Sláinte Leanaí Éireann
Children's Health Ireland

Sláinte Leanaí Éireann (SLÉ), Herberton, Siúlán San Séamas, Rialto, D08 HP97, Éire
Children's Health Ireland (CHI), Herberton, St James's Walk, Rialto, D08 HP97 Ireland

By Email

19 September 2023

Ms Sarah Cremin
Committee Secretariat
Committee of Public Accounts
Leinster House
Dublin 2
D02 XR20

Email: pac@oireachtas.ie

Re: Ref: S1411 PAC33

Dear Ms Cremin

In response to your letter of 31 July 2023, Children's Health Ireland (CHI) have outlined the responses to the questions from the Public Accounts Committee below.

In relation to the completion of the eleven theatres in the hospital it was agreed to request the following information:

1. *What reports, reviews or examinations have been undertaken on the issue, and that copies of same be provided to the Committee; and*

Children Health Ireland (CHI) in collaboration with the National Paediatric Hospital Development Board (NPHDB) engaged STS in 2017 to carry out an independent review of the Specialist Ventilation Systems for the new children's hospital (NCH).

This Independent review, which is ongoing, comprises a design review, first fix review and system performance review. There are circa 700 specialist ventilation rooms within the hospital.

Design Review

- A review report of the Design issued from STS in January 2018 was responded to by NPHDB in March 2018.
- A further review took place in August 2018 of the Air Handing Units proposed by the Contractor as part of its compliance submission to meet the NCH Contract.
- A further Factory Acceptance Testing Review of an Air Handling Unit (part of the Design Review) took place in March 2019.

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- In addition to CHI engaging STS to carry out a design review of the specialist ventilation systems, the NPHDB commissioned an international design consultant DSSR in August 2018, to review the whole of the Mechanical and Electrical design of the new children's hospital, based on the design included within the GMP.
- This report was shared with CHI and following engagement between CHI and NPHDB all actions were closed out in March 2019.
- None of the Design reviews highlighted the position of the grilles within the 11 theatres as a potential risk.

First Fix Review

- The first fix review commenced in April 2021 and continued in May 2022.

System Performance Review

- In October 2022 a second fix review took place and a report was produced by STS.
- In February 2023 the NPHDB presented a report to CHI and STS in response to some of the issues set out in the STS October 2022 report.
- Further engagement is ongoing between CHI and the NPHDB regarding the design and coordination issues raised in the STS October 2022 report which included the Operating Theatres, this is expected to conclude in October 2023.
- As the installation is at the early stage of commissioning there will be further engagement between CHI and the NPHDB on installation and performance of the system up to Substantial Completion.

Copies of the relevant reports are attached and I understand further information is being provided by the NPHDB.

CHI continue to work closely with STS and the NPHDB in relation to these matters

Yours sincerely

Eilísh Hardiman
Chief Executive
Children's Health Ireland

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Date: 05.05.2021

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First Fix inspection report Childrens Hospital 28 April 2021

Participants:

- Jack Quinn Arup
- Ian Smith ?
- Ed McIntyre NPH
- Malcolm Thomas STS
- Siggi Volkmann STS

Ladies and Gentlemen,

Please find hereafter the 1st fix inspection report taken place the 28th of April 2021 in the CH in Dublin. Purpose of this inspection was to get a general feeling for the site and its specificities as well as for the first installed and connected AHU's in plantroom North.

The general impression was really good, the site is clean, most of the duct work is capped to stay clean and we had unlimited access to all we wanted to see.

The AHU's in plant room North look tidy. We have only inspected in detail one of the units (we could not identify which it was as in the moment not labelled and the supplier label not accessible) but we consider the remarks apply to all of them:

1) Care needs to be taken with the duct connection to avoid too hard bends and changes in duct section immediately before or after the AHU. In the unit inspected, the intake duct change of section will obstruct the even airflow over the components in the AHU which will lead to poor performance. We discussed this on site with Jack Quinn..

2) The heat recovery wheels need to get correctly aligned. They are currently installed at an angle and therefore will have significant by-pass. If run in this condition they will damage their seals. After the alignment, the seals need to be adjusted to avoid unnecessary leakage.

3) The drip tray of the wheel needs to be easily accessible for inspection and cleaning & drying out on its whole length. This point has been made several times since the project commenced and has been a point of discussion on the other sites

4) The Magnehelic gauge range does not always suit the pressure range of the filters, but if memory is correct there was a decision to use 500 Pa Magnehelics everywhere.

5) Temperature sensor is positioned directly in front of the fan nozzle which may lead to very unstable readings as this area which has an extremely turbulent air stream. Reconsidering the location is strongly recommended

6) The frost protection sensors are wrongly installed. Their capillary tube length is too short, they need to cover more of the lower area than of the top as cold air flows along the bottom of the AHU. The position on the downstream side of the cooling coil is questionable as there is no glycol in the cooling circuit and this coil is the most likely to freeze. A location upstream of this coil but after the Heat Wheel would be probably a better choice.

7) The sensors connection box needs relocation out of the doorway. It is obstructing the entry into the AHU unnecessarily and is very likely to be hit off!

8) It needs to be checked if the main electrical box needs some ventilation to be protected from overheating. In this case an opening into the Box from the fan casing, slots in the e-box door and a transfer grill in one of the cover doors to the outside would be a possibility. In any case the airflow needs to be such that smoke in a case of fire cannot be sucked into the AHU

9) The fans do not have quick electrical connectors. This will significantly affect the time taken and trades necessary to change a fan.

10) The pipe work was already insolated, so it couldn't be checked that the connections in front of the coils could be isolated and disconnected without emptying the whole circuit. Jack Quinn confirmed it would be possible.

11) The dampers should be self-closing in the case of crucial failure or power loss of the AHU (drive open motors with spring return)

12) There is a discussion to have about the function and the position of the main electrical isolation switch. It should not be at a position where it will be used to shut down the AHU for a filter change etc.. As currently positioned, it invites people to shut down the unit by that switch, this will not be a controlled shut down but just cut the power to

everything including the inspection lights making maintenance or a filter change more difficult.

13) The AHU should be pressure tested before being connected to the ducts. To do it after duct connections are mounted it might lead to unnecessary discussions as to who is responsible for any leakage.

14) We have not detailed inspected the isolation room units. We could state that no changes we have proposed in our letter from the 13th of March 2019 were implemented. As the design risk lays at Arup, it really comes down to the final acceptance test of the system on site to conclude if it is fit for purpose or not.

15) We note that duct pressure test equipment was evidently being used in the Isolation rooms plant room.

Our Thanks to Ed McIntyre for guiding us around the site.

Best Regards

Sigrid Volkmann & Malcolm Thomas

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Date: 23.05.2022

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First Fix inspection report Childrens Hospital 11/12th

Participants:

- Jack Quinn Arup (12th May)
- Ed McIntyre NPH (11/12th May)
- Colin Gaffney STS (11th May)
- Siggi Volkmann STS 11/12th May)
- Allan Maddan NPH (11th May)
- Stuart Doolin Arup (12th May

Ladies and Gentlemen,

Please find hereafter the 1st fix inspection report for the 11-12th of May 2022 at the CH in Dublin. Purpose of this inspection was to get a general feeling for the theater layouts on level 2 and installed and connected AHU's in plantroom 3 North & South.

The general impression was really good, the site is clean, most of the duct work is capped to stay clean and we had unlimited access to all we wanted to see.

The AHU's in plant room 3 N&S look good, although not all were installed, and the space constraints are huge. We had only inspected in detail 3 specimen units for different areas and application (OT AHU5, ICU001, Isolation Room not identified). All remarks apply to all critical units!

1) In small units the switch board is significantly obstructing the return air filter surface (check if pressure loss and surface is still OK for the chosen filter). For maintenance cost it would be better to reduce the filter behind the switchboard by half a filter so all filters when changed will be equally dirty.

2) In the switch box there is an opening into the return air stream on the suction side of the return air fan, which is OK for cooling purpose. But you need another opening to the units outside (through the base) to get air in. If you consider not to need cooling, close the existing opening

3) The bypass damper of the plate heat exchangers should be on the ODA intake (motor can be easily reached from the ground floor and checked)

4) Quick change of fans in 20 min is not possible as even if they would be connected with quick connectors (as agreed on first factory test), the fan-motor combi doesn't fit through the access door, will mean fan-motor needs to be dismantled or the side wall needs to be removed (in either case it's a day work)

5) Check all spring vibration mounts under the fans, some are not correctly loaded (shifted during transport?)

6) Check if after complete installation there is enough space to get all components out, turned and through the aisles

7) Check that all drip trays and drip eliminator which are designed to be removable can get removed and slide back in (some of the seem to be stuck, some handles are loose or broken)

8) Dielectric seal couldn't be checked (copper /black steel piping)

9) Rotors need to get correctly aligned (not leaning in any direction) and seals correctly placed. How do you get easily to the controller?

10) The drip tray of the wheel needs to be easily accessible for inspection and cleaning & drying out on its whole length. This point has been made several times since the project commenced and has been a point of discussion on the other sites. Cleaning & dry out of drip tray under Heat Wheel needs to be proved (no syphon but capped spigot to be unscrewed for maintenance)

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11) Check number of humidifier lances (1 lance for a big area is not enough to get even humidification or reasonable control, even if theoretically the capacity could be achieved with 1 big one)

12) Don't mount sensors in the doorway or directly in the fan intake (see my remarks on Arup document attached). In the first case somebody can get hurt and the sensors broken and in the second case you get a very unstable reading.

13) Put a handle at the supply and return air damper and label clearly position open and close

14) Care needs to be taken with the duct connection to avoid too hard bends and changes in duct section immediately before or after the AHU. Some of the units will not have even airflow over certain components, which will lead to poor performance and high pressure drops as well as sound problems

15) Motorised dampers should be self-closing in the case of crucial failure or power loss of the AHU (drive open motors with spring return)

16) The AHU should be pressure tested before being connected to the ducts. To do it after duct connections are mounted it might lead to unnecessary discussions as to who is responsible for any leakage.

17) At the inspection of the isolation room units Jack Quinn confirmed, that the unit design with 2 fans is serving 2 isolation rooms and the smaller ones which only serve 1 room have only one fan

18) For all double stacked units, the access to the sections on the top are difficult due to the space constraints. Make sure, that are enough mobile working plat forms available for regular, secure, and easy maintenance (take care, that the system put in place, once positioned, allows staff to open the doors without danger, remove drip eliminators etc)

19) Make sure, that the fresh and exhaust air plenums have lights or at least sufficient sockets to install lights for maintenance (service needs to be done in use!)

20) Most of my remarks from the last report were not taken in account.

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Inspection of theatres on level 2

1) Many of the theatre supply air diffusers appear to be positioned close to the theatre walls. The efficient distribution of air within the theatre may be compromised by this layout. RCP should be reviewed to confirm proposed terminal locations as suitable. (Tony will know the problems experienced in a similar installation)
2) Most theatres have only 1no. low level extract air grille installed, when 2no. would appear to be more appropriate.
3) Some low-level extract air plenums have been installed on a vertical plane while other are tapered as recommended.
4) A demonstration of maintenance checks on the control room fan coil units will be required when ceiling finishes are complete.
5) Some dust caps have become loose with dust loading evident at grille boxes
6) Some anaesthetic supply air diffusers are positioned close to the corridor end of the ceiling. Short circuiting of anaesthetic supply air to the corridor via the pressure stabilisers may be an issue.
7) All UCV quadrant terminal connections to the primary supply air ductwork should align to avoid sudden changes in direction (sharp offsets) which could generate turbulence and negatively affect the performance of the canopies.
8) Lay-up Prep pressure stabilisers in UCV theatres should be baffled to ensure that the air discharged through them does not interfere with the UCV canopy velocity profiles.
9) The position of all ceiling air terminal devices should consider the requirement for them to be accessible when furniture is installed, for routine measurement of air flow rates.
10) T11 anaesthetic room has a re-heat coil in the ceiling void with no drip tray (HC-HB-02-019).
11) Shallow extract air plenum boxes could result in the generation of excessive noise levels.
12) Heater batteries located in corridor ceiling voids do not appear to have been fitted with drip trays. All drip trays should cover the complete heater battery unit including headers.

Best Regards

Sigrid Volkmann & Colin Gaffney

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Date: 17.11.2022

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Second Fix inspection report Children's Hospital 26/27th October 2022

Participants:

- Michael Callan CHI
- Colin Gaffney STS
- Siggi Volkmann STS
- Malcolm Thomas STS
- Allan Madden NPHDB
- Kevin Burke Arup

Ladies and Gentlemen,

Please find hereafter the2nd fix inspection report covering our site visit scheduled for 26/27 October 2022 at the CH in Dublin. The purpose of this inspection to check on installation progress since our previous visit in May. It was also intended that the AHU and ventilation system serving the following be inspected as specimens and the of the standard required: -

A general conventional operating suite

A UCV theatre suite

A single isolation suite

A pair of isolation suite served by a single AHU

Unfortunately, the agreed program could not be carried out. When inspecting the site, the general impression was that very little had changed. The AHU's have yet

to be powered up, so it was not possible to make a start on checking their dynamic performance.

This time AHU 8 was checked in detail, but all previous remarks still apply to all critical Air Handling Units.

In our report dated 30 May 2022 we made the following remarks, almost none of these issues have been addressed so the following list still stands + **some added points.**

1) *In small units the switch board is significantly obstructing the return air filter surface (check if pressure loss and surface is still OK for the chosen filter). For maintenance cost it would be better to reduce the filter behind the switchboard by half a filter so all filters when changed will be equally dirty.*

2) *In the switch box there is an opening into the return air stream on the suction side of the return air fan, which is OK for cooling purpose. But you need another opening to the units outside (through the base) to get air in. If you consider not to need cooling, close the existing opening.* ***Check temperature in the compartment during start up.*** **AT AHU 8 the cable connections outside the casing are obstructing access to the upper AHU components**

3) *The bypass damper of the plate heat exchangers should be on the ODA intake (motor can be easily reached from the ground floor and checked)* **Motor mounted outside the air stream is preferred. No syphon needed at supply air side, screw on top, which can be removed for maintenance is OK.**

4) *Quick change of fans in 20 min is not possible as even if they would be connected with quick connectors (as agreed on first factory test), the fan-motor combi doesn't fit through the access door, will mean fan-motor needs to be dismantled or the side wall needs to be removed (in either case it's a day work).*

5) *Check all spring vibration mounts under the fans, some are not correctly loaded (shifted during transport?)*

6) *Check if after complete installation there is enough space to get all components out, turned and through the aisles*

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7) *Check that all drip trays and drip eliminator which are designed to be removable can get removed and slide back in (some of the seem to be stuck, some handles are loose or broken).* **Why at AHU for ICU 1 a plate with cut outs is obstructing access to the drip tray? AHU 8 drip eliminator will be very difficult to remove for maintenance due to very tight access.. Check air speed over cooling coil to confirm an eliminator is needed.**

8) *Dielectric seal couldn't be checked (copper /black steel piping)*

9) *Thermal wheel rotors need to get correctly aligned (not leaning in any direction) and seals correctly placed. How do you get easily to the controller?*

10) *The drip tray of the wheel needs to be easily accessible for inspection and cleaning & drying out on its whole length. This point has been made several times since the project commenced and has been a point of discussion on the other sites. Cleaning & dry out of drip tray under Heat Wheel needs to be proved (no syphon but capped spigot to be unscrewed for maintenance)*

11) *Check number of humidifier lances (1 lance for a big area is not enough to get even humidification or reasonable control, even if theoretically the capacity could be achieved with 1 big one)*

12) *Don't mount sensors in the doorway or directly in the fan intake (see my remarks on Arup document attached). In the first case somebody can get hurt and the sensors broken and in the second case you get a very unstable reading.*

13) *Put a handle at the supply and return air damper and label clearly position open and close* ***Done at AHU 8***

14) *Care needs to be taken with the duct connection to avoid too hard bends and changes in duct section immediately before or after the AHU. Some of the units will not have even airflow over certain components, which will lead to poor performance and high pressure drops as well as sound problems*

15) *Motorised dampers should be self-closing in the case of crucial failure or power loss of the AHU (drive open motors with spring return)*

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16) The AHU should be pressure tested before being connected to the ducts. To do it after duct connections are mounted it might lead to unnecessary discussions as to who is responsible for any leakage.

17) At the inspection of the isolation room units Jack Quinn confirmed, that the unit design with 2 fans is serving 2 isolation rooms and the smaller ones which only serve 1 room have only one fan. Control strategy needs to be explained

18) For all double stacked units, the access to the sections on the top are difficult due to the space constraints. Need to ensure enough mobile working platforms available for regular, secure, and easy maintenance (take care, that the system put in place, once positioned, allows staff to open the doors without danger, remove drip eliminators etc.)

19) Make sure, that the fresh and exhaust air plenums have lights or at least sufficient sockets to install lights for maintenance (service needs to be done in use!)

20) Most of the remarks from the last report have not been actioned and the following new issues were noted.

21) All door handles need resetting

22) Light switches should be mounted at accessible height and be positioned such they do not need to be removed when replacing a component (to keep lighting in use)

23) Frost protection wrongly mounted (no temperature pick up in the lower part of the coil)

24) Why at AHU 8 temperature sensor after the heating coil is mounted across the floor and not across the coil? It will be damaged during maintenance and will pick up wrong temperature.

25) AHU 8 access to HEPA Filter is obstructed

26) How do you measure the filter and filter frame leakage after the HEPA filter? Which special measure was put in place for the ducting considering HEPA filter class?

27) Check, that all labels for doors on the pressure side are glued on.

28) **Reset alarm indication on Magnahelic correctly (best 50Pa lower than recommended alarm pressure to allow time to schedule maintenance)**

29) **AHU 8 air flow measurement points in the ductwork are unsuitable**

30) **K-factor for supply and return fans should be marked on the casing**

31) **Identification of AHU / Serving Area is insufficient and needs to be rechecked.**

Inspection of PPVL Isolation suite on level 2

A permeability test had been carried out, but the suite failed. Remedial work to rectify the faults was in progress. For the rest the previous list still stands.

1. Drip trays have not been installed at some heater batteries in ceiling voids.
2. The location of lobby to room pressure stabilisers should be reviewed to confirm that they will not discharge directly onto the patient's bed. Deflector plates are not acceptable on isolation room pressure stabilisers.
3. Some access hatches have not been installed at fire smoke dampers (FSDs).
4. Isolation suites with a shared air handling unit have motorised isolation dampers installed in the ceiling voids. The control philosophy for these dampers should be made available for review. The method of confirmation of damper status and access to the dampers for routine inspection and maintenance should be demonstrated.
5. Some of the supply air ductwork lagging is incomplete.

Inspection of theatres on level 2

The Theatre ventilation progress was particularly disappointing. None of the issues raised following our previous visit have been addressed and some new ones were discovered. We have listed below issues of particular concern which will result in the installation failing to be accepted as fit for purpose and compliant at final validation.

1) Many of the theatre supply air diffusers are positioned close to the theatre walls. The efficient distribution of air within the theatre **will** be compromised by this layout. To make a bad situation worse, in some cases the theatre

supply air terminal is effectively in a corner with a low-level extract terminal directly below. This will lead to air short circuiting and is not acceptable. Theatre supply terminals should be located in the centre of each quadrant of the theatre ceiling or along a line joining the centre points. That way the complete area of the theatre will be effectively and efficiently ventilated. As presently installed the theatres will not be efficiently ventilated and will not be acceptable at final Validation. (Tony will know the problems experienced in a similar installation)

2) Most theatres have only 1no. low level extract air grille installed, when 2no. would appear to be more appropriate.
3) Some low-level extract air plenums have been installed on a vertical plane while other are tapered as recommended.
4) A demonstration of maintenance checks on the control room fan coil units will be required when ceiling finishes are complete to ensure adequate access.
5) Many duct end dust caps have become loose with dust loading evident at grille boxes
6) Some anaesthetic supply air diffusers are positioned close to the corridor end of the ceiling. Short circuiting of anaesthetic supply air to the corridor via the pressure stabilisers **will** be an issue.
7) All UCV quadrant terminal connections to the primary supply air ductwork should align to avoid sudden changes in direction (sharp offsets) which could generate turbulence and negatively affect the performance of the canopies.
8) Lay-up Prep pressure stabilisers in UCV theatres should be baffled to ensure that the air discharged through them does not interfere with the UCV canopy velocity profiles.
9) The position of all ceiling air terminal devices should consider the requirement for them to be accessible when furniture is installed, for routine measurement of air flow rates.
10) T11 anaesthetic room has a re-heat coil in the ceiling void with no drip tray (HC-HB-02-019).
11) The size and depth of back boxes fitted throughout the Theatre suites seems completely random. Some are evidently sized for a standard 600 x 600 grille. Others in identical rooms in neighbouring Theatres are sized for a 450 x 450 grille. Generally, supply grilles need a deep back box as this helps to reduce noise generation by reducing turbulence due to the transition from a round supply duct to a square back box to a four-way blow grille. Extract back boxes can be shallow as turbulence is not such a problem. The use of deep or shallow back boxes on supply and extract ducts appears

completely random in this installation and does not conform to the concept described above. This will result in noise problems.

12) Heater batteries located in corridor ceiling voids do not appear to have been fitted with drip trays. All drip trays should cover the complete heater battery unit including headers.

13) The vinyl floor covering in the theatres fitted with UCV terminals is to have an inner square in a contrasting colour representing the "clean zone" under the UCV footprint. This is correct and care needs to be taken to get the size and position of the "clean zone" correct, liaison with the UCV supplier is recommended. However, it was discovered that it is intended to lay a "clean zone" within the floor covering of all general conventional operating theatres and interventional imaging rooms. **This is incorrect and will not be acceptable as it will be dangerously misleading to the eventual users.** There is no designated clean zone in conventional theatres and imaging rooms as the ventilation provides a well-mixed space of equal cleanliness.

14) Permeability testing of the theatre suites was discussed during the visit. There seemed to be some confusion as to what would be required. To clarify, the theatre suite or interventional imaging suite envelope (slab to slab and around its periphery) needs to be tested as a single compartment. Individual rooms within the envelope do not need to be tested. Permeability testing is carried out to establish that there is no significant air leakage via the ceiling voids, service spaces and service penetrations between theatre suites. It serves to check that the fire stopping between fire compartments is complete as it is not always possible to visually inspect every section.

15) Scrub rooms have been provided with ceiling mounted active extract air over scrub sinks only. Low-level active extract air under the scrub sink or low-level passive extract (pressure stabiliser), positioned close to the scrub to corridor door would be a more effective and appropriate solution with respect to the control of aerosols generated in the scrub.

16) A pressure stabiliser between the theatre and scrub indicates that a door is to be installed between them. This door is unnecessary and may be considered an inconvenience by scrubbed staff.

17) It is unclear why a mixture of damper types (iris & OBD) have been installed in ductwork serving the same room.

18) Theatre 6 Prep Room supply air temperature sensor has been located close to an iris damper. This might compromise its accuracy and stability.

19) The ventilation strategy for Theatre 16 (oversized footprint & UCV canopy) should be clarified

NB:- The foregoing lists should not be taken as exhaustive. They are not snagging lists but rather indicative of the major generic faults / non-compliance's / un-resolved issues found during the walk arounds. The longer that these issues take to get resolved the more expensive and time consuming it will become.

If the present approach to the installation of the ventilation systems serving the critical areas in this hospital is not corrected, the systems will fail the final validation and not be fit to be taken into use.

When the site visit was set up it was intended to take two days but because of the lack of progress one day sufficed. Please note that two days were programmed, and the time allocated, flights booked, and hotel accommodation reserved. We will therefor invoice accordingly.

Best Regards

Sigrid Volkmann, Colin Gaffney & Malcolm Thomas

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