Agenda No	484/23

Name of meeting	Executive Management Board
Date	28th February 2024
Name of paper	Evaluation of power infrastructure and generators to identify issues with design, configuration, installation, resilience, and redundancy
Responsible Executive	Chief Finance Officer
Author	Head of Critical Systems
Update summary	The improvement case encompasses critical power infrastructure issues across [redacted] sites, highlighting the risks of power failures and safety hazards. [redacted] will conduct comprehensive assessments and implement remote monitoring systems to ensure real-time visibility into generator status. However, it's crucial to note that the improvement case covers consultancy and remote monitoring only, with resolution of issues requiring further approval and costs once the consultancy is completed. Option 4, offers a proactive approach to begin to address infrastructure vulnerabilities, laying the groundwork for uninterrupted service delivery and informed decision-making. Failure to implement these measures could result in prolonged service disruptions, jeopardising patient care and operational continuity.
Recommendations, decisions, or actions sought	It is recommended that EMB support Option 4 and ensure IT and operational colleagues collaborate with suppliers for the implementation of assessments and consultancy. This collaborative effort will involve agreeing on required resilience levels and navigating minor outages to facilitate a thorough assessment of critical infrastructure.

Does this paper, or the subject of this paper, require an equality impact analysis ('EIA')? (EIAs are required for all strategies, policies, procedures, guidelines, plans and business cases).	No

South East Coast Ambulance Service NHS
NHS Foundation Trust

Evaluation of power infrastructure and generators to identify issues with design, configuration, installation, resilience, and redundancy

22 February 2024

Author(s): Head of Critical Systems

Executive Lead: Chief Finance Officer

Directorate: Finance & Corporate Services

Improvement Brief Ref:

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Final Decision:

Date proposal reviewed	By	Decision made

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Please record all key changes made to the document and how these have been approved (either person or committee			
Version	Date	Author and title	Summary of key changes
0.1	22/02/24	[redacted]	Initial version
0.2	22/02/24	[redacted]	Minor revisions
0.3	23/02/24	[redacted]	Finance input

Review and Approvals log:

Please ensure you log (in chronological order) all reviews and approvals to show the audit trail for support for your proposal				
Version shared	**Person and title or Committee**	**Date reviewed**	**Recommendation given (reviewed and support, approved, reject)**	**Rationale**
0.1	Chief Finance Officer	23/02/24	Support	Generators are key to resilience to our MRCs and sites and therefore our service.

1. Improvement Summary

Background

Initially, the responsibility for power infrastructure, switchgear, generators, and uninterruptible power supplies rested with Estates. However, [redacted] which identified a business need to move the responsibility for managing these critical components to the IT department.

A supplier, [redacted] was appointed as the primary service provider for sites housing generators, communication rooms, or data centres. [redacted] brings considerable expertise in delivering resilient and redundant infrastructure for data centres, having served as designers and installers for data centres at both [redacted] sites. It is important to note that their involvement did not extend to power or generators at either location.

All sites underwent an initial assessment process, prompted by a lack of handover documentation. Numerous issues have been discovered, varying in scale and complexity. Efforts were made to address these issues through routine repairs. However, [redacted] sites—[redacted]—emerged with significant challenges necessitating a thorough exploration before a comprehensive resolution plan could be developed.

[redacted]

Furthermore, it is worth noting that there is currently no remote monitoring available for any generators across the sites. This lack of monitoring means that current and past supporting providers have been unable to promptly respond to faults as they arise, lack knowledge of generator usage, and remain unaware of any fuel supply issues.

Current State

The current state of affairs across various sites, [redacted] presents several challenges requiring immediate attention.

At [redacted], critical issues have been identified [redacted], where [redacted] risks such as fuel leaks, excessive noise levels, and the ingress of exhaust fumes into the building. Additionally, concerns persist regarding the electrical infrastructure, [redacted] compromising the system's robustness and resilience. These have been further compounded by the site's original design intent for two generators, subsequently reduced to one to save costs, amounting to less than £100k. Unfortunately, it appears that this decision was made without revising the electrical infrastructure designs accordingly, leading to discrepancies in the current setup (confirmed by the original design company).

Furthermore, the consequence of choosing, at [redacted], to reduce redundancy at the Trust's now most critical site [redacted] has become evident through

recent generator failures at both the [redacted] sites. These failures underscore the critical importance of having redundant backup systems, such as a second generator, to ensure uninterrupted operations. Despite the cost-saving rationale, the lack of a second generator now poses significant risks to operational continuity, particularly considering recent failures and the criticality of the site.

Similar concerns extend to the [redacted] sites, where the reliability and functionality of the Automatic Transfer System (ATS) have come under scrutiny. Despite repeated power failures at [redacted] site, investigations have revealed that the issues are not related to the incoming power supply. [redacted], confident in their assessment, attributes these failures to local on-site infrastructure issues, contrasting with their successful support of the nearby stadium and universities who share the same power supply.

In addition to these challenges, none of the sites currently benefit from remote monitoring for generators. This absence of monitoring capabilities hampers fault detection and response, leaving maintenance providers unaware of operational status or fuel supply issues. The lack of remote monitoring also complicates efforts to ensure timely maintenance and intervention, increasing the risk of prolonged downtime during critical situations.

These challenges highlight the pressing need for intervention to safeguard operations and personnel safety. Effective solutions must be implemented promptly to address the identified deficiencies and ensure the uninterrupted functioning of critical systems across all sites. Failure to address these issues in a timely manner risks further disruptions and compromises operational resilience.

Risks or Issues

[redacted]

[redacted]

[redacted]

A backup connection intended for emergencies suffers from significant drawbacks, including its location in the tyre store at height resulting in issues connecting the required cabling size

and weight. Additionally, the lack of auto-switching capability means that connecting a backup generator would result in the site running entirely on generator power, significantly reducing resilience.

[redacted] sites share similar equipment and operational methodologies and initial findings reveal concerns regarding the Automatic Transfer System (ATS). The reliability and functionality of the Automatic Transfer System (ATS) pose significant concerns, with recurring power failures that not only disrupt operations but also raise doubts about the resilience and effectiveness of the current ATS setup. Addressing these concerns is paramount to ensure uninterrupted power supply and mitigate potential operational disruptions.

There is no remote monitoring available for any generators. This means current and past supporting providers have been unable to respond to faults as they have arisen, have no knowledge that the generator is in use, or awareness of any fuel supply issues. The current maintenance company responds to any generator start event to ensure a smooth continuous operation for the site, as well as any fault event, 24/7 365. This is not possible without remote monitoring and is entirely dependent on IT staff escalating issues. However, typically, that is then too late.

Improvements

[redacted] engagement encompasses a multifaceted approach aimed at assessing and enhancing the operational resilience of critical infrastructure across various sites, including [redacted]. While the deployment of remote monitoring capabilities will form a significant aspect of their strategy, [redacted] primary focus is on conducting comprehensive site assessments and developing tailored plans to address identified deficiencies.

At [redacted], [redacted] will conduct a Requirements Analysis Workshop in collaboration with the Trust to ascertain resilience needs and assess existing infrastructure capabilities. Following this analysis, [redacted] will produce firm pricing, proposal documents, and project programmes for remedial upgrades, laying the groundwork for subsequent remediation efforts.

Across all sites [redacted] consultancy services will entail thorough surveys and reviews of existing controls, cabling, and resilience measures. Senior design engineers from [redacted] will collaborate to outline specifications for switchgear and generator manufacturers, informing subsequent remedial actions to enhance system robustness and reliability.

For [redacted] specifically, [redacted] proposes a comprehensive solution to mitigate exhaust fume infiltration into the building. Through Computational Fluid Dynamics (CFD) modelling, potential exhaust recirculation risks will be assessed, guiding the installation of a new stainless steel flue to redirect exhaust emissions away from building air intakes. Collaboration with Estates will facilitate planning permission and ensure adherence to safety protocols and local emissions laws.

At [redacted] where issues with the Automatic Transfer System (ATS) have been identified, [redacted] recommends replacing the existing ATS system with a conventional setup controlled via a local controller or manually operated override. This approach aims to enhance system reliability and mitigate the risk of generator issues.

In parallel, [redacted] will initiate the deployment of the [redacted] Building Management System (BMS) across all sites with generators, enabling real-time monitoring of critical

equipment, including generator faults and status, power supplies, fuel levels, and facilitating proactive fault detection. This integrated monitoring solution will enhance operational oversight and responsiveness, ensuring timely intervention in the event of equipment failures and optimising overall system resilience. Additionally, a centralised dashboard will provide stakeholders, including [redacted], the IT team, and onsite personnel, with immediate visibility into operational conditions, thereby enhancing overall infrastructure reliability

Upon the conclusion of the design and consultancy phase[redacted] will aid the IT department in the production of a comprehensive improvement brief detailing the findings, proposed solutions, and exact costs for [redacted]. These improvement cases will serve as crucial decision-making tools for the Trust, enabling informed prioritisation and allocation of funds and resources towards the most critical infrastructure enhancements. With [redacted] expert guidance and thorough analysis, the Trust will be empowered to make decisions that align with its strategy and ensure the long-term resilience and reliability of its critical facilities.

Options Considered

Option 1 - Do nothing:
This option involves maintaining the status quo without implementing any changes or improvements to the current infrastructure. While it may require no upfront investment, it leaves the Trust vulnerable to ongoing risks and potential disruptions. For instance, a failure of the generator at [redacted] during a power outage would result in the necessary closure of the site and immediate commencement of national contingency procedures, as well as the transfer of [redacted] staff to [redacted]. Similarly, a loss of power at [redacted] would likely result in a similar closure of the site after just a short period of operation due to exhaust fumes entering the building, depending on prevailing winds. Both scenarios pose significant impacts to operations and put patients at risk.

Option 2 - Add remote monitoring only (already in progress as part of end of year spend):
This option entails focusing solely on implementing remote monitoring solutions across all sites, a measure already underway as part of planned end-of-year expenditures. While this addresses the immediate need for enhanced oversight and early detection of equipment issues, it does not address underlying infrastructure deficiencies or potential risks and leaves many of the same concerns as those that exist in option1. However, it provides a foundational step towards proactive maintenance and improved operational resilience.

Option 3 - Complete consultancy on [redacted] and add remote monitoring:
Under this option, the Trust would prioritise conducting comprehensive consultancy on the [redacted] site to identify critical infrastructure gaps and develop tailored solutions. Simultaneously, remote monitoring capabilities would be implemented to enhance visibility and early warning systems. By focusing resources on [redacted], the Trust can swiftly address urgent concerns, mitigate immediate risks, and lay the groundwork for future infrastructure enhancements.

Option 4 - Complete consultancy on all sites and add remote monitoring:
This comprehensive approach involves conducting consultancy assessments across all sites, including [redacted], to comprehensively evaluate infrastructure deficiencies and propose remedial measures. Concurrently, remote monitoring systems would be deployed to bolster oversight and maintenance capabilities across all sites. While this option requires a greater initial investment of time and resources, it offers the most holistic approach to identifying and addressing vulnerabilities across the Trust's critical infrastructure, ensuring long-term resilience and operational continuity.

Preferred Option
Option 4 - Complete consultancy on all Sites and add remote monitoring

Option 4, which involves completing consultancy on all sites and adding remote monitoring, emerges as the preferred choice due to several compelling reasons. Firstly, undertaking consultancy on all sites allows for a comprehensive assessment of the current infrastructure, identifying existing issues, weaknesses, and potential risks across the board. This thorough evaluation with partner suppliers ensures that all critical areas can be addressed, mitigating the likelihood of future failures and operational disruptions.

Furthermore, the addition of remote monitoring offers real-time visibility and proactive management of key equipment, including generators, power supplies, and fuel levels. By implementing remote monitoring, the Trust gains the ability to swiftly detect and respond to any emerging issues, minimizing downtime and ensuring continuous operational readiness.

Moreover, prioritising [redacted] for consultancy acknowledges its critical role within the Trust's operations and the urgent need to address existing challenges, such as generator failures and exhaust fume issues. By focusing on [redacted] initially, the Trust can prioritise resources where they are most needed, safeguarding critical services and patient care.

Overall, Option 4 presents a strategic approach that combines comprehensive consultancy with proactive remote monitoring, enhancing reliability, resilience, and operational efficiency across all sites. By investing in proactive maintenance and infrastructure improvements, the Trust can better protect its critical operations, minimise risks, and ensure uninterrupted service delivery to patients and stakeholders.

Once the consultancy piece has concluded, an improvement case will be submitted to assess the options of how to proceed. Current worst-case estimates are [redacted] for [redacted], and [redacted] for [redacted]; however these are believed to include many elements that will not be necessary, but cannot be confirmed until the consultancy is complete. The second improvement case will provide a detailed analysis of the proposed solutions, including cost-benefit analyses, risk assessments, and implementation timelines. By considering these factors comprehensively, the Trust can make informed decisions regarding the prioritisation and allocation of resources to address the identified infrastructure challenges effectively.

Cost

[redacted]

2. Impact of not implementing the Proposal

Briefly outline the impact if the proposal is not approved?

The failure to implement the proposed solution could have severe consequences across several key areas of the Trust's operations. Primarily, operational disruptions would persist due to the reliance on infrastructure with known issues, leading to frequent power failures and equipment malfunctions. These disruptions pose a direct threat to patient care and safety, potentially compromising critical healthcare services.

Moreover, the safety risks associated with unresolved issues, such as generator failures and exhaust fume ingress, remain a significant concern. Continued exposure risk carbon monoxide poisoning, endangering staff within the facility and patients following the

evacuation. Without prompt resolution, these safety hazards could escalate, exacerbating the risk landscape.

In addition to safety concerns, the Trust faces potential business continuity threats. In the event of a generator failure during a power outage, essential facilities like [redacted] may be forced to shut down, triggering a business continuity event and staff relocation, as well as the [redacted]. Such disruptions not only disrupt patient care but also strain resources and undermine the Trust's ability to maintain operational continuity.

Regulatory compliance is another area of concern, as operating infrastructure that fails to meet regulatory standards could result in penalties. Failure to address these compliance gaps may damage the Trust's reputation and expose it to legal liabilities, further complicating its operational landscape.

Furthermore, the financial implications of unresolved infrastructure issues are significant. Recurrent operational disruptions and emergency repairs necessitated by unresolved issues incur substantial costs, including maintenance expenses, equipment replacements, and potential fines or legal fees related to non-compliance.

In summary, the failure to address the identified infrastructure challenges poses multifaceted risks to the Trust, encompassing patient safety, operational efficiency, regulatory compliance, and financial stability. Proactive measures to address these challenges through infrastructure improvements and maintenance are imperative to safeguarding the Trust's mission-critical operations and ensuring the delivery of high-quality healthcare services.

3. Resources

What resources are required to implement the preferred option and are they covered in the Cost table below?

A Technical Implementation Manager will be required to oversee this element and will be key to seeing the final delivery upon the second improvement case with the final works required. This is already resourced.

Support from Service Desk and Critical Systems will be required out of project capacity as needed during any potential outage works. However, these will be brief and well within the existing capacity of the teams.

Operational Team Leaders, Emergency Operations Centre Managers, Duty Emergency Operations Centre Managers, Assistant Contact Centre Manager, Operational Managers and Operating Unit Managers may be engaged with on-sites.

Estates Managers will be engaged throughout.

Power outages may be necessary at any of the sites during the consultancy. It is expected that these would be brief (10-15 minutes) but would require the engagement of all relevant staff on-site to ensure that it went smoothly, without interruption to services.

4. Financial Analysis

a) Costs of the preferred option,

[redacted]

All the above has been confirmed by: [redacted]

b) How will the improvement be funded?

This has partially been funded within the 2023/24 capital plan, the remaining value will need to be included within the 2024/25 capital plan.

c) Please include narrative of workings of costs, savings and all financial and activity assumptions

[redacted] **Consultancy**

- Detail/Construction Electrical Design
- Project Management Design Phase
- CDM (H&S Construction File)
- Principal Designer (CDMc)
- Client training
- Creation of Operations & Maintenance manuals

[redacted]

[redacted] **Consultancy**

- Preliminaries
  - Desktop Review of O&M for [redacted]
  - Coordination of Third-Party Specialist Consultants ([redacted])
  - Project Management and Administration (based on a 6-week programme)
  - Travel / Subsistence
    [redacted]
- Requirements Analysis Workshop (RAW)
  - RAW (Teams) Sessions
  - RAW Report
    [redacted]
- Professional Services
  - [redacted] Electrical Design Survey
  - Ancillary Systems Design Survey – BMS Connectivity
  - Concept Structural/Architectural Design - Planning / Drawings / Documentation
  - Generator Consultancy fee - Full controls and wiring survey and drawings

- [redacted] - Intrusive Switchgear Wiring Survey / Updated as built drawings / New proposal drawings
- Generator Manufacturer - Review existing design
- [redacted] / Review existing design
- Switching Procedures to be provided by SECamb / [redacted]
- [redacted] CFD of Generator Exhaust
- Stage 3 - Electrical Design
- Stage 3 - Mechanical Design
- Stage 3 - Ancillary Systems Design
- Stage 3 - Structural/Architectural Design
- Stage 3 - Design Second Generator Set 1250kVA
- Stage 3 - Design Generator Flue
- Stage 3 - Design Switchgear Panels
- Solution Pricing Document
- Master RAID Log
- Preparation of RAW / SPOF and Deliverable templates

[redacted]

[redacted]

Remote monitoring of generators

- [redacted] Uninterruptable Power Supplies; Air Handling Units; Generators and Static Transfer Switches
- [redacted] iMeter Masters
- UPS Relay Cards
- AHU Interface Cards
- Generator Relay Cards
- Installation
- Maintenance for 5 years
- Structured cabling installs by sub-contractor [redacted]
- [redacted] Licensing
- STS for BMS

[redacted]

[redacted]

5. Key Milestones and Timelines

1. March 24 – Approval to commence, project scoping
2. April 24 – Funding authorised, works planned
3. May – August 24 – Completion of assessments across sites
4. May – November 24 – Installation of remote monitoring

Upon conclusion of the assessments, a further improvement case will be submitted for phase 2. This will cover the remediations necessary at each site, along with exact costings.

6. Procurement Process

[redacted] will be utilised to conduct the assessment. As an existing supplier, contracted to maintain and monitor all elements discussed for the next 4 years, and with extensive experience in providing services to critical organisations such as the Trust, it is appropriate that they supply the services described. A single tender waiver will be used if necessary, however procurement are establishing a potential direct award route to be utilised via a framework.