to the required temperature, or the cooling coil will dehumidify the air if it's too wet in summer. Say you want to reduce humidity in the space, you just cool it down and then you can heat it and then you have the secondary filter. The run-around coil is just an energy recovery device, so you recover energy from the extract air stream.

Q Then we have got the secondary filter. How does it differ from the primary filter?

A A higher grade. So, if you imagine one face mask is the equivalent of the primary filter, the secondary filter might be three or four equivalent face masks. So that becomes thicker, it has a higher pressure drop. So, the required energy to force air through the filter increases.

Q Then we have got the attenuator, again to reduce noise and then the air comes down into the space----

A Yes.

Q -- and then in the bottom left- and right-hand corners we have got extract grills. What are they doing?

A The extract is to relieve the pressure in the space and it's low level because anaesthetic gases are typically heavier than air. So, you don't want to present a risk to the operating theatre staff by having a buildup of expired, or exhalated anaesthetic gas. So that's why it's specific to have low level extract in those spaces.

Q Then behind the extract grill, would we see another fan to be drawing the air through?

A You'd have a duct that connects up to the extract system that goes up to the plant room, which is

where you would recover the energy from.

Q If we think of the extract grills at the bottom there, is there any risks that could arise if there was excess moisture there?

A Not that I'm aware of, no.

Q Are you familiar with the term "thermal wheels"?

A Yes, I am.

Q What are they?

A A thermal wheel is an energy recovery device that's highly efficient. They have a challenge in them in healthcare environments because there's a potential cross-contamination between airstreams. So, you have, like a bike wheel, that rotates between the extract air and the supply air. They are challenging to install because it's a circle, it can only get air handling units of a certain configuration. If you use a plate heat recovery device, which is a series of intermeshed air channels, you can change the shape of the air handling unit so it'll fit in a different size of plant room. If you use a run-around coil, then you use a heater battery like a car radiator in one airstream and another one in another airstream, and you pump a fluid between the two to transfer the heat and the energy. In

terms of efficiencies, the highest efficiency is a thermal wheel, then a plate heat recovery device, then a run-around coil.

Q In terms of the identified risks that you outlined, what would be the specific risks if you had a thermal wheel in an area that was used to treat immunosuppressed patients?

A You could get-- Theoretically, you can get cross-contamination between the airstreams because you're passing air between one and the other. There are devices that can go into them, but they are, I suppose, not preferred in certain instances.

Q In your experience, would it be appropriate to install a ventilation system with a thermal wheel when the intended use of the room was immunocompromised patients?

A I would challenge it and just say, “Is it really the right solution?” The problem-- One of the challenges you have with hospital-quality air handling units is those components that you see there make the air handling unit extremely large. Even on a small air volume, they come to about, say, nine metres long and it takes up an awful lot of space.

Q If there was a

consideration to use a thermal wheel in an area with an immunocompromised patient, what would you expect to happen?

A You'd agree it with Infection Control or the-- Infection Control and the operational estates team, “Are you happy with this?” Because it puts an element of maintenance on people as well, that they have to go and keep these things clean.

Q How would you keep it clean?

A Vacuuming, brushing, a steam lance, something like that.

Q How regularly would that happen?

A Off the top of my head, I’d say at least quarterly inspections. I'd have to look in HTM 03-01 Part B just to see what the defined schedule is. It's not something I can recall off the top of my head.

Q But if we looked in Part B, we would find----

A It would tell you.

Q Are you familiar with the term “comfort module”?

A I wasn't until it came up in this discussion.

Q What is your understanding of the term “comfort module”?

A It's a particular product from a particular manufacturer. It's-- We use chilled beams a lot to provide cooling into a space. A chilled beam might be-- These are 600 tiles, so a chilled beam might be 600 millimetres long by, say, 2.4 metres long. Sorry, 600 wide by 2.4 metres long. A comfort module is just a square device. So a chilled beam blows air two ways, a comfort module blows it four ways. I've never used them before and I've only seen them in reference on this project.

Q Would you be able to give a detailed analysis of what the difference between a comfort module and chilled beam is?

A Not without going into a lot of detail on that one. I've only had a very quick review of what that product is. My understanding is it's just a square chilled beam that gets a different air distribution.

Q You've mentioned the term “chilled beam”. What is a chilled beam?

A A chilled beam is a device that's got cold water going through it, it can have heating, and it provides environmental temperature control in the space. So you would assess what the heat gain is in a space from people, lights, solar gain

through the outside, and determine if you can-- if you need a chilled beam to deal with all those gains. If you're mechanically ventilating a space, you can cool it with the air that you're supplying to it. But if the heat gains in the space are such that you can't deal with fresh air, you either increase the fresh air or you put another cooling device in the space.

Q In your experience and opinion, are there any particular risks associated with the use of chilled beams in an area of a hospital where mechanical ventilation is required?

A They need more maintenance, typically quarterly cleaning with a vacuum cleaner. A scheme that we've just finished has them in every clinical space, but the latest HTM has outlawed them. I have a feeling that is going to be challenged down the line because they are an efficient way of getting heat into the space, but the first primary aim of an engineer is to reduce the heat gains in a space. We can reduce the solar gain by putting high-performance glazing, but then you’re just relying on the internal heat gains in the space, so computers, people, equipment, medical equipment, and so on.

Q You alluded to some potential risks with a chilled beam.

What risks, if any, are associated with chilled beams when it comes to immunocompromised patients?

A You might just get some bacteria that gets stuck on the chilled beam, and that's why you have to clean it regularly to make sure it's operating in peak performance.

Q Again, in terms of a cleaning regime, would that have been found in Part B of the HTM?

A In the old one, yes, it would have been.

Q I think you said that there had been a change in terms of the latest guidance and they are not recommended?

A They're not recommended in clinical-- I think it's just clinical environments.

Q Again, just to be clear, why not?

A Because of the need to go in on a quarterly basis with a vacuum cleaner and just clean them. It's felt that you shouldn't really be-- you should try and avoid maintenance protocols that would require you to regularly go into a ward space because there's a very high turnover of patients delivering-- being cared for. The balance of every hospital is to adequately maintain it and operate it.

Q I want to ask you some

questions about filters. What is a high-efficiency particulate filter?

A High-efficiency particulate filters are used in certain specific applications. Again, if we go back to the face mask scenario, you would have one face mask as your primary filter, say, three, four or five as your secondary. A HEPA filter would be possibly the equivalent of 14 face masks. So by the time you've got these all sat next to one another, the energy required to push air through them increases significantly. So with a HEPA filter, you get very high-quality air downstream of it, but you're paying a price because you have to push air at a greater power ratio. So you've got more power to force the air through. They're expensive, they take up a lot more space than a normal filter, but in certain situations, they are essential to maintain the cleanliness of a space.

Q Again, what role would they play in the prevention of infection?

A Making a space more sterile.

Q Is there any particular patient group that they might be relevant for?

A Let me just remind myself what they are, please. Neutropenic patients in the isolation

room, so you put a HEPA filter serving that patient because that patient's at risk. An ultra-clean operating theatre is a prime example of where HEPA filters have been used for a long time. Do you want me to explain what that theatre is?

Q Yes, please.

A An ultra-clean operating-- A conventional operating theatre, as shown on the diagram that we looked at a moment ago, is ventilated at 25 air changes. The air is uniformly distributed around that space for general surgical procedures. An ultra-clean operating theatre was developed during the 1960s by an orthopaedic surgeon who discovered that there were lots of infections from hip replacements of Professor John Charnley, who was the pioneer of hip replacement, and he wanted to understand how he could improve patients' wellbeing rather than give them a hip replacement and then load them up with antibiotics. So with an engineer called Howorth from Bolton, and Charnley was from Wigan, they developed a Charnley-Haworth hood which, in modern parlance, is a 2.8-metre-by-2.8-metre zone on the floor, which is where the operating theatre sits, and above it is a filter panel which is full of HEPA filters.

So the air is pushed in at the top, and then just cascade-- it's pushed down in a laminar flow. So the whole of that 2.8 metres by 2.8 metres has got a laminar airflow pushing right down over the operating table, creating about 600 air changes an hour within that 2.8-metre zone. That means that the air is really, really clean and the risk to the patient for future infections is much, much reduced. They don't have to be loaded up with antibiotics if there's an infection. Because a hip replacement wound is quite a large wound, maybe 40 centimetres long, something like that, so ultra-clean operating theatres were developed and they use a HEPA filter. They get protected by a coarser filter so they'll last longer. A HEPA filter can last five years before it needs replacing, so they're expensive, they consume power, but they do last a long time.

Q Thank you. Can you have a portable high-efficiency particulate filter?

A I believe so. I've never come across them or used them. I've seen them in trade journals, but it's another piece of device in a room that takes up space.

Q Would you be able to offer any view on whether a portable HEPA filtration system would be

required in a space that already had a HEPA filter fitted?

A I don't see the point in putting one in. If it's already got a HEPA filter in the air handling unit, why would you be putting a portable one it?

Q So what conclusions, if any, do you think could be drawn in relation to the effectiveness of the existing mechanical ventilation system if it had a HEPA filter and the space then required a mobile HEPA filter?

A Something's failed or something's leaking. In other words, the HEPA filter that you've put in the main plant is not operating as it's intended, and you'd have to do a remediation measure to clean that space or provide that space with purer air.

MR MACGREGOR: Lord Brodie, I am conscious that that is 1 o'clock. I think I would only be 10 more minutes with Mr Maddocks however the lunch break may provide an opportunity if there are any issues that core participants wish to raise. I am very much in your Lordship's hands. I am happy to continue, but I am equally happy to break.

THE CHAIR: That would seem to be the most efficient way of doing things. Turning to the legal representatives, you have heard what

counsel has said. If there is anyone who has a matter to raise with Mr MacGregor, I would encourage you to do it over the lunch break. If that can be resolved, that would mean that you can finish in your planned 10 minutes. Mr Maddocks, you have heard that exchange. What I propose to do is break for about an hour for lunch, so if you could be available to resume at 2 o'clock.

A Yes. That's perfect, yes.

THE CHAIR: Mr MacGregor indicates maybe just another 10 minutes or so, but we will see how it goes.

A That's fine.

THE CHAIR: Right, thank you.

MR MACGREGOR: Thank you.

(Lunch adjournment)

THE CHAIR: Good afternoon, Mr Maddocks.

A Good afternoon.

THE CHAIR: Are we are ready to resume, Mr MacGregor?

MR MACGREGOR: Yes, my Lord.

Mr Maddocks, you said in your evidence before lunch that it would be standard to complete room data sheets before the contract was agreed?

A Yes.

Q Now, can I just check, could it sometimes be appropriate to merely agree a limited number of room data sheets before going out to do a competitive tendering exercise?

A If those room data sheets represented the majority of the development, then there is an argument that that is a possibility.

Q Okay.

A Key areas of the development.

Q So I just want to be clear: are you saying key areas or a majority of areas?

A I would-- personal preference, a majority of areas that represented the whole development.

Q Again, just so I am understanding: would the ideal be that all room data sheets are agreed?

A Ideally, yes, for every single room. But you might say, "Well, here's one exemplar for a single bed ward. Here's one exemplar for an operating theatre." You know, depending on how many room categories and styles there are in development, then you might choose to agree a reduced number.

Q Thank you.

A But understand the risk of the-- if they're not all covered.

Q What would the risk be if you had not completed every room data sheet?

A That something might change, a room's-- You know, one of the things with healthcare is that clinical practices change much more frequently than the building does, so something might change as-- certainly when you're on a large project and the-- You know, what you start out with at day one may not be what you end up when the building is finished. An example of that could be a radiology department where technology advances quicker than the building process and you have to go in amend areas.

Q The final document I would wish to discuss with you, Mr Maddocks, is in bundle 8 at page 3, which should be a position paper produced by Mott MacDonald. Do you see that?

A I do.

Q Have you seen this document before?

A Yes, I have.

Q Have you had a chance to consider it?

A I've read it once through, yes.

Q If I could ask you to look, firstly, please, to page 8. So this is the

executive summary, there are the quotations and then, approximately just over halfway down the page, there's a paragraph beginning: “There are a myriad of potential sources…” Do you see that?

A Yes, I do.

Q So Mr Bentley states:

“There are a myriad number of potential sources of hospital acquired infection (HAI), with ventilation potentially a less onerous influence compared to direct contact sources of infections such as hands, linens, clothing and intravenous equipment. Whilst there have been a number of academic studies to assess the potential prevalence of virus, bacteria and fungal spores in the air around a patient, it is very, very difficult to link these airborne contaminants directly to an HAI [which I think has been defined above as a healthcare-acquired infection] incident.”

Do you see that?

A Yes, I do.

Q Do you have any observations on what Mr Bentley stated?

A No, I concur with him.

Q Mr Bentley then continues:

“Malcolm Thomas (the coordinating author of HTM 03-01 (2021)) recently stated that ‘*With very small infection rates – which fortunately we have now – it’s much more difficult to understand what influences acquired infections, whether that be from changing the surgeon’s gowns, or the room ventilation air change rate*’.”

Do you see that?

A I do, yes.

Q Would you agree with that?

A From what I've read of latest documentation, yes.

Q If we can look over the page, please, on onto page 9, just over a third of the way down, there is a paragraph beginning: “As Malcolm Thomas identifies”. Do you see that?

A Yes.

Q On page 9, Mr Bentley states:

“As Malcolm Thomas identifies ‘..*ventilation rates noted in the HTM 03-01 guidance are not ‘opinion’ they have been proven to work in practice and over an extended period of hospital design and operation. History appears to show that this*

is a correct way of doing things'."

Do you see that?

A Yes, I do.

Q Do you have any observations on that?

A No. It's like I said earlier the design guide, if you look at 2025, the first one we looked at, there were maybe eight rooms identified, and then it's been extended to a series of other rooms because-- The keenness of the industry to follow this documentation and get it expanded has been quite interesting. People want the guidance to tell them how to do things. So, this latest version of the guide-- at a seminar, a few years ago now, pre-COVID, Malcolm Thomas was presenting a draft version of this HTM, and the room was double capacity of engineers wanting to find out what is the new HTM going to tell people because they were keen that-- they see that-- You know, engineers see these documents as best practice, as we've discussed, and want to see what's going to happen, what's going to change.

Q Still within page 9, this time in in the penultimate paragraph, Mr Bentley states: "The conventional mechanism record room data, including ventilation design criteria, is a Room Data Sheet." Do you see that?

A Yes.

Q Presumably, from your evidence this morning, you would agree with that?

A Yes, I do.

Q If I can ask you to look to the final sentence of that paragraph, Mr Bentley states:

> "For a traditional procurement process it is convention to prepare a full suite of room data sheets for the whole building and to have these formally approved by the client and their authorising engineers in advance of commencing detailed design."

A Correct.

Q Do you see that?

A Yes.

Q Again, is that your understanding?

A Yes, I-- it is.

Q If I can ask you to look to page 14, please. Still within Mr Bentley's report. Page 14, the penultimate paragraph beginning: "Ventilation should be seen…" See that?

> "Ventilation should be seen as a constituent part of a number of operational procedures in hospitals that

together have been proven, through historical precedents, to reduce (not secure) the risk of infection. These operational procedures include:

- Washing hands and/or wearing surgical gloves.
- Movement around the patient (particularly important in Operating Theatres).
- Wearing clean gowns/aprons.
- Clean bedding.
- Good levels of clean fresh air."

Do you have any observations on those comments?

A No, I agree with those-- that statement.

Q If I can ask you to look on, please, to page 20. So this is section 8 of Mr Bentley's report. Page 20, section 8:

"'SHTM 03-01 Part A; Design and Validation', has been developed from historical precedent, industry best practice, and academic research to provide guidance on how to design and validate ventilation systems in healthcare buildings.

'SHPN 04-01 Supplement 1 Isolation facilities in acute settings' has been developed to provide guidance on the design of single occupancy isolation rooms in healthcare buildings. The document includes extensive information on the control of room pressure and associated mechanical ventilation design."

Do you agree with that?

A Yes, I do.

Q If we could look to the next paragraph and to the final sentence of that paragraph beginning: "However, it is normal practice…" Do you see that?

A Yes.

Q So Mr Bentley states:

"However, it is normal practice in the design of healthcare buildings to assess what guidance is applicable to a particular project, and where relevant seek approval of derogations from the guidance."

Now, just thinking specifically about HTM 03-01 and SHTM 03-01,

which you have described throughout your evidence as best practice, would you agree or disagree----

THE CHAIR: Sorry, Mr MacGregor, it is entirely my fault – although you have allowed your voice to drop just a little. Could you just remind me where we are in the Mott MacDonald paper?

MR MACGREGOR: Yes, so bundle 8, and it should be page 20. So, section 8, headed up "Guidance documents…"

THE CHAIR: Yes, I have it. Thank you.

MR MACGREGOR: So I'd read out the first two paragraphs, and then I was looking to the third paragraph and to the final sentence beginning: "However, it is normal practice…" Third paragraph, final sentence: "However, is normal practice…" Final paragraph in paragraph 8.1, just above 8.2, three lines up.

THE CHAIR: Thank you.

MR MACGREGOR:

> "However, it is normal practice in the design of healthcare buildings to assess what guidance is applicable to a particular project, and where relevant seek approval of derogations from the guidance."

Do you see that?

A Yes.

Q Now, just thinking back to the discussion this morning, in terms of HTM 03-01 and SHTM 03-01 which you described as best practice guidance, would you be anticipating, with a new build hospital, to be seeking a derogation from that guide?

A Not initially. I would discuss with the client team if there was a need for change from the guidance, whether it be financially driven or clinically driven or operationally driven, and then look at – if there was a need for a derogation – recording that.

Q Then if I could just ask you, for completeness, please, to look on to page 36, which is a journal article from January 2022 in the Health Estate Journal. Do you see that?

A I do.

Q By Malcolm Thomas, "Guidance on ventilation revised and updated". Have you seen this before?

A I have.

Q What is it?

A The Health Estate Journal is the journal of the industry, and this is an article that really summarised the changes to the HTM 03-- As I mentioned earlier, there was a lot of anticipation of this revision

coming forward, so Malcolm issued that article last year as a summary.

Q Thank you. If we look on page 36, in the left-hand column, approximately a third of the way up from the bottom, do you see a sentence beginning: “When you have significant infection rates in operating theatres…”?

A Yes. Excuse me.

Q Do you see that, Mr Maddocks?

A Yes, I do.

Q

> **“**When you have significant infection rates in operating theatres, it's quite easy to see whether – if you change the colour of the paintwork – it makes any difference. Conversely, with very small infection – which fortunately we know we have now – it’s very difficult to know whether changing the surgeon's gowns, the air change rate, or the colour of the walls, or putting carpet in, makes any significant difference. We're talking about low percentage changes. We're in a situation now where people think changes will improve things, but they don't actually know, and it's hard to prove what is a good or a bad thing.”

Do you see that?

A Yes, I do.

Q Do you have any observations on that comment?

A It's a bold statement to make.

Q What is your professional view?

A It almost puts a bit of doubt onto things, I think. Reading further-- I have read the article previously and read that and thought-- I think what he's saying is that-- you know that the procedures and the processes in-- are such that there are many different factors that can cause increased infection, and not just ventilation. It sort of drops the ventilation down the order of probable areas of problem.

Q In terms of what you are talking there about, a whole range of things, where would you put ventilation?

A I would still put it as up there as an importance. I think working practices is more important. You know, you see that the hands cleaning and all the sort of clinical infection protocols, infection control nurse protocols and policies are equally as important.

Q An important factor but there are other equally important factors.

A I believe so, yes.

MR MACGREGOR: Thank you, Mr Maddocks. I don't have any further questions, but Lord Brodie may have questions or there may be applications from core participants.

THE CHAIR: Now, does anything arise from Mr Maddock's evidence that anyone wants to take up? Right, I will take that as a negative. Thank you very much, Mr Maddocks, that is the end of your evidence and you are free to go. Thank you very much indeed.

THE WITNESS: Thank you.

(The witness withdrew)

THE CHAIR: Now, as people will be aware, our next witness, Professor Humphreys, is giving evidence remotely online. So what I propose to do is rise and give the technical people the opportunity to make sure we have got a link with Professor Humphreys. It should not be more than five or ten minutes, I would hope, and therefore if people wouldn't go too far away-- but we will rise just for the moment.

(Session ends)