SCOTTISH HOSPITALS INQUIRY

Provisional Position Paper 2

The Environmental Matrix for the Royal Hospital for Children and Young People and Department of Clinical Neurosciences

Purpose of the Paper

This Provisional Position Paper has been produced to assist the Chair in addressing the terms of reference. It outlines the Inquiry Team's understanding of the development of the environmental matrix utilised for the Royal Hospital for Children and Young People and the Department of Clinical Neurosciences (RHCYP/DCN).

An earlier draft of this paper was circulated to Core Participants (CP) for consideration and comment. Those comments have been considered by the Inquiry Team and taken into account in finalising this paper.

In due course, the Chair is likely to be invited by the Inquiry Team to make findings in fact based on the content of this paper. The Inquiry Team does not presently intend to lead further detailed evidence on the matters outlined in it with the exception of areas where the position is currently unclear. Therefore, some of the matters addressed in the paper will be touched upon to a greater or lesser extent in the hearing set to commence on 24 April 2023. In addition, it is open to any CP – through evidence or submissions – to seek to correct and/or contradict the content of the paper. It is therefore possible that the Inquiry's understanding of matters set out in the paper may change, and so the position set out in this paper remains provisional. If it is the case that the Inquiry Team's understanding does change significantly, a revised edition of this paper may be published in due course.

Contents

1. Introduction

1.1 NHS Lothian (NHSL) had responsibility for the RHCYP/DCN project. NHSL, with the assistance of its advisers, required to specify the technical requirements for the new hospital. This included briefing prospective tenderers on the technical requirements for key systems within the new hospital, including the ventilation system.

1.2 NHSL issued a document called an 'Environmental Matrix' (the EM) to prospective tenderers. The EM was essentially a spreadsheet that listed parameters for the ventilation system – including pressure and air changes per hour (ACH) - for various rooms in the new hospital. This paper seeks to address the purpose of the EM and how it was developed in the period from 2010 until the conclusion of a contract between NHSL and the preferred bidders (Integrated Heath Solutions Lothian (IHSL)) in February 2015. The paper also considers the ventilation specifications contained in the EM for key room types and compares this with published guidance, including Scottish Health Technical Memoranda (SHTM).

2. What is an Environmental Matrix?

2.1 An 'environmental matrix' is a spreadsheet that sets out a variety of technical parameters. This was addressed by Mr Stephen Maddocks, chartered building services engineer, in his oral evidence to the Inquiry on 12 May 2022. Mr Cantlay of Mott MacDonald Limited (MML), in his oral evidence to the Inquiry on 20 May 2022, described an 'environmental matrix' as:

> "…a spreadsheet which is pulling together all the environmental parameters into a single list against rooms so that they're all…in one place."

2.2 An 'environmental matrix' is different to a 'room data sheet'. The concept of a 'room data sheet' is addressed by Mr Maddocks at paragraph 3.3.2 of his

report dated 10 April 2022. An example of a 'room data sheet' is included in Appendix A of Mr Maddocks' report.

2.3 A 'room data sheet' is a multi-page document that sets out the requirements, including environmental requirements, for a specific room or space in a building. There would be a separate room data sheet for each room or space in a building. In contrast, an 'environmental matrix' lists all of the environmental parameters for spaces in the building in one table.

2.4 'Room Data Sheets' can be produced by way of a computer programme. For example, the Department of Health in England operated the 'Activity Database' (ADB), to assist with designing a hospital. ADB is a computer software package that assists healthcare planners, architects and teams involved in the briefing, design and equipping of healthcare environments. Content for ADB is developed from technical guidance such as Health Building Notes and Health Technical Memoranda (HTM). SHTMs are the Scottish equivalent of HTMs.

2.5 A room data sheet produced using ADB would comply with the requirements of HTMs because the room data sheet would automatically be populated with environmental parameters – including air changes per hour and pressure requirements - from the database. The database includes detailed information for various types of room required for a hospital. As long as the correct room type is selected, the room data sheet will be populated with the parameters set out in HTMs.

2.6 An environmental matrix is created by values being manually entered into a spreadsheet. The spreadsheet is not automatically pre-populated with values from a database. Accordingly, an environmental matrix would not automatically comply with published guidance such as HTMs. Such compliance would depend on the robustness of the process adopted for determining the values to be input into the spreadsheet. There is scope for errors to arise in the creation an environmental matrix. For example, transcription errors.

2.7 In his report, Mr Maddocks describes room data sheets as "…the most critical design document" when designing a new hospital. In his oral evidence, Mr Maddocks described room data sheets, created using the ADB system, as "best practice". He considered that presenting technical specifications for a hospital in an alternative way, such as by way of a spreadsheet, could "lead to misunderstanding."

3. CEL 19 (2010) and The Policy on Design Quality for NHSScotland

3.1 The Scottish Government (SG) imposed a mandatory requirement on all NHS bodies to use the ADB system, or a suitable equivalent, as the tool for the briefing, design and commissioning stages of any new hospital project. This is addressed in Provisional Position Paper 1 on the Reference Design for the RHCYP/DCN from paragraph 3.12 onwards. A summary of the position is set out below.

3.2 This requirement was set out in HDL (2006) 58. The policy was updated by way of a Chief Executive Letter issued in 2010 (CEL 19). CEL 19 includes a document called 'A Policy on Design Quality for NHSScotland' (the Design Quality Policy). CEL 19 remained extant for the duration of the RHCYP/DCN project.

3.3 Mandatory requirement 7 of the Design Quality Policy states that:

> "All NHSScotland 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 NHSScotland Body to demonstrate that the alternative is of equal quality and value in its application.]

3.4 The Design Quality Policy also contains a section entitled ‘Activity DataBase (ADB)’ which states that:

> “Activity DataBase (ADB) 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. ADB is produced by the Department of Health in England and is mandated for use in Scotland by the Scottish Government Health Directorates as the preferred briefing and design system for NHSScotland (see Mandatory Requirement 7 of this Policy). It has been developed to assist in the construction, briefing development, design and alteration of healthcare facilities.
>
> 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 Health Facilities Notes (SHFNs) and Scottish Health Technical Memoranda (SHTMs) as published by Health Facilities Scotland.”

3.5 A responsibility was therefore placed on NHSL to utilise ADB, or an equivalent tool, for the briefing, design and commissioning of the hospital. If NHSL determined that the ADB system was inappropriate for the RHCYP/DCN project as a briefing, design and/or commissioning tool, an obligation was placed on NHSL to demonstrate that the alternative tool adopted was of equal quality and value to the ADB system.

4. SHTM03-01: Ventilation for Healthcare Premises, Part A – Design and Validation

4.1 SHTMs are the Scottish equivalent of HTMs. SHTM 00 is entitled ‘Best practice guidance for healthcare engineering – policies and principles’. It states that the aim of the guidance is to ensure that everyone concerned with the management, design, procurement and use of a healthcare facility understands the requirements of the specialist, critical building and engineering technology involved.

4.2 The content of SHTM03-01 sets out guidance on ventilation for health care premises. The detailed content of SHTM03-01 was addressed at the hearing in May 2022.

4.3 SHTM03-01 was not in place in the early stages of the project. It was first issued in October 2011. Prior to that, the relevant Scottish Guidance was set out in SHTM2025 (which did not include an equivalent of Table A1 in SHTM03-01, which sets out environmental parameters for rooms or departments requiring specialised ventilation).

4.4 Paragraph 1.2 of SHTM03-01 states that it provides “comprehensive advice and guidance” to healthcare managers and design engineers on specialist ventilation in healthcare settings. Section 7 is entitled “Specialised ventilation systems”. Paragraph 7.2 provides that specialised ventilation is required for “critical areas and high-dependency units of any type”. Paragraph 7.3 states

that design information is provided in Table A1. Paragraph 7.13 notes that air change rates are specified in the Table in A1.

4.5 Table A1, in Appendix 1, provides guidance on technical parameters, including air changes per hour and pressure regimes, for various areas of a hospital. Table A1 states that a ‘General Ward’ requires six air changes per hour. A ‘single room’ requires six air changes per hour. ‘Critical care areas’ require 10 air changes per hour. SHTM03-01, Appendix A, does not list parameters for every possible room. For example, there is no entry for a “4 bed room”.

5. The Purpose of the Environmental Matrix

5.1 NHSL did not utilise room data sheets, created using ADB, as a tool for briefing of prospective tenderers on its requirements for the ventilation system. The Inquiry Team understands that the EM was utilised as a substitute at the procurement stage.

5.2 This is set out in emails between Hulley & Kirkwood (H&K), who created the original EM, and BAM Construction (The original Principal Supply Chain Partner for the project) in 2010:

> ‘With regards to environmental issues, rather than employ ADB M&E sheets, HK will produce Environmental Matrix spreadsheet for each room type for easy reference as a user sign off tool.’ [15 February 2010]

> ‘This document is intended as an easier tool to replace ADB RDS M&E sheets for the elements covered in the matrix.’ [8 September 2010]

5.3 The EM was issued to prospective tenderers at both the Invitation to Participate in Dialogue (ITPD) stage and the Invitation to Submit Final Tenders (ISFT) stage of the procurement exercise. The ITPD stated certain room data sheets would be require to be submitted as part of the tender

process. However, a full set of room data sheets would only need to be created by the preferred bidder before financial close.

5.4 The ITPD also set out the Board's Construction Requirements (BCR). Section 2.2(b) of the BCR included a requirement that the design complied with CEL 19. Given this stipulation, and CEL 19's requirement for the ADB system to be utilised as a tool for briefing and design, it is not clear to the Inquiry Team why NHSL also sought to issue the EM to prospective tenderers.

5.5 It is not clear to the Inquiry Team precisely when NHSL determined that room data sheets, created using the ADB system, would not be utilised at the briefing stage of the RHCYP/DCN project. It is also not clear why this decision was taken given the guidance set out in CEL 19.

5.6 CEL 19 places a responsibility on NHSL to demonstrate that any alternative briefing tool to ADB is of equal quality and value in its application to room data sheets created using ADB.

5.7 H&K were asked by the Inquiry Team to confirm how it was demonstrated that the EM was of equal quality and value to ADB. H&K have advised the Inquiry Team that this relates to information outwith H&K's knowledge.

5.8 To date, no documentation has been provided to the Inquiry that demonstrates that NHSL considered CEL 19 or the NHS Design Quality Policy at the time the decision was taken to utilise the EM as a briefing tool for the project. It is not clear to the Inquiry Team what basis NHSL had for considering: (i) that the use of the ADB system was inappropriate for the briefing stage of the project; and (ii) that the EM would be as effective as the ADB system for the purposes of the briefing stage.

5.9 To date, no information or documentation has been provided to the Inquiry that suggests that the EM was of equal quality to room data sheets created using ADB. The Inquiry Team's provisional view is that the EM was not of a similar quality to room data sheets produced using the ADB system. That is

because the EM was a spreadsheet that was not automatically populated with information held on a database of technical information that complied with HTMs and/ or SHTMs. This gave rise to the potential for errors, including transcription errors, to arise.

5.10 NHSL maintains that tenderers required to produce room data sheets using ADB and to ensure compliance with CEL 19 and published guidance including SHTM03-01. These matters will require to be explored with witnesses at the April 2023 hearings.

6. Development of the Environmental Matrix for the RHCYP/DCN Project

The Creation of the EM

6.1 The EM for the RHCYP/DCN project was originally developed by H&K. H&K are a firm of mechanical and electrical engineers. H&K have informed the Inquiry that the EM was created by information being manually input to a spreadsheet by a qualified engineer. The EM was not created using the ADB system or any similar computer software system.

6.2 As described above, the EM is a spreadsheet setting out technical information concerning the ventilation system in the hospital. In addition to that, there is a ‘Guidance Notes’ section and a ‘Comments Summary Section’. Thereafter, there are entries for various areas in the hospital. For example, ‘Critical Care/HDU/Neonatal Surgery’. Each type of room in the proposed hospital is given a separate line entry under the heading ‘Room Name’. Columns are provided for environmental data. This includes entries for:

- Temperature
- Relative Humidity (removed 03/02/2012)
- Heating
- Cooling
- Cooling Type

- Ventilation including type, supply air changes per hour (ac/hr), extract ac/hr, relative pressure, minimum filtration
- Safety temperatures – surface, water
- Lighting

6.3 Information such as department code, department name, department sub-group and room name, quantity (of a particular room type), area (this was removed in later versions) and notes are also included. From 2012 onwards, another column was added for 'room function' and a separate sheet was included in the EM called 'Room Function Reference Sheet'. This is addressed in section 8 of this paper, 'Reference Design development for RHSC-DCN project procured under NPD: 2012'

6.4 Technical specifications are aligned to the function of each room. For example, the environmental conditions required to make an operating theatre safe and comfortable for its users differ from those needed for rooms without special clinical requirements.

6.5 The starting point in creating the EM was the 'Schedule of Accommodation' (SoA). The SoA is a spreadsheet containing: (i) the departments; (ii) room types within each department; and (iii) the number, and square metreage, of each specific room type. A schedule of accommodation is typically produced by a specialised healthcare planner, and is the end-product of close dialogue with the clinicians who will be working at the prospective hospital. In particular, the clinicians will inform the healthcare planner of their room requirements within specific departments, which will then be translated into a schedule format by the healthcare planner. The Schedule of Accommodation used for H&K's EM was initially prepared by Tribal, healthcare planners to the Project under Frameworks Scotland. Versions of the EM produced by H&K in 2012 used the SoA prepared by NHSL.

6.6 The EM contains guidance notes at the beginning of the document which refers to NSS guidance, building standards and other NHSL requirements.

From 2012 onwards, every line entry in the 'notes' column of the EM contains the instruction "See Guidance Notes"[1].

6.7 While the EM provided very specific technical information relating to different departments, other design documents such as design briefs and Clinical Output-based Specifications gave an overview of the clinical services intended for each department, and the considerations that tenderers design teams needed to take into account to allow the facilities to meet the needs of users and enable services to run safely and efficiently. This included high-level information relating to environmental conditions, and reference to design guidance. These documents were produced at an early stage of the project by clinical task sub-groups, and signed off by the Clinical Management Team, the Project Clinical Directors, and the Project Sponsor. Clinical Output Specifications were included in the Invitation to Participate in Dialogue (ITPD) Volume 3, which set out the Board's Construction Requirements.

The Stages of Development

6.8 There were five versions of the EM created by H&K. Thereafter, the EM was developed by prospective bidders. From the point the preferred bidder (IHSL) was appointed, the preferred bidder took over development of the EM.

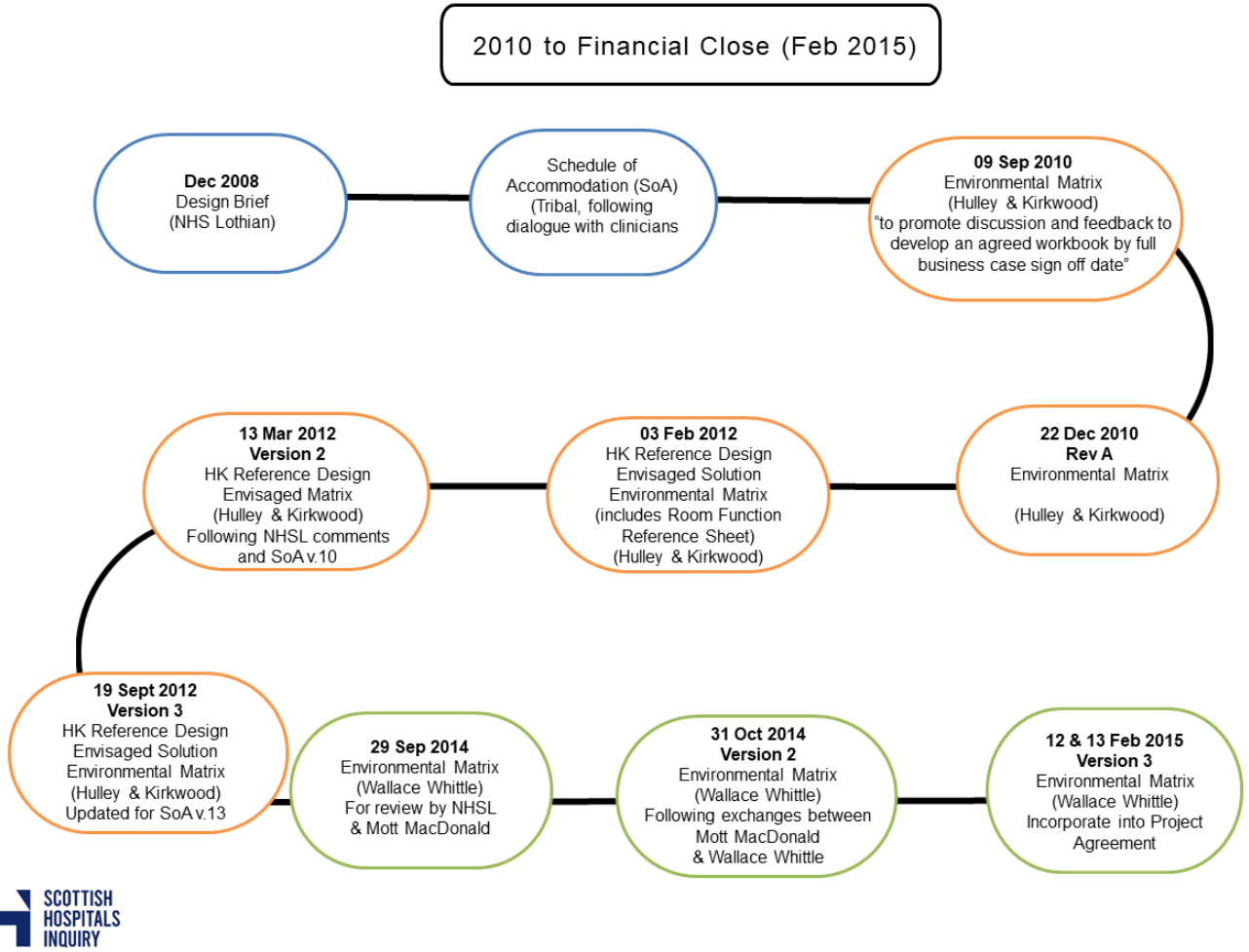
6.9 The table below provides a summary of the development of the EM at different stages of the project.

Stage of Project	Party Responsible for the EM	Comments
2010: RHSC Project under Frameworks Scotland	H&K, subcontracted by BAM, who were the principal consultants under Frameworks Scotland.	• 09/09/10 "First Issue" • 22/12/10 "RDS Environmental Matrix updated in accordance with Tribal SoA[2] Sheets Version 8. H&K Scheme Design Update"

[1] The 2010 versions contained more specific instructions in the notes column.
[2] SoA – Schedule of Area or Accommodation

Stage of Project	Party Responsible for the EM	Comments
2012: Reference Design development for RHCYP/DCN project procured under NPD	H&K as part of the reference design team (commissioned by Davis Langdon, a sub-contractor of MML) This version was reviewed by NHSL Estates.	• 03/02/12 "First Issue Based of Schedule of Area V8" • 13/03/12 "Second Issue Based on Schedule of Area V10 Ward Room T Max Reduced from 28 to 25 Degrees Celsius Revised to suit NHSL Comments" • 19/09/12, "Third Issue Based on Schedule of Area V13"
March 2013 – Jan 2014 Competitive Dialogue and final tender submission	The bidder's design teams. Bidders were asked to confirm acceptance of NHSL's Environmental Matrix, highlighting any proposed changes on an exception basis.	
2014: Further development of Preferred Bidder's design proposals up to Financial Close	IHSL was appointed as preferred bidder. Multiplex were contracted by IHSL for the design, procurement, construction and commissioning of the Works. Wallace Whittle, were the Mechanical and Engineering design consultants to Multiplex. MML provided comments on behalf of the Board. The EM was not approved by NHSL at Financial Close, and was subject to the Reviewable Design Data process.	• 29/09/14 (revision) • 31/10/14 (revision) • 14/02/15, "Financial Close"

ENVIRONMENTAL MATRIX
For the Royal Hospital for Children and Young People and Department for Clinical Neurosciences, Edinburgh



7. RHSC Project under Frameworks Scotland: 2010

7.1 The EM was originally created in 2010, when the project was restricted to the re-provision of the Royal Hospital for Sick Children (RHSC), which was being procured under Frameworks Scotland. Frameworks Scotland was a procurement programme managed by Health Facilities Scotland (HFS) through which HFS selected a number of Principal Supply Chain Partners (PSCP) who would then be available to partner with NHS bodies on healthcare projects. NHS bodies could choose one of these PSCPs rather than conducting a lengthier, standalone, procurement exercise.

7.2 BAM Construction, one of Framework's Scotland's PSCPs, was appointed Principal Supply Chain Partner for the RHSC Re-Provision project on 10 July 2009. NSHL and BAM negotiated the contract for the delivery of stages 3 and 4 of the project, which involved design development and assistance in preparing for the Full Business Case, and the completion of design, construction and handover of the project.

7.3 The Project Manager was Fraser McQuarrie from Davis Langdon and the Supervisor was David Stillie of MML. BAM's Mechanical and Electrical Engineering Design consultant was H&K. The healthcare planner was Tribal. Although the contract was only concluded in 2010, work on the project began before the conclusion of the contract.

7.4 In June 2009, a RACI[3] matrix was produced, showing which parties were responsible, accountable, consulted and informed of different elements of the project, including the design. According to this matrix, the PSCP was responsible and accountable for undertaking the design of the project, and co-ordinating and managing the design process and design teams. The Board of NHSL was responsible and accountable for developing the clinical

[3] RACI stands for 'responsible, accountable, consulted, informed'.

brief, carrying out the clinical review of BAM's design and advising and issuing all NHSL policies to the PSCP for design requirements. NHSL was accountable for managing the clinical review of BAM's design but the advisers were responsible for this. Advisers were also both responsible and accountable for many aspects of reviewing BAM's design, including scrutinising BAM's design and construction information on all technical matters relating to the project.

7.5 In December 2009, BAM prepared a programme for Stage 3 of the project (development of design and preparation for the full business case), which included an activity schedule. According to this schedule, H&K was responsible for Concept Design, Scheme Design and Detail Design and Market Testing. Responsibilities under Scheme Design including amongst other things "Services Input into RDS & C Sheets". The Inquiry Team understands that RDS stands for Room Data Sheets (which are addressed at paragraph 5 above).

7.6 On 15 February 2010, Michael O'Donnell from H&K wrote to David Muir of BAM, copying in other design team members, providing feedback on the Stage 3 Programme. Under the heading 'HK Scheme Design' Mr O'Donnell wrote:

> "With regards to environmental issues, rather than employ ADB M&E sheets, HK will produce Environmental Matrix spreadsheet for each room type for easy reference as a user sign off tool."

7.7 On 2 July 2010, in an email to Graeme Brodie the Architectural & Technical Services Manager for BAM Construction, Michael O'Donnell described the approach H&K would take to control the maximum temperature in different rooms of the hospital on the hottest summer day. This email introduces a figure of four air change rates for bedrooms.[4] Mr O'Donnell noted that for a

[4] Ventilation has an effect on the temperature of a room, similar to the cooling effect of a breeze. The higher the air change rate (written as ac/hr) or air flow, the cooler the room becomes (without an additional source of heating).

typical bedroom to meet the HTM 03-01 criteria of a 18°C to 28°C float range, HTM recommends 6ac/hr through mechanical supply or natural ventilation (or both) and stated that:

> "Design Solution for RHSC- Dynamic Simulation Modelling we have carried out in previous schemes show that with around 4ac/hr of cooled supply air to for example a typical ward room can maintain such conditions. Normally, extract is achieved through en-suites. This would be supplemented by opening windows for natural ventilation."

7.8 For High Dependency Units (HDU), Mr O'Donnell stated that:

> "Design Criteria - HBN 57 gives specific guidance as well as HTM 03-01 - esp Appendix 2 for air change rates - 10ac/hr S&E[5], 18°C to 25°C control range.
>
> The department should be air conditioned and controlled on a zonal basis.
> Design Solution for RHSC - With 10ac/hr of cooled supply and extract air and with multiple zoned ducted reheat batteries on supply to critical care wards/individual/zoned rooms it is possible to maintain such conditions. Central AHU plant requires humidification."

7.9 Therefore, at the preliminary stages of the project, H&K was aware of the need for HDU and critical care areas to have 10 air changes per hour.

7.10 H&K issued the first EM in September 2010. The Guidance Notes section stated that:

> "1. This workbook is to promote discussion and feedback to develop an Agreed Workbook by FBC sign off and is intended as an easier

[5] Supply and Extract. Extract systems tend to be used to remove contaminated air or air containing odour, whereas supply systems are used to supply fresh air to a room, when the air movement in the room needs to be controlled.

reference tool to replace ADB RDS M&E Sheets for elements described on these sheets"

7.11 The first EM contained a number of potential inconsistencies with the guidance set out in HTM 03-01: Specialised Ventilation for Healthcare Premises. (The Scottish version of this guidance, SHTM 03-01: Ventilation for healthcare premises, was not yet available and SHTM 2025: ventilation in healthcare premises, did not contain recommendations for air change rates.)

7.12 The tables below replicate relevant columns of the EM with the recommendations from HTM 03-01 given in bold where they vary from those given in the matrix. These tables show extracts relating to certain rooms and are not intended to be a comprehensive list of all incidences in the EM where figures potentially vary from those in published guidance including HTM 03-01 (SHTM 03-01 not being in existence in 2010).

B1 Critical Care/HDU/Neonatal Surgery

Room Name	Temperature		Ventilation					Notes
	Design max deg C	Design min deg C	Type	Supply ac/hr	Extract ac/hr	Relative Pressure	Min filtration	
Open Plan Bay (4 beds)	25	18	S&E **S**	10	10 **0**	Balanced **Positive**	F7	See p.2 guidance notes - Note 13
Single Bed Cubicle	28 **25**	18	S	4 **10**	0	positive	G4 **F7**	See p.2 guidance notes - Note 13

Guidance note 13 states: "The internal temperature in mechanically ventilated rooms shall not exceed the maximum temperature as listed on these Environmental Matrices provided external summer design criteria is not exceeded."

C1 InPatient Pathway/ Ward Care

Room Name	Ventilation					Notes
	Type	Supply ac/hr	Extract ac/hr	Relative Pressure	Min filtration	
4 Bed Room[6]	S	4 **6**	0	Positive **Balanced or negative**	G4	See p.2 guidance notes – Note 5
Bedroom – single	S	4 **6**	0	Positive **Balanced or negative**	G4	See p.2 guidance notes – Note 5

Guidance note 5 states: "Ventilation air change rates and the use of natural ventilation in Patient Areas shall be reviewed throughout the detail design process to ensure a maximum internal temperature of 28°C (dry bulb) is not exceeded for more than 50 hours per year during norm occupancy as listed in HTM 03-01 Clause 2.15."

7.13 The Open Plan Bays (with four beds) in Critical Care were given air change rates consistent with those outlined in HTM 03-01. However, the ventilation type and pressure regime were inconsistent with HTM 03-01. For single-bed cubicles, the air change rates, maximum temperature and minimum filtration were all inconsistent with HTM 03-01.

7.14 For single-bed rooms and multi-bed rooms in 'InPatient Pathways/Ward Care', the air change rates and pressure regime was inconsistent with the recommendations in HTM 03-01.

7.15 The ventilation design solution is explained in guidance note 14 and reiterates H&K's approach to controlling temperature:

[6] SHTM 03-01 does not specify the requirements for multi-bed rooms. According to HFS advice received from NHSL these are to be treated the same as single bedrooms. The 2011 and 2013 versions of Activity Database room data sheets confirm this.

"**Typical bedroom:** Design Criteria - HTM 03-01 Clause 2.15 - internal temperatures in patient areas should not exceed 28°C db for more than 50 hrs per year. Appendix 2 HTM 03-01 gives 18°C to 28°C float range. Design Solution for RHSC- Dynamic Simulation Modelling shall show that with around 3 to 4 ac/hr of cooled supply air to for example a typical ward room can maintain such conditions. Normally, extract is achieved through en-suites. This would be supplemented by manually opening windows for natural ve [ventilation]

HDU bed areas – Design criteria HBN 57 gives specific guidance as well as HTM03-01 – esp Appendix 2 air change rates 10 ac/hr S&E, 18°C to 25°C control range. (Capability shall be provided but not at the summer and winter external ambient design extremes)

…

Design solution for RHSC – With 10 ac/hr of cooled supply and extract air…to critical care wards…

…

Critical Care areas – Design Criteria – HTM03-01 – esp Appendix 2 for air change rates – 10 ac/hr S&E…"

7.16 The guidance note above correctly identifies the parameters for high dependency units and critical care areas.

7.17 The second version of the EM was produced in December 2010. The air change rate for single bed cubicles in Critical Care was corrected to 10 ac/hr, but the ventilation type, relative pressure, minimum filtration and maximum temperature were all potentially inconsistent with recommendations in HTM 03-01.

B1 Critical Care/HDU/Neonatal Surgery

Room Name	Ventilation					Notes
	Type	Supply ac/hr	Extract ac/hr	Relative Pressure	Min filtration	
Open Plan Bay (3 beds)	S & Ex **S**	10	10 **0**	Balanced **Positive**	F7	See p.2 guidance notes - Note 13
Single Bed Cubicle	S & Ex **S**	10	10 **0**	Balanced **positive**	G4 **F7**	See p.2 guidance notes - Note 13

7.18 Neither iteration of the EM by this stage of the project provided detail regarding the sub-departments with 'InPatient Pathways/Ward Care', for example, the Haematology/Oncology department, which provides services for neutropenic patients and thus has specialist clinical requirements.

8. Reference Design development for RHSC-DCN project procured under NPD: 2012

8.1 On 17 November 2010, the SG introduced a policy change and announced that RHSC would be funded under the Non-Profit Distribution (NPD) model. With the change in funding, it was also decided that the Department of Clinical Neurosciences (DCN) would be co-located with the RHSC.

8.2 The change in the method of funding necessitated a change in the structure of the project. Rather than appointing a contractor to design and build the hospital, a project agreement required to be put in place. This required a standalone procurement exercise to be conducted which complied with the relevant statutory regulations (the Public Contracts (Scotland) Regulations 2006 and thereafter the Public Contracts (Scotland) Regulations 2012). In the circumstances, NHSL adopted the competitive dialogue procedure. The Inquiry Team's provisional understanding of the competitive dialogue procedure, in relation to the development of the EM, is set out in section 10 of this paper, 'The Environmental Matrix during Competitive Dialogue'.

8.3 The decision was made to follow a Reference Design approach, which had implications for the extent of design development to be undertaken by a)

NHSL's advisers in advance of procurement, and b) bidders during competitive dialogue.

8.4 The reference design approach is the subject of a separate paper produced by the Inquiry Team. However, in essence, a reference design provides bidders with certain fixed requirements which the contracting authority considers are mandatory (otherwise, the 'mandatory elements'). This can be contrasted with an exemplar design which provides one possible solution but tenderers have the ability to submit alternative solutions.

8.5 NHSL appointed MML as Technical Adviser, for the revised project with the new funding model, on 22 March 2011. According to the 'Technical Adviser Scope' included in the contract, MML would, amongst other things, manage and co-ordinate the review of any design proposals against the scheme brief during the preparation of the Business Cases, lead on the preparation of Reference Design documentation, and check the Reference Design for compliance with all appropriate NHS and legislative guidelines and requirements and identify any derogations.

8.6 MML contracted Davis Langdon as sub-consultant on 10 May 2011. According to the 'Technical Adviser Scope', included in the sub-consultancy agreement, Davis Langdon would, amongst other things, act as Lead Technical Adviser and point of contact for NHSL, and prepare the 'Invitation to Partake in Dialogue' [sic] including Output Specification, Payment Mechanism etc.

8.7 MML and Davis Langdon appointed H&K to the Reference Design Team on 11 July 2011. H&K's role was Services Engineer, with the following responsibilities (amongst others):

- Developing the environmental information to use for Room Data Sheets
- Input to Building Research Establishment Environment Assessment (BREEAM) pre-assessment workshops and provision

of preliminary 'evidence' as necessary, relating to requirement for a BREEAM 'excellent' rating.[7]

- Support BREEAM pre assessment with M&E Strategy Drawings and Statements, Energy strategy and schedules of power, heating and cooling loads, Engineering design philosophy.
- Review and advise the client on the engineering services requirement elements contained within the ADB room data sheets.
- Review architects proposals for compliance with section 6 (energy) of the Scottish Building Regulations and SHTM 07-02: Encode – making energy work in healthcare.
- Determine the mechanical services system philosophies, including on natural ventilation and mixed mode ventilation.

8.8 The change in the funding model occurred at a point where significant design work had already been undertaken. The Inquiry Team has seen no documentation which suggests that NHSL, or its design team, re-appraised whether an environmental matrix was the correct approach for the revised project when the design team was re-appointed.

8.9 H&K produced three further iterations of the EM, now called 'HK Reference Design Envisaged Solution Environmental Matrix'. According to H&K, the information contained in the EM was derived from reference to SHTM/HTM/HBN Guidance current at the time of the reference design (2011/2012) and Reference Design client briefing information, as referred to within the Guidance Notes page of the matrix.[8] SHTM 03-01 was issued in October 2011.

8.10 The 'HK Reference Design Envisaged Solution Environmental Matrix' introduced the 'Room Function Reference Sheet' (RFRS). The RFRS is essentially a summary of room types that occur in the matrix. It was intended

[7] BREEAM is a method of assessing, rating and certifying the sustainability of buildings
[8] A40151858 H&K response to EM paper, p.23.

to be used to facilitate design review and refine inputs. An extract from the Room Function Reference Sheet is reproduced below:

Room Function Reference Sheet

The following table details reference templates which are used to populate cells within the environmental matrix. Refer to individual department sheets for individual room environmental conditions.

Room Function	**Temperature**		**Ventilation**					**Notes**
	Design Max deg C	Design Min deg C	Type	Supply ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
Bedroom	25	20	Central Supply Air	4	0	Positive	G4	See Guidance Notes
Changing Facilities	28	18	Central Supply and Extract	5	4	Positive	G4	
HDU	25	18	Central Supply Air	10	0	Positive	F7	See Guidance Notes
Multi-bed Wards	25	18	Central Supply Air	4	0	Positive	G4	See Guidance Notes
Isolation lobby	25	18	HBN4 Dependent	HBN4 Dependent	HBN4 Dependent		F7	See Guidance Notes
Isolation bedroom	25	21	HBN4 Dependent	HBN4 Dependent	HBN4 Dependent	Balanced	F7	See Guidance Notes
Operating Theatre Recovery	25	18	In line with SHTM 03-01	In line with SHTM 03-01	In line with SHTM 03-01	Balanced	F7	See Guidance Notes
Recovery Bay/ Recovery Room	28	20	Central Supply and extract	4	0	Positive	G4	See Guidance Notes

8.11 As noted in the sub-heading of the Room Function Reference Sheet, the room function reference sheet acted as a ‘reference template’ used to “…populate cells within the department sheets for individual room environmental conditions”. A new column for ‘room function’ was added to the department sheets.

8.12 Not all of the ‘room functions’ set out in the EM appear in HTM 03-01 or SHTM 03-01. For example, there is no ‘Application’ listed in Appendix 2 of HTM03-01, or Table A1 of SHTM 03-01, for the terms ‘Multi-bed ward’ or ‘HDU’. HTM 03-01 and SHTM 03-01 include various ‘Applications’ including: ‘General Ward’; ‘Critical Care Areas’; and ‘Neutropenic patient’. None of these appear as ‘room functions’ in the RFRS.

8.13 It is not clear to the Inquiry Team how the creator of the EM determined what ‘Room Functions’ should be included, how they should be named, and how parameters should be ascribed to the stated ‘room functions’.

8.14 For rooms in various departments in the hospital, it is not clear how a ‘Room Function’ was chosen from the RFRS. In particular, it is not clear to the Inquiry Team if this was a decision taken by an engineer acting in isolation or whether there was clinical input into this decision. This is relevant because there are various ‘Room Functions’ whereby the creator could face a range of options. For example, area B1 is given the department name ‘PICU and HDU’s – 24 Beds’. It is an area where critical care will be provided. There are a range of department sub-groups and room names in the EM for B1. One room names is ‘Open Plan Bay (4 beds)’. The ‘Room Function’ of ‘Multi-bed wards’ is set out in the EM. It is not clear to the Inquiry Team why this ‘Room Function’ was chosen rather than ‘HDU’. It is a general ward but it is a general ward in a critical care area.

8.15 The issues outlined above will require to be explored with witnesses at the hearing in April 2023.

8.16 The first issue of the 'Reference Design Envisaged Solution Environmental Matrix' dated 3 February 2012, was reviewed by NHSL's Estates Team. The following comments were received via email on 7 March 2012.

> Environmental matrix
>
> 1. NHSL guidance states that all general medical/clinical areas temp design max of 25°C.Critical Care, theatres up to 28°C, Burns & Plastic Dressings may be higher.
> 2. Localised control +/- 2C.
> 3. Comfort cooled will be by AHP.

8.17 The Second Issue, dated March 2012, was revised to align with SoA10 as well as the comments from NHSL's Estates Team. The Third Issue, dated September 2012, was revised in accordance with SoA 13 which arose after the Reference Design Deliverables had been completed.

8.18 No comments were provided by NHSL highlighting any potential problem with the 'Room Function' ascribed to any room in the hospital. That included critical care areas where the values in the EM were potentially lower than those stated in HTM 03-01 and SHTM 03-01.

8.19 The table below contains selected extracts from the department sheets of the third issue of the 2012 EM, which is the version ultimately shared with prospective tenderers.

8.20 The department sheets contained a number of potential inconsistencies with published guidance, including SHTM 03-01. Where figures in the department sheets differ from the parameters and values contained in SHTM 03-01, or SHPN 04-01 Supplement 1 for isolation rooms, the recommended figures have been put in bold.

Selected Extracts from the Environmental Matrix third issue 2012[9]									
Dept Name	**Dept Sub Group**	**Room Name**	**Room Function**	**Ventilation**					**Notes**
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtration**	
B1 PICU and HDUs	PICU – 8 beds	Single Bed Isolation Cubicle	Isolation Bedroom	HBN4 Dependent **SHPN4 supp1**	HBN4 Dependent **SHPN4 supp1**	HBN4 Dependent **SHPN4 supp1**	Balanced	F7	See Guidance Notes
		Gowning lobby	Changing Facilities **Isolation lobby**	Central Supply and Extract **Supply**	5 **69**	4 **0**	Positive	G4 **F7**	See Guidance Notes
		Single Bed Cubicle	Bedroom **Critical Care Areas (Corresponds with 'HDU' on RFRS)**	Central Supply Air	4 **(10)**	0	Positive	G4 **F7**	See Guidance Notes

[9] Not intended as a comprehensive list of all examples of where figures differ from parameters and values contained in SHTM 03-01.

Selected Extracts from the Environmental Matrix third issue 2012[9]									
Dept Name	**Dept Sub Group**	**Room Name**	**Room Function**	**Ventilation**					**Notes**
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtration**	
		Open Plan Bay (4 beds)	Multi-bed Wards **Critical Care Areas (Corresponds with 'HDU' on RFRS)**	Central Supply Air	4 **(10)**	0	Positive	G4 **F7**	See Guidance Notes
	High Acuity – 6 beds	Single cot cubicle	Bedroom **Critical Care Areas (Corresponds with 'HDU' on RFRS)**	Central Supply Air	4 **(10)**	0	Positive	G4 **F7**	See Guidance Notes
		Single Bed Isolation Cubicle	Isolation Bedroom	HBN4 Dependent **SHPN4 supp1**	HBN4 Dependent **SHPN4 supp 1**	HBN4 Dependent **SHPN4 supp 1**	Balanced	F7	See Guidance Notes
		Gowning Lobby	Isolation Lobby	HBN4 Dependent	HBN4 Dependent	HBN4 Dependent	0	F7	See Guidance Notes

Selected Extracts from the Environmental Matrix third issue 2012[9]									
Dept Name	**Dept Sub Group**	**Room Name**	**Room Function**	**Ventilation**					**Notes**
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtration**	
				SHPN4 supp1	**SHPN4 supp 1**	**SHPN4 supp 1**			
		Open Plan Bay (4 beds)	Multi-bed Wards **Critical Care Areas. Corresponds with 'HDU' on RFRS**	Central Supply Air	4 **(10)**	0	Positive	G4 **F7**	See Guidance Notes
C1.1 Medical Inpatients	Medical	Single Bedroom	Bedroom	Central Supply Air	4 **(6)**	0	Positive **balanced or negative**	G4	See Guidance Notes
		4 Bed Room	Multi-bed Wards[10]	Central Supply Air	4 **(6)**	0	Positive **balanced or negative**	G4	See Guidance Notes

[10] SHTM 03-01 does not specify requirements for 4 bed rooms, however ADB room data sheets c.2011 show same requirements as Single room.

Selected Extracts from the Environmental Matrix third issue 2012[9]									
Dept Name	**Dept Sub Group**	**Room Name**	**Room Function**	**Ventilation**					**Notes**
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtration**	
C1.4 Haematology /Oncology Inpatients and Daycases	Paedia-tric Beds	Single Bedroom	Bedroom **Neutropenic Patient ward. No correspon-ding room function on RFRS**	Central Supply Air	4 **(10)**	0	Positive	G4 **H12**	See Guidance Notes
	Day Facilitie s	Multi Bed Room: day care, 4 beds & 2 chairs	Multi-bed Wards **Neutropenic Patient ward. No correspon-ding room function on RFRS**	Central Supply Air	4 **(10)**	0	Positive	G4 **H12**	See Guidance Notes

Selected Extracts from the Environmental Matrix third issue 2012[9]									
Dept Name	**Dept Sub Group**	**Room Name**	**Room Function**	**Ventilation**					**Notes**
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtration**	
P1 Combined theatres	RHSC Patient Pre-Discharge Areas	Post Anaes-thetic Recovery	Recovery Bay/ Recovery Room **Only one type of recovery room in SHTM 03-01. Operating Theatre Recovery on RFRS**	Central Supply and Extract	4 **(15)**	0 **(15)**	Positive **balanced**	G4 **F7**	See Guidance Notes

8.21 Each line entry contains the instruction ‘see guidance notes’. For Critical Care/HDU, as well as post theatre recovery areas, the information contained in the guidance notes differed from that contained in the department sheet. Guidance Note 15 states:

> **“HDU bed areas** - Design Criteria - SHTM 03-01 - esp Appendix 1 for air change rates - 10ac/hr S&E, 18°C to 25°C control range.(Capability shall be provided but not at the summer and winter external ambient design extremes).
>
> The department should be air conditioned and controlled on a zonal basis.
>
> Central AHU plant requires humidification to achieve RH range during winter (HBN 57 Clause 4.60).
>
> **Critical Care areas** - Design Criteria - SHTM 03-01 - esp Appendix 1 for air change rates - 10ac/hr S&E, 18°C to 25°C control range.(Capability shall be provided but not at the summer and winter external ambient design extremes). NHSL may require specific rooms to have a control range up to 28°C.
>
> Central AHU plant requires humidification to achieve RH range during winter (HBN 57 Clause 4.60).
>
> **Post theatre recovery areas** - Design Criteria - SHTM 03-01 - esp Appendix 1 for air change rates – 15 ac/hr S&E , 18°C to 25°C control range. (Capability shall be provided but not at the summer and winter external ambient design extremes against the maximum and minimum range conditions)."

8.22 It is not clear why values were inserted into the EM which did not conform to the statements made in the Guidance Notes. This issue will need to be explored with witnesses at the April 2023 hearings diet.

8.23 The room functions ascribed to rooms in key departments do not reflect the range of rooms requiring specialised ventilation described in SHTM 03-01. For example, SHTM 03-01 provides specific requirements for Critical Care Areas and Neutropenic[11] patient wards. In the EM bedrooms and multi-bed rooms in the critical care department and the haematology/oncology ward (which accommodates neutropenic patients) respectively have been given the room function 'bedroom' and 'multi-bed ward'. The corresponding environmental data for bedroom and multi-bed ward does not meet the same air changes, pressure regime and filtration recommended for these more specialised areas.

8.24 The room function reference sheet did in fact contain a room function 'HDU' that corresponded with the recommendations contained in SHTM03-01, but this room function was not assigned to any of the rooms listed in the 'department sheets'.

8.25 Similarly, the room function 'operating theatre recovery' which corresponded with 'recovery room' in SHTM 03-01 wasn't assigned to the 'post-anaesthetic recovery' area. Instead, a different room function with less onerous ventilation specifications was used.

8.26 This version of the EM also retained the ventilation figures for single and multi-bed rooms which were potentially inconsistent with the air change rates and pressure regime outlined in HTM 03-01 and SHTM 03-01. This version of the EM does not refer explicitly to a mixed mode ventilation strategy although Guidance Note 5 states, "Ventilation air change rates and the use of natural ventilation in Patient Areas shall be reviewed throughout the detail design process to ensure a maximum internal temperature of 25°C (dry bulb) is not exceeded during normal occupancy."

[11] Neutropenia is a condition characterised by abnormally low levels of white blood cells. The condition can increase the risk of infections.

8.27 The use of 4 ac/hr for bedrooms outside of Critical Care areas was referred to in H&K's report titled 'Ward Room Thermal Comfort Analysis' in February 2012, which showed that "the internal temperatures in ward rooms can be maintained at comfortable levels with 4 ACH (air changes per hour) of cooled fresh air supply mechanical ventilation and could be controlled in summertime between 22°C and 25°C maximum." The implication of this, according to the report, was that the design was not reliant on natural ventilation to keep the rooms at the required temperature. The report did not analyse "critical care and high dependency type ward rooms which receive air change rates in the region of 10 ACH".

8.28 In February 2012, H&K also produced a report titled "Reference Design Stage Section 6 SBEM Compliance Report Revision A". The report was prepared "in order to demonstrate that the proposed Reference Design envisaged energy approach and envelope performance criteria for the Royal Hospital for Sick Children/Department of Clinical Neurosciences building could be compliant with the 2010 version of Section 6 Energy of the Scottish Building Regulations." Section 6 outlines SG's carbon emission reduction requirements. According to the report these requirements could be met if, amongst other things, the "ventilation solutions as aligned to the RHSC-DCN Matrix" were incorporated into the design of the hospital.

8.29 In March 2012, H&K produced a paper titled 'M&E Reference Design Approach' which referred to the use of natural ventilation. It stated that:

> "The ventilation systems to the Hospital shall be designed in accordance with Health Technical Memorandum SHTM 03-01. Ventilation shall be provided to suit both the operational and statutory requirements of the development. Although the development will be designed to maximise the use of natural ventilation, it is intended that rooms will not be reliant on natural ventilation alone, unless they comply with maximum temperature limits listed in the RDS Environmental Matrices."

8.30 The paper included an 'Encode checklist' to check for compliance with SHTM 07-02 which is titled 'Encode - making energy work in healthcare' and provides guidance on reducing energy use in the healthcare sector. This contained questions about the use of natural ventilation and mixed mode ventilation:

3. Design integration		
Has every effort been made to include renewables?	✓	Reference Design PiP Sustainability Statement
Can thermal storage, heat recovery, free cooling he used to minimise services further?	✓	Refence Design - Included where beneficial and clinical functionality allows
Has natural ventilation been optimised to minimise services?	✓	As above

6. Ventilation		
Has every effort been made to use a natural ventilation strategy?	✓	where clinical function permits -NDP solution to be reviewed
If natural ventilation is not possible, can a mixed-mode approach be used?	✓	NDP solution to be reviewed
If mixed-mode ventilation is not possible then has every effort been made to use the most efficient ventilation in accordance with Health Technical Memorandum guidance	✓	NDP solution to be reviewed
Has every effort been made to avoid humidification and/or dehumidification?	✓	NDP solution to be reviewed
Has night cooling been considered?	✓	Considered not suitable for a 24hr acute hospital
For full fresh air systems, has ventilation heat recovery been incorporated?	✓	Reference Design Anticipated Approach
Where mechanical plant is essential, is it the most efficient possible?	✓	NDP solution to be reviewed
Is ductwork designed to give low pressure drops?	✓	NDP solution to be reviewed
Does the ventilation design have effective controls (including variable speed drive (VSDs), good zoning and local user controls)?	✓	NDP solution to be reviewed

The report indicates that mixed mode ventilation was always part of the strategy for the ventilation system.

9. Ensuring Compliance with SHTM03-01

9.1 MML have advised the Inquiry Team that prior to the reference design team's departure from the project, MML sought assurance that the Reference Design had been developed in compliance with applicable guidance (see paragraph 4.11 of the Provisional Position Paper on the Reference Design).

9.2 On 28 February 2012, Andy Duncan of MML wrote to Thomas Brady of Davis Langdon to seek this assurance. The email stated:

> "There is an action on the Reference Design Team to confirm that the Reference Design complies with NHS Guidance and key legislation. I attach the requirement schedule for each of the Reference Designers to respond to. We require a statement from each designer to confirm that the Reference Design complies with the Requirements Schedule. Should it not fully comply then each designer shall confirm that the Reference Design complies with the Requirements Schedule with a schedule of derogations. We will need the compliance statement from the Reference Designers before they leave the project to work for potential bidders."

9.3 On 16 March 2012, Nightingale Associates, BMJ Architects, H&K and Arup issued a joint statement in response to this email: "relating to compliance generally and derogations." The document stated:

> "issues relating to compliance shall only be relevant in so far as the proposals have generally been required to be developed to an equivalent level of RIBA Stage C."

9.4 Beneath the heading 'Reference Design Compliance Statement Requirement', the following text appears:

> "Health Technical Memoranda and Scottish Health Technical Memoranda - We have followed SHTMs and also HTMs when there is no Scottish

equivalent."

A full list of derogations is then included in the letter. There are no derogations relating to SHTM 03-01.

9.5 The Inquiry Team understands that this was the only occasion where environmental information within the Reference Design was officially reviewed and signed-off for compliance with healthcare guidance. The assurance was provided in March 2012. However, the version of the EM that was issued with the ITPD was not completed until 19 September 2012.

9.6 It is not clear to the Inquiry Team what basis the reference design team had for providing the assurance that they did. In this paper, the Inquiry Team has highlighted potential inconsistencies between the environmental matrix and published guidance including SHTM 03-01. This issue will require to be explored at the hearing commencing in April 2023.

10. The Environmental Matrix during Competitive Dialogue

10.1 The 'Reference Design Envisaged Solution – RHSC/DCN Environmental Matrix version third issue' was shared with prospective tenderers who were invited to take part in competitive dialogue. Competitive dialogue is a method to identify the bidder whose proposals will best satisfy the contracting authority's requirements. This is accomplished through regular meetings and communications with prospective tenderers to discuss and clarify the requirements for the project and potential proposals to meet them.

10.2 At the beginning of the process, prospective tenderers were issued with the ITPD, which was made up of four separate volumes and multiple appendices. Two volumes of the ITPD are particularly relevant with regard to the EM. Volume 1 contains instructions to bidders, specifically: "background information on the Project, the conditions of participation, the arrangements

for the Dialogue, the Informal Submissions that Bidders must provide during the Dialogue Period, Draft Final Tender requirements, envisaged Final Tender requirements and how the Board intends to evaluate the Final Tender, award the Project and communicate with Bidders." Volume 3 contains the Board's Construction Requirements. Volume 3 was accompanied by a suite of documents making up the appendices.

10.3 An 'Important Notice' at the start of ITPD volume 1 explained that:

> "Any summaries or descriptions of documents or contractual arrangements contained in any part of the Invitation cannot be and are not intended to be comprehensive, nor any substitute for the underlying documentation (whether existing or to be concluded in the future), and are in all respects qualified in their entirety by reference to them."

10.4 Paragraph 2 was entitled "Pre-construction phase". It stated that:

> "2.2 Room layouts are to be prepared using ADB to include fully loaded 3D views"

10.5 In ITPD Volume 1, the EM is defined as "the matrix contained in ITPD Volume 3, Schedule Part 6, Section 3, Appendix C". ITPD Volume 3 defines the EM as:

> "…the Environmental Matrix, which details the room environmental condition requirements of the Board required within each department/unit/space/area. The title is Reference Design Envisaged Solution – RHSC/DCN Environmental Matrix version third issue as set out in Appendix C of this Section 3 (Board's Construction Requirements) of Schedule Part 6 (Construction Matters) (as varied, amended or supplemented from time to time in accordance with the Project Agreement)"

10.6 The EM is referred to twice in Volume 1: in Section 2 "Technical Overview" and Appendix A (ii) Submission Requirements.

10.7 Section 2, which contains an overview of the technical requirements of the project, explains that the specific requirements for the facilities are set out in the Board's Construction Requirements, but that "certain elements of the design as they relate to Operational Functionality are mandatory". The following sub-sections go on to describe mandatory elements as well as the indicative elements of the reference design. The mandatory elements, listed in Appendix E, relate to minimum room areas, points of access, room layouts and adjacencies[12].

10.8 Section 2.5.1 addresses the Schedule of Accommodation and Reference Design Schedule of Accommodation. Section 2.5.2 addresses Room Layouts. In these sections, bidders were informed of which design documents and drawings had already been included in the Reference Design, and what the bidders would need to develop themselves during Competitive Dialogue, and, if they were selected as preferred bidder, before Financial Close. Paragraph 2.5.2, explains that bidders would be required to develop 1:50 layout drawings for specific rooms in the hospital. A list of these rooms is provided in the document.

10.9 Following on from that, paragraph 2.5.3 on Room Data Sheets states:

> "Standard format Room Data Sheets have not been prepared by the Board for the Project. The specific room requirements (the 'Room Information') are detailed in a combination of the following documents:
>
> - The Board's Construction Requirements;
> - The Environmental Matrix;
> - The Schedule of Operational/Design Notes;
> - The Equipment Schedule;
> - The Equipment Responsibility Matrix;
> - The Draft Schedule of Accommodation; and

[12] Which areas need to be close to other areas for the most effective patient flows.

- The Operational Functionality elements of the Reference Design.

During Dialogue Bidders will be required to develop Room Data Sheets, incorporating the Room Information, for those rooms for which 1:50 layout drawings have been prepared. For the avoidance of doubt this shall include all Key Rooms and Generic Rooms in addition to those rooms identified in the table at paragraph 2.5.2 above. The Room Data Sheets will form part of the Bidders proposals. The Preferred Bidder will be required to complete Room Data Sheets for all remaining rooms prior to Financial Close."

10.10 Appendix A (ii) – Submission Requirements, sets out what bidders were required to include in their technical submissions, and how these were to be set out. Technical submissions for Approach to Design and Construction (Section C) would ultimately form part of the preferred bidder's proposals in accordance with the NPD Project Agreement.

10.11 The EM is mentioned in C8, M&E Engineering Design Proposals. C8.1 states that

"Bidders must submit proposal setting out engineering services design for each element of the scheme in sufficient detail to demonstrate compliance with the Board's Construction Requirements."

10.12 C8.2 asks bidders to set out how their design would be developed to meet certain requirements and asks for an 'environmental conditions/room provisions matrix for both mechanical and electrical services for each room in the Facilities'. C 8.3 states:

"Whilst Bidders are required to undertake their own design, the Board has provided a draft Environmental Matrix as part of the ITPD documentation. Bidders must confirm acceptance of the Board's Environmental Matrix, highlighting any proposed changes on an exception basis."

10.13 In Volume 3, which set out the Board's Construction requirements, the EM is mentioned in relation to general construction requirements and mechanical and electrical engineering requirements. It is defined as:

> "…the Environmental Matrix, which details the room environmental condition requirements of the Board required within each department/unit/space/area. The title is 'Reference Design Envisaged Solution – RHSC/DCN Environmental Matrix version third issue' as set out in Appendix C of this Section 3 (Board's Construction Requirements) of Schedule Part 6 (Construction Matters) (as varied, amended or supplemented from time to time in accordance with the Project Agreement)"

10.14 Volume 3 states:

> "Paragraph 5 General Construction Requirements
> 5.3 Thermal Requirements,
> c) The building fabric shall include passive design measures to limit summer temperatures to figures given within the Environmental Matrix;
>
> Paragraph 8 Mechanical & Electrical Engineering Requirements
> Project Co shall provide the Works to comply with the Environmental Matrix.
> …
> Project Co shall take cognisance of all the building services implications of the requirements described in the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).
>
> For the avoidance of doubt the hierarchy of standards and advice detailed in paragraph 2.5 shall apply to this paragraph 8."

10.15 Paragraph 8.1 also specifies minimum engineering standards and includes reference to SHTM 03-01, as well as "publications in paragraph 2 of this Sub-Section C Project Wide Requirement" which includes amongst others

requirements “Adherence to the requirements set out in CEL 19 (2010) A Policy for Design Quality for NHSScotland, 2010 Revision published by the Scottish Government”.

10.16 Paragraph 8.5.2 is entitled ‘Thermal Comfort’. It states that:

> “Where maximum internal summer time temperature calculations indicate that the internal temperature will exceed those limits set out in the Environmental Matrix, Project Co shall provide means of reducing the temperature rise.”

10.17 Clinical Output Based Specifications were also included within the ITPD Volume 3 (Board’s Construction Requirements), Schedule Part 6, Section 3, Sub-Section D (Specific Clinical Requirements). The Inquiry Team understands that these seek to describe the clinical requirements for different parts of the hospital. The Clinical Output Based Specification for Critical Care Areas contained the following information is set out in paragraph 1.8:

- Flexibility in the use of the Critical Care beds for both High Dependency and Intensive Care is key to maintaining efficient use of high specification beds. All three critical care areas must be co-located

- Single cubicles will be used for privacy or isolating ordinary infectious conditions

- Lobbied single bed isolation cubicles are required for both source and protective isolation of patients and they all require to have identical design of pressure control with positive pressure lobbies with filtered air, and negative extraction cubicles. It is required that contaminated air must not flow back into any of the open Critical Care areas. It is required that the lobby must be joined to the room at the foot end of the bed.

- All PICU and HDU bed spaces are required to be of the same specification to allow greatest flexibility of use.

10.18 The Clinical Output Based Specifications for Critical Care also listed the following design guidance:

- HBN 23: Hospital Accommodation for Children & Young People
- HBN 57: Facilities for Critical Care
- SHTM 2025: Ventilation
- SHFN 30: Version 3: Infection Control
- SHTM 61: Flooring
- HBN 14: Pharmacy
- Paediatric Intensive Care Society Standards Document published in 2001

10.19 The ITPD was issued to bidders on 11 March 2013, marking the start of competitive dialogue, which lasted until 13 December 2013 when bidders were invited to submit their final tender. By the time that the ITPD was issued, SHTM 2025 had been superseded by SHTM 03-01.

10.20 The relevant draft proposals of tenderers were submitted in April 2013, for review and feedback.

10.21 M&E Engineering was discussed at Dialogue Meeting 2, which was held in May. It is not clear to the Inquiry Team whether there were any significant discussions with tenderers regarding the EM during the competitive dialogue stage. This issue will require to be explored at the April 2023 hearings.

10.22 The Inquiry Team understands that one bidder – Bidder C – submitted a marked up version of the EM during the procurement process. This sought to amend some of the entries to reflect Bidder C's ventilation strategy, 'to enhance the proposed design criteria or to adjust values based on intended

room use'. Bidder C changed the air change rates for single bed cubicles and open plan bays in the PICU (Paediatric Intensive Care Unit) and Low Acuity department sub-groups from 4 ac/hr to 10 ac/hr. For single bed cubicles and open plan bays in the Neo-Natal and High Acuity department sub-groups Bidder C modified the air change rates to 6 ac/hr.

10.23 During Competitive Dialogue Bidder C had also requested to "explore the acceptability" of their ventilation strategy which would deliver "a lower air flow than the 6 air changes/hour specified in SHTM 03" and "review the specialist ventilation strategy for clinical areas" such as isolation rooms, including the "application of isolation room guidance to Critical Care single rooms". In their final tender Bidder C wrote, "we have proposed a lower air flow of four air changes/hr (which have been agreed in dialogue meetings, despite being lower than those specified in SHTM 03)…These will result in a similar air flow to the provision of four air changes/hr included in the reference design."

10.24 Bidders were required to submit a list of assumptions and derogations outlining where their proposals varied from the Board's Construction Requirements. Bidder C included a "clarification" with respect to Section 8: Mechanical & Electrical Engineering Requirements: "Project Co shall provide the Works to comply with the Environmental Matrix", referring NHSL to their own (Bidder C's) amended environmental matrix.

10.25 It is not clear whether this was discussed by NHSL and its advisers. It is also not clear to the Inquiry Team why all tenders were deemed to comply with the specified criteria when one tenderer was offering to provide a different solution to that set out in the EM issued with the ITPD and ISFT. These issues will require to be explored at the April 2023 hearings.

11. The Environmental Matrix at Final Tender Stage

11.1 IHSL submitted its final tender on 13 January 2014. IHSL was selected as the preferred bidder by NHSL. In its final submission for section C8 'Clarity, Robustness and Quality of M&E Engineering Design Proposals' it stated that the "…Mechanical, Electrical and Public Health Services are designed to provide efficient, safe, secure services in accordance with the Brief, British Standards, CIBSE guides and NHS guidance documents".

11.2 IHSL also stated that the outline designs have "…been reviewed for compliance with SHTMs" (C8.1 i).

11.3 In section C8.2, the EM is addressed:

> "C8.2 (x) Environmental Conditions Room Matrix
>
> The mechanical and electrical services shall be provided in accordance with the reference design environmental matrix and we shall provide an addendum matrix for any rooms on an exception basis highlighting any changes at preferred bid stage.
> …
> Environmental Conditions:
> We have followed the reference design and have utilised the reference design matrix to compile the room environmental proposal drawings…
>
> The room temperature set points, air change rate and ands [sic] shall be in accordance SHTM 03 [sic] and lighting information as CIBSE guide LG2."

11.4 A table was included that sets out typical rooms. HDU is specified as requiring 10 air changes per hour. That was not replicated in all the entries in EM although this was stated in the Guidance Notes section at the front and there were a number of entries stating "See Guidance Notes".

11.5 Section C8.3 stated:

> "C 8.3 Environmental Matrix
>
> As indicated above no changes proposed at this time nor envisaged in the future but we will continue to review and advise back. The solutions are refenced on the Heating, Ventilation and Cooling strategy drawings, sequence 521, 524 and 525 recorded in AP1.1 Section 5.1 Mechanical Drawing Schedule."

11.6 IHSL did not submit their own 'room conditions matrix' in the form of a marked up version of the 'reference design envisaged solution EM' as they did not propose any changes.

11.7 IHSL described a mixed mode ventilation strategy in their final tender submission for Building Services Deliverables at paragraph 5.9. IHSL sought to maximise natural ventilation where appropriate including "examples of simulations that were carried out to reach a final solution". One of those referred to an approach for a single bedroom, as follows:

> "Single Bedroom Ward, South Facing Exposed (Summer) with mixed mode ventilation
> Opening windows – restricted opening to 100mm.
> Supply air provided if the room air temperature is great than 25°C.
> External air 4 ACH cooled to 18°C.
> No reliance on uncontrolled infiltration for cooling."

11.8 It was proposed that all ward rooms adopt a mixed mode approach (paragraph 5.9.6.4 of IHSL's submission for 'Building Services Deliverables).

11.9 Draft room data sheets were produced by IHSL in October 2013. These concerned certain key and generic rooms. The room data sheets for rooms in Critical Care/HDUs appear to replicate the environmental data contained in the EM which is potentially inconsistent with SHTM 03-01. For example, the

room data sheet for area B1 'PICU and HDU's' stated a value of 4 air changes per hour for "4 beds low acuity" notwithstanding that the room was in a High Dependency/Critical Care area of the hospital. Table A1 of SHTM 03-01 indicates that such areas should have 10 air changes per hour. It is not clear to the Inquiry Team if these were submitted along with the final tender.

11.10 IHSL stated that the ventilation system complied with published guidance including SHTM03-01:

> "The ventilation systems to the Hospital are designed in accordance with Scottish Health Technical Memorandum [sic] SHTL 03-01. Ventilation shall be provided to suit both the operational and statutory requirements of the development" (paragraph 5.9.7)
>
> "The M&E specifications shall comply with SHTMs and general healthcare guidance notes…" (paragraph 5.12.2)

11.11 It is not clear to the Inquiry Team how IHSL could have stated that there would be compliance with SHTM 03-01 and compliance with the EM (given that the EM contained values – including critical care areas – that do not appear to comply with SHTM 03-01). This issue will require to be explored with witnesses at the hearing commencing in April 2023.

12. The Environmental Matrix in the period from the Appointment of the Preferred Bidder to Financial Close

12.1 After being selected as the preferred bidder, IHSL became responsible for developing the design of the ventilation system. The Inquiry Team understands that the EM was not to be included in the Project Agreement as reviewable design data as the preferred bidder was to develop a full set of room data sheets before financial close. Therefore, the EM should have been superseded as a briefing and design tool by financial close. However, the requirement for a full set of room data sheets to be produced by financial close was waived by NHSL and the EM came to be included as reviewable design data within the contract. The reasons for this decision being taken will require to be explored with witnesses at the hearing in April 2023. As a result of the decision, the Inquiry needs to understand the development of the EM in the period to financial close.

12.2 On 3 July 2014, Multiplex requested a copy of the EM which had been prepared by NHSL and which formed part of the ITPD. Ken Hall, M&E Design Manager of Multiplex asked specifically for a version in Excel format to allow Stewart McKechnie of TUV SUD/Wallace Whittle to populate the matrix with any changes. MML acceded to the request on 11 July 2014.

12.3 According to the minutes of a Project Management Group Meeting held on 27 August 2014, Liane Edwards of MML, “advised that during a review of the Environmental Matrix a number of discrepancies have been uncovered impacting on RDS [Room Data Sheet] production and requested input from NHSL. IHSL to raise RFI”. RFI is a commonly used acronym for ‘Request for Information’ literally, an information request to another party usually using a standardised template such as a register.

12.4 The minutes of the Project Management Group meeting on 3 September 2014 note, 'RDS [Room Data Sheet] schedule on the basis of generic and specialist rooms to be proposed by IHSL for agreement by Board'.

12.5 At a Project Delivery Group (PDG) meeting attended by representatives from NHSL and IHSL on 12 September 2014, it was noted:

> "RDS list with Board for review. Board have comments and will forward shortly. Target approval 30th September 2014."
>
> 'Environmental Matrix: IHSL to confirm proposed format and integration with RDS. It was noted the IHSL environmental matrix is to be read in conjunction with RDSs as available at FC and supplemented through the RDD process during the construction phase.'

12.6 Draft room data sheets dated 18 September 2014 were prepared by HLM, a member of IHSL's consortia. These show single cubicles and open plan bays to have 4 ac/hr which corresponds with the 'department sheets' in the EM but is potentially inconsistent with SHTM 03-01. These contain some differences from the room data sheets submitted during dialogue in October 2013. Specifically, ventilation type has been changed from central supply air to natural and central supply air for rooms other than the isolation room. The single bed cubicle and 'open plan bay: 3 cots' were also shown to have extract via en-suite.

12.7 On 25 September 2014, Colin Macrae, Senior Building Services Engineer at MML emailed Graeme Greer and Maureen Brown (MML) with initial comments on IHSL's EM, which had been prepared by Wallace Whittle and is 14 September 2014. These identify a number of areas where the figures provided on the EM differ from those stated in SHTM 03-01. For example, bedroom air changes per hour were stated to be four when SHTM03-01 stated six. An issue around the pressure regime for bedrooms was also identified. Wallace Whittle issued a revised EM on 29 September 2014.

12.8 This iteration of the EM was in Excel format. The guidance notes section was retained. A version of the RFRS was included in a tab called ‘Room Function Reference Sheet’. This was not an exact copy of the version issued with the ITPD and ISFT. Changes made by Wallace Whittle included:

12.8.1 The room function ‘HDU’ was removed from both of the Room Function Reference Sheets. It is not clear to the Inquiry Team why this reference was removed. It resulted in there being no reference to a high dependency unit or to critical care in the ‘Room Function’ section of the ‘Room Function Reference Sheet’.

12.8.2 The room function ‘operating theatre recovery’ was also removed from both RFRS.

12.8.3 The environmental data provided for Recovery Bay/Recovery Room was changed in the RFRS in the ‘All Rooms’ Tab to reflect the air change rates and relative pressure contained in SHTM 03-01, although the figures for temperature and minimum filtration remained the same as the previous version.

12.8.4 The Room Function Reference Sheet contained in the ‘All Rooms’ tab also introduced changes to the specifications for Bedroom and Multi-bed Ward room functions, including changes to the temperature, ventilation type (natural and central supply air), extract (via en-suite) and relative pressure (positive to en-suite).

12.8.5 A column was added for ‘ADB code’. An ‘ADB code’ was included for some rooms. However, not all rooms contained an ‘ADB Code’.

12.9 The ‘All Rooms’ tab contained the following information (with some changes such as the deletion of ‘HDU’ highlighted). Specifications recommended by SHTM 03-01 and SHPN 04 supplement 1 are in bold where they differ from those in the RFRS.

Tab: All Rooms

Room Function	ADB Code	Ventilation					Notes
		Type	Supply Ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
Bedroom		Natural and Central Supply Air (previously 'central supply air'. SHTM 03-01 recommends central supply air)	4 **(6)**	Via en-suite (previously '0')	Positive to en-suite (previously 'positive', SHTM 03-01 recommends **balanced or negative)**	G4	See Guidance Notes
Changing Facilities		Central Supply and Extract	5	4	Positive	G4	
HDU **(removed)**		Central Supply Air	10	0	Positive	F7	See Guidance Notes
Multi-bed Wards[13]		Natural and Central Supply Air (previously 'central supply air' SHTM 03-01 recommends central supply air)	4 **(6)**	Via en-suite (previously '0')	Positive to en-suite (Previously 'positive' SHTM 03-01 recommends **balanced or negative** for single bedrooms)	G4	See Guidance Notes
Isolation lobby		Central Supply	69	0	Positive	F7	See Guidance Notes

[13] SHTM 03-01 does not specify requirements for 4 bed rooms, however ADB room data sheets c.2011 show multi-bed wards to have same requirements as Single Room

Room Function	ADB Code	Ventilation					Notes
		Type	Supply Ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
Isolation bedroom		Supply via lobby	10	0	Positive (SHPN 04 suppl 1 states pressure differential to corridor should be **nominally 0**)	F7	See Guidance Notes
Operating Theatre Recovery **(removed)**		In line with SHTM 03-01	In line with SHTM 03-01	In line with SHTM 03-01	Balanced	F7	See Guidance Notes
Recovery Bay/Recovery Room		Central Supply and extract	15	15	Balanced	G4 **(F7)**	See Guidance Notes

12.10 In the department sheets, contained in the 'All Rooms' tab, the column for Department Sub-Group was removed. A column was added for 'ADB code'. The error in relation to the isolation room lobby in Critical Care was corrected. The table below shows the remaining potential inconsistencies with SHTM 03-01 and also marks up the erroneous inclusion of 'en-suite' to rooms in Critical Care, since these were not required in this department.

Dept Name	Room Name	Room Function	ADB Code	Ventilation					Notes
				Type	Supply ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
B1 PICU and HDUs	Open Plan Bay (4 beds)	Multi-bed Wards **SHTM 03-01: Critical Care Areas. No corresponding room function on RFRS**	B1609-01 (also B1609-02)	Natural and Central Supply Air **(Supply Air)**	4 **(10)**	Via en-suite **(no en-suite)**	Positive to en-suite **(no en-suite)**	G4 **F7**	See Guidance Notes
	Single Bed Cubicle	Bedroom **SHTM 03-01: Critical Care Areas. No corresponding room function on RFRS**	B1401	Natural and Central Supply Air **(Supply Air)**	4 **(10)**	Via en-suite **(no en-suite)**	Positive to en-suite **(no en-suite)**	G4 **F7**	See Guidance Notes
	Single cot cubicle	Bedroom **SHTM 03-01: Critical Care Areas. No corresponding room function on RFRS**	B1421	Natural and Central Supply Air **(Supply Air)**	4 **(10)**	Via en-suite **(no en-suite)**	Positive to en-suite **(no en-suite)**	G4 **F7**	See Guidance Notes

Dept Name	Room Name	Room Function	ADB Code	Ventilation					Notes
				Type	Supply ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
	Open Plan Bay (3 Cots)	Multi-bed Wards **SHTM 03-01: Critical Care Areas. No corresponding room function on RFRS**	B1407-01	Natural and Central Supply Air **(Supply Air)**	4 **(10)**	Via en-suite **(no en-suite)**	Positive to en-suite **(no en-suite)**	G4 **F7**	See Guidance Notes
C1.1 Medical Inpatients	Single Bedroom	Bedroom	B0305-01	Natural and Central Supply Air	4 **(6)**	Via en-suite	Positive to en-suite **balanced or negative**	G4	See Guidance Notes
	4 Bed Room	Multi-bed Wards[14]	B0405	Natural and Central Supply Air	4 **(6)**	Via en-suite	Positive to en-suite **balanced or negative**	G4	See Guidance Notes
C1.4 Haematology/ Oncology Inpatients and Daycases	Single Bedroom	Bedroom **SHTM 03-01: Neutropenic Patient ward. No corresponding room function on RFRS**	B0305-01	Natural and Central Supply Air **Supply Air**	4 **(10)**	0	Positive to en-suite	G4 **(H12)**	See Guidance Notes

[14] SHTM 03-01 does not specify requirements for 4 bed rooms, however ADB room data sheets c.2011 show same requirements as Single room

Dept Name	Room Name	Room Function	ADB Code	Ventilation					Notes
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtration**	
	Multi Bed Room: day care, 4 beds & 2 chairs	Multi-bed Wards **SHTM 03-01: Neutropenic Patient ward. No corresponding room function on RFRS**	B0405-01	Natural and Central Supply Air **Supply Air**	4 **(10)**	0	Positive to en-suite	G4 **(H12)**	See Guidance Notes
P1 Combined theatres	Post Anaesth-etic Recovery	Recovery Bay/Recovery Room		Central Supply and Extract	15	15	Balanced (this differs from the RFRS)	G4 **F7**	See Guidance Notes

12.11 The notes column still contained the instruction ‘see Guidance Notes’. The guidance notes contain requirements that differ from the figures provided in the department sheets. Specifically, Guidance Note 15 states:

> **“HDU bed areas** - Design Criteria - HBN 57 gives specific guidance as well as SHTM 03-01 - esp Appendix 1 for air change rates – 10 ac/hr Supply, 18°C to 25°C control range. (Capability shall be provided but not at the summer and winter external ambient design extremes against the internal maximum and minimum range conditions).
>
> The department should be air conditioned and controlled on a zonal basis.
>
> Central AHU plant requires humidification to achieve RH range during winter (HBN 57 Clause 4.60).
>
> **Post theatre recovery areas** - Design Criteria - SHTM 03-01 - esp Appendix 1 for air change rates – 15 ac/hr S&E , 18°C to 25°C control range.(Capability shall be provided but not at the summer and winter external ambient design extremes against the maximum and minimum range conditions).
>
> **Critical Care areas** - Design Criteria - SHTM 03-01 - esp Appendix 1 for air change rates – 10 ac/hr Supply , 18°C to 25°C control range.(Capability shall be provided but not at the summer and winter external ambient design extremes against the maximum and minimum range conditions). NHSL may require specific rooms to have a control range up to 28°C
>
> Central Air Handling Plant requires humidification to achieve RH range during winter (HBN 57 Clause 4.60).

12.12 As in the previous ‘reference design’ version of the environmental matrix, the air change rates and minimum filtration for the Critical Care areas described

in the department sheets are potentially inconsistent with SHTM 03-01. The Wallace Whittle version contains further detail relating to extract via en-suite and use of natural ventilation, which the Inquiry Team understands may not be suitable for rooms in Critical Care/HDU.

12.13 This version of the EM retained the ventilation figures for non-Critical Care single and multi-bed rooms which were potentially inconsistent with the air change rates and pressure regime outlined in SHTM 03-01, although natural ventilation is referred to in the column for ventilation type, and ‘extract via en-suite ’ is included.

12.14 The air change rates for post-anaesthetic recovery were now consistent with those recommended in SHTM 03-01, but the minimum filtration figure was inconsistent. The pressure regime was consistent with SHTM 03-01 but differed from what was outlined in the room function reference sheet.

12.15 On 14 October 2014, MML sent Multiplex a copy of NHSL's technical comments on the draft environmental matrix. The comments noted that the air change rates and pressure regime for bedrooms provided in the environmental matrix differed from SHTM 03-01 and that ‘Recovery stated as 4 ac/hr, SHTM says supply and extract 15 ac/hr’.

12.16 Although the comments note an error with figures for Recovery Room, these had in fact already been changed to 15 ac/hr in the ‘All Rooms’ tab but had not been changed in the ‘room function reference sheet’ tab.

12.17 No issues were raised by NHSL in relation to the values set out in the EM for critical care areas.

12.18 On 28 October 2014, Multiplex forwarded Wallace Whittle's response to the initial technical comments to MML. An extract of the relevant points are copied below (Wallace Whittle's response being the right-hand column in the table).

The Board has the following initial technical comments on the draft 1 of the Environmental Matrix	**IHSL Update 27 October 2014**
1. The submitted Environmental Matrix does not reflect the current Schedule of Accommodation, e.g. theatres and DCN acute care changes are not included. IHSL to provide up to date Environmental Matrix.	Theatre requirements are contained within the guidance notes section. The document will be updated to include these rooms as per item 5 below.
2. Issues within the guidance notes relating to:	
a. Environmental Matrix still dated as version 13 issued 19th September 2012	Date has been removed.
b. Humidification, the requirement is for the space for future installation,	Guidance notes amended accordingly.
c. HK Design reference to be removed	Reference removed.
3. The detail contained in the Clinical Output Specification requires theatre temperatures to be able to be raised to 31°C for certain operations. IHSL to reflect this in the Environmental Matrix.	Guidance notes amended accordingly.
6. SHTM 03-01 clause 2.11 states;	
“Internal temperatures in patient areas should not exceed 28°C db for more than 50 hrs per year”, however the Board added an additional BCR clause regarding the 25°C as clarified below:	Rooms at 25°C are identified within the matrix.
“Measures shall be assessed, modelled and implemented to demonstrate that the internal air temperature of any room or area does not exceed the maximum acceptable level of 25°C for more than 50 hours per annum”.	This is not agreed for all rooms. Refer to Environmental Matrix for individual room temperatures.
Further review and development of the Environmental Matrix is required to clarify the following:	The BCR’s allow for several rooms to go to 28 deg C and we have not received a change order to reduce the temperature in these rooms.

The Board has the following initial technical comments on the draft 1 of the Environmental Matrix	**IHSL Update 27 October 2014**
a. There are some rooms at 28°C which are provided with comfort cooling.	We understand that Internal temperatures in these rooms should not exceed 28°C db for more than 50 hrs per year
b. There are areas/rooms in the Environmental Matrix that contradict the above BCR clause, hence once IHSL produce an updated Environmental Matrix, further discussion is required with the Board to confirm which rooms or areas are not going to meet the Clause.	As indicated during the workshops we do not consider this as a contradiction. The BCR has two clauses one for specific rooms based on the 25°C and another for rooms on the 28°C criteria.
7. Bedrooms 4 ac/hr, SHTM says 6 ac/hr Bedrooms have no extract Bedroom en-suites 10 ac/hr, SHTM says 3 ac/hr Bedrooms stated as positive pressure, SHTM says 0 or –ve pressure The supply air to a bedroom has to be balanced with extract e.g.Bedroom area 19m2 and 2.4m high = volume 45.6m3 x 6ac/hr = 273.7m3 / hr En-suite area 5m2 and 2.4m high = 12.0m3 x 3ac/hr = 36m3 / hr To achieve balanced pressure within bedroom extract required = 276.3 – 36 = 237.6 m3/hr	The scheme is based on the Reference design throughout which is essentially mixed mode with openable windows and 2/3rds mechanical supply air to all bedrooms. This gives physiological benefits with access to fresh air control by user and obvious Energy Benefits. We have amended the environmental schedule to show the room being balanced which is provided by opening the window.
8. Recovery stated as 4 ac/hr, SHTM says supply and extract 15 ac/hr	15 ac/hr utilised with the current design, matrix amended accordingly

12.19 These comments show that NHSL had highlighted to IHSL potential inconsistencies between the EM and:

- the current Schedule of Accommodation (a document listing all the rooms in the hospital, along with room sizes);
- the Clinical Output Specifications (which describes the clinical function and requirements for departments);
- the Board's Construction Requirements; and
- SHTM 03-01.

12.20 The comments also indicate a difference of opinion between NHSL and IHSL on the correct interpretation of NHSL's published requirements.

12.21 On 31 October 2014, Multiplex issued an updated version of the EM to MML. The guidance notes section stated that:

> "1. This workbook is prepared for the Financial Close Stage as an easier reference tool to replace ADB RDS M&E Sheets for the Environmental Criteria Elements as described on these sheets"

12.22 The Inquiry Team notes that by financial close, room data sheets should have been prepared for all spaces in the hospital. It is not therefore clear why the EM would still be required at financial close. It is not clear when a decision was taken to dispense with the requirement for all room data sheets to be completed by financial close or why this decision was taken.

12.23 A meeting with the subject 'Environmental Matrix NHSL Comments Feedback' was convened on 11 November 2014. The meeting was attended by representatives from Multiplex, Wallace Whittle, NHSL and MML. Notes of the meeting were prepared by MML and issued by e-mail on 11 November 2014. Bullet 4 related to the pressure regime for single bedrooms and stated, "Detailed proposal awaited on bedroom ventilation to achieve balanced/negative pressure relative to corridor".

12.24 NHSL's Infection Control team and technical adviser MML expressed concern that IHSL's proposal for single bedroom ventilation was not compliant with

SHTM 03-01. Specifically, there was concern around the pressure regime, and the reliance on opening windows to maintain the required balanced pressure regime.

12.25 On 12 November 2014, Colin Macrae (MML) asked his colleague William Stevenson (MML) for comments on a summary of lHSL's ventilation strategy for single rooms. The proposal involved the opening of windows. The document attached to the email states:

> "Single bedroom ventilation
>
> Project Co's current ventilation strategy for the above room is as follows:
>
> Supply air to bedroom at 4 ac/h and 17m2 x 2.4m high = 40.8 m3 x 4 ac/h = 163.2m3/h
>
> Extract air from en-suite at 10 ac/h and 4.5m2 x 2.4m high = 10.8 m3 x 10ac/h = 108m3/h
>
> This leaves an excess of 55 m3/h supply air to be discharged by other means to achieve balanced ventilation within the bedroom. Project Co have stated that this is satisfied by opening the window or the trickle vent on the window if the window is closed.
>
> Extract from the corridor will reduce the resultant corridor pressure.
>
> SHTM 03-01 Table A1

Room	Ventilation	Air change rate	Pressure	Comment
Single bedroom	supply/extract/natural	6	balanced or negative	
En-suite	extract	3	negative	

Mott MacDonald concern is that the room will be at a slight positive pressure relative to the corridor which would allow infection such as MRSA or Norovirus to spread."

12.26 William Stevenson responded on 12 November 2014 stating:

"I would tend to agree with your comments.

There is an excess of positive pressure air in the bedrooms.

Project Co are stating that the excess air will pass through the ventilator.

That would appear to imply that the ventilator would be required to be open all year round which would have an impact on energy targets – heat would be lost through the ventilators rather than recovered through the heat recovery systems?

There are still issues over them achieving the required 6 air changes in the room as per SHTM 03-01."

12.27 On 13 November 2014 this email was forwarded from Graeme Greer (MML) to Brian Currie (NHSL). Mr Greer stated:

"Further to the Environmental Matrix meeting on Monday, please refer to the email below and attached that summarised the issue with the single bedroom ventilation.

As discussed at the Environmental Matrix meeting we added the following comment on the Environmental Matrix,

'Detailed proposal awaited on bedroom ventilation to achieve balanced/negative pressure relative to corridor.'

However this may come down to an dispute over the SHTM requirement/ Infection Control requirements.

Might be worth raising this again at the RDD meeting?"

12.28 'RDD meeting' refers to meetings held to discuss Reviewable Design Data, which would be included in the Project Agreement Schedule Part 6 (Construction Matters) Section 5 (Reviewable Design Data), referred to as the 'RDD Schedule'. Reviewable Design Data refers to information, such as design deliverables and Project Co proposals, that had not yet been approved by the Board of NHSL and were subject to amendment in accordance with Board comments.

12.29 On 13 November 2014, Graeme Greer also emailed Brian Currie regarding the revised payment mechanism and GSU[15] table. Attached to the email was a report regarding a review of IHSL's Schedule of Accommodation (SoA) and Environmental Matrix, which MML had undertaken with a view to updating the Gross Service Unit Table (GSU) for inclusion in Schedule Part 14 (Payment Mechanism). The purpose was to mitigate the risk of using inaccurate data in the Payment Mechanism. MML found that IHSL's SoA revealed differences between the reference design and IHSL's design, and also did not reflect the current 1:200 drawings for the hospital. For example, the SoA referred to rooms that had been removed since the reference design, and did not include some rooms that had since been added to the design. Thus, the SoA was out of date. The problems highlighted with the EM, specifically in relation to IHSL's SoA and Payment Mechanism, included:

- The EM issued is closer to the Hulley and Kirkwood Reference Design SoA, hence is out of date
- Environmental Parameters can therefore not be set for rooms that do not exist

[15] GSU - Gross service units. Relates to energy consumption.

MML stated that the "EM therefore needs to be updated once the SOA has been updated."

12.30 Following an RDD Meeting on 13 November 2014, the requirement to update the Schedule of Accommodation "to reflect all of the individual elements of the proposed Facilities in accordance with Good Industry Practice" was included in the 'RDD Schedule'.

12.31 The Inquiry Team understands that on 19 November 2014, a Healthcare Associated Infection (HAI) – System for Controlling Risk in the Built Environment (SCRIBE) (HAI-Scribe) meeting was held at which it was recorded that the ventilation system design was not fit for purpose given the potential for infection spread via ventilation systems. The reason stated was that some concern has been raised in relation to a potential issue with ventilation with regard to negative/balance pressure in single bed rooms. Drawings and further information were require to fully understand if there was a risk/issue.

12.32 In an email of the same date, Liane Edwards-Scott emailed Ken Hall stating that: "Motts have just informed the HAI scribe that the vent system doesn't comply with infection control because it relies on the windows being openable- can you shed some light or offer opinion?". Ken Hall forwarded this email to Stewart McKechnie, stating:

"Can you treat as priority the bedroom sketches for the vent before the door closes and we have no alternative but to comply with infection control requirements.

Realistically I think we need:

1.0 Interpretation of SHTM for bedrooms
2.0 Air flow movement under a few scenarios, natural vent etc
3.0 And how this impacts on the adjacent corridor ventilation

We will need to chat it through internally then table with infection control."

12.33 Mr McKechnie, of TUV SUD Ltd, replied stating "Told you wouldn't wait till RDDDDDDDDDD !!!" [sic].

12.34 TUV Sud/Wallace Whittle produced a draft report for air movement to single bedrooms dated 27 November 2014. A second draft was produced on 12 January 2015, titled 'RHSC-DCN Edinburgh Air Movement Report For Single Bedrooms (Draft)'. Under the section headed, 'Interpretation of SHTM 03 [sic] Ventilation for Healthcare Premises', the report states:

> "A single room within Appendix 1 : Table A1 : Recommended air-change rates is given under the ventilation column as supply/extract/natural, with 6 ac/hr and room pressure as zero or negative. The single room WC from the table is 3 ac/hr and room pressure is negative.
>
> Current bedroom ventilation design is supply into the room at 4 ac/hr with opening windows and trickle vents to provide natural ventilation, this gives a balanced room pressure as long as the window is open.
>
> The single bedroom WC extract has been enhanced to 10 ac/hr and the room pressure is negative."

12.35 The Conclusion section states:

> "…When the windows and trickle vents are utilised for natural ventilation the bedroom pressure is balanced and the corridor becomes negative.
>
> If some of the windows and trickle vents are closed, these bedrooms will become positive and the bedrooms with open windows again will be balanced, where the corridor is negative.
>
> Should all the bedroom windows and trickle vents be closed, the bedroom pressure is positive and the corridor shall be balanced as the corridor

extract rate will match the supply air coming from the bedrooms via their doors.

The window trickle vents should be left open when the rooms are occupied, this will ensure that the bedroom pressure is balanced.

By utilising the proposed mixed mode ventilation proposal for the bedrooms, ie. opening windows and trickle vents with the supply air reduced from 6Ac/Hr to 4Ac/Hr direct into the bedroom, this will provide the most energy efficient solution for the space.

We believe that we have complied with the reference design concept as detailed within the original Environmental Matrix."

12.36 On 13 January 2015, an 'MEP' (mechanical, electrical and plumbing) workshop meeting was held at which the issue of pressure regimes was discussed. This was originally planned as a HAI-Scribe Stage 3 review which was cancelled due to lack of attendance of key people. However, ventilation was discussed by those who attended.

12.37 According to an 'RFI Summary' issued on behalf of NHSL, a query was raised on 13 January 2015 regarding HAI Scribe stage 3 Construction:

We had scheduled a meeting today to complete HAI Scribe Stage 3 but unfortunately we could not proceed with the meeting as key individuals were not present. We did however manage to discuss the ventilation query and we will now review the information we were given at the meeting, which Ken is going to send electronically. As you will be aware this stage of HAI Scribe has to be completed prior to any construction starting on site. HFS have recently reviewed and changed HAI Scribe documentation and it is the new documentation that we are using.

When we completed Stage 2 at the workshop on 19th November we agreed that NHSL and their TAs would review the Stage 3 template and complete it in draft format which we would then review with IHSL at today's workshop. In order to progress this those of us who were at today's workshop agreed that in the first instance we would send you the completed draft and request that you review this and amend the document as appropriate. It is important that the [sic] as well as checking the yes/no/n/a responses that additional information is provided in the comments boxes to justify the response.

Given the need to have this completed prior to construction commencing and the need for us to review the completed documentation internally before we can sign off we do need to turn this around quickly. It may also be that we will require to meet to review the documentation but will advice [sic] of this once we have the completed documentation back from you."

12.38 On 13 January 2015, Janette Richards, NHSL's lead HAI-Scribe Infection Prevention and Control Nurse, sent an email to Ian Stewart (Consultant within HFS' Engineering and Environment department). David Stillie was copied into this email. In her email, Ms Richards provides detail on isolation rooms and then addresses the issue around pressure in single bed rooms:

"Single bed room accommodation will have positive pressure ventilation with negative in the en-suite facility but there will be no option to make the room negative pressure if infected patient in the room-however my understanding, from speaking with Mr Stuart Mckecnie who used to work with you I believe, is if the window/window grills are open the room then becomes negative pressure. I am concerned that we will not have a local option to have neg/pos pressure ventilation option. Most of the facility will be single room accommodation and if the rooms all have positive pressure then nothing should go into the rooms via the doors so immunocompromised patients should still be protected if they have to go into isolation other than the isolation rooms.

12.39 Mr Stewart responded on 14 January 2015, stating:

> "The situation regarding what SHPN 04 Supplement 1 describes as an enhanced single bed room (ie with gowning lobby) is that
>
> The lobby will have positive mechanical ventilation (over 60 air changes)
> The en suite will have extract ventilation creating negative pressure
> The bed room is 'balanced' without any supply or extract directly to/from the room allowing cascading of air from the lobby to the room via a pressure stabiliser and from the room to the en suite via a fixed grille (probably part of the door assembly).
>
> For what it is worth, I wrote this SHPN!
>
> Its philosophy is much simpler than it used to be. The concept of optional positive/negative ventilation, controlled by staff, for the actual bed room is outmoded. Staff were invariably confused as to when they should provide which and this led to human error and unwanted or unintended air-flow patterns.
>
> The logic now adopted is that if a patient is infectious, the positive pressure in the lobby will stop any 'infected' air getting into the corridor affecting other patients who are not isolated. If a patient is susceptible to infection, the reverse will occur and the corridor air will not get into the bedroom.
>
> I don't think I know Mr McKechnie but I am surprised at reference to the use of openable windows. This could lead to ingress of unfiltered air or egress of infectious air that could find its way to a nearby openable window (whether or not in an isolation room) or to a nearby air intake. In short, have sealed windows as this will enable ait [sic] flow patterns to be controlled."

12.40 Ms Richards forwarded Mr Stewart's response to Janice Mackenzie and David Stillie. Mr Stillie forwarded it on to Colin Macrae. Ms Mackenzie forwarded it to Maureen Brown on 16 January 2015.

12.41 On 14 January 2015, Ms Mackenzie, Clinical Director, NHSL, emailed Fiona Halcrow, attaching the Report by TUV SUD/Wallace Whittle entitled "RHSC – DCN Edinburgh Air Movement Report For Single Bedrooms (Draft)" as well as drawings headed G1547(57) showing air flows and resultant pressure using an extract taken from level 2 bedroom ventilation. According to this report, bedrooms could achieve 6ach/hr and balanced pressure through opening windows. Ms Mackenzie stated:

> "FYI, we discussed this yesterday and what was meant to have been the HAI Scribe Stage 3 workshop but other than the M&E people who were there to talk about the ventilation query the correct people weren't there!!
>
> Anyway David is going to discuss with Colin and Janette with HFS. IHSL do appear to have followed the relevant SHTM, so we await outcome of these discussions."

12.42 On 19 January 2015, Multiplex issued the following Request for Information to MML:

> "As per meeting of Tuesday 13.01.15 and our request for clarity on negative/positive pressure regime within the bedrooms, we attach the sketches distributed at the meeting and seek confirmation/acceptance from the NHS review with infection control."

12.43 Ken Hall (Multiplex) asked again for confirmation in an email to Kamil K Kolodziejczyk on 21 January 2015, copying in Maureen Brown and Colin Macrae. In an email dated 23 January 2015 Mr Macrae stated that:

> "The definitive answer that Ken is looking for from Tuesday's meeting is as follows:

- The single room with en-suite ventilation design shall comply with the parameters set out in SHTM 03-01.

- The design solution should not rely in any way with the opening windows as these will be opened or closed by patient choice.

- The critical factor from SHTM 03-01 for infection control will be the resultant pressure within the room being balanced with or negative to the corridor."

12.44 Graeme Greer responded stating:

"Can we run this past the Board prior to issue to Ken?"

12.45 Maureen Brown sent the comments on to Janice Mackenzie and Janette Richards to review and confirm whether they were happy for it to be released to IHSL. Janice Mackenzie responded on 26 January 2015 stating:

"…based on what Colin is saying are we therefore saying we are happy with their proposal for the isolation rooms?

If this is the case then I think this seems fine, but would want Janette to confirm she is happy."

12.46 Janette Richards responded on 28 January 2015:

"I have forwarded the information re isolation room ventilation from HPS, if the ventilation is now being put in place as per these requirements that were sent to David Stillie then I am happy with that."

12.47 On 29 January 2015 Maureen Brown (MML) responded to Ken Hall (Multiplex) using the Aconex system, stating:

"Following your recent RFI, the Board respond as follows:

- The single room with en-suite ventilation design shall comply with the parameters set out in SHTM 03-01.

- The design solution should not rely in any way with the opening windows as these will be opened or closed by patient choice.

- The critical factor from SHTM 03-01 for infection control will be the resultant pressure within the room being balanced with or negative to the corridor.

- Isolation room ventilation shall comply with SHPN 04 Supplement 1.

12.48 According to a document entitled 'Design risks to the Board at Financial Close', the risks at 28 January 2015 included an item on ventilation. The issue is not described, but it is given a 'high' risk impact. The current mitigation measures were:

"The single room with en-suite ventilation design shall comply with the parameters set out in SHTM 03-01.

The design solution should not rely in any way with the opening windows as these will be opened or closed by patient choice.

The critical factor from SHTM 03-01 for infection control will be the resultant pressure within the room being balanced with or negative to the corridor.

Isolation room ventilation shall comply with SHPN 04 Supplement 1."

12.49 The Inquiry Team understands that the issues outlined above were not definitively resolved before NHSL entered into a contract with IHSL in February 2015. It is not clear to the Inquiry Team why NHSL were prepared to enter into the contract when such issues remained unresolved. This issue will require to be explored with witnesses at the hearing in April 2023.

12.50 In the review process described above, no one commented on the air change rates, or pressure regimes, specified for High Dependency Units/ Critical Care within the EM.

12.51 At Financial Close, the EM was included in the Project Agreement as one of 'Project Co's Proposals'. This iteration again contained two room function reference sheets. Extracts from the second, which contained the most changes, are shown below. Where the stated figures differ from those set out in SHTM 03-01, the Inquiry Team have added the figure from SHTM 03-01 in bold for ease of reference.

Room Function	**ADB Code**	**Ventilation**					**Notes**
		Type	Supply Ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
Bedroom		Natural and Central Supply Air **(Central supply air)**	4 **(6)**	Via en-suite **(Not specified)**	Balanced (previously 'positive to en-suite')	G4	See Guidance Notes
Multi-bed Wards		Natural and Central Supply Air **(Central supply air)**	4 **(6)**	Via en-suite	Positive to en-suite **(Balanced or negative)**	G4	See Guidance Notes

Room Function	**ADB Code**	**Ventilation**					**Notes**
		Type	Supply Ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
Recovery Bay/Recovery Room		Central Supply and extract	15	15	Balanced	G4 **(F7)**	See Guidance Notes

12.52 As before, there is no ‘room function’ for HDU or neutropenic patient ward.

12.53 The pressure regime for single bedrooms had been changed from ‘positive to en-suite ’ to ‘balanced’, in line with comments received in relation to the ventilation solution for single bedrooms. However, the pressure regime for multi-bed wards remained the same as previous versions.

12.54 The pressure regime for recovery bay/recovery room had been changed to ‘balanced’.

12.55 The table below shows remaining potential inconsistencies between the EM and SHTM 03-01. It also marks up the potentially erroneous inclusion of ‘en-suite’ to rooms in Critical Care, which, the Inquiry Team understands, were not required in this department.

Dept Name	Room Name	Room Function	ADB Code	Ventilation					Notes
				Type	Supply ac/hr	Extract ac/hr	Relative Pressure	Min Filtration	
B1 PICU and HDUs	Open Plan Bay (4 beds)	Multi-bed Wards **SHTM 03-01: Critical Care Areas. No corresponding room function on RFRS**	B1609-01 (also B1609-02)	Natural and Central Supply Air **Supply Air**	4 **10**	Via en-suite **no en-suite**	Positive to en-suite **no en-suite**	G4 **F7**	See Guidance Notes
	Single Bed Cubicle	Bedroom **SHTM 03-01: Critical Care Areas. No corresponding room function on RFRS**	B1401	Natural and Central Supply Air **Supply Air**	4 **10**	Via en-suite **no en-suite**	Balanced **positive**	G4 **F7**	See Guidance Notes
	Single cot cubicle	Bedroom **SHTM 03-01: Critical Care Areas. No corresponding room function on RFRS**	B1421	Natural and Central Supply Air **Supply Air**	4 **10**	Via en-suite **no en-suite**	Balanced **positive**	G4 **F7**	See Guidance Notes
	Open Plan Bay (3 Cots)	Multi-bed Wards **SHTM 03-01: Critical Care Areas. No**	B1407-01	Natural and Central Supply Air	4 **10**	Via en-suite **no en-suite**	Positive to en-suite **no en-suite**	G4 **F7**	See Guidance Notes

Dept Name	Room Name	Room Function	ADB Code	Ventilation					Notes
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtra-tion**	
		corresponding room function on RFRS		**Supply Air**					
C1.1 Medical Inpatients	Single Bedroom	Bedroom	B0305-01	Natural and Central Supply Air	4 **6**	Via en-suite	Balanced	G4	See Guidance Notes
	4 Bed Room	Multi-bed Wards[16]	B0405	Natural and Central Supply Air	4 **6**	Via en-suite	Positive to en-suite **balanced or negative**	G4	See Guidance Notes
C1.4 Haematology/Oncology Inpatients and Daycases	Single Bedroom	Bedroom **SHTM 03-01: Neutropenic Patient ward. No corresponding room function on RFRS**	B0305-01	Natural and Central Supply Air **Supply Air**	4 **10**	0	Balanced **Positive**	G4 **H12**	See Guidance Notes

[16] SHTM 03-01 does not specify requirements for 4 bed rooms, however ADB room data sheets c.2011 show same requirements as Single room

Dept Name	Room Name	Room Function	ADB Code	Ventilation					Notes
				Type	**Supply ac/hr**	**Extract ac/hr**	**Relative Pressure**	**Min Filtration**	
	Multi Bed Room: day care, 4 beds & 2 chairs	Multi-bed Wards **SHTM 03-01: Neutropenic Patient ward. No corresponding room function on RFRS**	B0405-01	Natural and Central Supply Air **Supply Air**	4 **10**	0	Positive to en-suite ***balanced***	G4 **H12**	See Guidance Notes
P1 Combined theatres	Post Anaesthetic Recovery	Recovery Bay/Recovery Room		Central Supply and Extract	15	15	Balanced	G4 **F7**	See Guidance Notes

12.56 The Department sheets included changes to the pressure regime in single bedrooms, but not in multi-bed wards.

12.57 For Critical Care/HDU areas, the ventilation type, air changes and minimum filtration figures are all potentially inconsistent with SHTM 03-01. En-suites are mentioned but Critical Care/HDU areas do not require en-suites. The pressure regime for single bed cubicles, while corrected for single bedrooms, was now inconsistent with that recommended for Critical Care areas.

12.58 The ventilation for post-anaesthetic recovery was consistent with SHTM 03-01 with the exception of minimum filtration.

12.59 The Inquiry Team understands that the draft room data sheets dated 18 September 2014 were included in the Project Agreement as Schedule Part 6 (Construction Matters) section 6 (Room Data Sheets) and that these had not yet been approved by the Board of NHSL as they were included in Part 3 of the RDD Schedule which included Reviewable Design Data 'not provided to the Board nor approved by the Board at Financial Close'. The draft RDS appears to replicate the environmental data contained in the EM, which contains potential discrepancies when compared to SHTM 03-01.

12.60 It is not clear to the Inquiry Team how these discrepancies could have arisen if room data sheets, showing room environmental data, were produced using ADB. The procedure for the creation of lHSL's room data sheets will require to be explored with witnesses at the hearing diet in April 2023, In particular, whether room data sheets were produced to comply with the values set out in the EM rather than published guidance and, if so, why this procedure was adopted and why it was deemed acceptable by NHSL.

12.61 The Inquiry Team has seen no information or documentation that suggests the potential divergence from published guidance (namely SHTM 03-01) in the room data sheets for critical care was spotted by NHSL or its advisers when tenders were assessed or in the period to Financial Close.

12.62 The Project Agreement provided a mechanism, known as a derogation register, by which IHSL could highlight to NHSL any proposed derogations from the Board's Construction Requirements (BCRs) so that they could be agreed by NHSL.

12.63 On 5 September 2014, a derogation was requested from BCR Clause 8 Mechanical and Electrical Engineering Requirements which states "Project Co shall provide the Works to comply with the Environmental Matrix". The reason for this derogation was that 'anomalies' had been found within the environmental matrix. No further detail was provided with respect to these anomalies in the initial derogation request. Following further dialogue regarding the environmental matrix, IHSL submitted a reworded derogation request on 13 November 2014 which NHSL approved on 14 November 2014. Project Co's proposal stated:

> "Anomalies within the environmental matrix have been reviewed and proposals incorporated within the room data sheets (refer to schedule for proposed variations).This shall be further developed in conjunction with the board on the basis of the schedule of comments contained in Section 5 (RDD) Part IV."

12.64 As at Financial Close, the derogation register did not identify any proposed derogation by IHSL from SHTM 03-01 in relation to air change rates, pressure regimes and filtration within Critical Care.

12.65 IHSL's EM was not approved by the Board of NHSL at financial close. Neither were IHSL's room data sheets, which were associated with the EM as per paragraph 2.5.2 of the ITPD, which referred to the EM as one of a suite of documents providing room information that could be used in the production of room data sheets.

12.66 The EM, along with other design data, was included in the schedule of Reviewable Design Data, contained within Schedule Part 6 to the Project Agreement, section 5.

12.67 Schedule Part 6 (Construction Matters) Section 3 (Board's Construction Requirements) of the Project Agreement provided that Project Co shall submit Reviewable Design Data for review by the Board of NHSL in accordance with Schedule Part 8 (Review Procedure) and Clause 12.6 (Board Design Approval) of the Project Agreement.

12.68 These clauses provided that Project Co was not to commence or permit the commencement of construction of the part of the facilities to which the Reviewable Design Data related until that Reviewable Design Data had been submitted to the Board of NHSL and either:

- It had been approved; or
- Project Co disputed that the comments/objections made by the Board in relation to that Reviewable Design Data were on grounds permitted by the Project Agreement, in which case Project Co could proceed with further design or construction at its own risk pending the outcome of any reference to the Dispute Resolution procedure.

12.69 Schedule Part 8 Paragraph 4 outlines the meaning of the different "levels" allocated to Reviewable Design Data reviewed by the Board. These are set out in the table below:

Level	Meaning
A	No comment. The submitted item of Reviewable Design Data shall be complied with or implemented by Project Co.
B	Proceed subject to amendment as noted. Project Co shall proceed to construct (or proceed to the next level of design) of the submitted item of Reviewable Design Data but take into account any amendments required by the Board in their comments.

Level	Meaning
C	Subject to amendment as noted. Project Co shall not act upon the submitted item of Reviewable Design Data, but amend the submitted item in accordance with the Board's comments and re-submit the same for review.
D	Rejected. Project Co shall not act upon the submitted item of Reviewable Design Data, but amend the submitted item and re-submit the same for review.

12.70 By Financial Close IHSL's EM had received only a Level C or D status from the Board of NHSL, and was included in Part 4 of the schedule of Reviewable Design Data. Part 4 was titled 'Non-Approved Project Co's Proposals Design Data comments' and it outlined the amendments that Project Co needed to make before resubmitting the item to the Board for review.

12.71 Part 4 of the schedule of Reviewable Design Data: 'Non-Approved Project Co's Proposals Design Data comments' contained the following in respect of the EM:

"Project Co shall update the Environmental Matrix to reflect the following Board comments

- The Environmental Matrix shall by [sic] updated by Project Co to reflect all the rooms and room types in the proposed Facility, this should be based on an updated Schedule of Accommodation that has been commented on separately by the Board. This also needs to reflect the names and room numbers in the GSU table.
- Include the requirements contained in the Clinical Output Specification including but not limited to the requirement that theatre temperatures are to be able to be raised to 31°C for certain operations
- Measures shall be assessed, modelled and implemented to demonstrate that the internal air temperature of the following room types to reduce the temperature control from 28°C to 25°C;
    - Treatment Rooms;
    - Consulting Rooms;

    - Laboratory;
    - Physiotherapy Studio;
    - Recovery.
- These room shall not exceed the maximum acceptable level of 25°C for more than 50 hours per annum
- Detailed proposal awaited on bedroom ventilation to achieve balanced/negative pressure relative to corridor.
- Colour rendering all stated as 80 where certain areas should be 90.

12.72 Room Data Sheets were mentioned in Part 3 of the schedule: 'Reviewable Design Data' - Reviewable Design Data not provided to the Board at Financial Close.

12.73 By Financial Close, the EM was not obsolete. It was included as part of the contract between NHSL and IHSL. The EM had undergone various stages of development and review. Further development of the EM and room data sheets was still required, and would take place through the Reviewable Design Data process.

12.74 Concerns had been raised about the pressure regime for single bedrooms, and mention made of the fact that SHTM 03-01 recommended 6 ac/hr and not 4 ac/hr as contained in the EM. However, there were still a number of other potential inconsistencies between the EM and SHTM 03-01 that had not been raised as an issue.

12.75 Single bed cubicles and open plan bays in Critical Care/HDU potentially did not meet the specifications for Critical Care Areas as outlined in SHTM 03-01. Specifically, the ventilation type, air change rates and minimum filtration were potentially inconsistent with SHTM 03-01, and the pressure regime for single bed cubicles in Critical care was potentially inconsistent with SHTM 03-01.

12.76 Single and multi-bed rooms in haematology/oncology department did not meet the specifications for neutropenic patient ward as outlined in SHTM 03-

01. Specifically, the ventilation type, air change rates, pressure regime and minimum filtration were all inconsistent with SHTM 03-01.

13. Provisional Conclusions

13.1 As outlined at the start, this paper seeks to set out the Inquiry Team's current understanding of the EM adopted for the Project. It is provisional in nature. There are issues highlighted in the Paper where the Inquiry Team's knowledge is incomplete. Such issues will need to be covered with witnesses at an oral hearing. The paper does not constitute any findings of the Chair of the Inquiry. It is open to any CP to seek to correct and/or contradict the contents of the paper. However, unless that is done, in addition to such other findings in fact that Counsel considers appropriate, the Chair is likely to be invited by Counsel to the Inquiry to make the following findings in fact at the conclusion of the hearing diet scheduled for April 2023:

13.1.1 CEL 19 provides guidance on the approach NHS Scotland bodies should adopt for the briefing and design stages of any new hospital.

13.1.2 CEL 19 mandates that all NHS Scotland Bodies use the English Department of Health's Activity Database (ADB) as a tool for briefing, design and commissioning. Where ADB is deemed inappropriate for a particular project, and an alternative tool is used, the NHS Scotland Body is required to demonstrate that the alternative is of equal quality and value to ADB in its application.

13.1.3 Room data sheets produced using ADB automatically comply with guidance and legislation applicable in England.

13.1.4 An NHS Scotland body utilising ADB would need to ensure compliance with Scottish guidance, including SHTMs.

13.1.5 NHSL did not use ADB as a tool for the briefing stage of the RHCYP/DCN project.

13.1.6 An ‘environmental matrix’ was utilised as part of the procedure for NHSL to brief prospective tenderers on its technical requirements for the ventilation system.

13.1.7 The ‘environmental matrix’ was a spreadsheet that set out environmental information, including air changes per hour and pressure regimes for various rooms in the proposed new hospital, in one spreadsheet.

13.1.8 The Inquiry has seen no documentation demonstrating: (i) why NHSL determined to deviate from using ADB as a briefing tool; and (ii) why it considered that the alternative approach that it adopted was of equal quality and value to ADB.

13.1.9 The ITPD informed prospective tenderers that the preferred bidder required to prepare room data sheets for every room in the hospital by financial close. Therefore, the environmental matrix should have been obsolete by Financial Close as a briefing and design tool.

13.1.10 H&K produced the original environmental matrix for the project on 9 September 2010.

13.1.11 H&K developed the environmental matrix in the period to 19 September 2012. This version of the environmental matrix was issued to prospective tenderers with the ITPD.

13.1.12 The environmental matrix stated that the document was an easier reference tool to replace ‘ADB RDS M&E’ Sheets.

13.1.13 The environmental matrix was not produced using ADB.

13.1.14 The environmental matrix was created by figures being manually input into a spreadsheet.

13.1.15 H&K stated to MML on 16 March 2012 that the Reference Design –which included the environmental matrix– complied with published guidance (including SHTM 03-01).

13.1.16 This assurance was obtained approximately six months before the environmental matrix was finalised by H&K.

13.1.17 The 16 March 2012 confirmation was the only occasion, prior to the conclusion of the contract with the preferred bidder, where 'environmental information' set out in the Reference Design concerning the proposed ventilation system for the hospital – including air changes per hour and pressure regimes - was formally reviewed and signed-off for compliance with published healthcare guidance (including SHTM 03-01).

13.1.18 The environmental matrix provided with the ITPD contained environmental information that was inconsistent with the guidance set out in SHTM 03-01. In particular, values inserted in the environmental matrix for certain critical care areas did not comply with the guidance in SHTM 03-01.

13.1.19 The environmental matrix contained a 'notes' section. The notes contained information that contradicted certain values in the environmental matrix itself in relation to critical care areas.

13.1.20 The environmental matrix had a 'Room Function Reference Sheet'.

13.1.21 The version of the environmental matrix issued with the ITPD had a 'room function' of 'HDU' (High Dependency Unit).

13.1.22 No room in the environmental matrix was designated as having the 'Room Function' of 'HDU'. This included rooms in critical care areas.

13.1.23 Multi-bed rooms in critical care areas of the hospital were assigned the 'room function' of 'multi-bed ward'. The values inserted in the

environmental matrix for these rooms, including air changes per hour, were inconsistent with those set out in SHTM 03-01 for critical care areas of a hospital.

13.1.24 ITPD Volume 1, Section 2.5.3 stated that tenderers were required to use the environmental matrix, and other 'Room Information' documents, to form the basis of Room Data Sheet production.

13.1.25 There was a lack of clarity in the procurement documents in relation to: (i) the purpose of the environmental matrix; and (ii) whether compliance with the environmental matrix was mandatory.

13.1.26 IHSL did not seek to change any of the values set out in the environmental matrix either at the competitive dialogue stage or when it submitted its final tender.

13.1.27 One tenderer, Bidder C, did change values in the environmental matrix.

13.1.28 Both IHSL and Bidder C were assessed by NHSL as having submitted compliant tenders. This assessment was made notwithstanding the fact that IHSL and Bidder C were offering to provide different technical requirements in terms of the environmental matrices submitted.

13.1.29 IHSL stated in its tender that its proposal for the ventilation system would comply with SHTM03-01.

13.1.30 Given the disconnect between the values in the environmental matrix (issued with the ITPD) and SHTM03-01, it is not clear why IHSL's tender was deemed by NHSL to comply with the published requirements.

13.1.31 IHSL developed the environmental matrix in the period to financial close.

13.1.32 IHSL removed the room function ‘HDU’ from the ‘Room Function Reference Sheet’.

13.1.33 IHSL produced certain room data sheets in advance of the contract being concluded.

13.1.34 IHSL’s room data sheets for certain critical care areas set out environmental information, including air changes per hour, that complied with the information in the environmental matrix. This was inconsistent with the guidance set out in SHTM 03-01.

13.1.35 No issue was raised by NHSL in relation to the environmental information in IHSL’s room data sheets for critical care areas in the period prior to conclusion of the contract.

13.1.36 In October 2014, environmental information for single bedrooms within IHSL’s environmental matrix was identified by the Board of NHSL as potentially non-compliant with SHTM03-01.

13.1.37 This was disputed by IHSL. IHSL maintained that it was proposing a mixed mode ventilation system – comprising of natural ventilation and mechanical ventilation - which complied with SHTM03-01.

13.1.38 NHS NSS corresponded with NHSL in relation to this dispute and expressed surprise that NHSL was considering having opening windows as part of the ventilation system.

13.1.39 In January 2015, the Board of NHSL determined that the ventilation design for single bedrooms should not rely on openable windows.

13.1.40 This was not reflected in IHSL’s environmental matrix submitted as part of its final tender.

13.1.41 Notwithstanding this disconnect between what the Board of NHSL wished and the solution being offered by IHSL, NHSL did not insist on any changes being made to IHSL's tender (including the environmental matrix submitted by IHSL) before a contract was signed.

13.1.42 NHSL agreed to waive the requirement for the preferred bidder to produce room data sheets for every space in the hospital by Financial Close.

13.1.43 NHSL entered into a contract with IHSL which stipulated that the environmental matrix would be 'Reviewable Design Data' under the contract. Therefore, the precise parameters for the ventilation system would be worked out after the contract was concluded.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