NHS Scotland Assure Lessons Learned

Overview for the Interim Review Service – Ian Storrar

Table of Contents

Introduction 3

Roles and Responsibilities3

Brief Development4

Auditing of the Design Process 5

System Compatibility5

Risk Assessments6

Understanding the Existing Infrastructure and Patient Service6

## Detailed Derogations Process7

### Detailed Schematics of Key Systems 7

Space Planning and Service Routing8

Auditing of the Contractor and Their Works9

## Contractor Design Packages9

## Commissioning, Demonstration and Handover10

## Summary10

Examples of Lessons Learned11

## Fire11

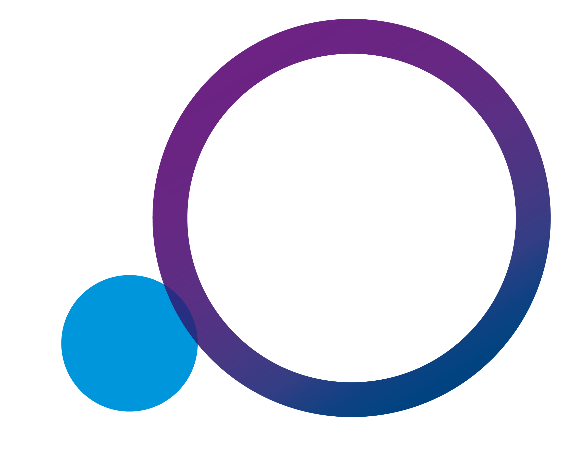
### Ventilation 11

Electrical12

## Medical Gas Systems12

### Water 12

Drainage13



# Introduction

Health Facilities Scotland (HFS) and Antimicrobial Resistance and Healthcare Associated Infection (ARHAI) Scotland as part of National Services Scotland (NSS), have undertaken assurance audits and investigations into outbreaks of infections and operational issues in a number of significant healthcare construction projects. NSS reviewed healthcare buildings at different stages of their development, including those at detailed design, those where construction is almost complete and those in a live operational phase.

A number of common themes were found where lessons need to be learned across NHS Scotland and its construction supply chain to reduce the potential for a repeat divergence from guidance. This document will showcase topics where more consideration and effort is required (from project briefing, to project handovers and into the operational phase) and how these topics can be identified and discussed.

Areas noted for improvement are governance, auditing, stakeholder interaction, application of guidance and procedures before and after the facility becomes operational. Further refinements of this information will be developed for future release. This will target different participants in the life cycle of the healthcare facility with appropriate focus to allow them to fully understand their role and its impact on patient and staff wellbeing.

The headlines of the overarching recurring themes are outlined in this document. The discussions should be seen as a prompt to consider these factors as they relate to current projects.

The Interim Review Service was the precursor to the reviews being carried out by NHS Scotland Assure. The lessons learned from the Interim Review Service have been used to inform in the Key Stage Assurance Review Workbooks.

## Roles and responsibilities

Clarity on roles and responsibilities is often an issue, especially for clinical teams whose contribution can be piecemeal. Late requests often result in significant design changes with associated risks. Lack of appreciation of the need for early decision making and guidance from clinical teams can also be a factor.

**Early resolution of the roles and responsibilities would help to ensure that the stakeholders understood who was a part of each group and how to interact.**



# Brief development

The foundations of a successful project begins with **establishing a clear brief** which is understood and agreed by all stakeholders. A common theme which has contributed to problems is that important stakeholders are either not consulted or only involved at a particular stage. The engagement of stakeholders may be too late and result in decisions being postponed to a later stage (sometimes due to a failure to recognise the correct participants) or not taken at all.

From an engineering perspective, together with the Health Board Construction Requirements (BCR) another critical document is the health board’s Environmental Matrix. This forms the basis of any Mechanical, Engineering and Plumbing (MEP) design and must be completed at the earliest possible date. It must have input from the full range of stakeholders and in particular reflect the clinicians’ views of patients requirements and service on a room-by-room basis.

The starting point for the development of the matrix should be a record of the patient cohort and the forms of treatment for each space. This should also help to identify where these criteria need to be developed from the base principles (such as those shown in Scottish Healthcare Technical Memorandum (SHTM) 03-01 Part A: Appendices) or to suit the needs of specialist medical equipment.

It would:

* identify the degree of temperature control and air cleanliness which are appropriate
* determine the medical gas provision required
* select the risk to patient from electrical devices
* assist with the development of room air pressures or air flows in relation to risks to patients/staff/visitors and assess the required resilience

The activities in the room will also allow the designers to provide a suitable lighting scheme, assess the appropriate type of electrical installation and determine cooling requirements.

**NHS Scotland Assure have a template for the Environmental Matrix which is available for health board use**. This is a result of the Interim Review Service lessons learned activity.

It may prove necessary to amend the brief as the process develops and the impact of any changes can then be tracked against the original brief. The Environmental Matrix should at least include the criteria set out in the NHS Scotland Assure template or technical equivalent.

The brief should also set out the plans for how the building works might be phased. This has a large impact on the design and installation of the MEP installations. It may also outline the format in which record information must be delivered (and its minimum content) plus any provision for soft landings.

# Auditing of the design process

It is critical to audit the designs, particularly at key stage reviews. Health boards must have the correct team with sufficient, competent resource in place to look after their interests. Where the health board doesn’t have a Chartered Engineer to review the engineering proposals and an infection control specialist with knowledge of environmental impacts, they should look to procure those professional services. This process must have a robust method of recording findings and a mechanism to ensure that any item raised is closed out to the health board’s satisfaction. Early consideration of Statutory Compliance Audit and Risk Tool (SCART) questions will help to ensure the design includes all elements needed to facilitate the processes covered in SCART.

Health boards may also wish to consider the NHS Scotland Assure Key Stage Assurance Review (KSAR) workbooks to assist in establishing the correct detail of design at particular gateways.

## System compatibility

Once room environment requirements are agreed, **it's essential the concept design for each room includes appropriate technology with sufficient capacity and control in order to produce the criteria**. For example, a room which must be capable of being maintained at 18oC is unlikely to achieve this if no cooling is provided. **The form of control must reflect whether the temperature is to be allowed to float within a range or to be controlled to specific points within a range.** It should be possible to meet the environmental criteria at any time when the external air is between the winter and summer design conditions that have been agreed to suit the local conditions and resilience.

Sizing and control of the system must acknowledge the need to retain percentage relative humidity (% RH) in the room no higher than the maximum values recommended by the Scottish Health Technical Memorandum (SHTM) (or any other value, which is set and agreed as part of the health board’s brief) or where specialist equipment and processes have specific requirements. The addition of moisture to the air (humidification) would only be considered in special circumstances.

Summer and winter external design conditions must be agreed and recorded in the environmental matrix.

The criteria should be agreed for:

1. the building load calculations
2. individual plant items (which may be different to point 1)

Design of the wholesome water systems must combat slow, infrequent or stagnant water flows, high cold-water temperatures or low hot water temperatures. An in depth risk assessment should be prepared of all of the measures that will be taken to limit adverse cold water temperature rise.

To avoid impacting on the existing service, it's necessary to understand the interaction with patient services and the existing hospital infrastructure.

For example:

* the full impact on the safety of the electrical network when new loads are added
* the ability of existing medical gas pipeline systems and plant to serve additional supplies
* the performance of standby electrical generators after new loads are introduced
* the impact on existing room air changes or pressure regimen

Resilience of all systems must be compatible with the service need. Plant, for example Uninterruptible Power Supply (UPS) units or air source heat pumps (ASHP), should be selected for all operating conditions to which they may be exposed. For example ASHP operating in very low external ambient temperatures, UPS operating on by-pass.

# Risk assessments

SHTMs, Scottish Health Planning Note (SHPN), Health Building Note (HBN) and the National Infection Prevention Control Manual (NIPCM) indicate the minimum extent to which risk assessments are required.

The intention is to ensure that elements that affect infection control, resilience, safety, maintenance and the impact on the existing estate are fully considered. Similar to the brief, it’s essential that all stakeholders are party to the assessments. It should be noted that there may be other risk assessments required by various legislation.

# Understanding the existing infrastructure and patient service

It's necessary to understand the interaction with patient services and the existing hospital infrastructure to mitigate the impact on the existing service. Planning for patient pathways plus fire evacuation needs concentrated input from all stakeholders.

The knowledge of the existing building services infrastructure often needs to be supplemented with tests and in some cases, studies, due to missing record information. For example; the full impact on the safety of the electrical network when new loads are added, the ability of existing medical gas pipeline systems and plant to serve additional supplies, the performance of standby electrical generators after new loads are introduced and impact on existing room air changes or pressure regimen.

## Detailed derogations process

It's important that the design begins with an in depth understanding of the extant guidance and not be limited to a review of reference tables within the guidance. As the design develops in conjunction with the stakeholders, it may be necessary to apply alternatives. **In every occurrence, a derogation must be prepared.**

All derogations must be subject to rigorous scrutiny by all stakeholders. They should include a fully developed argument as to why the change is necessary and an explanation as to how standards of patient care, safety, environmental control and energy conservation are as technically as good, if not better, than those achieved by compliance with guidance. Care should be taken to ensure that terminology is clearly defined together with its context. An auditable record trail must be managed which clearly identifies that all stakeholders have understood and agreed with the derogation. The derogation process must be clear about which stakeholder has the authority to sign off on each derogation.

Derogations should not be a tool for ‘value engineering’ or cost reduction.

### Detailed schematics of key systems

Schematics of the key MEP systems are essential to the successful development of the respective systems through design, installation, commissioning and operational stages of a project. They are a concise way of demonstrating the correct inter-relationship between components.

Schematics must be produced, as a minimum, for the following services. This is not an exhaustive list:

* water services plant
* water services networks
* ventilation plant
* ventilation systems networks
* above ground drainage
* heating plant
* heating networks
* cooling plant
* cooling networks
* HV Distribution
* LV Distribution
* UPS and Medical IT Distribution Systems
* earthing and bonding
* fire detection and alarms
* nurse call
* fuel supply systems
* fire suppression systems
* medical gas plant and manifolds

# Space planning and service routing

Successful planning of the building layout will need to carefully include the provision for plant location and the routing of the services. It’s also important to fully consider the ergonomic planning for spaces, including their associated medical equipment items.

**The plant must be located where it can be easily accessed and safely maintained without creating disruption to clinical or patient services.** Procedures that are contained in the Construction Design & Management (CDM) regulations should ensure that the finished product can be operated and maintained safely. The acoustic performance of the plant must also be considered to ensure no detrimental impact to the clinical or patient environment. Future access and replacement plans must also be clearly identified and form a part of the design.

The plant locations should also consider the suitability of routes from there to the point of use for the building service. Avoid arrangements which necessitate routing main building service routes through patient clinical spaces or which require access to components via a ceiling void or riser or from a patient room. Diverse routing and fire protection of essential building services must be factored in.



Planning of building service risers should not only consider the route on plan of any building service in the riser, but also how all building services enter and exit it. Routing of wholesome cold-water pipework in separate risers will reduce the temperature rise of cold water.

Minimising the heat gain to cold water systems must look at the entire installation where wholesome cold water pipes are kept away from hot water pipework, heat emitters, heat rejection equipment, high void temperatures and such like.

Inadequate planning of above ground drainage routes coupled with insufficient vertical drain stacks, can give rise to horizontal drains above clinical spaces, electrical or IT equipment or sensitive items. For example, ground floor drainage stacks, which are located to serve the ground floor sanitary ware, should not simply offset across and up through the building to pick up all drains in upper level rooms. The design should be planned such that access to clear blocked drains, in ceiling voids of sensitive spaces, should not be necessary. Drains should not dry out.

Consideration should also be given to the location and installation of fire and smoke dampers to ensure that they are fully accessible from both sides and can be installed in full compliance with the manufacturers certified installation details. Locations for medical IT systems and their associated EBBs, relative to the components that they serve, must be fully compliant with SHTM 06-01 and BS7671.

# Auditing of the contractor and their works

This process starts with selecting the contractor. It’s essential to assess their competence for the size, complexity and programme for the work, as is their specific experience in the type and use of the building.

Reference should be made to Health and Safety Executive (HSE) guidance (leaflet - Using Contractors - INDG 368 (rev 1) published 06/12) and the emerging standards on competency from British Standards Institution (BSi); BSI Flex 8670.

Fully developed project specific Quality Assurance processes and

Quality Plans should form an integral part of the contractors’ processes. These should incorporate all matters relating to sub-contractors including designers.

The health board should ensure that the contract includes the correct representation from the contractor to properly manage the works plus monitor and drive the specific healthcare needs of the project. The health board must also ensure that contractors have the correct skills, resource and time in the team that they assemble (to represent the interests of the health board) to audit the quality.

## Contractor design packages (CDP)

The health board should ensure that contractor design packages (CDP) are suitably recorded within the contract and that the level of detail provided in relation to these is reflective of the project stage. **CDP can have an impact on other services including power, cooling and ventilation. They can also have an impact on spatial co-ordination for plant and services distribution routes.**

Often the CDP are based upon a performance specification and it’s vital that it is suitably developed to allow not only cost certainty, but also to ensure that compliance with appropriate standards can be audited. The anticipated space planning and builders’ work needs for the CDP must be considered during the early design process as part of the complete solution. Co-ordination with other disciplines must also be monitored.

The main MEP designer should be retained to review the CDP meets the design brief and the designer’s intent (technically and spatially). CDP should be included in the BIM model.

# Commissioning, demonstration and handover

Planning for commissioning should start during the design phase. As the design develops, a commissioning plan should be formed and recorded in parallel. Commissioning specialists, Authorising Engineers, Estates and Infection Prevention and Control must provide early, useful checks during the design. Designers must produce designers commissioning briefs in accordance with SHTM Guidance.

Programmes for pre-commissioning and for commissioning must not be shortened to falsely save time on a project time line or hurry handover. All test and commissioning results should be witnessed by the health board or their representatives**.**

The health board should consider the use of an independent commissioning manager to monitor and report on the process and its efficacy.

All record information must be made available in the format required by the contract before starting the client demonstrations. Record documentation that is given to the health board must include handover checklists, training records and SCART data that has been completed and signed off together with commissioning data.

## Summary

**These discussions are not exhaustive, but are intended to highlight areas where it has been evidenced that more rigour is required.** While the comments are relatively brief, they are intended to add emphasis to the significant guidance that is available.

Some projects will benefit from an independent assurance audit in the future via NHS Scotland Assure. Others will not. It’s critical that the **due diligence** applied by each health board can stand alone from an independent audit perhaps using the Key Stage Reviews as a reference point.

It’s hoped the reader can recognise the footprint of the discussions above in the headings. They reflect elements of governance around specific areas where the healthcare built environment would benefit from applying greater rigour. Even in processes which are well established, such as HAISCRIBE and other interfaces with IPC, gaps exist in their implementation which should be managed.

The **key to improvement** is unlikely to lie in only targeting the most common deviations from guidance, but recognising that any of these points could cause a problem for patients and staff.

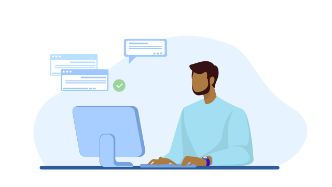
## Contact details

Email: nss.nhsscotlandassure@nhs.scot

Website: [Assurance | National Services Scotland (nhs.scot)](https://www.nss.nhs.scot/browse/nhs-scotland-assure/assurance)

**If you require an alternative format please contact** [NSS.EqualityDiversity@nhs.scot](mailto:NSS.EqualityDiversity@nhs.scot)

**Telephone 0131 375 6000**

**BSL ContactScotlandBSL ContactScotland** ([contactscotland-bsi.org](https://eur01.safelinks.protection.outlook.com/?url=https%3A%2F%2Fcontactscotland-bsl.org%2F&data=05%7C01%7CChris.McVey%40nhs.scot%7C85c5f0686e17440e588108da98079425%7C10efe0bda0304bca809cb5e6745e499a%7C0%7C0%7C637989456055671173%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=4VbRWpRKubyMELOAFuA50rvZpPG9STQRjP3J3hVuc2A%3D&reserved=0))

# Examples of lessons learned

This section includes brief notes around problem issues. It is not an exhaustive explanation of each finding but aims to include enough detail to generate a future awareness of elements which should be considered by health boards and their advisors.



## FIRE

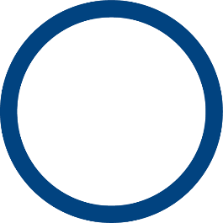
* absence of combined fire and smoke dampers between corridors and patient sleeping accommodation
* self-closing devices missing from half leaf doors
* self-closing devices missing from doors between corridors (which access patient sleeping accommodation) and offices, stores (which are not kept locked)
* inadequate justification for omission of smoke detection in ceiling voids
* inadequate justification for omission of automatic detection from spaces such as toilets in accordance with BS5839
* absence of certification for fire curtains
* charging of electrical devices in corridors
* damaged fire seals at doors
* unprotected gaps in fire resisting materials

### VENTILATION

* inadequate design air change rates
* inadequate/unclear room pressure differentials
* inadequate number of combined fire and smoke dampers
* filters incorrectly seated on frames in the AHUs
* isolation room ventilation not separated from the general system
* incorrect or unclear location for air pressure stabilisers (APS)
* inadequate separation between air intakes and discharges
* roof mounted AHUs without maintenance protection from the elements
* inadequate consideration of system performance creep associated with terminal HEPA filter fouling

# ELECTRICAL

* unclear allocation of clinical risk categories (SHTM 06-01) and medical grouping (BS7671)
* excessive distance to Medical impedance terra earthed (IT) panels from outlets
* absence of or inappropriate siting of equipotential bonding busbars
* site fabricated equipotential bonding busbars not in compliance with BS7671 requirements.
* discrepancies or uncertainty around selectivity
* inadequate provision of fire protection of cables and busbars
* no local changeover for Medical IT
* incorrect completion certificates
* unexplained errors in test sheets
* conflicting information on documents



## MEDICAL GAS SYSTEMS

* inappropriate location for safety valve
* inappropriate location of area valve service units (AVSUs)
* poor labelling and signage
* single point of failure on oxygen vacuum insulated evaporator (VIE) supply.
* difficult access to emergency isolation valve
* economiser difficulties
* missing/unclear derogations
* inadequate protection to oxygen incoming supply
* non-return valves missing
* inappropriate location of alarm panels



### WATER

* abnormally high gram negative bacteria and TVC
* high cold-water temperature
* low hot water temperature
* type of expansion vessels either no flow or not clear
* lack of maintenance on taps
* assessment of bulk storage unclear
* filtration issues
* low carbon steel pipework used
* over sizing pipework
* insufficient valves
* dead legs in pipework

# DRAINAGE

* use of air admittance valves (AAVs) in clinical areas with no evidence of hospital acquired infection (HAI) review or estates input regarding maintenance.
* lack of co-ordination of drainage pipework with other services, including stacks, falls and vents to atmosphere
* access to drainage manholes difficult and disruptive to “normal” operations
* lack of resilience in pumped systems

