March 2024

Kings College Hospital NHS Foundation Trust

DENMARK HILL HOSPITAL

Decarbonisation Proposals Stage 2 Report

QUALITY CONTROL

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CONTENTS

Tables

Figures

Appendices

EXECUTIVE SUMMARY

This design report brings together the proposed thinking for the heat energy decarbonisation of the Kings College Hospital Denmark Hill site, based on an agreed outline development sequence for the site that includes key building refurbishments and replacements over the period up to 2040. The development sequence is scheduled to meet the key mandated decarbonisation goals as set out in the NHS Net Zero Carbon Building Standard.

The design proposals reached are based on all new heat generating plant and associated infrastructure requirements being provided directly on site in new and dedicated energy centre complexes, one to be provided initially as part of the proposed Link building replacement, that will serve the buildings south of the Bessemer Road and the other as part of the proposed Dental/Day Surgery building replacement north of the Bessemer Road. The report is aware of but does not consider in detail the potential for connection to an external district heat energy provider system. A furthermore detailed study into a district network connection would be necessary in order to fully understand the implications in terms of on-site plant, connection location, timing logistics and system resilience.

This report preparation has been funded entirely through the GLA Local Energy Accelerator grant funding scheme. The LEA is a £6million programme co funded by the Mayor of London and the ERDF that supports the development of clean and flexible local energy projects, with the goal of reducing overall carbon emissions in London. This report builds on the decarbonisation roadmap report set out by Mott Macdonald in 2022 and WSP have been assisted in its preparation by Veolia, who currently manage the Denmark Hill on site gas CHP/steam boiler energy centre.

The report identifies the key risks associated with the new heat energy centre provisions as, 1) the potential impact on the new Link building development, which is intended as a clinical services building but will need to accommodate substantial plant provision and infrastructure connections at ground and/or basement level, 2) the absence of a developed and signed off site development master plan, 3) availability of sufficient electrical energy capacity from the DNO, 4) the significant costs of developing and constructing the new heat energy centres and associated distribution and electrical power infrastructure systems that could exceed £350million and 5) the potential to miss mandated decarbonisation deadlines if not implemented in time.

This report concludes that two separate energy centres should be provided as outlined above. The impact of the south energy centre on the new Link building can be mitigated to some degree by providing it across two or more levels of Basement rather than utilising the ground floor space. A detailed site development master plan should be developed in parallel with an overarching clinical plan to drive the wider accommodation requirements and this should be undertaken immediately and consider the heat energy network infrastructure spatial requirements. Discussions with UKPN based on the potential electrical energy demands of the envisaged decarbonised and redeveloped site requirements are already underway. This thinking should be expanded to include neighbouring large scale energy users, (KCL & SLAM) in order that UKPN can fully understand the impact these decarbonisation demands could have on their supply network and what reinforcement measures need to be implemented and when.

ELECTRICAL SUPPLY & DISTRIBUTION

Decarbonisation of the Kings College Hospital Denmark Hill site will be a gradual process achieved through the replacement and redevelopments of existing buildings to reduce heat losses through improved thermal performance and the deployment of high efficiency low carbon heat energy generating plant and infrastructure. These changes, predominately driven through the use of electrically powered heat generating plant, together with the proposed extensive masterplan/building redevelopment changes to the site ultimately result in a huge increase in electrical power demand that cannot be met by the existing electricity supply infrastructure.

WSP have determined through this study that electricity demand increases will be gradual up to 2030/31, manageable initially within the existing UKPN supply and Trust distribution infrastructure plant capabilities, but with gradual increases in the site agreed supply delivery capacity required. It is also clear that the site average electricity demand is now marginally greater than the existing CHP plant delivery capacity and indeed the site agreed supply capacity delivered via UKPN and thus an immediate upgrade in agreed supply capacity is recommend from the current 4MVA to 5MVA. This will ensure supply capacity will be available for KCH utilisation in the event that the Veolia managed CHP is unavailable. A further step increase in agreed supply capacity to 6MVA is envisaged as necessary during 2027 in order to cater for site wide developments, including the proposed new Haematology and modular theatre building developments and further Cheyne Wing CRF imaging load requirements.

However, WSP estimate that a significant increase in supply capacity to **13MVA** will be necessary to enable the new southern energy centre and Link building development. This level of demand is anticipated to be required for 2030, the latest point at which the new south energy centre is required to be fully operational in order to meet the end of the target timeline window to have achieved an 80% reduction in overall carbon emissions. WSP would recommend that this supply capacity and infrastructure are available at least one or two years prior to 2030 to enable a manageable time frame in which to transfer from the existing and connect and commission the new energy centre.

This upgrade will only be manageable through comprehensive reconfiguration of the site electrical supply plant configuration, upgrading from the current 11kV supply to a 33kV supply configuration and the significant electrical distribution infrastructure investment that this will require to enable the anticipated further demand increases resulting from site redevelopment up to and beyond 2040, where an anticipated electrical load demand of between **17MVA and 19MVA** might be realised and when net zero carbon targets for the site energy consumption have to be met.

In the compilation of this report WSP have identified a further 6 key electrical infrastructure updates in addition to the new south energy centre supply and infrastructure upgrade, that are necessary to enable the wider site developments identified and agreed with the Trust and likely to be implemented between now and 2041. These include six new transformer substation facilities to be constructed

and connected to the existing 11kV distribution ring feeder circuits A & B. These include the following:

- New south substation for KCL funded CRF imaging requirements - Ring Circuit B – 2025;
- New Haematology building/substation 10 replacement – Ring Circuit A – 2027;
- Normanby site new substation to enable A&B clinical supply configuration – Ring Circuit B – 2030;
- Business units 7 & 8 replacement new substation to enable A&B clinical supply configuration – Ring Circuit B – 2037;
- Dental & Day Surgery building replacement new substation to enable A&B clinical supply configurations – Ring Circuit B – 2040; and
- Bessemer Wing replacement new substation – Ring Circuit B – Post 2040.

WSP have been in early discussions with UKPN, sharing the potential site development and decarbonisation load demand profiling with them in order to establish how this and other local large consumer decarbonisation/development plans might impact their infrastructure network, what changes to their network and infrastructure plant might potentially be required, their impact/timescales to implementation and ultimately how to guarantee the necessary supply capacity, when required to Kings College Hospital.

HEAT NETWORK ENERGY CENTRE AND DISTRIBUTION

In order to decarbonise the heating system at Denmark Hill a new LTHW distribution network is proposed to be developed on the site to replace the existing steam system and will distribute new LTHW pipework from a new Energy Centre to connect to the majority of site's heat loads for the buildings south of Bessemer Road. For the buildings north of Bessemer Road local decarbonised plant is proposed to be provided to be installed when these buildings and areas are redeveloped.

The main new Energy Centre (new South Energy Centre), located in the Link Building redevelopment, is proposed to connect into the new LTHW distribution system. Primary plant within the EC would include high-temperature Air Source Heat Pumps (maximum generation temperature of 85°C) and electrical resistance boilers. This system would serve the majority of the site's heat demand; that is, all loads currently connected to the existing EC, plus the following developments: An 85ºC supply temperature system was chosen to align with the existing systems supplied from the existing steam plant with the option to reduce this temperature in the future as the connected loads are designed to accept lower temperatures.

- Units 1 to 5;
- Units 7 and 8;
- Link Building replacement; and
- Bessemer Wing replacement.

The estimated peak load on the South EC (which would occur post-2040) is around 9.4MW.

Development of the new South EC is proposed to be brought forward in the programme in order to target initial operation at the start of 2030, if not before. The drivers for accelerating this development are as follows:

- NHS decarbonisation ambitions (2028-2032);
- To provide a replacement for ageing heat generation plant in the existing EC; and
- Expiry of existing, and planned extension to, Veolia contract.

This will require the early planning works to begin in 2026, assuming a two-year period for design and enabling works and a two-year period for construction. In order to provide a smooth changeover from the existing energy centre to the new South Energy Centre, a one-year transition period is proposed for 2030, during which both energy centres should be operational.

It is proposed that the following new developments to the north of Bessemer Road are to be heated by their own independent heating systems:

- Pharmacy (Normanby carpark);
- Phlebotomy (Normanby carpark);
- Willowfield 2; and
- Haematology - Unit 6 replacement.

The future Dental/Day Surgery development is proposed to be served heat from its own stand-alone plant facility. The building and its heating systems should be designed to permit a standard ASHP system (using conventional refrigerants), generating at more efficient lower temperatures, as opposed to the high temperature system proposed for the new South Energy Centre.

The ambient loop proposal for the developments north of Bessemer Road detailed within the Mott MacDonald 2023 decarbonisation plan was reviewed. However, local plant for the developments north of Bessemer Road was believed to be more feasible due to the following:-

- minimal cooling loads for large proportions of the year.
- Advanced provision of the Normanby carpark building development proposals.

These can be further reviewed at the next stage.

1

Introduction

1 INTRODUCTION

1.1 PURPOSE OF THE REPORT

Decarbonisation of the Denmark Hill hospital site is a commitment on the part of King's College Hospital (KCH) NHS Foundation Trust to meet the NHS target deadline for their portfolio of sites to become Net Zero Carbon by 2040, with an ambition to achieve an overall 80% carbon reduction between 2028 and 2032.

As part of this commitment WSP have been appointed by KCH NHS FT to provide a RIBA Stage 1 Mechanical and RIBA Stage 2 Electrical design proposals for the decarbonisation of their main Denmark Hill hospital site.

The purpose of this report is to:-

- Investigate and identify the existing base site energy consumption loads for space & water heating and electrical power;
- Identify the potential future loads for the same based on an agreed outline sitewide development plan extending up to 2040;
- Investigate options and establish an outline design plan for replacement resilient heat generation & power supply infrastructure systems to meet the site development plans; and
- To investigate and establish a process for delivering the necessary electricity supply capacity to the site with the local DNO – UKPN.

The King's College Hospital Denmark Hill Campus is a major trauma centre and one of London's longest established, largest and busiest teaching hospitals and is known around the world for the first-rate care it provides to the critically ill. It serves a local population in excess of 700,000 in the London Boroughs of Southwark and Lambeth and also serves as a referral centre to millions of patients across southeast England. Patients travel from far afield to access the hospital's diverse range of specialist services in areas including liver disease, transplantation, neurosciences and Haematology. Kings College Hospital Denmark Hill is, together with Guy's Hospital and St Thomas's Hospital the location for Kings College London School of Medicine and one of the institutions that comprises the Kings Health Partners.

This document will cover the following:-

- Review of the existing site electrical supply capacity and its expected increase to meet decarbonisation requirements;
- Overview of the Denmark Hill Hospital Estate expansion plans;
- Review implications of removing the steam heating system;
- Baseline heat energy analysis;
- Central low carbon plant options appraisal;
- Central plant proposal including details of air source heat pumps;
- Site wide electrical distribution expansion strategy;
- Centralised heat distribution pipework strategy;
- Decarbonisation and site development scale and sequence;
- Comment on the existing buildings thermal performance and possible options to improve energy efficiency;
- Cost modelling of all options;
- Recommendations and next steps; and
- Further opportunities.

1.2 SITE LOCATION

Kings College Hospital is located on Denmark Hill in southeast London, (SE5) and comprises in excess of 25 individual buildings set predominately along Bessemer Road, which is completely contained within the hospital grounds. These buildings range in age and style from the traditional Nightingale type ward block buildings dating from the turn of the last century right up to the current day modular constructed Willowfield building, providing a diverse range of scale and uses. The site is bounded to the south by a railway line and the open space of Ruskin Park and to the east by Denmark Hill and the Maudsley Hospital, operated by the South London and Maudsley NHS Foundation Trust. To the North-West sits the Kings College London University campus. The actual Denmark Hill hospital site extends north to include the Normanby and Dental Wing building complexes. Although further buildings do exist beyond these limits along Denmark Hill and Caldecott Road, these are not considered as part of the main site and do not receive electrical or heat energy from the main site distribution infrastructure systems.

1.3 DISTRICT HEATING NETWORK CONNECTION

During the preparation of this design report, it has come to the attention of the stake holders that a large independent heat energy network provider,(SELCHP) are proposing to extend their existing wide area heat distribution pipe network into the Camberwell area and would be interested in providing centralised heat energy (as a bi product of waste incineration) to large steady/base load consumers such as KCH, KCL and SLAM. Whilst initial discussions with the providers have been held and the potential benefits to both the providers and KCH, this report does not look further into this option, which would need to be the subject of a further detailed study and discussions with the network operators and all stake holders.

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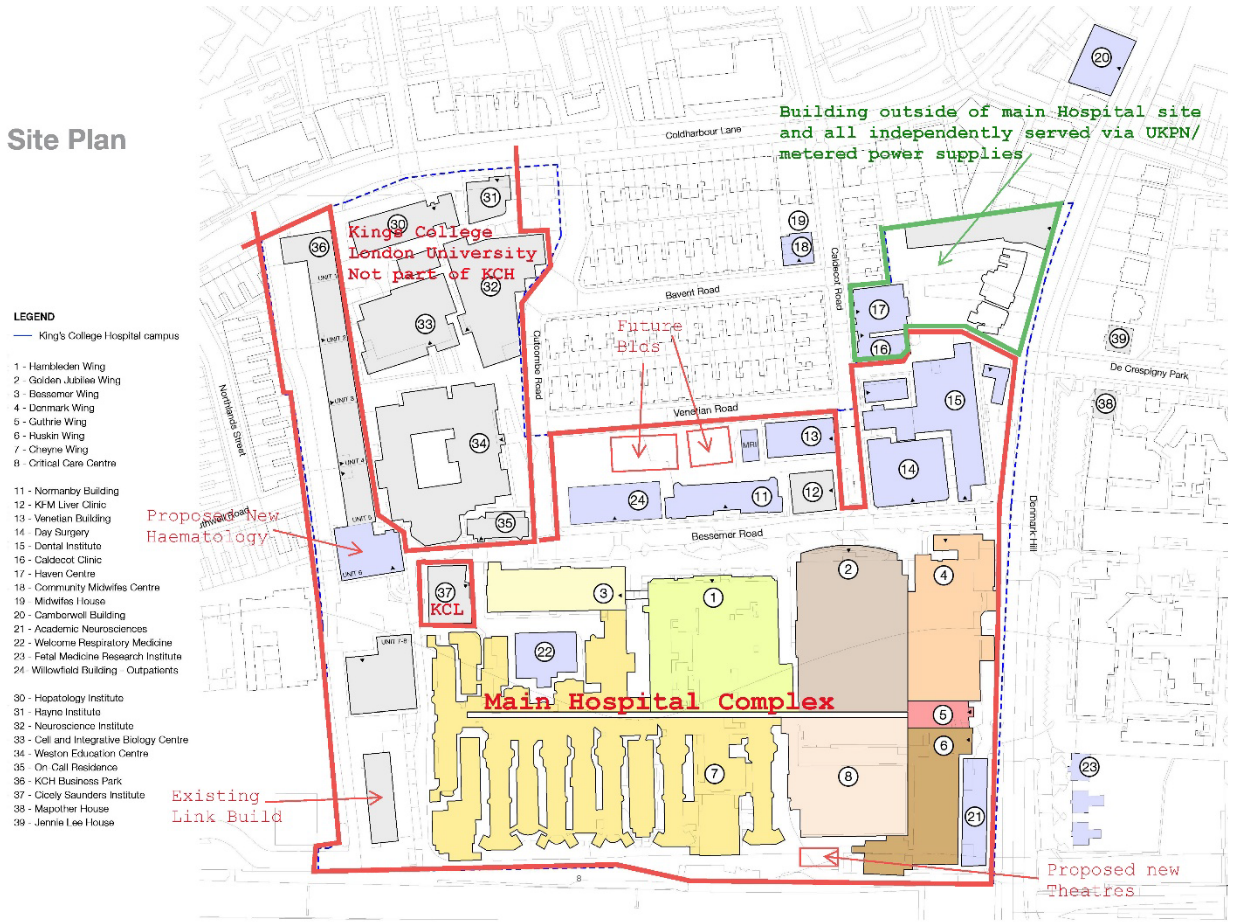

Figure 1-1 – Denmark Hill Hospital Site

1.4 PREVIOUS WORK

This Stage 2 design report builds on previous work carried out by Mott Macdonald in 2023 where they provided an Energy Centre Feasibility Study for the site together with an overarching Heat Decarbonisation plan for the entire Kings College Hospital estate. WSP have also recently completed a decarbonisation options study for the Orpington Hospital site and been involved with the recent detailed design for the extension of the medium voltage electrical distribution infrastructure for the Denmark Hill site, comprising the completion of the second 11,000-volt distribution ring main circuit system and provision of three new electrical distribution substations on this ring circuit serving the existing Denmark, Dental and Normanby buildings.

1.5 SITE WIDE DEVELOPMENT MASTERPLAN

In undertaking the decarbonisation Stage 2 design study and in order to understand both the anticipated heat and electrical energy load demand requirements leading to both partial, (80% carbon saving between 2028 and 2032) and net zero carbon by 2040, WSP have had to interrogate and understand the possible overall development strategy for the Denmark Hill hospital site.

The authors are aware that for a fully detailed site master plan to be developed a clearly defined clinical plan would first have to be agreed between the Kings Health Partners, (Kings College, Guy's and St Thomas's hospitals) and approved by the NHS. As far as WSP are aware no such clinical plan currently exists.

A separately commissioned study to produce a site Development Control Plan, (DCP) was undertaken by Ryders Architects in late 2023, based on a brief provided by the Trust Estates team and delivered to WSP for consideration on the 23rd of January 2024. This study is intended to assist the Trust, future land owners, the London Borough of Lambeth, local councillors and local communities in ensuring that the site is developed with the original vision and aspirations of all stakeholders and to give a rudimentary overview of potential redevelopment scale and location, but without developed detail on final building use, timescale to fruition or cognisance of existing site infrastructure services and the decarbonisation spatial requirements specifically.

Furthermore, the Ryders DCP did not include certain key historic potential development opportunities that WSP are aware of that have been investigated and discussed in the past or indeed some newer proposals that are now being investigated, notably:-

- Demolition of the existing Bessemer Wing and its replacement with a nine-storey block on the same footprint;
- Redevelopment of the Kings Business Park industrial units to three floors including a build over of their existing car parking spaces;
- Provision of addition operating theatre buildings to the south of the new CCU building;
- Specific replacement or rebuilding of the existing original Hambleden, Cheyne or Guthrie Wing buildings; and
- Provision of new Energy Centres as identified by Mott Macdonald in their 2023 feasibility studies.

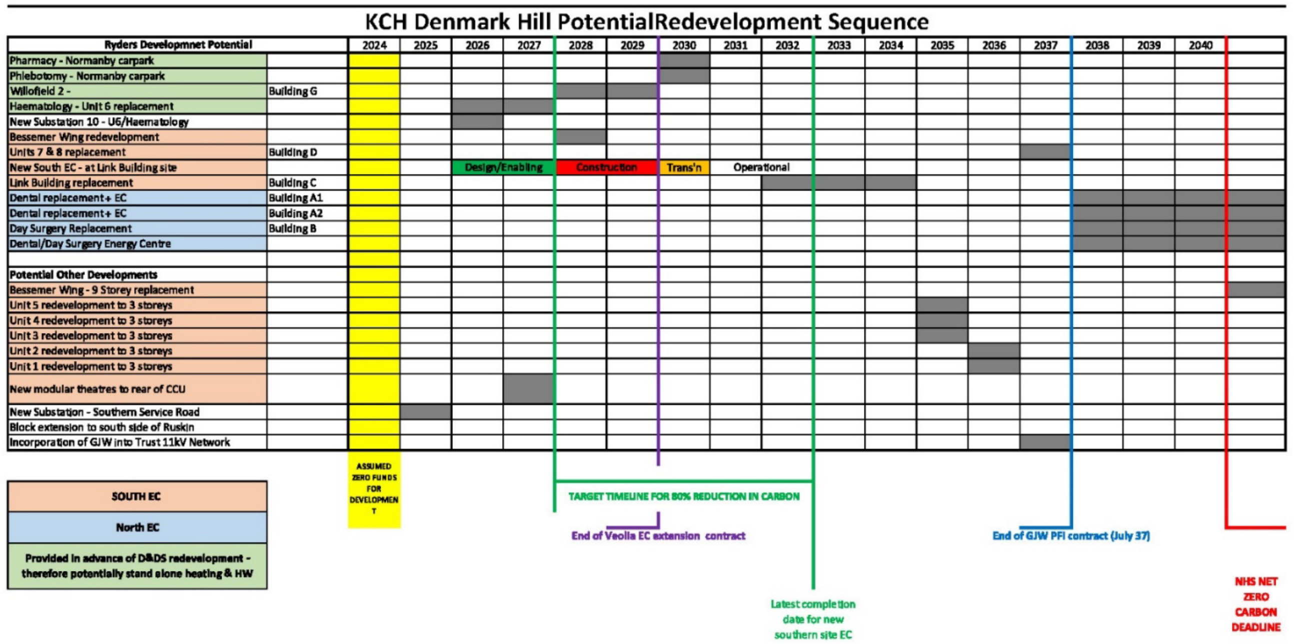

Figure 1-2 – Outline Development Sequence

WSP have for the purpose of this design study prepared an Outline Development Sequence, (detailed in Figure 1-2) agreed with the Trust Estates team, based on the Ryders DCP and inclusive of the above wider reaching potential site developments scenarios over the period up to 2040. A larger, more detailed version of this can be found in Appendix G.

The development sequence high lights specific key dates and targets in relation to the proposed individual building development projects, notably:-

- GREEN Text/Date Lines: 2028-2032 target window for NHS 80% reduction in carbon emissions.
- PURPLE Text/Date Line: End 2029 Veolia energy centre contract ends.
- BLUE Text/Date Line: End 2037 GJW PFI Management contract ends.
- RED Text/Date Line: 2040 NHS Target for Net Zero Carbon operation.

1.6 PROJECT RISKS

Decarbonisation of a site such as the Denmark Hill Kings College Hospital site does not come without significant risk, due in the main to the extent of new heat distribution and power supply infrastructure developments necessary to support the decarbonisation and site wide development plans.

The key risks associated with the decarbonisation and wider site development are:

- The potential impact on the new Link building development. Intended principally as a clinical services building, this will need to accommodate substantial plant provision and infrastructure connections at ground and/or basement level;
- The absence of a developed and signed off site development master plan;
- Availability of sufficient electrical energy capacity from the DNO;
- The significant costs of developing and constructing the new heat energy centres and associated distribution and electrical power infrastructure systems; and
- The potential to miss mandated decarbonisation deadlines if measures are not implemented in time.

Further and more wide-reaching risks are scheduled out in Appendix H.

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2

Existing Plant and Site Survey

2 EXISTING PLANT AND SITE SURVEY

In order to develop an understanding of the site and the existing infrastructure, several site surveys have been conducted, in addition to review of information received from the Trust and various stakeholders. This includes record information with respect to the buildings, infrastructure services, utilities and record drawings.

Weekly surveys have also been undertaken to record and establish the existing site base electrical demand and the demand of various key buildings on the site that will be impacted by both the decarbonisation requirements and the proposed site development masterplan.

2.1 PLANT

2.1.1 HEATING AND COOLING

The majority of the Denmark Hill site is currently heated by a central steam distribution system heated by 3no. steam boilers coupled with 2No. CHP (combined heat and power) units for increased utilisation at the existing energy centre.

The steam is distributed to each of the buildings via steam pipework wrapped in deteriorated insulation. An extent of the steams condensate pipework was repaired to improve the recovery of the condensate heat (otherwise wasted to leaks). The extent of repairs have not been confirmed.

Cooling is generally localised to buildings but a central absorption cooling chiller is also located in the energy centre that serves a number of the southern buildings.

2.1.2 ELECTRICAL

The existing Trust operated Denmark Hill site ring distribution system operates at 11,000v and delivers energy via two separate distribution ring circuits, (Ring A & Ring B) to a series of 14No remote transformer substations located around the site.

Each substation connected to the HV network serves a large proportion of the Denmark Hill site, with the exception of the Golden Jubilee Wing PFI building, the old Link building and Kings Business Park units 1, 2, 3 and 5, which are served directly via independent DNO supplies.

The existing Ring A distribution circuit currently serves Substations 2A, 7, 8, 9, 6, 10, 1B & 1A. The existing Ring B ring B distribution circuit currently serves Substations 11, 2B, 12, 13 & 16.

An MV interconnector switchboard is provided in the Ruskin Basement where both sides of ring A and B can be coupled together. At this point transformer No.4 can be fed from either ring A or ring B and thus used to assist in the balancing of loads between the two rings. There are no substation No's 3 or 5 as these have been decommissioned. The numbers have deliberately not been used again for new substations in order to avoid any confusion.

There are two transformers in the GJW. These are not included in the total of 14No transformers above. The two transformers in the energy centre generator house are also not including in the total of 14 transformer substations.

A full schedule of the existing MV distribution plant is provided in **Appendix E.**

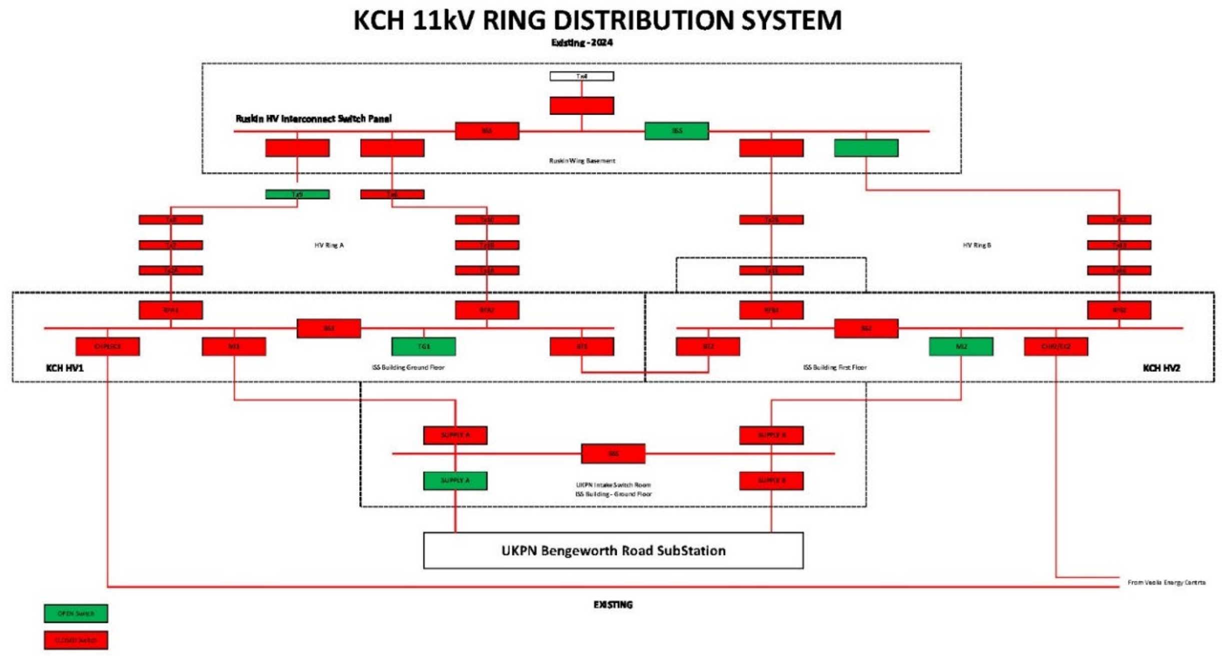

Figure 2-1 – Simplified Existing MV Site Wide Electrical Distribution Arrangement

2.2 UTILITIES

2.2.1 GAS

The incoming gas supply supplies the existing Energy Centre with the 3 no. steam boilers and the 2 no. CHP (combined heat and power) units serving the existing heating energy requirements of the site. Gas supplies are also provided to local plantrooms around the site including Normanby to the north of Bessemer Road. The existing incoming gas meter chamber is located the vicinity of the existing Energy Centre which could be a constraint for the future development of the new LTHW network and will need to be coordinated with new pipework.

2.2.2 FUEL OIL

The existing energy centre and central emergency standby generator system are provided with a significantly underground large bulk fuel oil storage facility, comprising two Bosari type oil tanks, above ground fill points, contents registers/alarm systems and multiple N+N fuel oil distribution pumping and pipework systems to deliver oil to both the energy centre main boilers, emergency standby generators and the Ruskin Wing boiler systems.

The Bosari tanks are large concrete constructed with above ground manhole access. As far as WSP are aware both tanks have been recently refurbished, but only one tank is currently utilised.

Both Bosari tanks are identical and have a maximum capacity of 250,000 litres. However, Tank 2 has an imposed limited capacity of a capacity of just 157,000 litres and is filled to this capacity. Bosari tank 1 is currently empty.

There is also a separate basement located 23,500 litre day tank that currently contains 12,690 litres fuel oil and is believed to have been decommissioned from the supply/delivery system. This has yet to be confirmed.

In addition to the Bosari tanks, each of the three standby generator sets each have a local day service tank with a capacity of 1800 litres.

2.2.3 MAINS WATER SUPPLY

There are several incoming mains water supply connections which provide the site with potable water and serve the fire hydrants. This includes the supply to the steam boilers system in the form of raw water make up to the system.

Majority of this supply from the utilities side, connects with the KCH (customer) site from the North West and North East of the site along Denmark Hill road and Bessemer Road connecting into the site a several points around this perimeter.

2.2.4 ELECTRICITY

The system is served via a dedicated-on site UKPN substation, (Ref 93645) by dual supply feeders from the adjacent UKPN Bengeworth Road MSS. Whilst both supply services to the UKPN on site substation are energised, only one feeder is connected and in operation at any one time to supply the hospital. The outgoing services to the Trust MV intake switch rooms HV1 and HV2 are both live but must not be connected together on the KCH distribution network at the same time. However, a no break transfer from one service to the other is permissible following permission from the UKPN control room. This is to prevent a parallel connection between the two services.

The agreed supply capacity to the Kings College Hospital Denmark Hill site from UKPN is 4MVA at 11000volts.

The UKPN Bengeworth Road facility is located directly adjacent to the hospital's western boundary and in addition now houses a national grid access facility to a key EHV subterranean cable highway.

In the past the Trust have typically generate sufficient electrical energy to supply the site from their Veolia managed energy centre CHP generating system, which is rated at 4.2MVA. Any excess capacity generated being exported back to the grid. The CHP system operates as the primary source of electrical supply together with the UKPN facility which serves to meet any excess demand beyond 4.2MVA or during periods where only partial CHP capacity is available or the entire duty where there is a total CHP generating outage.

Through careful and regular load monitoring and calculation WSP have estimated the current average total site load demand as a little over 4.2MVA. This excludes the Golden Jubilee Building, the Link Building and certain of the Business Park Units, all of which are currently independently served by UKPN. Though some seasonal variations are to be expected these are only anticipated to be very slightly downward during the summer/off heating period. Although no significant site development projects are planned until at least 2027, WSP anticipate that the average electricity load demand could reach as much as 5.4MVA by 2027.

Future load demand profiles taking into consideration the decarbonisation energy demands and all agreed potential site development projects are given in detail in section 3.7 of this report.

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3

Heat Demands

3 HEAT DEMANDS

3.1 EXISTING SITE LOADS

Thermal energy analysis of the site's existing heating loads has been undertaken by Veolia, through a process of targeted steam and LTHW metering. Data provided by Veolia included 8760 heat demand profiles, and a supporting document '*Analysis of Heat and Steam Metering at King's College Hospital - LTHW Heat Model Supporting Document*' which described the process that was undertaken by Veolia to validate the data.

A Sankey diagram showing the metered loads and energy flows through the existing EC heat distribution system was produced by Veolia (below). Note that the figures on the chart represent the daily average loads, rather than absolute peaks.

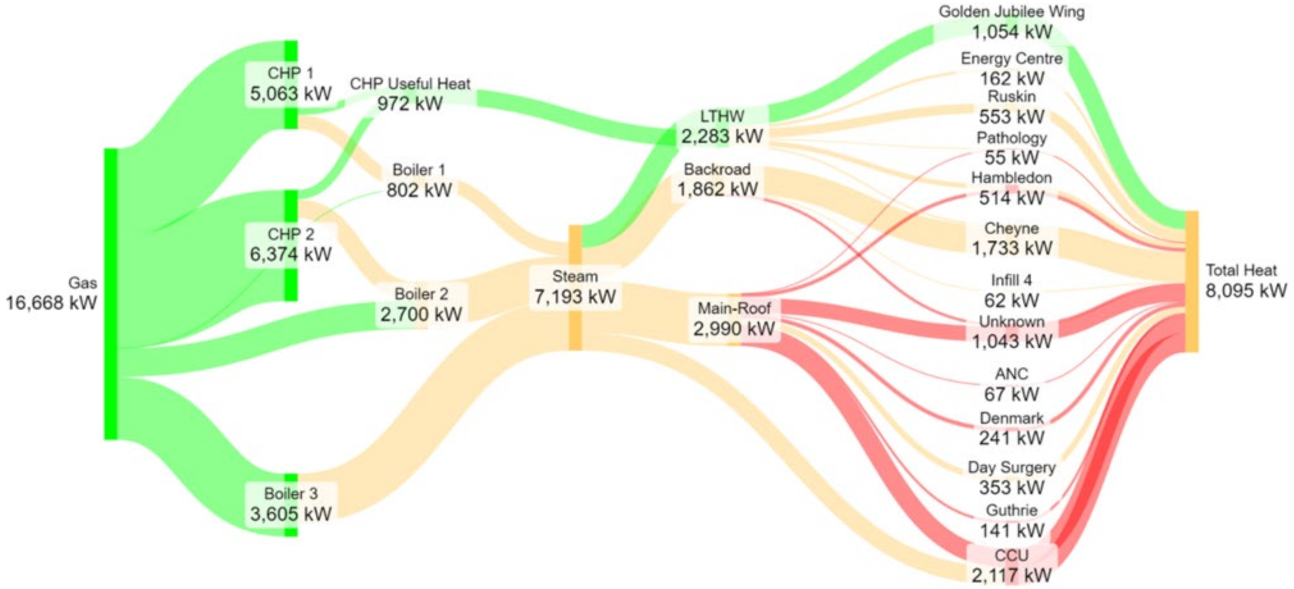


Figure 3-1 – Sankey diagram (Veolia) showing energy flows from the existing energy centre.

Further analysis has been undertaken by WSP, based on the data provided by Veolia, in order to establish parameters for the initial designs of centralised heating plant and associated systems.

3.1.1 WSP HEAT DATA ANALYSIS – EXISTING LOADS

An assessment of the data provided by Veolia is summarised as follows. The aim of this exercise was to understand the heat demand for the existing buildings that would need to be served by a new LTHW system, which would replace the existing steam network (as proposed in Section 4).

Following an initial review of the supplied heat metering data, and discussions with Veolia, it was agreed with the Trust that WSP would base their assessment of the existing EC heat demands on a separate file provided with the model: '*Site Heat Demand Daily Data.xlsx*', which contained half hourly heat demand data for 2023. The data (when converted to hourly figures) is shown in chart form in the following image and suggests a peak demand on the existing EC of approximately 8.3MW and an annual demand of around 37.6GWh.

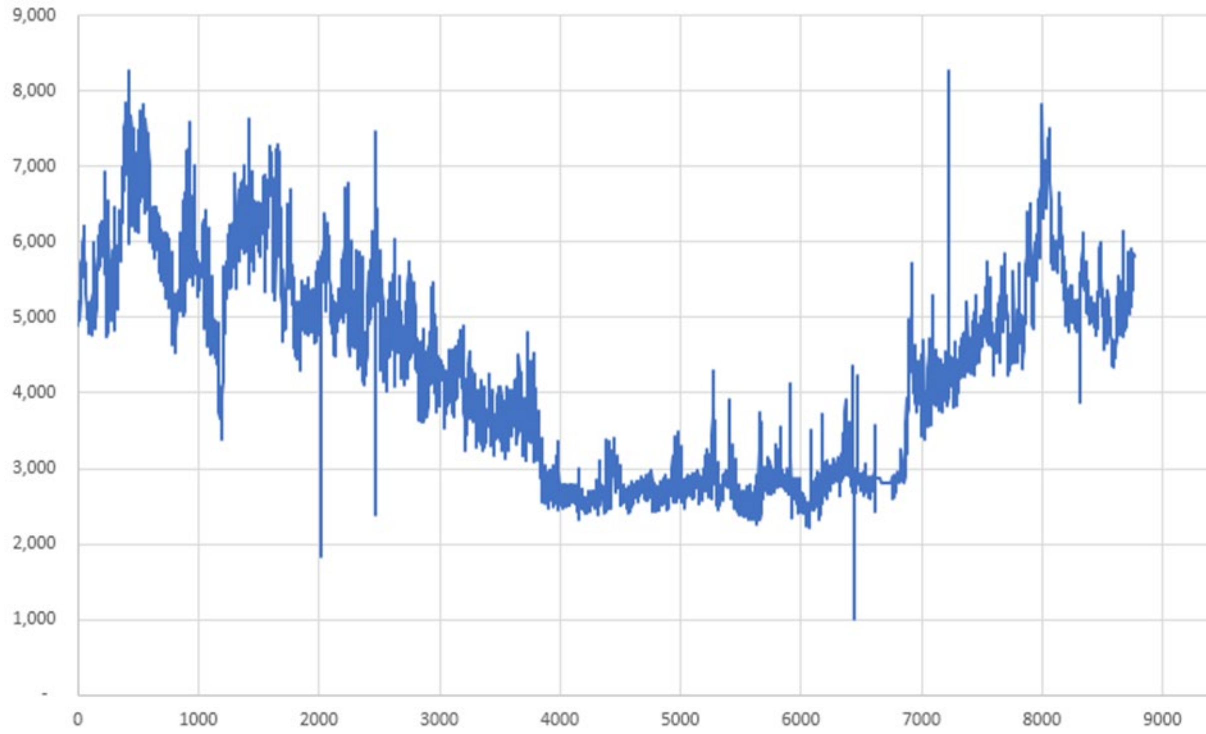


Figure 3-2 – Annual heating profile (hourly data points) from Veolia energy analysis.

Potential outliers, e.g. the spikes visible in the chart above, were reviewed by Veolia and a revised data file ('*Site Heat Demand Daily Data RV.1.xlsx*') was re-issued to WSP on 31st January 2024 for further analysis.

As part of this analysis, further outliers were identified and removed from the profile. One of the outliers identified was due to an anomaly resulting from a half-hour data spike which had been extrapolated to give a full hour data point. The data point was adjusted to reflect an average of the surrounding hourly demands and resulted in the peak demand dropping by around 600kW.

As the data provided by Veolia provided includes heating which would not be a factor in a future LTHW network (e.g. losses related to the steam system and use of autoclaves), further discussions with Veolia and the Trust were held to understand the nature of the loads being served by the existing EC.

3.1.2 ASSESSMENT OF STEAM USAGE AND RELATED LOSSES

An assessment of the steam usage and related losses was required as part of the study as losses that are specific to a steam system would need deducting from the heating load in the instance of a future LTHW system.

The following data was sought from Veolia and the Trust:

- Details of autoclaves currently being served with steam from the existing system; and
- Esight reports which document condensate returns and recovery.

Data requested on autoclaves included the following:

- capacities (kW) and manufacturer/model details;
- number of units;
- hours of operation; and
- annual consumption (kWh).

The reports and data have been interrogated and validated (see Table 3-1) to verify the heating data calculation methodology of the reports to understand the parameters used and any limitations that need accounting for when assessing the system heat losses.

The heating profile data was reviewed with particular focus on peak energy use and where there were significant increases or decreases in load over time and as part of the data cleaning exercise were removed as described in section 3.1.1 above.

Table 3-1 – Validation Exercises

Validation	Comment	Overall Result
Peak Loads Analysis	Analysis and interrogation of heat load to identify points of outliers	There were several extreme outliers which were removed.
Inquisitions with Veolia to establish applied calculation methods	To determine the extent of calculation, Veolia were engaged to establish the calculations methods	The calculation methods adopted would not take into account parameters for precision which would be inherently lost within the margins of inaccuracies of the measuring equipment.
Inconsistent data reporting	Interrogation of data from the reports that may appear as outliers, or fluctuate between negative and positive figures	Instances of reporting percentages of the heating system fluctuated between positive and negative figures and additionally exceeded an expected figure confirmed by steam boiler manufacturers. The former was very minor and assumed a calibration error and the latter a result of upstream plant maintenance down time.

Below is a breakdown of the heat losses of the existing steam heating system that have been calculated from the energy information reports, site surveys and manufacturer advise.

Steam Pipework Distribution Losses

Following site surveys and the development of drawings (see Appendix K) of the existing steam pipework distribution system, the pipework lengths, sizes and fluid volumes were calculated alongside approximations on the condition of lagging to determine heat losses from the distribution system. Table 3-2 tabulated the summary of pipework heat loss. It is assumed that the condensate pipework mirrors the length of the steam.

Table 3-2 – Steam Pipework Losses

Pipework	Heat Loss (kW)
Steam	131
Condensate	53

Calculating the steam heat loss through the pipe distribution system is significant due to the deterioration of pipework lagging over time on an older network and the much larger temperature difference of a steam network to the surroundings compared to a LTHW (low temperature hot water) system resulting in a much higher rate of heat loss to the surrounding environment from the pipework.

Central Steam System Losses

The central steam generation system losses are primarily composed of the energy required to heat up raw incoming water from a relatively low temperature of around 5ºC up to 100ºC. This raw water heat up relates to the steam condensate not being returned to the steam boilers, as opposed to the steam boiler systems routine ‘blowdown’ process to discharge impurities that collect as residue in the boiler system. The losses associated with the raw water heat up process is tabulated in Table 3-3.

Table 3-3 – Peak Steam Raw Water Injection Heat Load

Load	Load (kW)
Average Winter Load	135

This is important to note as such a heat up process will not be required for an LTHW system and needs accounting for to adjust the Veolia heat loads.

Autoclave losses

Part of the steam system connects to 2no. autoclave sterilisation units, other units we have been advised by KCH are connected to their own local heating system. These use steam to sterilise and the used steam/condensate is then drained and constitutes as a heat loss from the system.

Table 3-4 summarises the installed units operations characteristics.

Table 3-4 – Autoclave Duties and Operation Characteristics

Parameter	Data	Comment
No. of units	2	-
Operation period	Day only	10am – 2pm
Cycle duration	Approximately 45 minutes	-
No. of cycle for unit 1	1430	Since Oct 2020
No. of cycles for unit 2	1713	Since Jul 2019
Peak Energy Use	36 kW	-
Average Energy Use	2 kW	-

The summary of heat losses that have been deducted from the Veolia heat demand in relation to the existing steam system have been summarised in Table 3-5.

Table 3-5 – Summary of Steam System Heat Losses

System	Heat Loss (kW)
Steam Raw Water Injection	96
Pipework Distribution	184
Total	280

3.1.3 ASSESSMENT OF PROPOSED LTHW LOADS

The LTHW distribution system will not be without its heat losses too and although less than that of a higher-grade heat steam system, will still need accounting for and adding onto the Veolia heat demands (rather than subtracting). Table 3-6 summarises this addition of heat loss and assumes the same length of pipework, however, pipe sizes will be larger than that of a steam system increasing the surface area of heat loss.

Table 3-6 – LTHW Distribution Heat Loss

System	Loss (kW)
LTHW Flow	91

From the heating systems perspective, the total losses to adjust the Veolia heating demands by a deduction of Table 3-5 and addition of Table 3-6.

3.1.4 DOMESTIC HOT WATER

The domestic water load has been assessed as approximately **2.7MW** determined from the site energy use during the summer periods where there are no space heating loads anticipated.

3.1.5 SUMMARY OF SOUTH ENERGY CENTRE LOADS BUILD UP

The sections previous to this have underpinned the existing recorded loads for the site, the seasonal demand and the energy metering use across the different systems of the site. The table below summarises all the information from the existing site, with the calculations developed to determine the new energy centre plant sizes and capacities after the loss characteristic of each respective system is taken into consideration and applied to a new heat pump and electric boiler system.

From section 3.1.1 the peak heat load is **7.7 MW** which is the figure Table 3-7 will be applying the tabulated adjustments to.

The above load includes for the dental and day surgery loads due to the strategy timeline and discussions found in section 4.2.

Table 3-7 – Summarised Peak Heating Load build up for New LTHW System

System	Original Veolia Load (kW)	Deducted Load (kW)	Additional Load (kW)	Comments
Total Existing Peak Heating Load	7873	-	-	Peak load with anomalous outliers removed

System	Original Veolia Load (kW)	Deducted Load (kW)	Additional Load (kW)	Comments
Steam Heating Raw Injection	-	96	-	-
Steam Distribution Pipe Losses	-	184	-	Steam and condensate distribution
Autoclaves	-	2	-	Average daily load
LTHW Distribution Pipe Losses	-	-	91	Flow and return distribution
Fabric Energy Efficiency	-	0	-	There is potential for improving building energy efficiency, however, this was agreed to be treated as zero as unlikely to be achieved in the short term of the strategy timeline
New LTHW Peak Heat Demand (kW)	**7682**			

3.1.6 EXISTING DENTAL / DAY SURGERY DEMAND

To inform subsequent analysis of heat demands in the future, when the Dental and Day Surgery is proposed to be redeveloped, the current heat demand for the site (which formed a part of the overall site demand represented in the profile described above and in Figure 3-2) was estimated.

Further discussions were held between WSP and Veolia to establish the magnitude and usage patterns for the existing site. The data file '*Dental Building Heat Demand.xlsx*' issued to WSP on 31st January 2024 was primarily used for this assessment.

Analysis by WSP estimated the existing Dental & Day Surgery heat demand at 2.3GWh annual and around 0.5MW peak. An annual hourly profile for the site is indicated in the following image.

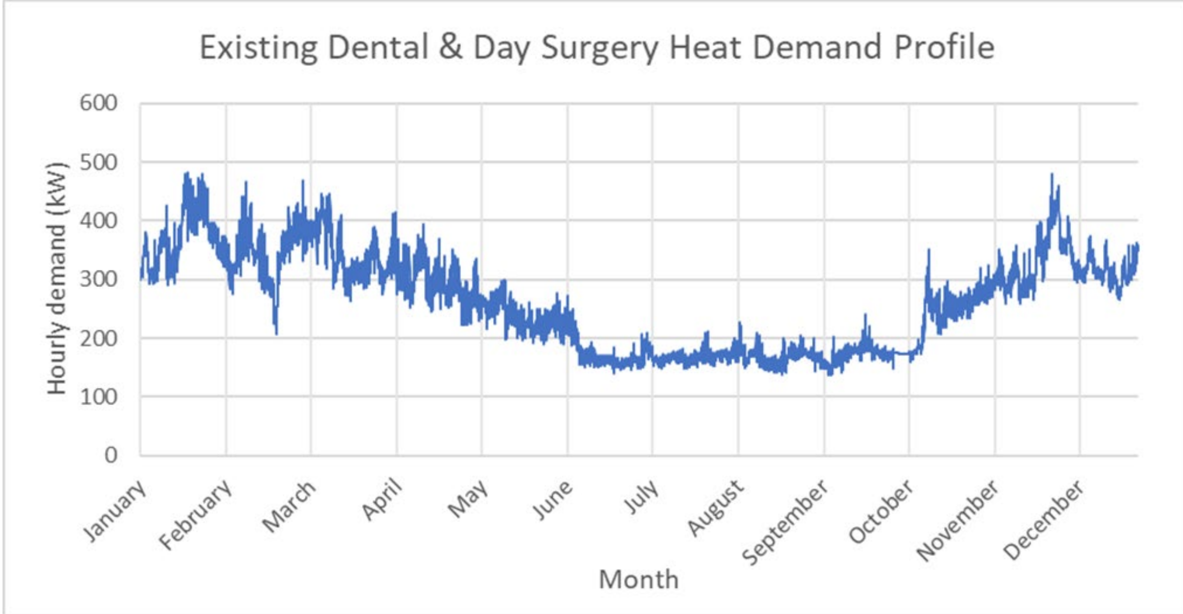


Figure 3-3 – Heat demand profile for existing Dental and Day Surgery.

3.1.7 SUMMARY OF EXISTING EC LOAD PROFILE

Based on the analyses described in the previous text, the following heat demand profile was established. This represents the load on the existing EC, if it were serving the current loads with a LTHW distribution network. This represents a peak heat demand of around 7.7MW and an annual demand of 35.9GWh.

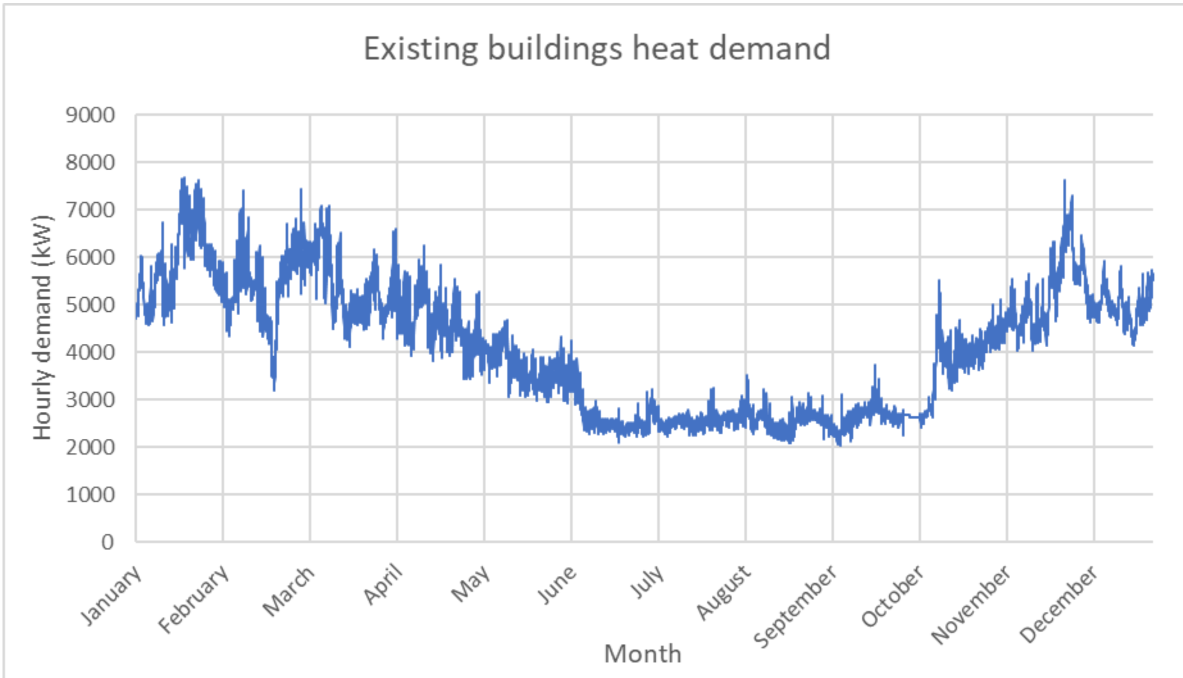


Figure 3-4 – Heat demand profile for all heat loads connected to existing energy centre (assuming a LTHW distribution system).

3.2 NEW DEVELOPMENTS

The annual heat demands for the new developments listed below were estimated using benchmarks for similar building types, i.e. clinical hospitals and offices. The benchmarks defined annual heat demand per unit of internal floor area, in kWh per square metre, for a given future construction year.

Floor areas for each development were established based on information available within the Ryder report and based on estimates for proposed development buildings not covered by the Ryder report.

The KCH Business Unit buildings 1-5 to be redeveloped were assumed to be offices, while the rest of the buildings were assumed to made up of a mix of clinical space, wards and operating theatre space.

The annual hourly 8760 heating demand profiles of the new developments were modelled based on profiles of representative hospital and office buildings, where applicable, and the annual demands calculated from the benchmark figures. The resultant annual demand of all the new developments (as listed in Table 3-8 below) is estimated to be 9.8GWh with a peak demand of 3.9MW.

Table 3-8 – Assumed floor areas and annual heat demands for new developments.

Load Name	Floor Area (m^2)	Assumed Building Primary Use	Annual Demand (MWh)
Pharmacy (Normanby carpark)	660	Clinical	128
Phlebotomy (Normanby carpark)	470	Clinical	91
Willowfield 2	1560	Clinical	321
Haematology - Unit 6 replacement	3100	Clinical	638
Units 7 & 8 replacement	4361	Clinical	790
Link Building replacement	16000	Clinical	3095
Dental replacement	7134	Clinical	1292
Day Surgery replacement	7160	Clinical	1296
Bessemer Wing - 9 Storey replacement	9856	Clinical	1711
Unit 5 (redevelopment to 3 storeys)	1434	Office	94
Unit 4 (redevelopment to 3 storeys)	1536	Office	100
Unit 3 (redevelopment to 3 storeys)	1536	Office	100
Unit 2 (redevelopment to 3 storeys)	1536	Office	100
Unit 1 (redevelopment to 3 storeys)	1343	Office	88

A refurbishment of the existing Bessemer Wing is forecast to take place in 2028. For the purposes of this assessment, any potential change in demand through these works is assumed to be relatively insignificant and has not been calculated. The Bessemer Wing is proposed for demolition and replacement after 2040.

3.2.1 SUMMARY OF NEW DEVELOPMENT HEAT LOADS

The annual demands for the new developments were profiled in order to develop a series of peak demands. Profiles used were based on similar usage types for the developments listed above. The resultant heat demand profile is illustrated in the following image. This represents a peak heat demand of around 3.9MW and an annual demand of 9.8GWh.

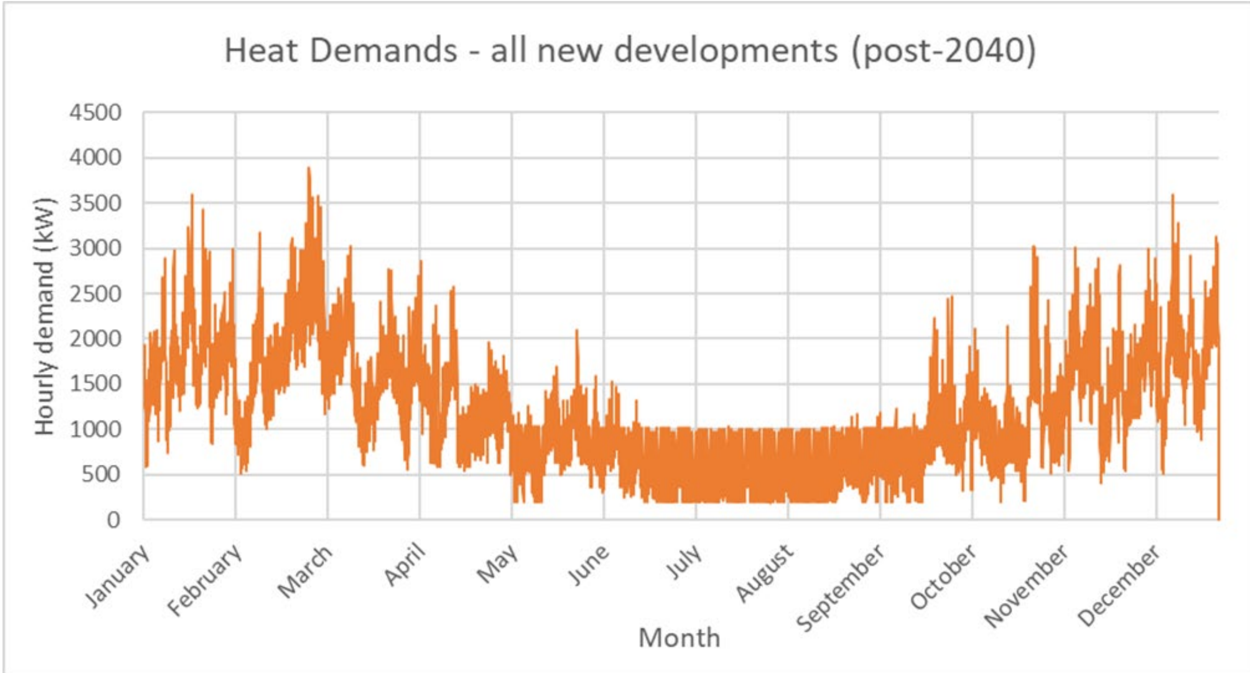


Figure 3-5 – Combined heat demand profile for all new developments.

3.3 SITE DEMAND SUMMARY – FULL BUILD-OUT

Following the completion of all currently proposed development work on the site, after 2040, it is estimated that the total annual heat demand (for buildings within the WSP scope) will be approximately 43.4GWh, with a peak load of around 10.5MW. This represents the summation of the heat demands from all the new developments and the existing buildings and subtracting the demand from the existing Dental & Day Surgery (which will be replaced with a new development).

Potential reduction in heat demand for existing buildings, which might come about from works to improve fabric performance or reduce infiltration has not been factored into the assessment of future loads. This is something that should be explored in later stages of the design when developing a more accurate heat demand assessment.

Table 3-9 – Summary of Site Energy Demands.

	Peak Demand (MW)	Annual Demand (GWh)
Existing EC demand	7.7	35.9
Existing Dental & Day Surgery demand	0.5	2.3
All new developments total demand (post-2040)	3.9	9.8
Total demand, full site (post-2040)	10.5	43.4

The resultant heat demand profile for the whole site, when fully built out, is illustrated in the following image. This represents a peak heat demand of around 10.5MW and an annual demand of 43.4GWh.

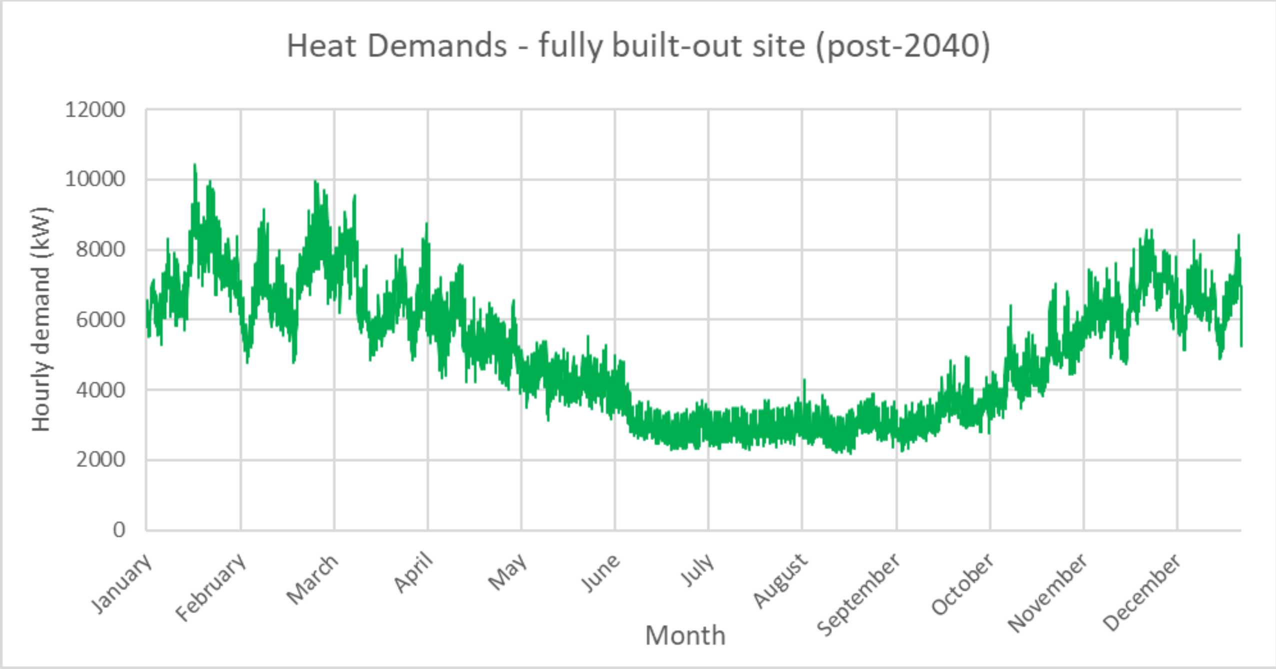


Figure 3-6 – Combined heat demand profile for full site in 2040

4

Heat Provision Strategy and Plant Options

4 HEAT PROVISION STRATEGY AND PLANT OPTIONS

4.1 HEAT DECARBONISATION PLAN (2023)

As part of the Heat Decarbonisation Plan (HDP) produced by Mott MacDonald in 2023 for the Kings College Hospital estate, proposals were developed for the provision of heat across the Denmark Hill site.

In summary, the proposals were as follows:

<u>Centralised LTHW Network and Link Building Energy Centre</u>

A centralised LTHW network (to replace the existing steam network) served from a 2-stage high temperature heat pump system located in a new EC within the redeveloped Link Building. It was proposed that all the buildings that are currently connected to the existing Energy Centre would be connected into this new LTHW system. Plant within the new EC would include roof mounted ASHPs with WSHPs within the internal plant space. Existing dual-fuel boilers were proposed to be retained for back-up and resilience. This new LTHW EC was the focus of Mott MacDonald's *Denmark Hill Energy Centre Feasibility Study*, which formed one of their HDP work packages.

<u>Ambient Heat Network</u>

It was proposed by Mott MacDonald in their HDP that the following buildings would be served by a centralised ambient loop network:

- Day Surgery;
- Neuroscience Offices;
- Normanby Building; and
- Lloyds Pharmacy.

The plant supporting this ambient network, was proposed to be located in the redevelopment of the Day Surgery/Dental Institute buildings.

Buildings which are currently not connected to the existing EC but which are to be retained (Caldecott Centre, Camberwell Building, Jennie Lee House, Units 1 KCH Business Park and Venetian Outpatients) were proposed to be served by local (de-centralised) 2-stage high temperature heat pump systems.

Other buildings, which are due to redeveloped (Faraday Building and Units 5,6,7,8 KCH Business Park) were proposed to be served by local (de-centralised) single-stage high temperature heat pump systems.

4.2 HEAT PROVISION STRATEGY

A heat provision strategy has been developed by WSP based on proposals in the Mott MacDonald and in line with the agreed redevelopment sequence described in Section 1.5 of this report.

A proposed timeline for how the site will be provided with heat is included in the following figure.

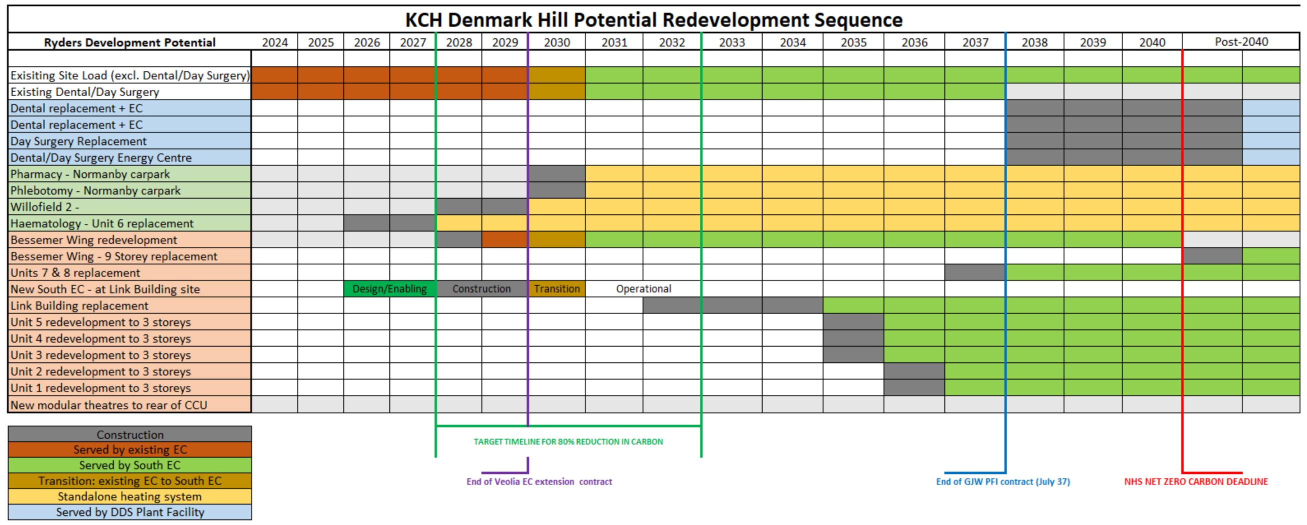


Figure 4-1 – Proposed strategy and timeline for provision of heat to the site.

In summary:

- A new South Energy Centre shall be developed to serve the bulk of the site's future heat loads (via a new LTHW network);
- The existing Energy Centre and associated plant shall cease operation at the end of 2030, following a 1-year transition period which is recommended to ensure a smooth changeover between the existing and new ECs. This will require a further extension to the proposed Veolia contract extension and a review of existing plant life/condition;
- New developments to the north of Bessemer Road shall be heated by their own independent heating systems; and
- The future Dental/Day Surgery (DDS) development shall be provided with heat from its own stand-alone plant facility.

The proposed approach to providing heat to the different areas of the site is illustrated in the following image, which has been based on a layout from the Ryder report.

Figure 4-2 – Illustrative layout showing proposed approach to provision of heat.

Further detail on these proposals for heat provision to the site are provided in the following sub-sections.

4.2.1 SOUTH ENERGY CENTRE

A new Energy Centre, located in the Link Building redevelopment, is proposed to connect into a new LTHW distribution system. Primary plant within the EC would include high-temperature (maximum generation temperature of 85°C) and electrical resistance boilers. This system would serve the majority of the site's heat demand; that is, all loads currently connected to the existing EC, plus the following developments:

- Units 1 to 5;
- Units 7 and 8;
- Link Building replacement; and
- Bessemer Wing (9 storey replacement, proposed post-2040).

Based on analysis undertaken as described in Section 3, the estimated peak load on the South EC (which would occur post-2040) is around 9.4MW. The annual heat demand profile developed is shown in the figure below.

Figure 4-3 – Heat demand profile for new South EC site in 2040.

A description of the proposal for the new South Energy Centre is provided in Section 6.

4.2.2 SOUTH EC HEAT DISTRIBUTION

The South EC heat distribution system will consist of new LTHW pipework ultimately replacing the existing steam distribution routes. This distribution due to the lower temperatures to that of the steam system, the proposed pipework will be up to 300mm in diameter for the main runs of the distribution network requiring installation space of a similar magnitude to accommodate. The proposed layouts can be found in Appendix K.

Further to the installation space required for that of the LTHW system, this distribution will require laying in unison with the steam distribution system for an overlap period whilst heating systems are switched over as illustrated in Figure 4-1.

4.2.3 LOCAL HEATING SYSTEMS

The following loads are proposed to be served by stand-alone (de-centralised) heating systems:

- Pharmacy (Normanby carpark);
- Phlebotomy (Normanby carpark);

- Willowfield 2; and
- Haematology - Unit 6 replacement.

Due to the perceived difficulties in routing LTHW pipework across the site and, in particular, across Bessemer Road, it is not proposed that these developments be served from the new South EC.

The timelines presented elsewhere in this report do not permit the construction of an energy centre to the north of Bessemer Road in time to serve these developments.

The Haematology development is understood to be designed already to operate with a stand-alone heating system.

4.2.4 DENTAL / DAY SURGERY PLANT FACILITY

Following the agreement of the outline redevelopment sequence (ref. Section 1.5) it became apparent that the ambient loop proposed by Mott MacDonald would not work with the proposed timelines as there would be no space available to house the required centralised plant space. Mott MacDonald had proposed that the centralised plant would be housed in the redevelopment of the Dental / Day Surgery (DDS), however the proposed sequence has this due for completion after 2040, much later than the other developments.

Other challenges relating to the development of an ambient network are as follows:

- The site is very congested with existing buried and above-ground services, making development of a pipe network more difficult.
- Ambient networks work best when there is a good balance between heating and cooling loads, as heat rejected from the cooling process can be captured in the network and distributed to where it is needed for heating purposes. The cooling loads for the KCH buildings outside of summer months are expected to be relatively low, thus offering minimal opportunities for heat recovery.
- Space for Water Source Heat Pumps (WSHP) and network connections would need to be safeguarded in buildings that are proposed for connection to an ambient network, and an outline strategy in place for how to change over from a standalone heating system to a networked system.

It is therefore proposed that the Dental / Day Surgery redevelopment stands alone from the rest of the site and is served by its own centralised plant facility. The building and its heating systems should be designed to permit a standard ASHP system (using conventional refrigerants), generating at more efficient lower temperatures, as opposed to the high temperature system proposed for the South EC.

The demand profile developed for the new DDS plant facility, based on analysis described in Section 3, is illustrated in the following figure. This shows a peak demand of around 980kW and an annual heat demand of around 2.6GWh.

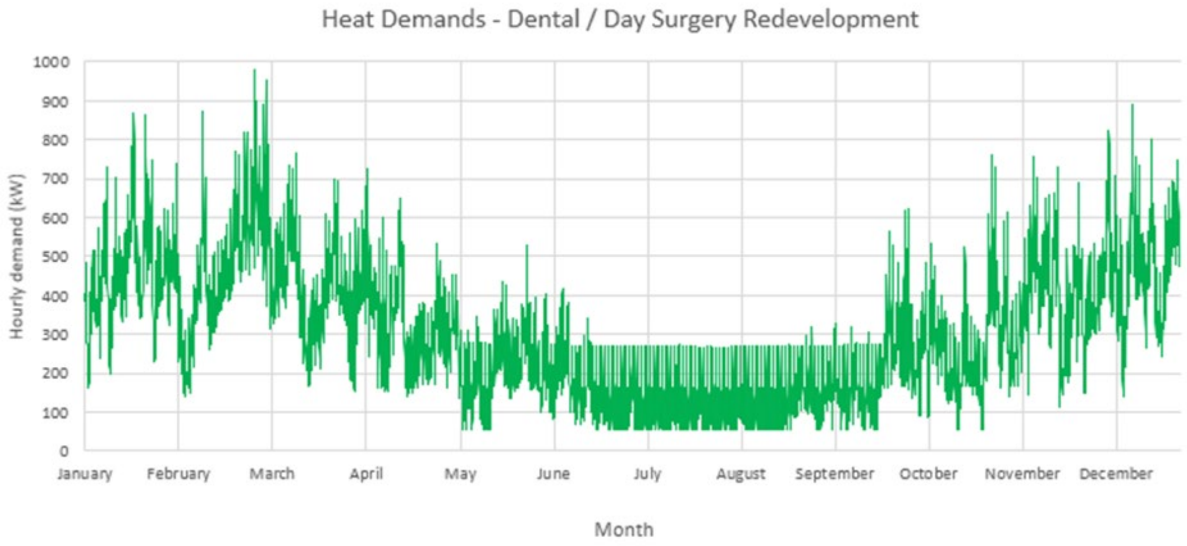


Figure 4-4 – Heat demand profile for new DDS Plant Facility.

4.3 TECHNOLOGY OPTIONS

The following text covers the technologies that have been considered to provide a resilient heat supply to the site.

4.3.1 AIR SOURCE HEAT PUMPS

Air Source Heat Pump (ASHP) systems use ambient air as the source of low-grade heat. Although ambient air might be considered an almost unlimited resource, temperatures can vary significantly throughout the year causing associated variations in ASHP efficiency.

In order to access the ambient resource, ASHPs or their de-coupled fan units are typically installed externally, often on roofs. This may result in a need for screening to reduce visibility and attenuation of fan noise.

The proposed distribution temperatures for the new LTHW distribution network are relatively high for heat pump technology and limit the options for plant selections. At these temperatures, heat pumps will likely need to employ refrigerants based on either hydrocarbons or ammonia.

Efficiency of the heat pumps at such high temperatures will be relatively low. Data provided through correspondence with heat pump suppliers would suggest that, operating with the proposed flow/return temperatures and at an ambient temperature of +5°C, a hydrocarbon ASHP system would have a Coefficient of Performance (CoP) of around 2.14, whereas an ammonia system would perform slightly better than this, with a CoP of 2.45. At an ambient temperature of -5°C, these CoPs would drop to 1.95 and 2.23, respectively.

Both refrigerant types have issues, such as flammability and toxicity, which need to be carefully considered, however, for the purposes of this study, it is proposed that two-stage hydrocarbon heat pumps are to be utilised.

4.3.2 ELECTRIC BOILERS

Direct electric boilers typically work on the principle of electric resistive heating, and as such are less efficient than heat pumps, with an effective Coefficient of Performance (COP) of approximately 1 (compared with heat pumps which may have COPs ranging from 2 to 4).

Capital costs and maintenance costs for electric boilers are typically a lot lower than that for heat pumps, due the relative simplicity of the plant.

Electric boilers are increasingly being considered for this peaking plant on decarbonisation schemes due to the lower emissions when compared with gas boilers, however this approach is likely to result in higher energy costs and a need for upgrades to existing electrical infrastructure (e.g. transformers, switchboards and DNO connection capacities) due to the increased peak electrical supply requirements.

4.3.3 THERMAL STORAGE

Although not a technology that generates heat, the inclusion of thermal storage can reduce peak demands on other plant which can mean smaller capacity units and, for electrically powered plant, lower peaks on power input. Thermal storage can also improve overall system effectiveness by reducing cycling of heat generation plant and improving lifecycle.

Thermal storage requires effective temperature stratification, and so vessels are often relatively tall. Typical limitations on provision of thermal storage often relate to space availability and height, particularly for externally sited vessels where visual impact is an issue.

4.4 PRELIMINARY PLANT CONFIGURATION ASSESSMENT

To inform subsequent plant sizing activities, an assessment was undertaken to understand the approximate ratio of plant required to effectively and efficiently provide low-carbon heat to the site. This involved energy modelling using the full site demand profile and running several iterations with different plant options and capacities:

- ASHPs;
- Electric boilers; and
- Thermal storage.

The modelling was based on the full site future built out demand (10.5MW peak, refer earlier section of report) to provide an indication of the upper bound of energy centre requirements.

Plant selections were made based on correspondence and discussion with plant suppliers. For the purposes of this assessment, it was assumed that the main heat generation would be provided by ASHP units with 1150kW capacity.

The modelling results suggests that 90% of the total heat demand could be met with the ASHPs, and the remaining 10% from electric boilers.

The assessment undertaken as described above has informed the following approach to plant capacity sizing and the configuration options taken forward in the rest of this study:

- Capacity of ASHPs, to be sized at 55% of demand peak; and
- Capacity of electric boilers, to be sized at 45% of demand peak.

5

Electrical Supply and Distribution Infrastructure

5 ELECTRICAL SUPPLY AND DISTRIBUTION

5.1 ELECTRICAL DISTRIBUTION ARCHITECTURE AND PLANT

In order to serve the increased electrical energy demands of the heat network decarbonisation and the gradual redevelopment of the Denmark Hill site, significant electrical supply and distribution infrastructure changes shall be required.

The existing site electrical distribution infrastructure receives a dual DNO supply from UKPN at a medium voltage pressure of 11kV and with an agreed supply capacity of 4MVA. The distribution architecture comprises two 11kV ring circuits serving 14No individual transformer substations of vary ages and condition.

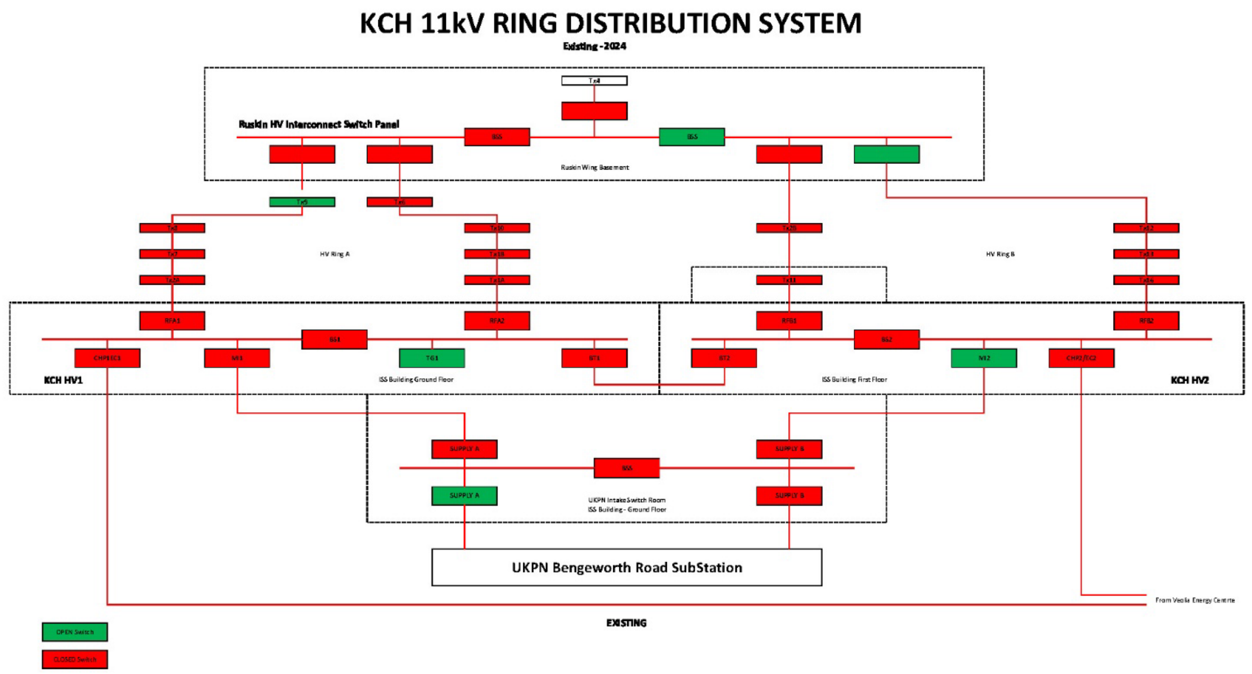


Figure 5-1 – Existing, (Simplified) MV Site Wide Electrical Distribution Architecture

Whilst this existing electrical distribution infrastructure plant will suffice in its current configuration for the short term to deliver electrical energy to the site, WSP's recent load monitoring exercise has identified that the overall load is now beginning to outgrow the existing CHP electrical generation capacity, (4.2MVA) and the UKPN agreed supply capacity which is currently set at 4MVA.

To recap; during normal operating conditions, (CHP system fully operational and UKPN supply healthy/available) the existing energy centre CHP system serves the Denmark Hill site electrical load requirement, with the UKPN supply making up any peak demand above the CHP capacity of 4.2MVA. Should the CHP partially or completely fail the UKPN supply will serve the site load demand. The existing UKPN site supply plant is understood to have a capacity of 7.6MVA at a pressure of 11kV. This has yet to be confirmed by UKPN.

Should there be a total CHP outage and for a load demand of up to 4MVA there should be no additional tariff charges levied by the Trust's electricity supplier. Should the site load demand exceed 4MVA, the supplier maybe at liberty to levy an excess demand charge. WSP are not aware of the actual contractual and fiscal arrangements currently in place.

5.2 EXISTING SYSTEM LOAD MONITORING

In order to understand the existing site load demand WSP undertook regular load monitoring of the main MV electrical distribution infrastructure over the period between the 15th of November 2023 and the 2nd February, 2024. This was achieved through weekly reading/recording of system loads at the four main meters, (Janitza UMG512's) on the Trust's HV1 and HV2 ring circuit supply feeder switches – RFA1, RFA2, RFB1 and RFB2.

5.3 FUTURE LOAD INCREASES AND IMPLEMENTATION TIMELINES

WSP have compiled a detail estimated electrical power demand load profile based on the following parameters:-

- Known existing site distribution infrastructure load demands;
- Anticipated existing load creep, (per annum);
- Anticipated existing building and infrastructure decommissioning;
- Gradual heat generating plant decarbonisation/electrification requirements; and
- Future site redevelopment and new building development plans.

The individual new development demands are estimated based on industry best practice allowances for the expected healthcare building types of the scale/anticipated size as outlined in the Ryders DCP document or otherwise agreed with the Trust These developments and their targeted construction windows are set out in the following sequence schedule, agreed with the Trust estates team, a larger version of which can be found in **Appendix G.**

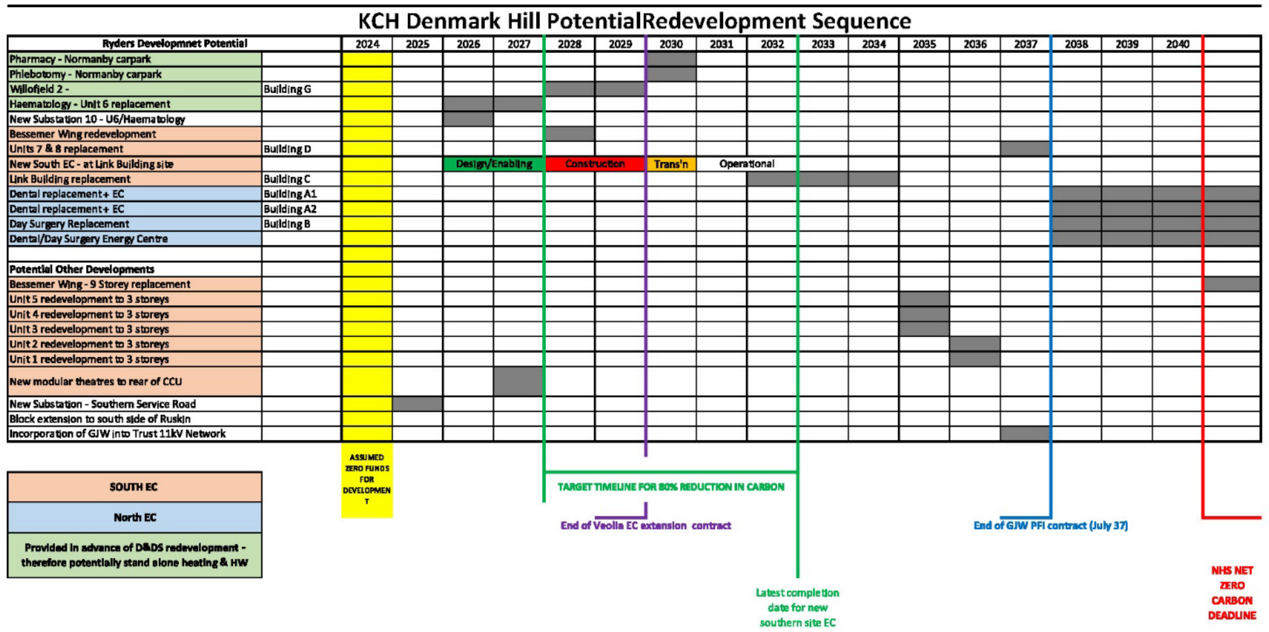


Figure 5-2 – Proposed Building Development Scale & Sequence

As can be seen from the above the heat decarbonisation and site redevelopment is anticipated to be undertaken over an extended period up to 2040, at which point central Government/NHS has mandated that the UK healthcare estate should be fully Net Carbon Zero. Between now and 2040 there is an ambition to achieve significant carbon savings with an overall saving of 80% to be achieved by 2032. This interim 80% saving can only be realistically achieved through replacement of the existing fossil fuel-based energy centre with a fully electrified alternative. However, it should be noted that even with a fully electrified energy centre, true carbon savings would only be possible if the electricity supply grid itself were fully carbon neutral and operating on power generated via fully sustainable and carbon neutral means.

It should be noted that the above schedule and development scales are notional at this stage and likely to change as the development masterplan is agreed in line with any clinical master planning adopted by the Kings Healthcare Partners teams. At this stage the following key development sequence has been identified and agreed with the Trust estates team.

1. Southern Service Road new Substation 19 for KCL funded imaging.
2. Business Park Unit 6 replacement with new Haematology Building and substation 10.
3. New Modular Theatres south of CCU building.
4. Normanby site, new Willowfield 2 new building and existing Bessemer Wing refurbishment.
5. Normanby site, new Pharmacy and Phlebotomy buildings.
6. New South Energy Centre construction and new Link building shell/core construction.
7. New Link building over new energy centre – fit out.
8. Business Park Units 3 – 5 redevelopments.
9. Business Park Units 1 & 2 redevelopment.
10. Business Park Units 7 & 8 replacement – new clinical building.
11. Dental & Day Surgery Wing new clinical building development.
12. Existing Bessemer Wing replacement – new clinical building.

These developments shall see the load demand increasing gradually over the period up to 2040. However, there will be some significant jumps in load demand as particular developments are brought online and where both significant supply and electrical distribution infrastructure upgrades and capital investment will be required.

In order to identify these significant milestones and in particular where increases to the site electrical supply and changes to the supply configuration are required, WSP have compiled the following outline load demand profile, (Figure 5-3) for the period up to 2040. This profile incorporates the existing network loads, their anticipated annual growth, existing loads to be decommissioned and estimates of all future new individual building and site development load demands. A larger version of this spread sheet is given in **Appendix C**.

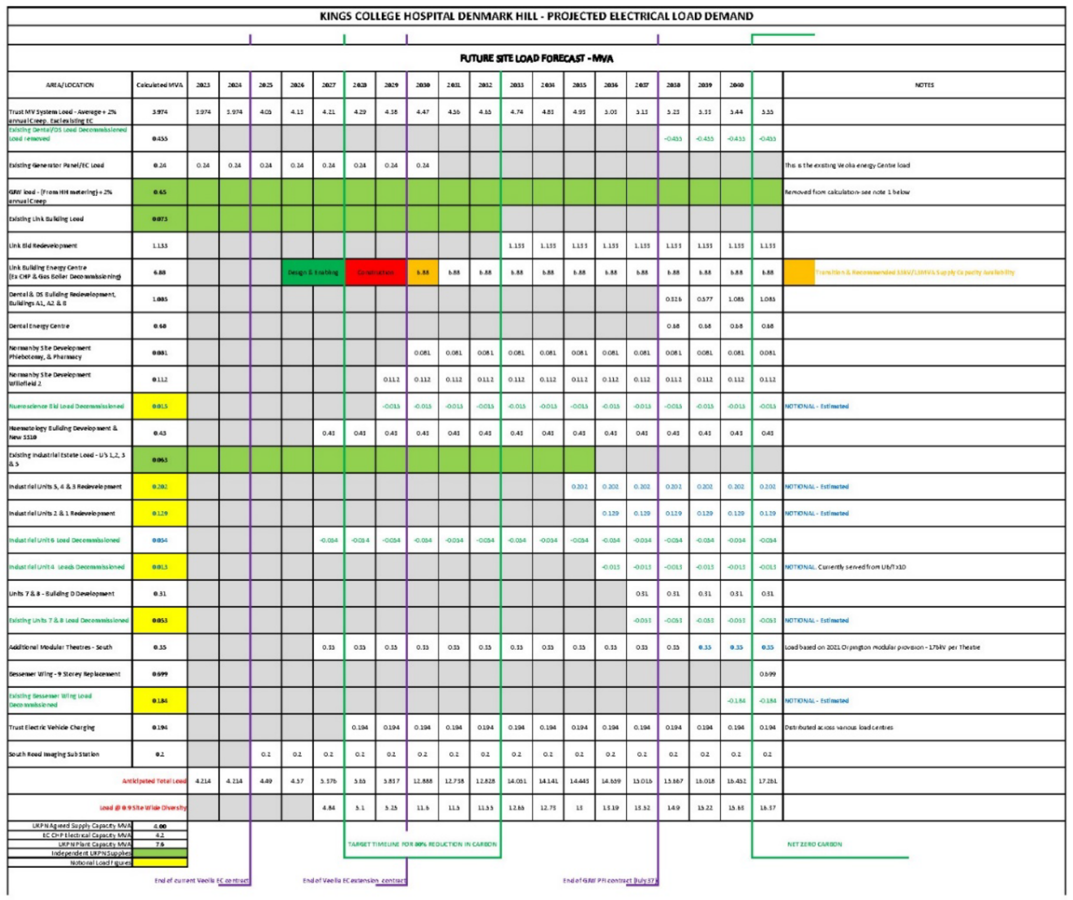


Figure 5-3 – Outline Load Demand Profile

WSP load monitoring and subsequent load profiling have clearly identified that the average load demand for the site is now exceeding both the CHP electrical power generation capacity, (4.2MVA) and the utility site supply capacity of 4MVA by a small margin. As a result of this profiling study WSP would recommend the following agreed supply capacity increases in order to cover for a total CHP power generation outage and safeguard sufficient capacity availability.

Increase Quantum	Required For	Reason	Proposed New agreed Supply Capacity
1MVA	Now 2024	Existing demand exceeds agreed supply capacity	5MVA
1MVA	2027	CRF Imaging growth New Haematology New modular Theatres Normanby site Willowfield 2, Pharmacy & Phlebotomy	6MVA
7MVA	2029-2030	New South Energy Centre	13MVA
1MVA	2033	New Link Building Development	14MVA
1MVA	2035	Business Park Redevelopment Units 1-8	15MVA
2MVA	2038	Dental & Day Surgery Redevelopment	17MVA
2MVA	2040-41	Bessemer Wing Redevelopment	19MVA

Figure 5-4 – Proposed Load Capacity Increase Timeline

The above supply capacity increase agreements are proposed to be in place at the commencement of the individual development projects.

5.4 ELECTRICAL DISTRIBUTION INFRASTRUCTURE & UPGRADED DNO SUPPLY CONFIGURATION.

In order to meet the individual development and decarbonisation power demands, new electrical distribution infrastructure facilities will need to be provided, including new transformer substations, associated low voltage distribution switchgear and standby power generating capacity. In addition, as a necessity to enable the new decarbonised, "all electric" south energy centre to be developed, a major upgrade in the utility supply to the site, including the provision of new onsite supply plant and feeder cable installation will be necessary, operating at a pressure of 33kV and with transformers to step this down to a distribution pressure of 11kV for supply to the Trust. It is envisaged at this stage that bulk electrical energy metering would be recorded at the new 33kV service.

The following sequence of electrical infrastructure development provisions are envisaged to serve needs of the site development proposals and outline sequence agreed with the Trust estates team. A larger version of this is given in **Appendix G**.

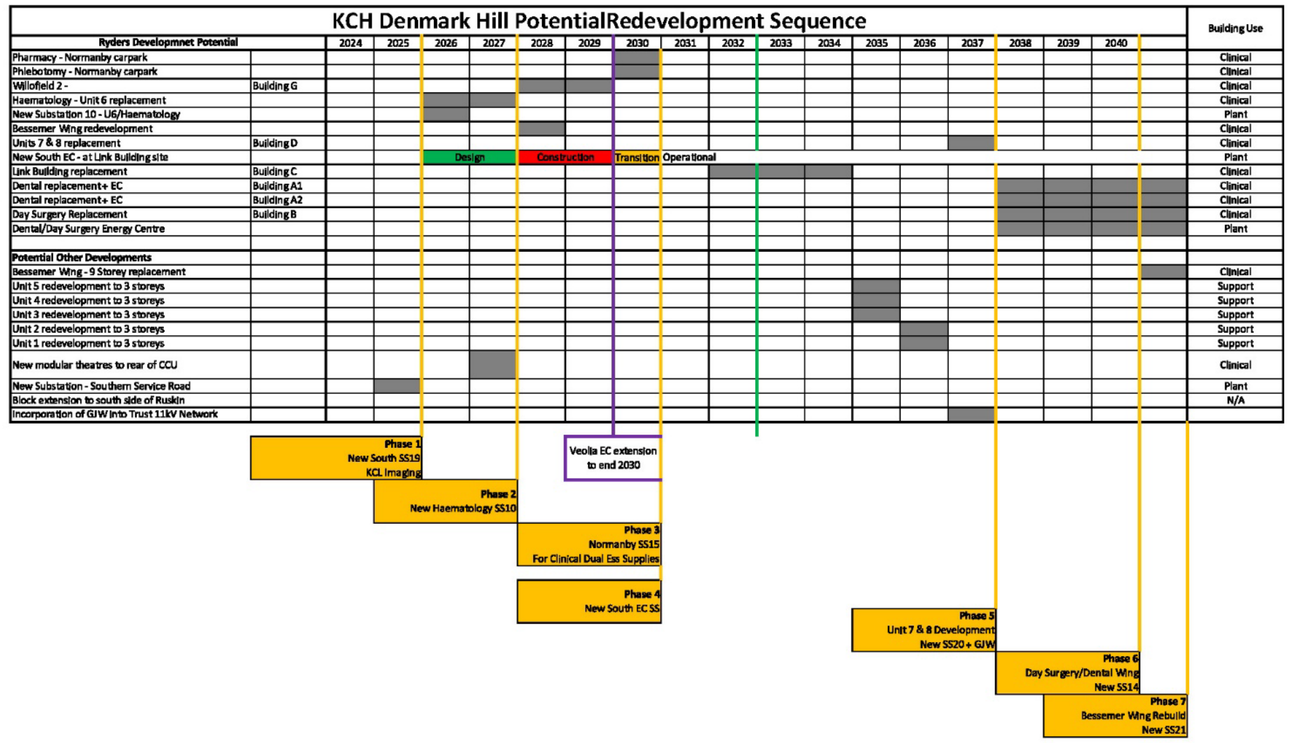


Figure 5-5 – Outline Development & Programme Sequence

Phase 1: New South Substation for KCL Funded CRF Imaging Requirements (Tx19)

New substation development on the south access road to the rear of Cheyne Wing Infill Block 3, to provide service to new KCL funded CRF imaging facilities.

Substation to comprise new outdoor 1.5MVA Midol oil filled (KNAN) transformer and close coupled MV gas filled (SF6) ring main unit in a purpose built oil containing compound, complete with remote operation capability and a separate containerised, weather proof automated two section, (essential/Non-essential) Form 4/Type 6 low voltage distribution switch panel, complete with bus section switch, LV interconnector facility with future new Bessemer Wing substation and remote generator connectivity.

To be connected onto existing MV Ring B, RFB1 feeder leg.

Facility required to be operational before end of 2025.

Phase 2: New Haematology Building/Substation 10 Replacement

New substation development to replace the existing substation to the rear, (east) of Business Park Unit 6 as part of the new Haematology building development. This substation has been fully designed by WSP as a standalone construction project and to enable the later follow-on construction of the new Haematology building.

Substation to comprise new indoor 1.5MVA Midol oil filled (KNAN) transformer and close coupled MV gas filled (SF6) ring main unit in a purpose-built oil containing and naturally ventilated chamber, complete with remote operation capability and a separate automated two section, (essential/Non-essential) Form 4/Type 6 low voltage distribution switch panel, complete with LV interconnector facility with existing substations 1A and 11 LV switch panels and remote generator connectivity. Diesel generator set to be located on the roof of the adjoining new Haematology building.

To be connected onto existing MV Ring A, RFA2 feeder leg.

Facility required to be operational prior to end of 2027.

Phase 3: Normanby Site Development New Substation (Tx15)

New substation development, to be provided on the west side of the Normanby site carpark to enable secondary/resilient supplies to be provided to serve new clinical building developments, (Willowfield 2, Pharmacy & Phlebotomy) on the Normanby site complex.

Substation to comprise new outdoor 1.5MVA Midol oil filled (KNAN) transformer and close coupled MV gas filled (SF6) ring main unit in a purpose-built oil containing compound, complete with remote operation capability and a separate weatherproof containerised automated two section, (essential/Non-essential) Form 4/Type 6 low voltage distribution switch panel, complete with bus section switch, LV interconnectors with existing Normanby NE switch panel and remote generator connectivity.

To be connected onto existing MV Ring B, RFB2 feeder leg.

Facility required to be operational before end of 2030.

Phase 4: New South Energy Centre & Link Building Development

The new Link building/south energy centre development shall be provided complete with a stand-alone resilient electrical distribution architecture comprising new utility supply incomers from UKPN at 11kV serving primary vacuum type switch panels, individual power transformer/LV switch panel systems to serve the mechanical and building systems and a dedicated N + 1 MV (11kV) diesel driven standby power generation system, located across the ground floor and basement of the new Link building development. In addition to serving the energy centre requirements the primary distribution switchgear shall also re-supply the existing site distribution network HV1 and HV2 distribution switchgear systems.

All new LV switchgear would be purpose built modular Form 4/Type 6 pattern, fully automated, utilising functional components from the Schneider Group and located in dedicated LV switch rooms.

The new energy centre/link building development shall result in a significant increase in the site energy demand, beyond what can be provided from the existing UKPN supply and site distribution plant. Prior to completion of this development a new and increased supply will be necessary to serve the site at 33kV rather than the existing 11kV. New UKPN plant including two new 33:11kV power transformers and a new dedicated 11kV supply distribution switch panel will need to be established on site. The final design and configuration for this plant is the subject of further ongoing discussion and agreement with UKPN.

Provision of the new energy centre is necessary in order to meet the mandated 2032 80% carbon reduction deadline.

The new energy centre is realistically required to be completed and operational in advance of 2032 and potentially as early as the end of 2029, when the proposed existing energy centre operating contract extension is due to terminate. At this point the existing CHP and boiler plant will be 21 years old. As WSP understand it, the existing CHP machines have already undergone one major mechanical refurbishment and a further inclusive refurbishment may not be financially tenable for the short term. WSP are therefore proposing that the new energy centre be available for transition of services and commencement of operation for the end of 2029, allowing for transitions to be completed over a year long period up to the end of 2030.

The new 33kV power supply infrastructure would therefore need to be in place and fully operational for this purpose at the end of 2029/commencement of 2030. The existing energy centre boiler plant would require to continue in operation throughout the transition period. The CHP plant could be decommissioned as soon as reasonably practicable.

Phase 5: Business Units 7 & 8 Replacement New Substation (Tx20)

New substation development to be provided integrally as part of the Business Unit 7 & 8 replacement with a new clinical building development.

Substation to comprise new indoor 1.5MVA Midol oil filled (KNAN) transformer and close coupled MV gas filled (SF6) ring main unit in a purpose-built oil containing and naturally ventilated chamber, complete with remote operation capability and a separate automated two section, (essential/Non-essential) Form 4/Type 6 low voltage distribution switch panel, complete with LV interconnector facility with existing substation 1A and remote generator connectivity.

To be connected onto existing MV Ring B, RFB2 feeder leg.

Facility required to be operational before end of 2037.

Phase 6: Dental Wing & Day Surgery New Substation (Tx14)

New substation development to be provided integrally as part of the Dental Wing & Day Surgery building replacement with a new multi-storey clinical building development.

Substation to comprise new indoor 1.5MVA Midol oil filled (KNAN) transformer and close coupled MV gas filled (SF6) ring main unit in a purpose-built oil containing and naturally ventilated chamber, complete with remote operation capability and a separate automated two section, (essential/Non-essential) Form 4/Type 6 low voltage distribution switch panel, complete with LV interconnector facility with existing Dental Wing substation and remote generator connectivity.

To be connected onto existing MV Ring B, RFB2 feeder leg.

Facility required to be operational before end of 2040.

Phase 7: Bessemer Wing Replacement New Substation (Tx21)

New substation development to be provided integrally as part of the Bessemer Wing replacement with a new clinical building development.

Substation to comprise new indoor 1.5MVA Midol oil filled (KNAN) transformer and close coupled MV gas filled (SF6) ring main unit in a purpose-built roof mounted oil containing and naturally ventilated chamber, complete with remote operation capability and a separate automated two section, (essential/Non-essential) Form 4/Type 6 low voltage distribution switch panel, complete with LV interconnector facility with new substation 19 and remote generator connectivity.

To be connected onto existing MV Ring B, RFB1 feeder leg.

Expected to be required post 2040.

Golden Jubilee Wing Electrical Infrastructure Incorporation, (Phase 5B)

The existing Golden Jubilee Wing is a PFI owned and operated building, currently managed by Sodexo on behalf of the Trust. The GJW is a clinical building complex and is currently supplied electrical power from two on site EDF substations at Basement level, via a UKPN 11kV ring interconnected service from Bessemer Road. The GJW building supply and distribution system is configured as a 2N arrangement comprising two separate 11kV/400v 1250kVA KNAN power transformers sharing the total building electrical demand, where one transformer is capable of serving the entire load in the event of a single transformer outage. In addition, the building benefits from a dedicated N+1 standby Diesel generator back-up supply system comprising two 800kVA LV/50Hz mains synchronising generating sets.

The existing agreed supply capacity for the GJW is 1.3MVA and the current average electrical power demand is in the order of 650kVA. Allowing for a year-on-year growth of 2%, WSP anticipate that this demand could grow to 900kVA+ by the year 2040.

There has been a past aspiration of the Trust to incorporate the GJW into the Trust's own site wide MV electrical distribution infrastructure, primarily to ensure a greater level of control/resilience and that energy used in the building would be purchased by the Trust from their preferred energy supplier at agreed/preferential tariff rates. WSP have previously provided a design, (as phase 3 of the recent MV infrastructure upgrade works) for the GJW incorporation into the Trust MV network.

The recent WSP design for the GJW incorporation included the provision of a new outdoor type 11kV, SF6 gas interconnect switch panel and separate ring interconnectors to both the Trust existing Ring A and newer Ring B distribution systems, as indicated by the purple line connections on the following Figure 5-7 Proposed (Simplified) MV Site Wide Electrical Distribution Architecture schematic diagram. This configuration enables either one or both of the GJW power transformers to be served from either one or both of the Trust MV ring networks. This work phase was never completed.

Whilst the current and anticipated 2040 load demands of the GJW building could be accommodated by the existing Trust A & B MV ring distribution infrastructure, WSP are advised that the Trust are now directly responsible for the procurement of electrical energy for the GJW via their preferred supplier and as such the benefits of implementing the Trust MV system interconnection are limited given the potential costs and likely disruption involved in constructing the necessary civil works and MV electrical interconnections, in particular as interconnections crossing the Bessemer Road would be required.

WSP would not recommend implementation of the GJW interconnection with the Trust MV electrical distribution infrastructure on the above basis.

5.5 RESILLIENCE AND ESSENTIAL POWER SUPPLY SERVICES

5.5.1 UTILITY POWER SUPPLY & SITE DISTRIBUTION

Due to the magnitude of the proposed decarbonised energy centre, the electricity demand for the Denmark Hill site is expected to grow significantly in the period leading up to 2032 and significantly again following the energy centre completion and in the period leading up to 2040 as the proposed new building developments are completed. By 2032 the demand is expected to reach 13MVA and by 2040, if all proposed developments are completed, the demand will increase to as high as 19MVA. These demands cannot be managed by the current supply plant infrastructure which has an assumed delivery capacity of 7.6MVA at 11kV.

To meet the energy centre and Link building load demands a new 33kV supply infrastructure will need to be in place on site from the DNO. This should comprise a dual supply arrangement comprising two separate supply circuits, each serving a full capacity, (20MVA minimum) 33:11kV step down KNAN transformer and thus each capable of serving the entire site load demand. Each transformer would be separately contained in a purpose-built oil retaining outdoor enclosure to full UKPN standards and feed a separate 11kV multi-section supply distribution switch panel. Each switch panel would be separately located in a dedicated/fire rated room and cable interconnected to each other enabling full N+N resilience operability.

The following new separated 11kV supply feeders would be provided to serve the Trust MV distribution systems:-

- HV1 Intake switchboard;
- HV2 Intake switchboard;
- South Energy Centre switchboard section A; and
- South Energy Centre switchboard section B.

5.5.2 TRUST 11KV DISTRIBUTION INFRASTRUCTURE

The Trust existing 11kV ring distribution infrastructure system, originating from intake switch rooms HV1 and HV2 would remain generally in its current configuration, with new substations constructed and brought on stream as described in the section 6.4 phasing sequence. The system would be re-fed from the proposed new UKPN supply substation switch room via two independent supply feeder circuits at a pressure of 11kV. In summary, the following 6No new substations are proposed, in line with the agreed development sequence:

- Phase 1: New South Substation for KCL Funded CRF Imaging Requirements (Tx19). HV2/Ring B - RFB2 connected.
- Phase 2: New Haematology Building/Substation 10 Replacement. HV1/Ring A – RFA2 connected.
- Phase 3: Normanby Site Development New Substation (Tx15). HV2/Ring B – RF2B connected.
- Phase 5: Business Units 7 & 8 Replacement New Substation (Tx20). HV2/Ring B – RFB2 connected.
- Phase 6: Dental Wing & Day Surgery New Substation (Tx14). HV2/Ring B – RFB2 connected.
- Phase 7: Bessemer Wing Replacement New Substation (Tx21). HV2/Ring B – RFB1 connected.

The anticipated impact of these new loads and the removal of existing loads on the Trust existing A & B MV ring distribution system as a result of site development is summarised below.

ANTICIPATED AVERAGE SYSTEM LOADS						
Ring Feeder Ref	Existing Load MVA	2040 Anticipated Load MVA	Load Currennt @ 11kV	Ring Switch Feeder Rating	Switch Panel Load Amps	Incommer Switch Feeder rating
RFA1	1.44	2	105	630	260	630
RFA2	1.53	2.95	155	630		
RFB1	0.38	1.42	75	630	180	630
RFB2	0.63	2	105	630		
Total Load MVA		8.37	Total Load Current		440	

Figure 5-6 – Existing MV Ring System Load increases

Two further UKPN 11kV supply circuits are proposed to serve the new south energy Centre, which shall comprise two separately located and cable interconnected 11kV vacuum switch panels. These shall each supply the array of individual 11kV/400v transformers necessary to serve the energy centre heat generation plant and the link building. This panel will be supported by an 11kV standby Diesel generator system.

Two transformers shall be provided to serve the Link building in an N+N configuration,)Tx ECS1 – Building Supply A and Tx ECS2 – Building Supply B) in order to facilitate critical clinical service resilience, wherein one transformer shall be capable of supporting the entire building load in the event of the other transformer failure.

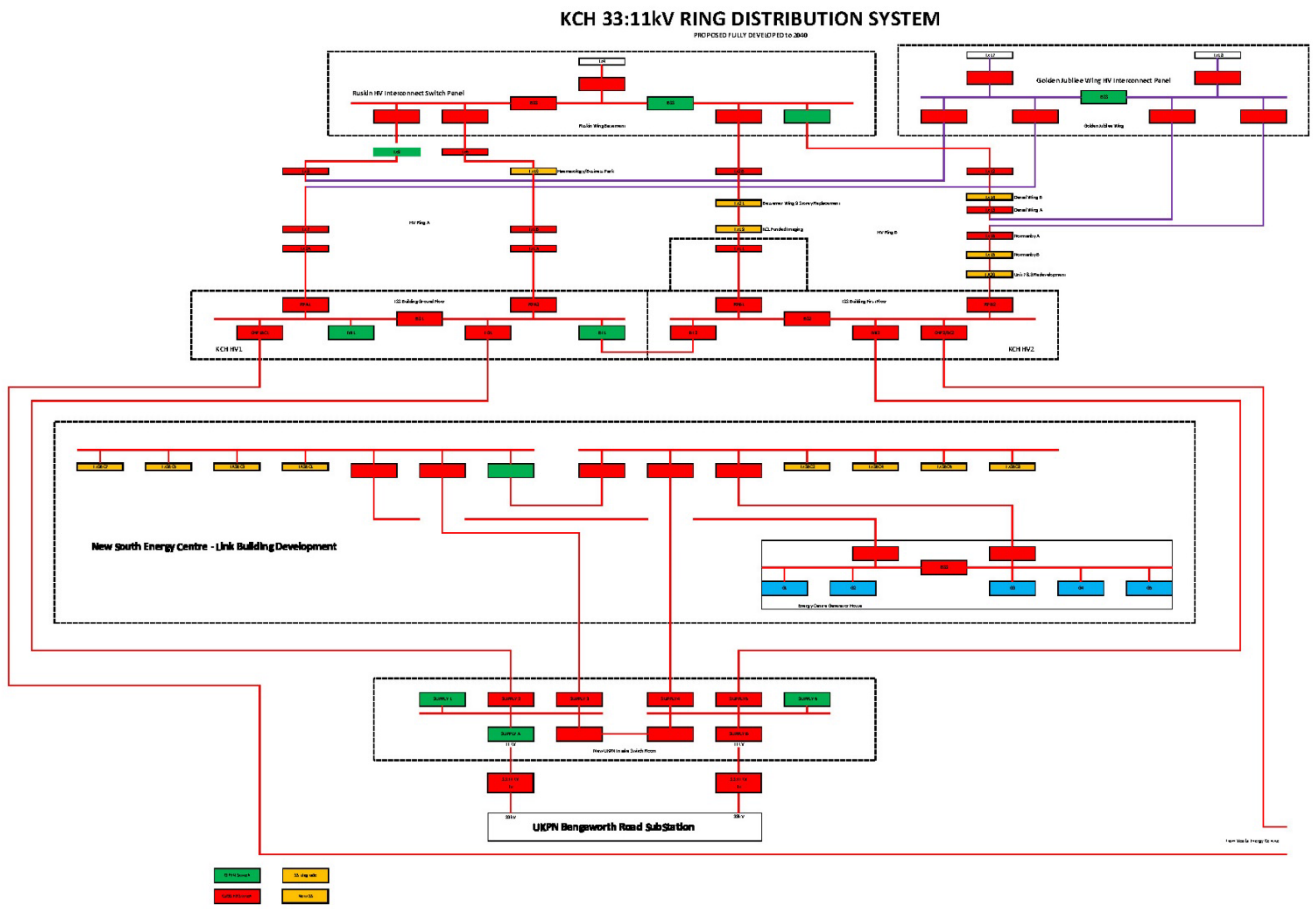


Figure 5-7 – Proposed, (Simplified) MV Site Wide Electrical Distribution Architecture

5.5.3 ESSENTIAL SERVICES STANDBY POWER SUPPLY SYSTEMS

Although the Denmark Hill site currently benefits from a centralised low voltage, (400V) Diesel powered essential services backup power supply system, this is understood as currently at capacity, both electrically and in terms of what can be physically connected to it. WSP understand that the system was originally conceived as an N + N + 1 configuration, wherein one generator set would serve the entire essential load demand with one set in standby and the third set as a spare in the event that one of the N+N pair of sets was out of commission. It is now understood that the connected essential load is such that two generating sets are required operate to meet the demand with a net resultant loss in resilience.

The existing central generator system comprises 3No 2MVA/400v diesel/alternator sets that feed into a large multi section output distribution switch panel in the event of a utility mains outage. The switch panel is located above the diesel engine house and is served by a permanent 400v supply from the two Energy Centre transformers.

This system is located in a dedicated building above the existing energy centre basement on the south side of the site, adjacent to the railway line boundary making large low voltage connections both awkward, technically challenging and expensive in terms of cabling connections. Several small remote stand-alone diesel generating sets have been provided to the more remote and awkward to serve areas of the site to overcome this issue.

Both the existing central generating system and individual remote located generating sets shall be retained in their entirety and shall continue to serve the existing connected essential services distribution systems.

As the site is developed and decarbonised in line with the agreed proposed scope and sequence, so new standby power generation facilities will be required. Typically, these shall include the new south energy centre MV Diesel generation system, necessary to support the existing hospital heat generating plant loads and link building together with additional remote systems allied to each new distribution substation and sized to suit the proposed essential service demand. WSP would recommend at this stage that the individual generators are fully sized to match the transformer provision, thus ensuring a 100% standby supply facility is achieved for HTM compliant clinical supply services.

The individual generator requirements should be reviewed as the brief and function, scope and scale of each individual building development is defined.

The new south energy centre standby power generation system will need to be significant to meet the all-electric demands of the decarbonised heat generating plant and proposed new multi-storey Link building development. The system shall comprise a dedicated N + 1 array of 5No 2MV, (11kV) Diesel generating sets, each individually housed and silenced at ground floor level with engine cooling radiators located at roof level of the link building. The sets would be interconnected via a dedicated separately housed MV Vacuum type switch panel. The generating sets would be designed and configured for short term mains parallelling operation to enable no break transfers between the mains and standby systems.

5.5.4 STANDBY DIESEL GENERATOR FUEL SUPPLY & STORAGE

The existing central standby power Diesel generation system currently shares it's bulk fuel oil storage capacity with the existing energy centre dual fuel boilers and comprises two below ground bulk storage tanks, (Bosari tanks) located to the east of the existing generator house adjacent to the railway line, together with a multi pump (N + N) fuel oil delivery system serving oil to the generator day tanks and to the energy centre heating boilers. These will be retained in their entirety for this purpose.

The new south energy centre standby generator system shall comprise an array of 5No 2MVA Diesel generator sets, operating as an N + 1, (four sets running + one set spare) configuration with an estimated fuel oil consumption of 530 litres an hour per set at full load. To meet the HTM 06-01 recommended fuel storage autonomy for these sets a storage capacity in the order of 424,000 litres would be required. A storage system comprising two tanks slightly exceeding this capacity, Dual N=N fuel delivery pumping systems and a bulk oil fuel polishing system to cater for the use/long term storage of HV Diesel oil installed at the basement level of the new energy centre is therefore recommended.

An alternative to this level of storage within the energy centre itself would be to utilise spare capacity, (realised through decommissioning of the existing dual fuel boilers) in the existing energy centre below ground oil storage system. However, this would require the provision of additional pumps and long delivery pipework flow and return lines from between the existing generator house and new Link building energy centre.

According to Trust records, (See Figure 5-8 below) the Bosari tanks have a combined storage capacity of 407,000litres, albeit this is with one tank artificially restricted to 157.000 litres where its true capacity is 250,000 litres. Possible total storage capacity is actually 500,000 litres. In addition, each existing generator set has a local day tank capacity of 1,800 litres.

The Trust's daily consumption figures for the existing central standby generator would appear to be somewhat low for two 2MVA sets operating at full load. WSP would estimate this consumption to be in the order of 1060 litres/hour, or 24,400litres over a 24-hour period for two sets running at 100% duty. The existing individual generator day tanks would therefore afford a run time of approximately 3.4 hours per set on this basis.

On the basis of the quoted Bosari tank storage capacity and an estimated full load hourly consumption rate of 1060 litres/hour, the HTM recommended fuel storage autonomy of 200 hours is well within the capacity of Bosari tank 1, which is quoted as having a 250,000-litre capacity. Even if all three existing generating sets were called into operation at a duty of up to 75% capacity, the existing larger Bosari tank would contain sufficient oil for in excess of 200hours of operation.

As the existing dual fuel steam boilers are proposed to be removed and back up heat generation provided via electro boilers for the new south energy centre, the full storage capacity of Bosari tank No 2, (250,000 litres unrestricted) could be utilised for the new energy centre generators. This would provide a run time reserve of approximately 118 hours for the 4No 2MVA new south energy centre generating sets running at full load. Only one tank would be required within the new south energy centre (of 174,000 litres minimum capacity) to achieve the recommended 200 hours full load fuel autonomy between the two storage tanks.

KCH NHS FT Oil Stock Levels 16th January 2024

LOCATION	TANK	Tank Maximum Capacity	Owner	READING	UNITS	LITRES	Estimated Daily Usage in Emergency - Electricity Generators and Heating Boilers	Days Available Capacity: Electricity Generators and Heating Boilers	Estimated Daily Usage in Emergency - Electricity Generators only	Days Available Capacity: Electricity Generators only	Estimated Daily Usage in Emergency - Heating Boilers Only	Days Available Capacity: Heating Boilers only	REMARKS
KCH Boiler House	Generator 1 Tank	1,800.00	Veolia	1,350	Litres	1,350			1,440.00	1.00			2 Generators are Required to run
	Generator 2 Tank	1,800.00	Veolia	1,450	Litres	1,450			1,440.00	1.00			1 Boiler at 10t/hr steam
	Generator 3 Tank	1,800.00	Veolia	1,450	Litres	1,450			1,440.00	1.00			
	Borsari Tank 1	250,000.00	Veolia	0	Litres	0	15,200	0.00	2,880.00	0.00	12,300.00	0.00	Tank emptied and 60,080 transferred into Bosari tank 2
	Borsari Tank 2	156,922.00	Veolia	100%	Litres	156,922	15,200	10.32	2,880.00	54.48	12,300.00	12.75	Tank refurbished and filled. 156,922 ltrs now the new 100% level
	Day Tank	23,500.00	Veolia	54%	Litres	12,690	1	1.00	2,880.00	4.40	1.00	1.00	6000 ltrs unusable
	Total KCH Boiler House			2,902		172,512							Litres

Figure 5-8 – Trust Bulk Oil Storage and Consumption Data

6

New South Energy Centre

6 NEW SOUTH ENERGY CENTRE

This section outlines the mechanical and electrical design considerations for the new South Energy Centre which is proposed to be located in the redevelopment of the Link Building.

Recommendations for central plant options are based on the assessments undertaken and set out in Section 5.

6.1 LINK BUILDING

The existing link building is proposed to be demolished to make way for a new 12 storey clinical building development on the site. The Ryders report gives a suggestion as to the approximate development scale in terms of footprint, outline structural frame arrangement and location. However, the Ryders proposal, with its much larger footprint compared with the existing Link building does not work in terms of vehicular access and does not appear to make allowance to retain the existing access roadways.

WSP propose that the new building ground floor level be reduced in size from that proposed by Ryders to enable the existing roadway routes to be retained. Floor levels above ground would be cantilevered out over the roadways, at a sufficient height over to enable the unobscured passage of large and articulated vehicles.

Furthermore, in order to accommodate all of the required plant to complete the energy centre, WSP are proposing to utilise the entire ground floor and provide a basement level, complete with an open ventilation/plant access well extending out to the roadway on the west side of the building. Where it is deemed untenable to utilise the ground floor of the new development, a second basement level, again extending out below the roadways on the west and south sides. This will however add a level of complexity to plant ventilation and plant replacement installation and withdrawal routes.

6.2 MECHANICAL PLANT

The South EC shall include plant and equipment to enable the new LTHW network to be provided with a resilient supply of heat. The following is a non-exhaustive list of items which should be provided:

- ASHPs (refer to description provided later in this report);
- Electric boilers;
- Thermal storage;
- LTHW network distribution pump set;
- Pressurisation and expansion plant;
- Water treatment plant, including system degasser, filtration (in-line and side stream) and dosing equipment;
- Cold water supply system;
- Ventilation provision;
- Electrical infrastructure (refer to Section 6.3);
- Fire protection systems;
- Security and access systems;
- Data and communications systems;
- Vertical transport & plant access systems;
- Building façade cleaning and/or access facilities;
- Renewable façade power generation facilities – there will be a south facing façade; and
- Solar shading and screening of the south facade.

Based on preliminary modelling, it is proposed that the volume of thermal storage provided for the South EC is $50m^3$.

A schematic drawing showing the basic configuration for the mechanical plant is provided in **Appendix I**

6.2.1 ASHP UNITS

The proposed ASHP installation will consist of 5no. 1150kW capacity units, each being made up of the following:

- Heat pump compressor unit (two-stage, using hydrocarbon refrigerants), with pump set;
- Fan array and valve manifold unit; and
- Interconnecting pipework (between compressor and fan array), using a water-glycol mix as a heat transfer medium.

Heat pump compressor units are proposed to be located in a plant room separate to the rest of the energy centre. Each heat pump compressor unit will comprise 3no. cabinets. Due to the high temperature heat generation required, the units will operate using hydrocarbon refrigerants. The compressor plant room will require extract ventilation in the event of a refrigerant leak. Relief lines, for refrigerant dispersal in case of failures within the compressor cabinets, will need to be routed to external.

Valve manifold units on the water-glycol circuit (proposed to be located near roof-level) control the fluid through the fan arrays and the defrost cycles.

The fan arrays will be mounted at roof level on a dedicated structure which will elevate the fans above the main roof in order to provide sufficient clear space underneath for the significant air flow that will be required. It is currently estimated that the fan arrays will need to sit at a height of 4.5m above the surrounding roof structure.

It is likely that some form of acoustic screening will be required in order to reduce noise at nearby receptors. A noise assessment should be undertaken in subsequent design stages.

6.3 ELECTRICAL PLANT

The new south energy centre electrical distribution configuration shall split between heat generation/mechanical plant services and the wider building general power, lighting and ancillary services distribution systems, with the latter provided as an N+N arrangement in order to meet any critical services needs of the proposed clinical building provision.

All power transformers shall be Midol oil filled (KNAN) types, installed in individual naturally ventilated fire rated chambers and served directly from the primary MV distribution switch panels. Two 1.5MVA machines shall be provided to serve the general building power and ancillary services N + N distribution systems and six 2MVA machines shall be provided to serve the heat generation and mechanical services plant requirements.

All new LV switchgear would be purpose built modular Form 4/Type 6 pattern, fully automated, utilising functional components from the Schneider Group and located in dedicated LV switch rooms.

The standby Diesel powered generation facility shall operate at MV, (11kV) and shall comprise a multi section vacuum type switch panel, complete with a bus section switch, 5No 2MVA Diesel generating sets, each to be installed within a dedicated fire rated room and complete with sound attenuated, combustion and room cooling air supply and remote, (building roof) located engine cooling radiators, a centralised generator control and monitoring panel and 2No neutral earth resistors.

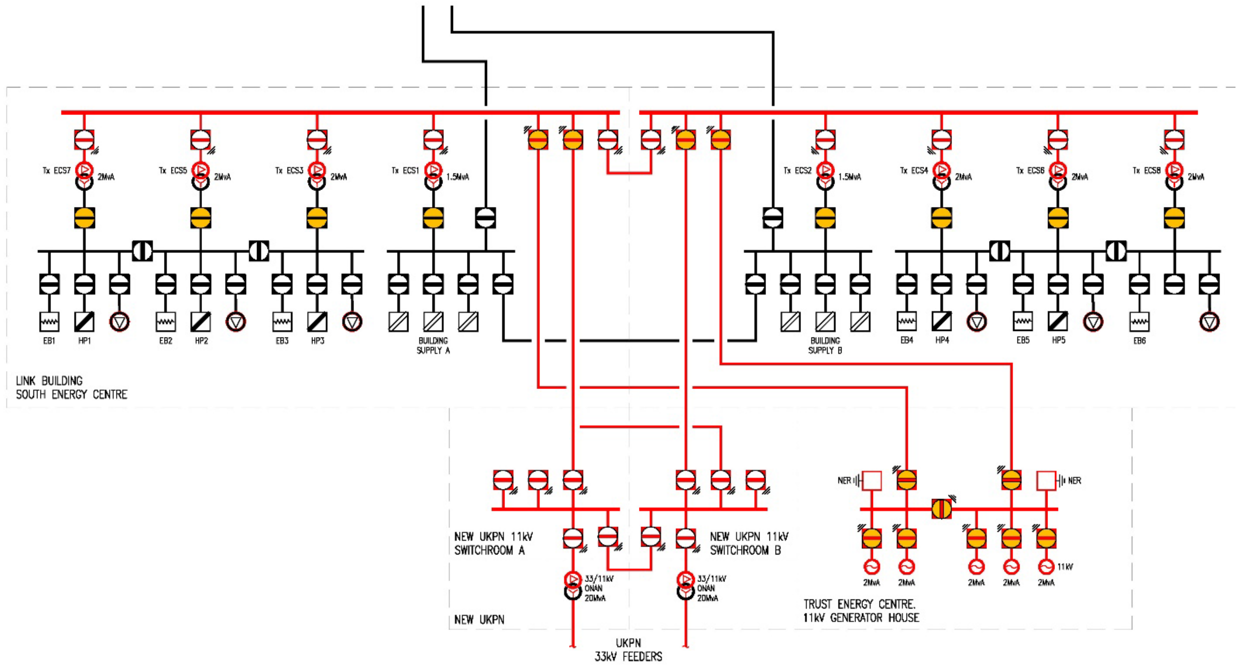


Figure 6-1 – South Energy Centre Outline MV & LV Electrical Distribution Architecture

6.4 RESILIENCE

Resilience for the heat supply to the LTHW network is proposed to be provided through a stand-alone resilient electrical distribution architecture as described in Section 6.4.

Resilience capacity is also provided in the form of an additional (N+1) electric boiler.

6.5 ENERGY CENTRE SPATIAL REQUIREMENTS

To determine spatial requirements for the new low-carbon plant and associated equipment, plant room and roof-top layouts were developed. These layouts have considered the following, however these will need to be developed further at the next stage of design:

- Installation and access for major plant items;
- Riser space for services such as pipework and electrical cabling;
- Maintaining sufficient airflow (for ASHP); and
- Heat pump, thermal storage and electric boiler capacities as stated elsewhere in this report.

It is proposed to house the compressor units for the heat pumps within a separate compressor room, adjacent to the main plant room, as this can provide a more practical means for mitigating against refrigerant leaks.

The typical split of plant provision within the energy centre will be as follows:

- ASHP radiators & Standby generator heat rejection radiators at roof level;
- ASHP's and associated LTHW pumping systems at Ground level, (or basement 1 where this is not possible);
- Electric boilers and associated pumps/controls at Basement level, (or basement 2 where this is not possible);
- MV Standby Diesel generators, MV generator switch panel, 4No power transformers and associated LV switchgear systems at Ground Level, (or basement 1 where this is not possible);
- Main electrical intake MV distribution switchgear and 4No power transformers/ associated LV switchgear systems at Basement level, (or basement 2 where this is not possible); and
- Fuel oil storage tank(s), fuel oil treatment and distribution pumping systems at Basement level, (or basement 2 where this is not possible).

Further consideration should also be made at the next stage of design for control rooms and welfare facilities.

6.6 PLANT LAYOUTS

Provided in Appendix D.

7

Cost Estimate

7 COST ESTIMATE

7.1 CENTRAL PLANT OPTIONS CAPEX

WSP have included a high-level cost estimate for providing a new Energy Centre at the Site in Denmark Hill.

The new Energy Centre is proposed to be housed in the basement, Ground floor and roof of a new 12 story building. An allowance for this new building has been included and the costs identified separately as 'Building Costs'.

An allowance for the demolition of the existing link building has also been included.

The estimate includes all the proposed plant and ASHP installation.

A summary is shown below:

Works Package	Total Estimate	Building Works	Energy Centre Works
TOTAL – excl Vat	**£300,000,000**	**£201,900,000**	**£98,100,000**
Total – incl 20% VAT	**£360,000,000**	**£242,280,000**	**£117,720,000**

An allowance for the new UKPN supply and intake plant has been included within the estimate. These costs are associated with both the decarbonisation as well as the proposed site redevelopment plan and are based on the entire network upgrade requirement resulting from KCH orientated works only and allows for the upgrade costs to be met in/around 2030. UKPN have advised that the costs for network reinforcement may be spread and met by them directly where the requirement is from a multiple series of demands, such as increases required by KCL and SLAM. Discussions with these adjoining users should be undertaken to ensure that network reinforcement savings can be implemented where possible. This highlights that there may be further cost savings directly related to the decarbonisation project but as both are required for the operation of the new energy centre, they have been included within the decarbonisation costs.

7.2 SUMMARY

The Estimate summary is shown in Table 7-1 and provides the split between the building works required and the Energy Centre costs.

The estimate excludes VAT, Legal Issues and Land Take. A full list of assumptions and pricing notes can be found in the estimate.

Table 7-1 – Cost Summary

4.1 Cost Summary

Kings College Hospital NHS Foundation Trust
Denmark Hill Hospital
Heat Decarbonisation Proposal Stage 1/2 Estimate

Item Description	Total Estimate	Building Estimate	Energy Centre Estimate
Direct Construction Costs			
Building Works			
Demolition and New Link Building	£90,800,000	£90,800,000	N/A
E/O cost for Energy Centre basement in new Link Building	£2,800,000	N/A	£2,800,000
Energy Centre			
Mechanical and Electrical Works	£64,500,000	£0	£64,500,000
Main Contractor's Preliminaries and Overheads and Profit	£39,600,000	£22,700,000	£16,900,000
Sub Total - Direct Construction Costs	£197,700,000	£113,500,000	£84,200,000
Indirect Construction Costs			
STATS Diversions	£4,000,000	£2,270,000	£1,730,000
Professional Fees	£29,700,000	£17,030,000	£12,670,000
Sub Total - Indirect Construction Costs	£33,700,000	£19,300,000	£14,400,000
Indirect Non-Construction Costs			
Design Risk	£46,280,000	£26,560,000	£19,720,000
Construction Risk	£23,140,000	£13,280,000	£9,860,000
Sub Total - Indirect Non-Construction Costs	£69,420,000	£39,840,000	£29,580,000
Inflation	£52,500,000	£29,350,000	£23,150,000
Total (Excluding VAT)	**£353,320,000**	**£201,990,000**	**£151,330,000**

Table 7-2 – Cost Estimate Build Up

Kings College Hospital NHS Foundation Trust
Heat Decarbonisation Proposal Stage 1/2 Estimate

3.1 Notes

Pricing Notes
Estimates are based at 1Q2024
Estimates have been based upon drawing numbers as scheduled on the attached and the WSP KCH Denmark Hill Decarbonisation Proposal Stage1/2 Report

Exclusions
Legal issues
Land take
VAT

Assumptions
Allowances have been included for the following:

1 Demolition of the existing building. An allowance has been included to provide an indicative cost. No details of the existing building have been provided.
2 Proposed new Link Building Construction Cost:-
Allowance for general Hospital outpatient 12 Story building (plus plant level on roof)
Total area as noted in the reports.
Indicative cost provided for budget purposes at this stage
3 Costs are based on information issued by WSP and discussions with the team
4 Air source heat pump costs are based on benchmark rates
5 Electric boilers are based on benchmark rates
7 The air handling unit pricing are based on benchmark rates
8 Firestopping is allowed to new penetrations / works only
9
Allowance for a service tunnel has been included for a section of the LTHW distribution pipework
10 The UKPN supply upgrades are priced as a provisional sum
11 Form of contract is assumed to be a single stage D&B for the decarbonisation works, placed with a Tier 1 MEP contractor or a general main contractor
12 Costs exclude any direct Trust costs outside of professional fees
13 Inflation has been included to 1Q 2029 (mid point of Construction of the link building)

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Facilitation Works					
Demolition	Allowance for demolition and removal of Building C ahead of new link building being constructed	1	item	2,800,000.0	£2,800,000
Building					
Proposed Development - link Building	Allowance for general Hospital outpatient 12 Story building (plus plant level on roof) Total area as noted in the reports. Indicative cost provided for budget purposes - excel Prelims OHP, which are included below.	16000	m2	£5,500	£88,000,000
Extra Over for Energy Centre	Allowance for Energy Centre building. Assume building is 20 x 43m at basement level with an extended section to provide a total of 1100m2 in the basement.	1100	m2	£2,500	£2,800,000
Energy Centre					
Electric Boilers					
Supply & installation of electric boilers	6nr in total each with a 1200kw capacity	7200	kw	£150	£1,100,000
Allowance for integration to heating system		1	item	£100,000	£100,000
Air Source Heat Pumps					
Air source heat pumps, supply & install	5nr in total each with a 1150kw capacity includes compressors and pumps	5750	kW	£2,050	£11,800,000
Allowance for plantroom equipment, pipework, including valves and insulation		5	nr	£100,000	£500,000
Circulation pumps and controls					
Expansion Vessels	3nr in total 1.5 x 2.5 1000kg	3	nr	£25,000	£75,000
Pump sets	4nr 1.2 x 1.7 x 2.3 2600kg	4	nr	£35,000	£140,000
Fuel Storage					
Fuel Storage Tanks	2nr 9 x 8.5 x 3m high, bunded storage tanks	2	nr	£250,000	£500,000
Fuel Pumps	assume 2 pumps	2	nr	£20,000	£40,000
Thermal Store	3 x 8.5m high cylindrical tower	1	nr	£50,000	£50,000
Fan heat collectors	9.5 x 2.4 x 2.0m 5 nr - 3m clearance below required. Plus pipework from store to roof	5	nr	£25,000	£125,000

Generator Rads	2.4 x 7.7m on roof - 5nr allowance for Structural Support	5	nr	£5,000	£25,000
	Generator rads and pipework	5	nr	£75,000	£375,000
Pipework allowance	2km of 300mm diameter galvanised pipe (insulated) - 80% below ground incl reinstatement	2000	m	£1,000	£2,000,000
Service Tunnel	260m of service tunnel from DHL to the north of Bessemer Road. Create tunnel to carry 300mm diameter pipe across the site. Assume service tunnel Size will be - 260m long, 2m wide, 2.5m high (incl ventilation and access points)	1	item	£10,000,000	£10,000,000
Electrical Works					
Phase 1	*Substation 19 - Cheyne Wing*				
New substation development to include:-					£300,000
11kV:400 /415 Distribution Transformer	TC19 Cheyne Wing - 1.5MvA	1	nr	£100,000	
11kV circuit breaker	TC19	1	nr	£10,000	
11kV ring switch		2	nr	£20,000	
LV switchgear panel and 2500A busbar	allowance	1	item	£100,000	
Weatherproof housing	GRP Housing	1	nr		£25,000
Phase 2	*Substation 10 - Haematology*				
New substation development to include:-					£300,000
11kV:400 /415 Distribution Transformer	for new substation 10 Haematology - 1.5MvA	1	nr	£100,000	
11kV circuit breaker		1	nr	£10,000	
11kV ring switch		2	nr	£20,000	
LV switchgear panel and 2500A busbar	allowance	1	item	£100,000	
Weatherproof housing	GRP Housing	1	nr		£25,000
Phase 3	*Substation 15 - Normanby*				
New substation development to include:-					£300,000
11kV:400 /415 Distribution Transformer	TC15 0.8MvA	1	nr	£100,000	
11kV circuit breaker	TC15	1	nr	£10,000	
11kV ring switch		2	nr	£20,000	
LV switchgear panel and 1250A busbar	allowance	1	item	£75,000	
Weatherproof housing	GRP Housing	1	nr		£25,000

Item Description	Notes / Assumptions	Quantity	Unit	Rate	Total
Phase 4 (Energy Centre)					
New UKPN Work	Allowance - currently under discussion with UKPN	1	item	£10,000,000	£10,000,000
New substation development to include:-					£2,900,000
11kV:400 /415 Distribution Transformer	6 x 2MVA transformers	6	nr	£150,000	
11kV:400 /415 Distribution Transformer	2 x 1.5MVA transformers	2	nr	£125,000	
11kV generator switch panel	10 switches	10	nr	£10,000	
Main MV switch Panel	2nr each with 7 switches	14	nr	£10,000	
LV switchgear panel and 2500A busbar	allowance	2	item	£100,000	
LV switchgear panel and 3200A busbar	allowance	2	item	£250,000	
Generators 2MVA 11kV	allowance 5nr (incl control panels)	5	nr	£160,000	
Phase 5	*Golden Jubilee Wing and Substation 20 for Unit 7/8 development*				
New substation development to include:-					£200,000
11kV:400 /415 Distribution Transformer	Tx17 & Tx18 - existing to be utilised	2	nr	£0	
11kV:400 /415 Distribution Transformer	TX20 - new plus RMU	1	nr	£125,000	
11kV circuit breaker		7	nr	£10,000	
11kV ring switch		4	nr	£20,000	
LV switchgear panel and 2500A busbar	existing LV panel to be utilised	1	nr	£0	
Phase 6	*Substation 14 - Dental/Day Surgery*				£300,000
New substation development to include:-					
11kV:400 /415 Distribution Transformer	1.5MVA Tx & RMU	1	nr	£100,000	
11kV circuit breaker		3	nr	£10,000	
11kV ring switch		0	nr	£20,000	
LV switchgear panel and 2500A busbar	allowance	1	item	£100,000	
Phase 7	*Substation 21*				
New substation development to include:-					£300,000
11kV:400 /415 Distribution Transformer	TC21 - 1.5MVA Tx	1	nr	£100,000	
11kV circuit breaker		1	nr	£10,000	
11kV ring switch		2	nr	£20,000	
LV switchgear panel and 2500A busbar	allowance	1	item	£100,000	
Ancillary Services					
Allowance for BMS, metering, etc to new plant installations		1	item	£1,000,000	£1,000,000
Testing & commissioning		£36,750,000	%	3%	£1,110,000
BWIC & Firestopping		£36,750,000	%	5%	£1,840,000
MEP Sub-contractor preliminaries		£36,750,000	%	15%	£5,520,000
Out of sequence working / Phased construction		£36,750,000	%	25%	£9,190,000
				sub-total	£158,100,000

Main Contractor's Preliminaries and Overheads and Profit	25%	£39,600,000
	sub-total	£197,700,000
STATS Diversions	2%	£4,000,000
Professional Fees	15%	£29,700,000
	sub-total	£231,400,000
Design Contingency	20%	£46,280,000
Construction Contingency	10%	£23,140,000
	sub-total	£300,820,000
Inflation to 1Q 2029 (mid point of Construction of the link building)	17%	£52,500,000
	sub-total	£353,320,000
Total Indicative Estimate	**Total**	**£353,320,000**

8

Recommendations

8 RECOMMENDATIONS

8.1 ELECTRICAL SUPPLY AND DISTRIBUTION INFRASTRUCTURE

The anticipated increase in electrical demand capacity brought about by the requirement to decarbonise the Denmark Hill hospital site are significant in their nature and will require a massive capital investment in order to procure in sufficient time to meet the government and central NHS mandated timescales for Net Zero Carbon. The impact of bulk decarbonisation, not just by KCH but also by their neighbouring large scale energy consumers, (KCL, SLAM) and others will all have an impact on the existing electricity DNO that will have to be managed and carefully planned to ensure these demands can be met.

Advanced steps must be undertaken with the DNO to ensure that the required supply capacity necessary to support decarbonisation, in a manageable and phased manner can be achieved and this process has been started by WSP, together with the Trust as part of this study.

Whilst WSP are aware of the future potential for the Denmark Hill hospital site to receive a bulk heat energy supply from a local private district heating consortium, this study has been commissioned to look specifically at how decarbonisation can be achieved by the Trust as a stand-alone process, through the provision of new centralised heat generating plant located within the confines of the Denmark Hill site, based on an agreed outline site development programme. On this basis the following recommendations are made in relation to the electrical supply and site distribution infrastructure.

- Develop a network supply plant and cable infrastructure design with UKPN for to cater for the anticipated fully developed site supply capacity requirements, (19MVA) that establishes the wider DNO infrastructure requirements, plant spaces and locations, cables diversions and routes, access requirements, legal, wayleave and lease issues, outline costs and a phased implementation program.
- Make an application now to UKPN for an increase in the agreed supply capacity reserve of plus 1MW, to increase it from the existing 4MVA to 5MVA.
- Commission detailed designs for the new CRF Imaging substation – TC19, Normanby secondary substation TC15 and new modular theatre infrastructure connection services.
- Make a further application at the beginning of 2027 for an increase in the agreed supply capacity reserve of plus 1MW, to increase from 5MVA to 6MVA to cater for the proposed new Haematology, CRF imaging and new modular theatre developments.
- Commence the planning and detailed design of the new Link building development, new integral south energy centre and heat distribution infrastructure enabling and permanent works at the start of 2026. This is with a view to commencing phased change over from the existing to new energy centre over a one-year period during 2030 and full operation of the new south energy centre in 2031.
- Allow for a minimum two-year new energy centre and heat/electricity infrastructure detailed design and enabling works phase to commence from 2026.
- Allow for a minimum two-year new energy centre and heat/electricity infrastructure construction period to commence in 2028.
- Make an application for an increase in the agreed supply capacity reserve of plus 7MVA to cater for the new south energy centre and link building developments. It is anticipated that this supply should start to be available during 2029.
- Make further timely applications for increases in the agreed supply capacity reserve to cater for the site development increases, generally in line with the WSP outline site load profile. These steps should be reviewed and aligned with the site master plan as this is developed in more detail.

8.2 HEAT AND MECHANICAL PLANT INFRASTRUCTURE

Based on the analysis and Stage 1 mechanical design work described in previous sections of this report, the following recommendations are proposed:

- A new LTHW distribution network is developed to replace the existing steam system, which will serve the majority of heat loads across the site.
- A new centralised heat supply is provided in the form of an energy centre within the proposed Link Building development (new South Energy Centre). Primary heat generation plant will be high-temperature ASHPs.
- Development of the new South EC should target initial operation at the start of 2030, if not before, in order to meet NHS decarbonisation ambitions and provide a replacement for ageing plant in the existing EC. This will require the early planning works to begin in 2026, assuming a two-year period for design and enabling works and a two-year period for construction.
- Plant within the existing EC should be retained and operated until the end of 2030 to provide a transition period during the changeover to the new South EC.
- The following new developments to the north of Bessemer Road shall be heated by their own independent heating systems:
    - Pharmacy (Normanby carpark);
    - Phlebotomy (Normanby carpark);
    - Willowfield 2; and
    - Haematology - Unit 6 replacement.
- The future Dental/Day Surgery (DDS) development shall be provided with heat from its own stand-alone plant facility. The design of this development shall permit the use of lower temperature ASHPs, using conventional refrigerants, as the primary heat source.

9

Recommended Next Steps

9 RECOMMENDED NEXT STEPS

9.1 SITE DEVELOPMENT MASTER PLANNING

This design report has been based on an agreed outline site development plan comprising elements proposed by Ryders Architects in their Site Development Control Plan and additional potential development elements proposed by WSP and previously discussed between the Trust estates team and WSP. Whilst it is understood by WSP that no clinical masterplan currently exists to drive the Kings Health Partners individual site master plan requirements it is clear that further detailed work is required to establish a firm masterplan and programme for the Denmark Hill site.

WSP would recommend the production of a more detailed accommodation masterplan study of the Denmark Hill site that establishes the overall condition, use and fit for purpose development potential of the entire existing building stock in addition to the major new building developments, (Link Building, Haematology, Units 7 & 8, Dental Day Surgery Wings) identified in the Ryders DCP document and this design report. This study should investigate and conclude on the following elements:-

- Building age, structural and fabric condition;
- Building physical and functional life expectancy;
- Building historic relevance and listing restrictions;
- Building Thermal performance and improvement potential/cost;
- Building services infrastructure condition/Life expectancy;
- Building clinical adjacency suitability;
- New medical technology requirements;
- Private healthcare provision requirements;
- Useable floor net areas and occupancy ratios;
- Pedestrian and vehicular traffic analysis;
- Existing land ownership titles, utility access and way leave rights of way;
- Existing buried services infrastructure limitations; and
- Site partnering requirements and joint venture potential with Kings College London University.

The report should further develop the detail of the major new/replacement building proposals with a view to establishing basic configuration, orientation, net internal floor areas, clinical use/adjacencies, plant accommodation, pedestrian and vehicular traffic flow entry/exit and vertical transport requirements and emergency service attendance and access requirements.

Furthermore, through the course of compiling this design report WSP have been made aware of the potential to connect the Denmark Hill site to a large scale, private joint venture district heating provider, who are currently looking to expand their existing heat network into the Camberwell area. The SELCHP consortium was set up in 1988 and their first energy from waste plant opened in 1994, producing both electricity and heat energy through the process of waste incineration and steam production. SELCHP have approach the Trust with a view to developing a connection to the Denmark Hill site and those owned/operated by KCL and SLAM.

WSP would recommend the further detailed investigation into this connection possibility, which has the potential to deliver the entire Denmark Hill site heating load demand sooner than the design proposals outlined in this report. If possible, this connection would significantly reduce the proposed energy centre plant, associated operational electricity load demand and the electricity supply and distribution infrastructure requirements.

However, any district heating service to the KCH site would need to be fully resilient and the proposed study should investigate and conclude on the following critical matters prior to a connection being agreed:-

- SELCHP heat generating plant resilience. Will 2N plant at the heat source be provided?
- SELCHP Back-Up plant provision to include alternative heat sources to the main incinerator so that the incinerators can be shut down for maintenance etc.
- How is delivery infrastructure guaranteed? Will dual circuit pipework along diverse routes be provided?
- How will resilience of onsite heat exchangers and distribution pumps be facilitated?
- Protection to be put in place to ensure the district heating services are not disrupted by industrial action, loss of mains power or the provider ceasing to trade.
- On site plant and infrastructure spatial requirements.
- Pipework entry/exit location coordination and on site PHX plant location.
- Legal access, wayleave and plant space lease issues.
- Connection electrical power demand profile and how this differs from that established for the stand-alone decarbonised heat energy centres set out in this design report.

9.2 DNO ELECTRICITY SUPPLY

WSP have already instigated early-stage negotiations with the local DNO – UKPN, in order to make them aware of the proposed decarbonisation and site development energy supply implications and the potential for the site electricity demand to creep toward 20MVA by 2040 if these plans are realised.

WSP would recommend the continuation of these discussions and negotiations with UKPN in order to establish the impact the load demand will have on their infrastructure, what upgrades they will have to make to accommodate these demands and how these demands can be met and delivered in a phased manner as detailed in this report.

An agreed total capacity phased draw down program should be agreed with UKPN based on delivery magnitudes established in this design report. At the same time the option for connection into the SELCHP district heat energy scheme should be investigated in detail and the associated electrical energy requirements established and shared with UKPN.

9.3 ELECTRICAL DISTRIBUTION INFRASTRUCTURE

Refer to the section 8 recommendations.

9.4 NEW LTHW SYSTEM TEMPERATURES AND HEAT DEMANDS

The existing LTHW systems are understood to be designed for temperatures of 82°C flow and 71°C return, although traditional systems of this type would generally provide higher return temperatures than design, particularly as the demand reduces.

The new LTHW system is proposed to operate at flow / return temperatures of 85/75. This assumes that the hospital secondary heating systems will be able to continue to operate under similar conditions to how they presently operate. The ability of the existing systems to provide sufficient heat to the buildings under the proposed conditions should be confirmed through a process of monitoring and testing.

Lowering heating system temperatures further could permit a reduction in carbon emissions, by improving heat pump CoPs and reducing distribution heat losses. It is recommended that any monitoring and testing of existing systems considers this potential to determine to what extent this could be achieved without replacement of heat emitters. Testing should involve the gradual lowering of temperatures whilst monitoring the impact on the building and occupants.

As heat emitters are replaced as part of the normal maintenance programme, these should be replaced with units that can operate at lower temperatures. This could permit a lowering of supply temperatures in a phased approach which could be planned for and managed accordingly.

Modifications to secondary systems which increase the delta between supply and return temperatures can improve system efficiency by reducing pumping energy and permitting smaller diameter pipework. One means to achieve this may be to replace any existing 3-port valves with 2-port valves. Achieving lower return temperatures may also be a requirement for a future connection into an external district heat network in the local area if this was to be pursued by the Trust.

Upgrades and improvements to building fabric, heat emitters and control systems could reduce the overall heating demand, also permitting a decrease in system temperatures, and improve the performance of a heat pump system.

Any new building developments on the site should be designed so that can operate on low heating system temperatures.

9.5 HEAT DEMANDS

Heating demands should be reviewed and re-assessed in order to provide more certainty around sizing of plant, network pipes and secondary system interfaces. This should include any future proposals for building energy efficiency works. It is recommended that all heating plant and interfaces are metered, to include monitoring and logging of heat generation and system temperatures on an hourly basis.

Peak demands may also be reduced by staggering the start-up times for the different heating systems on the site or bringing heat on at a lower rate earlier in the day.

9.6 DESIGN DEVELOPMENT FOR NEW SOUTH ENERGY CENTRE

The following tasks should be undertaken as part of the next steps for development of the centralised heat supply design:

- Assess potential impacts from ASHP fan arrays on building occupants. This should include consideration for attenuation of noise and visibility, as well as impacts from cold pluming. It is likely that some form of acoustic screening will be required in order to reduce noise at nearby receptors.
- Investigate structural loadings on roof from ASHP fan units and a cantilever proposal to coordinate with the existing road infrastructure but maintain building areas proposed by Ryders Architects.
- Review of the type of refrigerant to be used in heat pump systems, to include whole life impact from changes in efficiency, safety issues and spatial requirements.
- Further evaluation of safety requirements which relate to heat pump refrigerants, e.g. emergency ventilation systems, fire protection and sprinkler systems, and their spatial requirements.
- Re-assessment of heat pump capacities in line with any proposed change in demand or temperatures. Any change in the demand profile and/or plant selection should also warrant a re-assessment of thermal storage capacity.
- Review of the Link Building footprint which was established as part of this study, to ensure that any access routes around the site can be preserved and get input from other stakeholders (e.g. UKPN).

- Development of EC plant layout to consider any architectural aims or operational requirements for the new Link Building, to include assessment of access routes, riser space, roof space requirements (considering any other plant that the Trust may want to locate in this area), and provision of welfare and/or control rooms within the plant room areas. A suitable location for the thermal store should also be investigated.

To ensure provision of heat supply to the site and a smooth transition between the existing EC and the new South EC, existing plant will need to be operated for an increased number of years, beyond that which is currently proposed. Further discussion with Veolia on remaining life of existing plant, in light of proposed decarbonisation sequence, should be undertaken as a next step.

It is recommended also that the approach to providing a resilient heat supply is also reviewed. There may be opportunities to utilise space within the existing EC for fossil fuelled LTHW plant. This could enable the capacity of emergency generator plant in the South EC to be reduced. Any decision to rely on fossil fuel plant for resilience should consider maintenance requirements for stored fuels, costs of gas standing charges, and future availability of spares for fossil fuel plant, if industry is moving away from such technologies.

Waste heat generation from electrical plant and ASHP within the same centre present the opportunity for waste heat reclamation. The potential for the generator heat rejection radiators to be either positioned below or combined into the ASHP air circuits, (both utilise water glycol circuits) are to be investigated in the next detail design phase. This has been raised with manufacturers and is a valuable avenue of further investigation for the energy centre.

9.7 LTHW NETWORK EXPANSION OPPORTUNITIES

Further work is required to progress the pipe routing for the new LTHW network and assess options which will be strongly influenced by the existing below ground and above ground congested service routes. The pipework route plans indicated in this report and found in appendix K have been identified as less congested options to underpin the feasibility of installation, however, there are many intricacies with existing below ground utilities, sensitivities and work feasibilities and as such further recommended survey and review to validate there legitimacy are suggested.

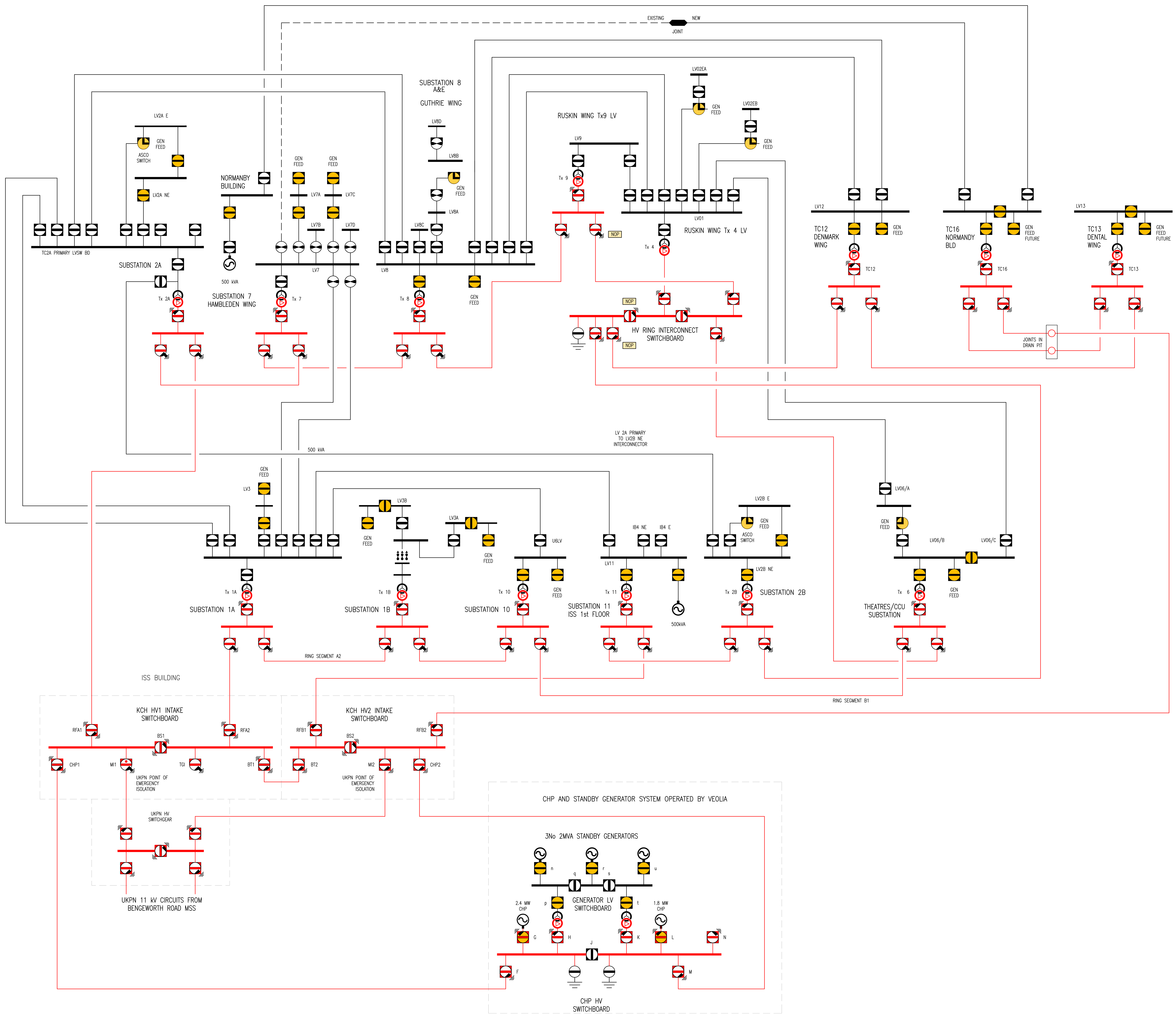
It is recommended that opportunities to expand the proposed LTHW network be explored. It may be possible to serve some of the new developments to the north of Bessemer Road, and even (potentially) the new DDS development, from the new South EC however further work to establish viable routes across the highway and assess capacity at the new EC for more heat generation plant is required.

Loads to the north of the site, beyond the Dental Wing Day surgery complex (which are currently excluded as these do not currently receive electrical power or heat from the existing Trust operated infrastructure systems and are interspersed by private dwellings and buildings) may also be considered for provision of heat from either the proposed DDS Plant Facility, or even from the new South EC, providing that the LTHW network can be developed to this extent and sufficient plant capacity can be accommodated in the EC.

Pipe routes across the more congested roads on the site should be investigated through the assessment of buried services and existing service tunnels.

Appendix A

HV/MV Site Wide Electrical Distribution Schematics



DO NOT SCALE

NOTES:–

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL AVAILABLE RECORD DRAWINGS AND DOCUMENTATION FOR THE SITE, STRUCTURES AND ENGINEERING SERVICES TOGETHER WITH HEALTH AND SAFETY PRE–CONSTRUCTION INFORMATION, WHICH HAS BEEN PROVIDED TO WSP.
3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.

LEGEND:–

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- 11kV
- 230–600V AND EARTH

REV	DATE	BY	DESCRIPTION	CHK	APD
P01	**/02/2024	TP	ISSUED FOR INFORMATION	TP	PW

DRAWING STATUS: INFORMATION

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CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

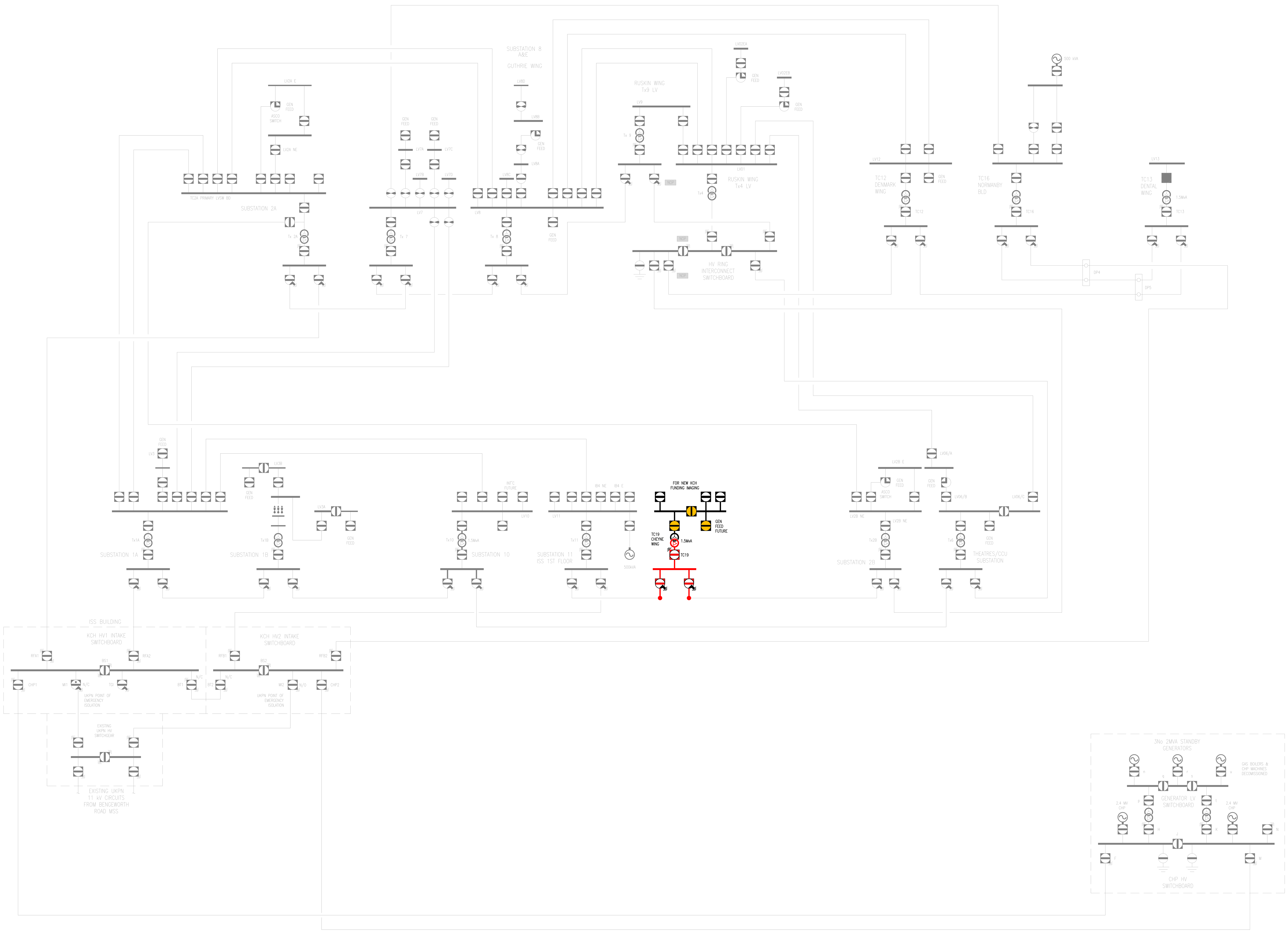
PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES EXISTING MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC

SCALE @ A0: NTS	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: JAN 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6091 REV: P01

PHASE 1



DO NOT SCALE

NOTES:–

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL AVAILABLE RECORD DRAWINGS AND DOCUMENTATION FOR THE SITE, STRUCTURES AND ENGINEERING SERVICES TOGETHER WITH HEALTH AND SAFETY PRE–CONSTRUCTION INFORMATION, WHICH HAS BEEN PROVIDED TO WSP.
3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.
4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:–

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV RING SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- ELECTRIC BOILER
- HEAT PUMPS
- CIRCULULATION PUMPS & CONTROLS
- 11kV
- 230–600V AND EARTH
- DP JOINTS IN DRAWPIT

DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE

PHASE 1

NEW CHEYNE WING SUBSTATION ON SOUTHERN SERVICE ROAD

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

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CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

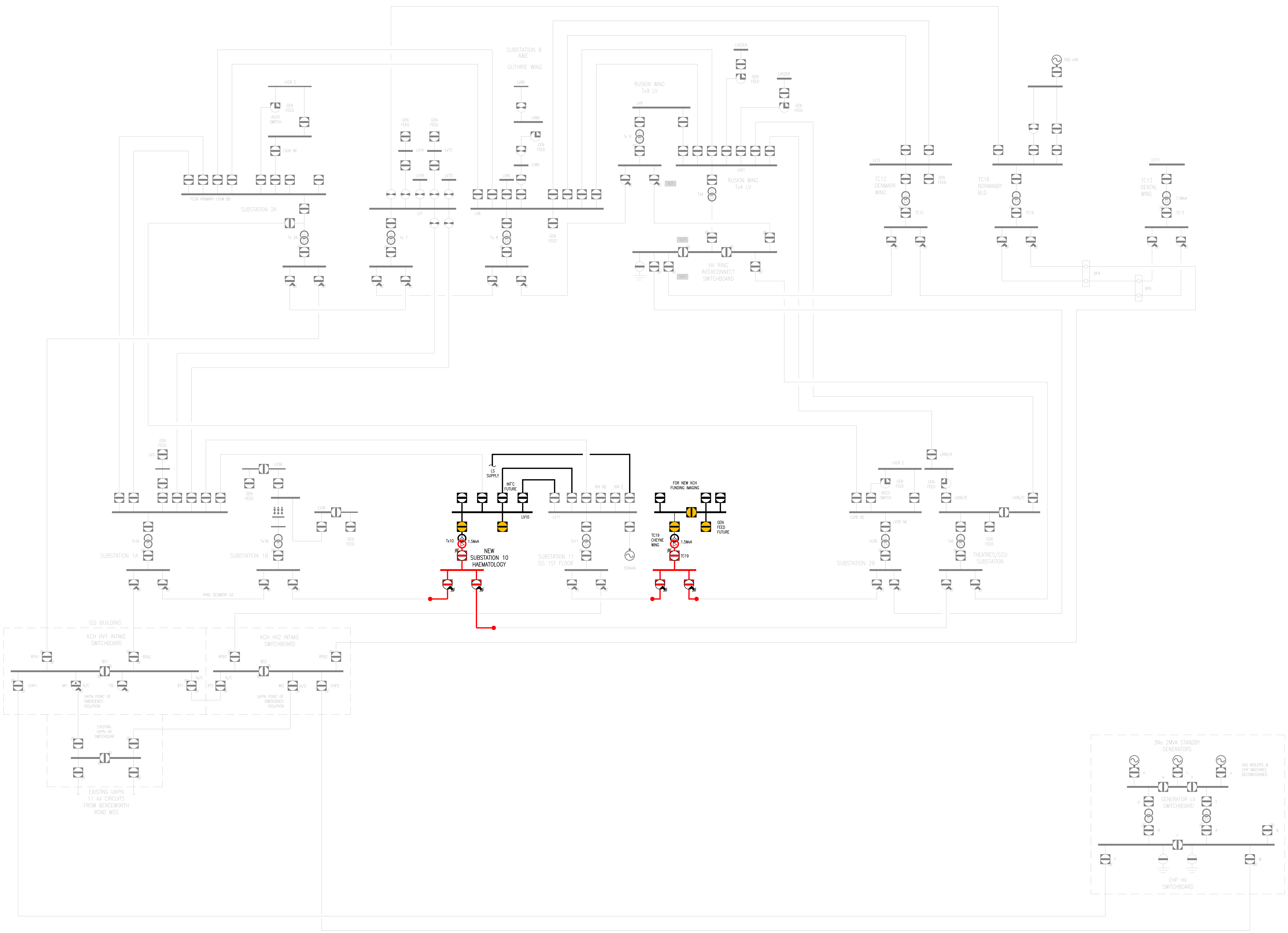
PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - PHASE 1

SCALE @ A0: NTS	CHECKED: TP	APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP / DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6092 REV: -

PHASE 2

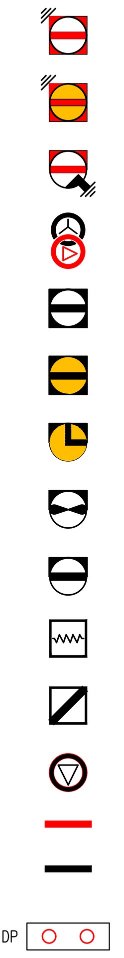


DO NOT SCALE

NOTES:–

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
2. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL AVAILABLE RECORD DRAWINGS AND DOCUMENTATION FOR THE SITE, STRUCTURES AND ENGINEERING SERVICES TOGETHER WITH HEALTH AND SAFETY PRE–CONSTRUCTION INFORMATION, WHICH HAS BEEN PROVIDED TO WSP.
3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.
4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:–



DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE COMPLETION

PHASE 2

NEW HAEMATOLOGY SUBSTATION

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

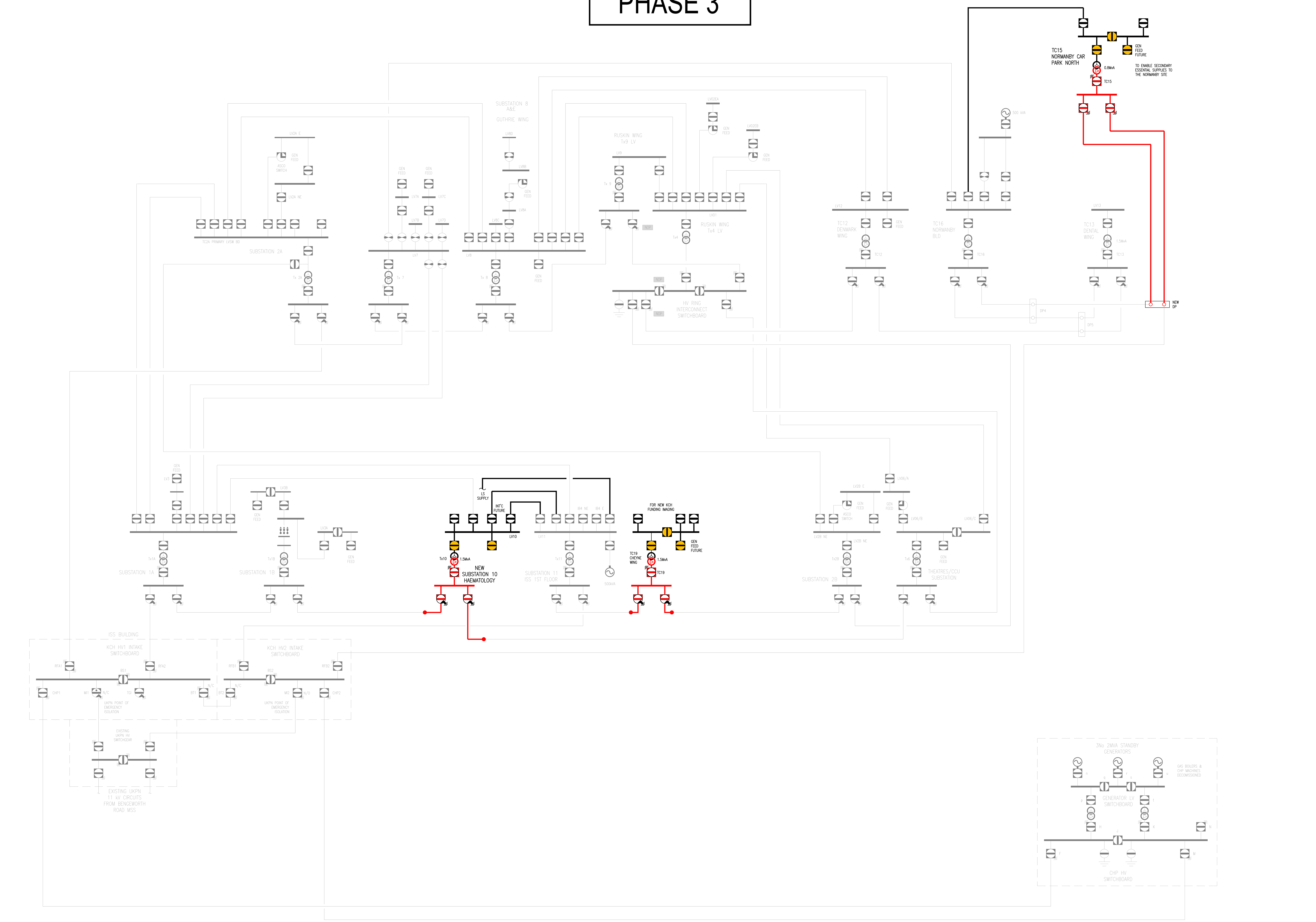
PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - PHASE 2

SCALE @ A0: NTS	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-6093 | REV: P01

PHASE 3



DO NOT SCALE

NOTES:–

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3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.
4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:–

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV RING SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- ELECTRIC BOILER
- HEAT PUMPS
- CIRCULATION PUMPS & CONTROLS
- 11kV
- 230–600V AND EARTH
- DP JOINTS IN DRAWPIT

DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE

PHASE 3

NORMANBY SITE SECONDARY SUBSTATION PROVISION

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

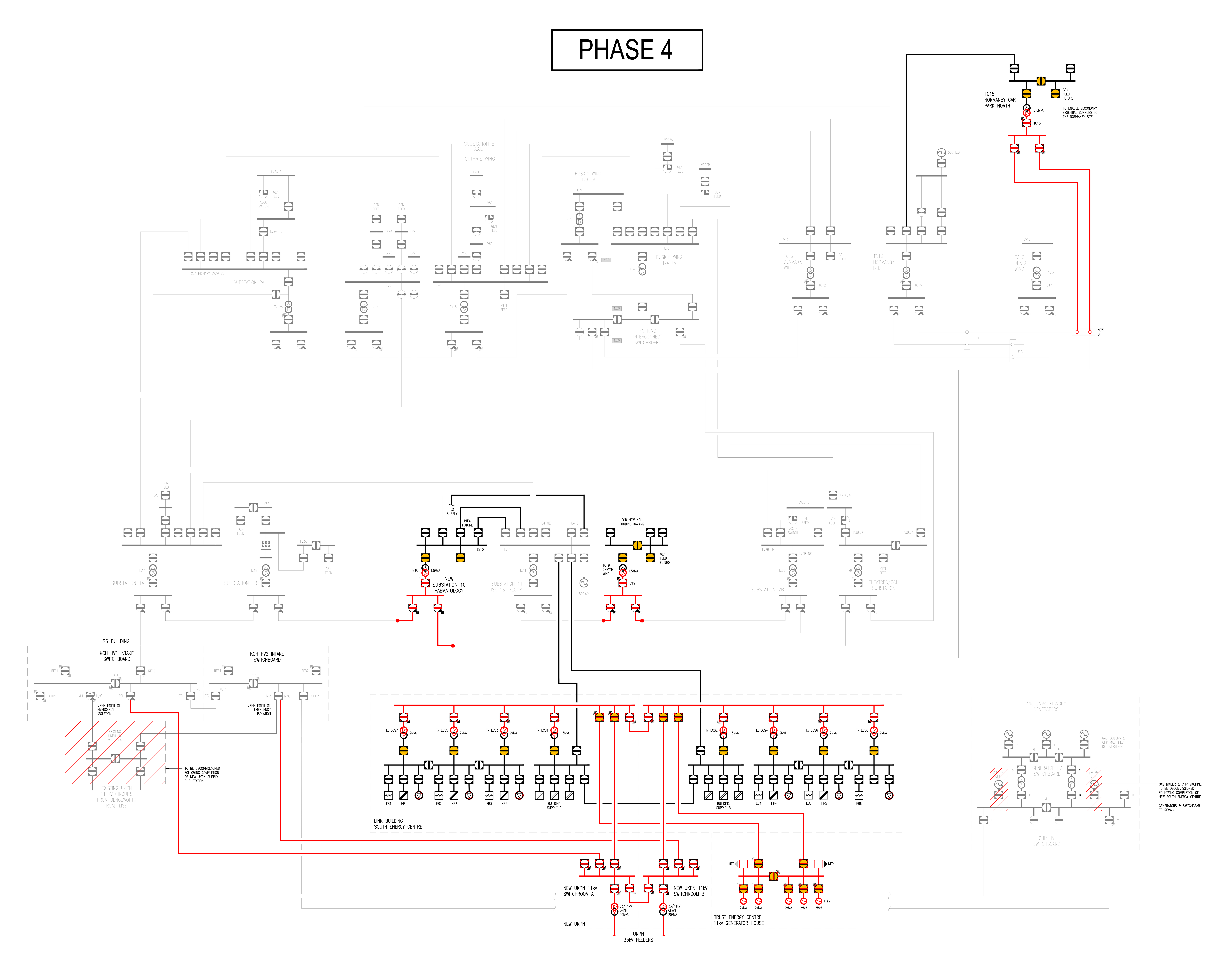
ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - PHASE 3

SCALE @ A0: NTS	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6094 REV: P01



DO NOT SCALE

NOTES:-

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
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3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.
4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:-

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV RING SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- ELECTRIC BOILER
- HEAT PUMPS
- CIRCULATION PUMPS & CONTROLS
- 11kV
- 230-600V AND EARTH
- DP JOINTS IN DRAWPIT

DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE

PHASE 4
NEW SOUTH ENERGY CENTRE & LINK BUILDING

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

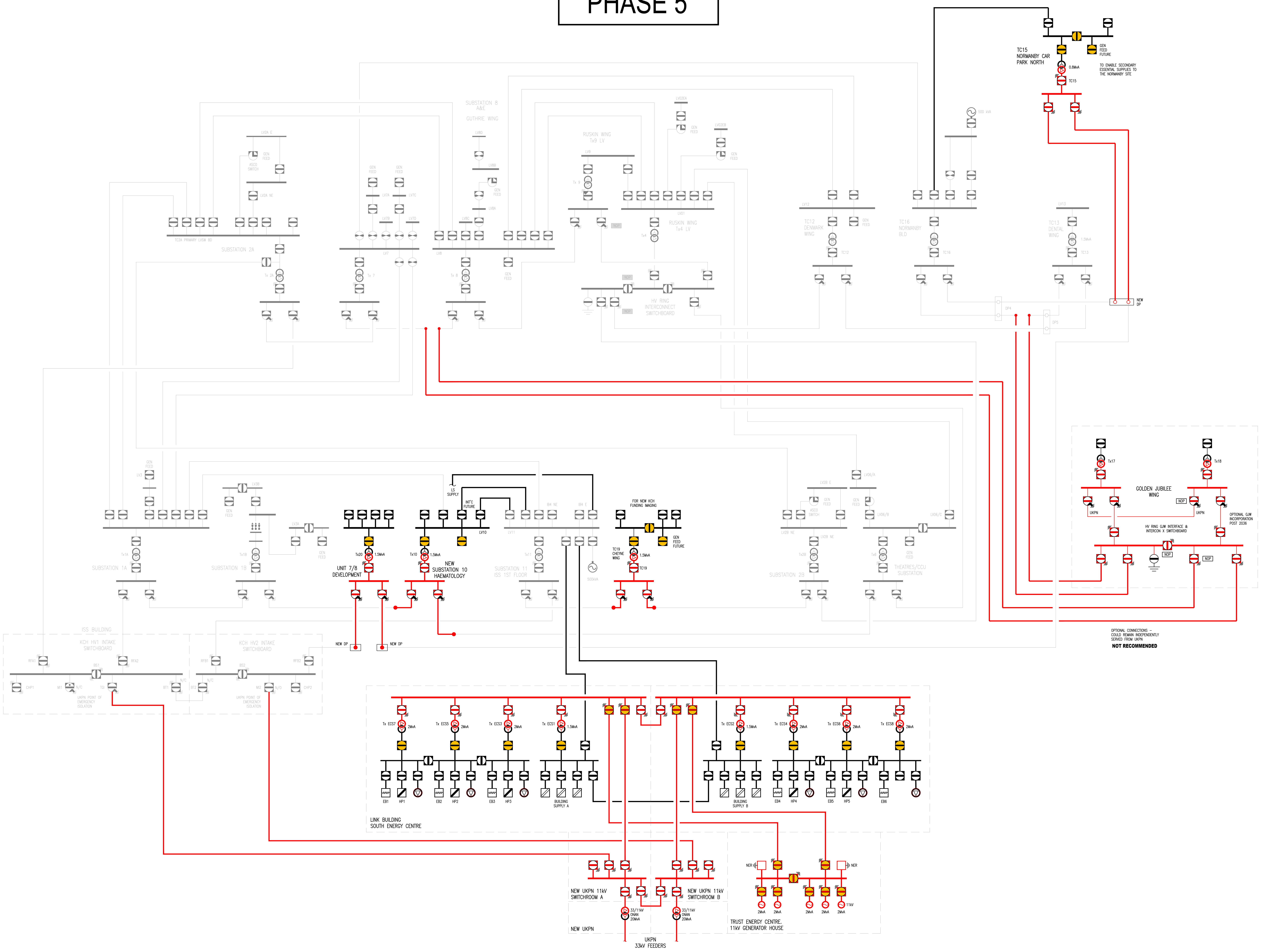
PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - PHASE 4

SCALE @ A0:	CHECKED:		APPROVED:
NTS	TP		PW
PROJECT No:	DESIGNED:	DRAWN:	DATE:
70096113	TP	CAD	FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6095 REV: P01

PHASE 5



DO NOT SCALE

NOTES:–

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
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3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.
4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:–

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV RING SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- ELECTRIC BOILER
- HEAT PUMPS
- CIRCULULATION PUMPS & CONTROLS
- 11kV
- 230–600V AND EARTH
- DP JOINTS IN DRAWPIT

DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE COMPLETION

PHASE 5

BUISNESS UNITS 7+8 SUBSTATION & GOLDEN JUBILEE INCLUSION

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

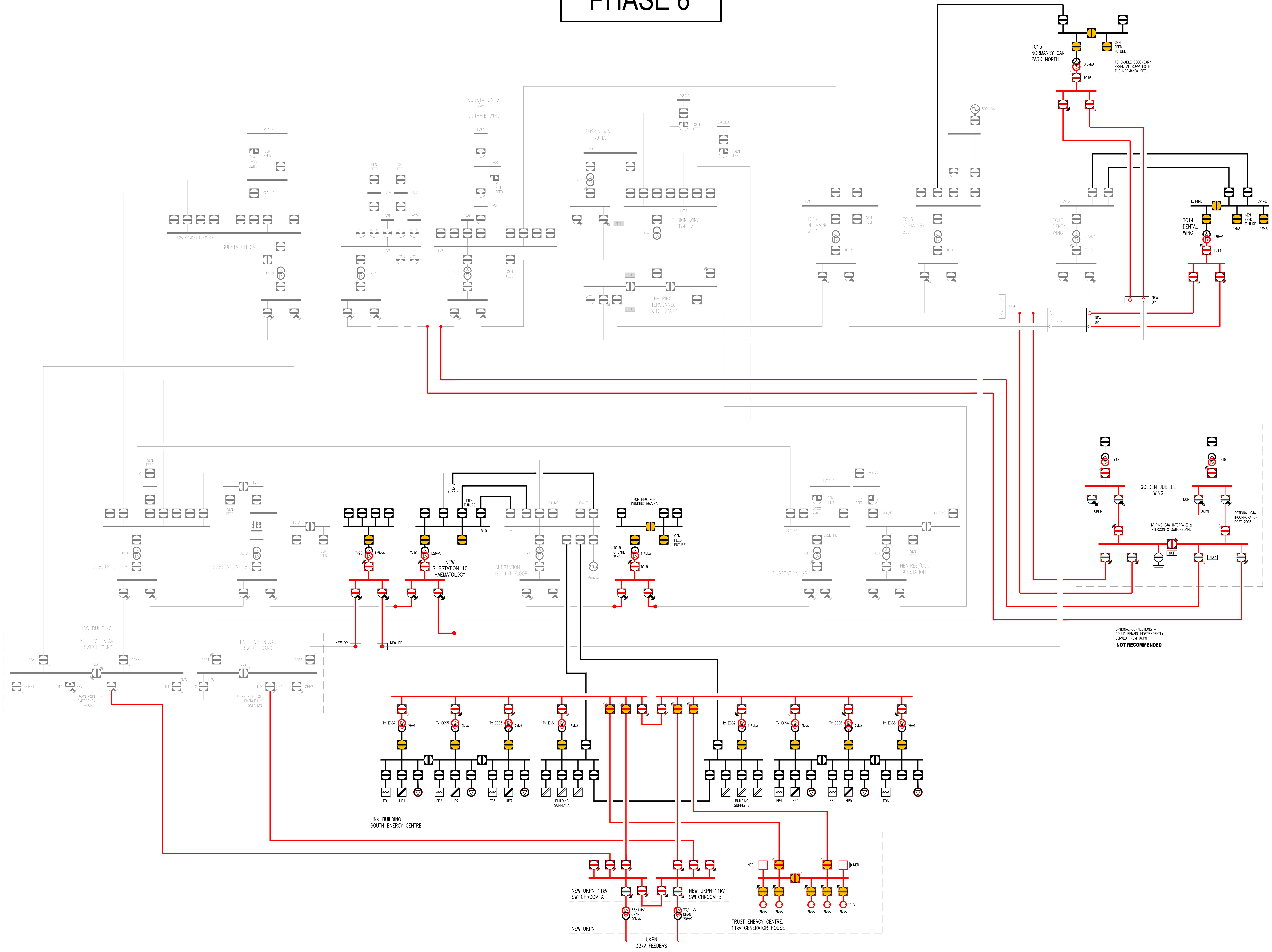
PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - PHASE 5

SCALE @ A0: NTS	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6096 REV: P01

PHASE 6



DO NOT SCALE

NOTES:–

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
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4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:–

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV RING SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- ELECTRIC BOILER
- HEAT PUMPS
- CIRCULATION PUMPS & CONTROLS
- 11kV
- 230–600V AND EARTH
- DP — JOINTS IN DRAWPIT

DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE

PHASE 6

DENTAL & DAY SURGERY WING RE–DEVELOPMENT SECONDARY SUBSTATION

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

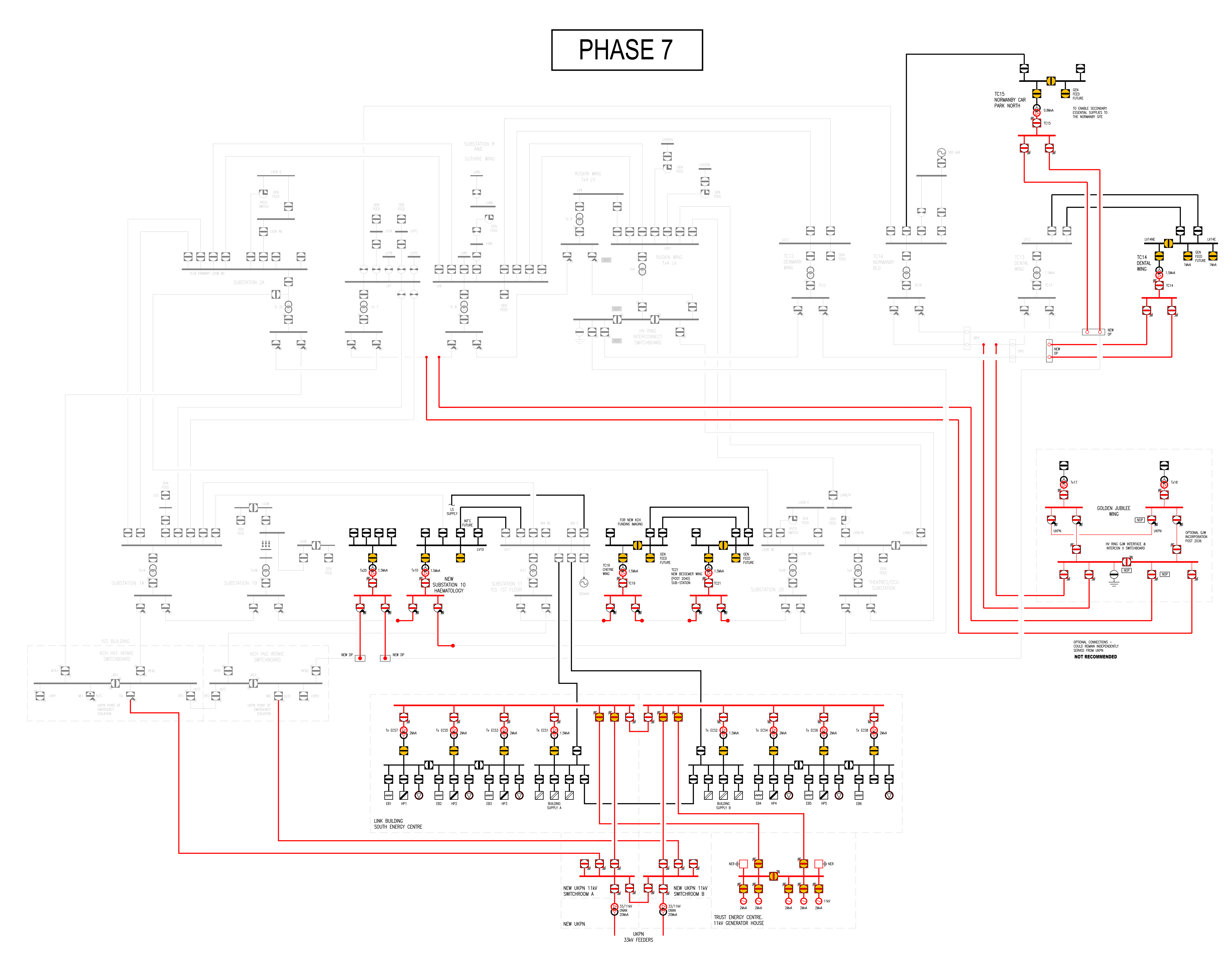
ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - PHASE 6

SCALE @ A0: NTS	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6097 — REV: P01



DO NOT SCALE

NOTES:–

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4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:–

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV RING SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- ELECTRIC BOILER
- HEAT PUMPS
- CIRCULULATION PUMPS & CONTROLS
- 11kV
- 230–600V AND EARTH
- DP JOINTS IN DRAWPIT

DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE

PHASE 7

BESSEMER WING REPLACEMENT SUBSTATION

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

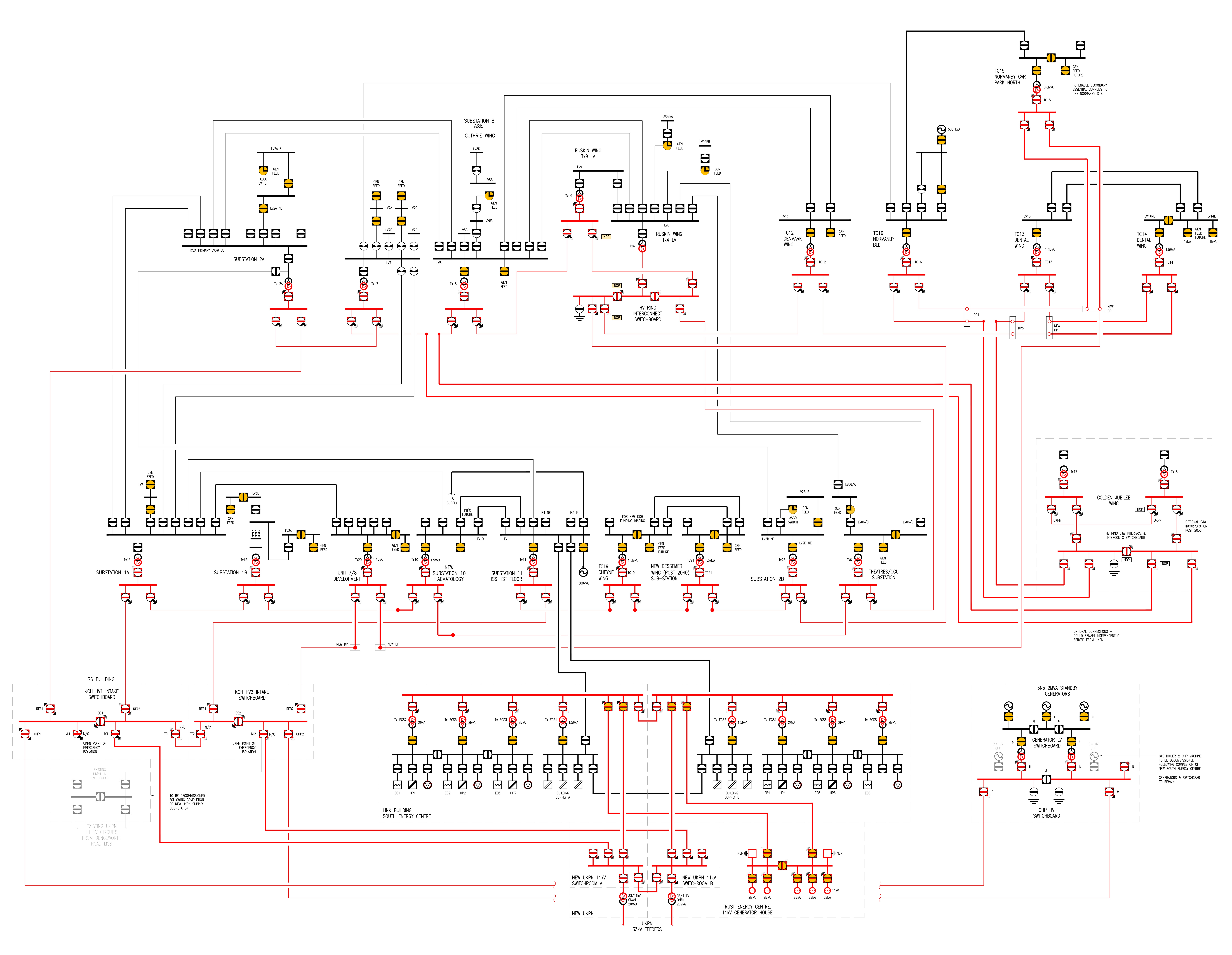
ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - PHASE 7

SCALE @ A0: NTS	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6098 — REV: P01



DO NOT SCALE

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4. PROPOSED SITE DEVELOPMENT/DECARBONISATION WORKS REQUIREMENTS ARE INDICATED IN BOLD. ALL OTHER ELEMENTS ARE EXISTING.

LEGEND:–

- 11 kV CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED 11kV CIRCUIT BREAKER
- 11 kV RING SWITCH
- 11 kV:400/415 V DISTRIBUTION TRANSFORMER
- LV (400/415 V) ACB/MCCB CIRCUIT BREAKER
- AUTOMATICALLY CONTROLLED LV (415/400V) CIRCUIT BREAKER ACB/MCCB
- AUTOMATICALLY TRANSFER SWITCH (ATS) INCLUDING ASCO SWITCHES
- FUSED SWITCH
- SWITCH/ISOLATOR
- ELECTRIC BOILER
- HEAT PUMPS
- CIRCULULATION PUMPS & CONTROLS
- 11kV
- 230–600V AND EARTH
- DP JOINTS IN DRAWPIT

DECARBONISATION AND SITE REDEVELOPMENT ELECTRICAL INFRASTRUCTURE UPGRADE COMPLETION

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

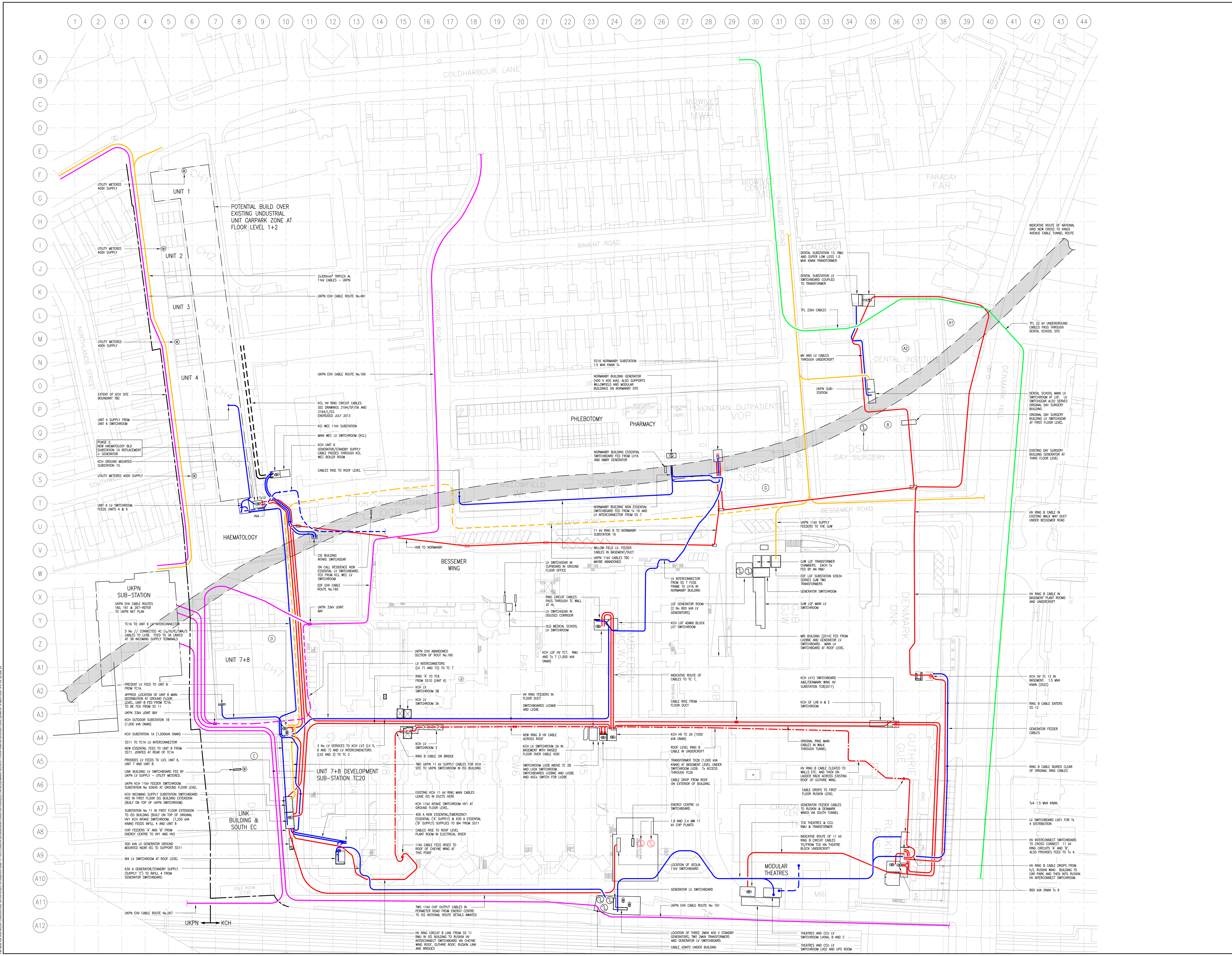
TITLE: ELECTRICAL SERVICES PROPOSED MV / LV SITE WIDE ELECTRICAL DISTRIBUTION SCHEMATIC - 2040

SCALE @ A0: NTS	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-E-6091 REV: -

Appendix B

HV/MV Site Wide Electrical Distribution Plans



DO NOT SCALE

BACKGROUND DRAWING INFORMATION

FILENAME	ORIGINATOR	DESCRIPTION	REV	DATE REC'D
GENERAL SITE PLAN	-	GROUND FLOOR GA	-	12-01-2024

NOTES:-

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
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3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.
4. THIS DRAWING IS INDICATING ONLY & DOES NOT PROVIDE DETAILED CABLE ROUTING INFORMATION. IT DOES NOT INDICATE THE FULL EXTENT OF TRUST OPERATED 400V SUB MAIN SERVICES. IT DOES NOT INDICATED PRECISE DETAILS OF UTILITY SERVICES CABLES & THEIR RECORDS SHOULD BE SORT BEFORE ANY EXCAVATION WORKS ARE UNDERTAKEN.
5. ABANDONED & DIVERTED CABLE ROUTES MUST NOT BE ASSUMED TO BE ISOLATED OR DEAD.
6. TRUST CABLES REFERED TO AS HV ON THIS DRAWING ARE OPERATED AT MEDIUM VOLTAGE - 11kV.

KEY:-

- TRUST 11kV NETWORK CABLES
- TRUST 11kV NETWORK CABLES ON BUILDING ROOF
- TRUST LV SUB-MAIN CABLES
- TFL 22kV CABLES
- UKPN EHV (33KV) CABLES
- ASSUMED ABANDONED
- UKPN 11KV NETWORK CABLES
- ASSUMED ABANDONED

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

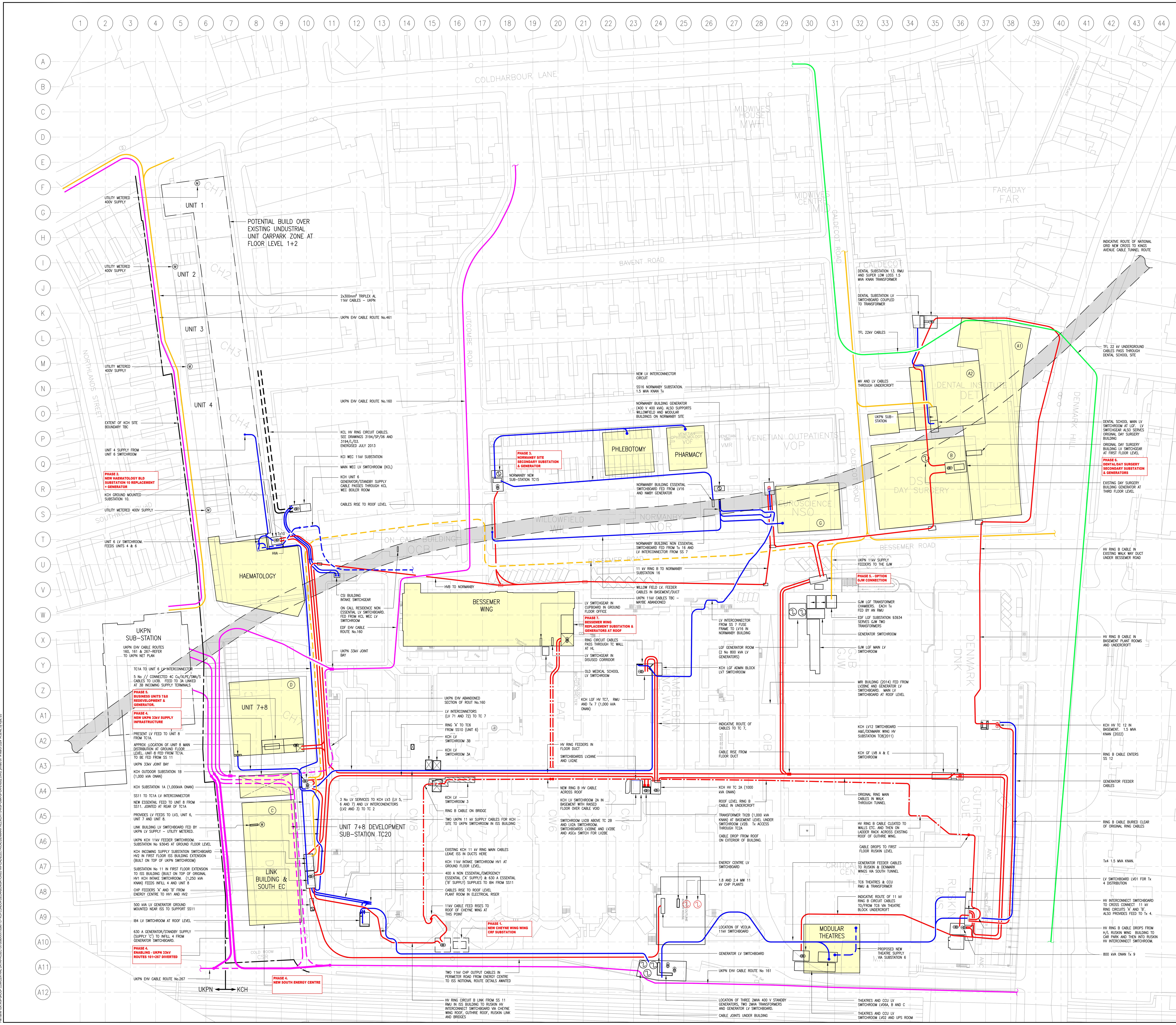
ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES MV / LV ELECTRICAL DISTRIBUTION EXISTING CABLE NETWORK PLAN

SCALE @ A0: 1:500	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: JAN 2024

DRAWING No: KCH113-WSP-DMK-GF-DR-E-6001 REV:



DO NOT SCALE

BACKGROUND DRAWING INFORMATION

FILENAME	ORIGINATOR	DESCRIPTION	REV	DATE REC'D
GENERAL SITE PLAN	-	GROUND FLOOR GA	-	12-01-2024

NOTES:-

1. THIS DRAWING IS A SIMPLIFIED OVERALL SCHEMATICAL REPRESENTATION OF THE EXISTING SITE WIDE ELECTRICAL DISTRIBUTION INFRASTRUCTURE & IS NOT INTENDED TO INPART DETAILED HV/LV OR GENERATOR SYSTEM DETAILS. FOR DETAILED SCHEMATIC INFORMATION REFER TO INDIVIDUAL SUBSTATION DISTRIBUTION RECORD INFORMATION.
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3. THE EXISTING DISTRIBUTION ARRANGEMENT INDICATED ON THIS DRAWING ARE TAKEN FROM CURRENT RECORD INFORMATION & IS DEEMED CORRECT AT THE TIME OF PUBLICATION.
4. THIS DRAWING IS INDICATING ONLY & DOES NOT PROVIDE DETAILED CABLE ROUTING INFORMATION. IT DOES NOT INDICATE THE FULL EXTENT OF TRUST OPERATED 400V SUB MAIN SERVICES. IT DOES NOT INDICATED PRECISE DETAILS OF UTILITY SERVICES CABLES & THEIR RECORDS SHOULD BE SORT BEFORE ANY EXCAVATION WORKS ARE UNDERTAKEN.
5. ABANDONED & DIVERTED CABLE ROUTES MUST NOT BE ASSUMED TO BE ISOLATED OR DEAD.
6. TRUST CABLES REFERED TO AS HV ON THIS DRAWING ARE OPERATED AT MEDIUM VOLTAGE – 11kV.

KEY:-

- TRUST 11kV NETWORK CABLES
- TRUST 11kV NETWORK CABLES ON BUILDING ROOF
- TRUST LV SUB-MAIN CABLES
- TFL 22kV CABLES
- UKPN EHV (33KV) CABLES
- ASSUMED ABANDONED
- UKPN 11KV NETWORK CABLES
- ASSUMED ABANDONED

NOTE: BUILDINGS HIGHTLIGHTED IN YELLOW SHADING ARE PROPOSED NEW DEVELOPMENTS EXTRACTED FROM THE RYDER'S ARCHITECTS DCP DOCUMENT 23/01/24. AND ARE INTENDED FOR INFORMATION PURPOSES ONLY.

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION UKPN POWER SUPPLY STAGE 2 DESIGN

TITLE: ELECTRICAL SERVICES MV / LV ELECTRICAL DISTRIBUTION PROPOSED CABLE NETWORK PLAN

SCALE @ A0: 1:500	CHECKED: TP		APPROVED: PW
PROJECT No: 70096113	DESIGNED: TP	DRAWN: CAD	DATE: JAN 2024

DRAWING No: KCH113-WSP-DMK-GF-DR-E-6002 REV:

Appendix C

Electrical Load Calculations and Profiling

KINGS COLLEGE HOSPITAL DENMARK HILL - SITE ELECTRICAL LOAD DEMAND MONITORING

4.0MVA Firm Supply Capacity Agreed with UKPN
4.2MVA Total CHP Electrical Capacity at Full load
7.621MVA Estimated UKPN/Plant Capacity at 11kV/400A

							1	2	3	4	5		6	7	8	9	10	11		11	
Existing A & B Ring Configurations							Load 15/11/23 MVA	Load 24/11/23 MVA	Load 30/11/23 MVA	Load 07/12/23 MVA	Approx load 15/12/24 MVA		Load 21/12/23 MVA	Load 04/01/24 MVA	Load 11/01/24 MVA	Load 17/01/24 MVA	Load 25/01/24 MVA	Load 01/02/24 MVA	Averaged Load		
HV1	RFA1	Tx2A	Tx7	Tx8	Tx9		1.296	1.44	1.56	1.43	1.43		1.39	1.33	1.58	1.59	1.4	1.36	15.806	1.44	Rounded
	RFA2	TX1A	Tx1B	Tx10	Tx6	Tx4	1.46	1.49	1.67	1.55	1.46		1.47	1.34	1.63	1.72	1.55	1.49	16.83	1.53	
HV2	RFB1	Tx11	Tx2B				0.35	0.35	0.39	0.37	0.39		0.35	0.33	0.49	0.39	0.33	0.36	4.1	0.373	
	RFB2	Tx16	Tx13	Tx12			0.56	0.59	0.64	0.66	0.63		0.55	0.64	0.77	0.84	0.54	0.52	6.94	0.631	
Approx Trust MV Ring System Load							3.666	3.87	4.26	4.01	3.91		3.76	3.64	4.47	4.54	3.82	3.73		3.974	
CHP Export Potential at Full Load							556kVA	330kVA	0	0	94kVA		171kVA	291kVA	0	0				0	
Notional Figure used						Add energy centre 11 kV load	0 MVA	0 MVA	0 MVA	0.198 MVA	0.196 MVA		0.269 MVA	0.269 MVA	0.269 MVA	0.206 MVA	0.246 MVA	0.246 MVA	1.899	0.237	
						Total site load	3.666 MVA	3.87 MVA	4.26 MVA	4.208 MVA	4.106 MVA		4.029 MVA	3.909 MVA	4.739 MVA	4.746 MVA	4.066 MVA	3.976 MVA		4.211	

15th November, 2023									
HV1	RFA1								
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1		69.6	115.1		P(MW)			2.06
	L2		67	112.6		S(MVA)			2.1
	L3		67.5	117.4		Q(MVAr)			1.13
			68.03			X 19052.6		1.296	
	RFA2								
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1		76.5	171.5		P(MW)			2.739
	L2		76.8	144.9		S(MVA)			2.81
	L3		76.6	153.7		Q(MVAr)			1.18
			76.63			X 19052.6		1.46	
HV2	RFB1								
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1		19.6	43		P(MW)		0.373	0.859
	L2		19.6	40.3		S(MVA)		0.35	3.76
	L3		20.5	45.5		Q(MVAr)		0.01	3.07
	RFB2								
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1		29.3	249		P(MW)		0.558	1.069
	L2		28.4	220.3		S(MVA)		0.56	3.71
	L3		28	235.2		Q(MVAr)		0.02	3.2

24th November, 2023										
HV1	RFA1									
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1	71	76.3	87.4		P(MW)	1.45	1.419	2.062
	L2	69	72.5	84.6		S(MVA)	1.44	1.44	2.1
	L3	72	74.7	84.6		Q(MVAr)	0.13	0.1	1.13
	RFA2								
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1	73	75.4	89		P(MW)	1.516	1.456	1.673
	L2	75	76.3	88.3		S(MVA)	1.51	1.49	1.69
	L3	75	76.4	88.2		Q(MVAr)	0.03	0.05	0.44
HV2	RFB1								
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1	17.4	18.4	30.9		P(MW)	0.34	0.341	0.859
	L2	16.9	18.1	30.5		S(MVA)	0.33	0.35	3.76
	L3	17.1	18.6	32.4		Q(MVAr)	0.01	0	3.07
	RFB2								
	AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
	L1	32	31.9	39.2		P(MW)	0.6	0.592	1.069
	L2	32	31.3	37.8		S(MVA)	0.6	0.59	3.71
	L3	32	31	37.8		Q(MVAr)	0.03	0.04	3.2

30th November, 2023

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	80	81.5	92.7		P(MW)	1.58	1.545	1.727
L2	76	78.3	90.1		S(MVA)	1.57	1.56	1.74
L3	80	80.5	89.8		Q(MVAr)	0.09	0.09	0.29

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	86	87.1	99.5		P(MW)	1.66	1.671	1.841
L2	86	87.8	99.4		S(MVA)	1.67	1.67	1.91
L3	87	87.9	100.3		Q(MVAr)	0.05	0.07	0.49

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	21	19.4	32.9		P(MW)	0.4	0.376	0.596
L2	21	19.2	31.4		S(MVA)	0.4	0.39	0.62
L3	22	19.6	32.6		Q(MVAr)	0.03	0.02	0.13

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	33	33.7	42		P(MW)	0.65	0.639	0.778
L2	34	33.5	41.5		S(MVA)	0.64	0.64	0.79
L3	34	33.3	0.2		Q(MVAr)	0.05	0.05	0.16

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1					P(MW)			
L2					S(MVA)			
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1					P(MW)			
L2					S(MVA)			
L3					Q(MVAr)			

Industrial Units - Clamp Tests

Unit 1 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 2 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 3 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 5 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

07th December, 2023 (15.25)

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	75	73.3	91.8		P(MW)	1.44	1.403	1.717
L2	72	71.3	89		S(MVA)	1.45	1.43	1.73
L3	75	73.3	89.8		Q(MVAr)	0.1	0.09	0.32

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	79	79.7	96.7		P(MW)	1.54	1.52	1.836
L2	79	79.2	95.6		S(MVA)	1.55	1.55	1.85
L3	79	79.2	96.3		Q(MVAr)	0.03	0.03	0.49

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	19	18.9	33.2		P(MW)	0.38	0.372	0.608
L2	19	19.4	32.4		S(MVA)	0.37	0.37	0.63
L3	20	20.1	33.5		Q(MVAr)	0.02	0.01	0.12

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	36	36.1	50.8		P(MW)	0.68	0.657	0.97
L2	34	34.2	49.7		S(MVA)	0.69	0.66	0.98
L3	35	34.7	50.5		Q(MVAr)	0.04	0.02	0.15

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1					P(MW)			
L2					S(MVA)			
L3					Q(MVAr)			

Included

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
S1	247	273			P(MW)			
S2	286	288			S(MVA)	0.192	0.198	
S3	302	295			Q(MVAr)			

Calculated from averaging recorded figures @ 400V

Industrial Units - Clamp Tests

Unit 1 - Amps-Live	
L1	13
L2	12
L3	8
Averaged Total	11
kVA	7.612

Industrial Units - Clamp Tests

Unit 2 - Amps-Live	
L1	17
L2	17
L3	17.5
Averaged Total	17.2
kVA	11.88

Industrial Units - Clamp Tests

Unit 3 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Meter not located

Industrial Units - Clamp Tests

Unit 5 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Meter not located

Calculated from averaging recorded figures @ 400V

Industrial Estate Rounded/Estimated	Unit 1	Unit 2	Unit 3	Unit 5	Total
	8	12	10	15	45

15th December, 2023

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	78	76.9	89.8		P(MW)	1.43	1.418	1.66
L2	75	73.4	86.4		S(MVA)	1.42	1.43	1.67
L3	75	74.2	87.7		Q(MVAr)	0.11	0.1	0.29

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	77	78.5	93.6		P(MW)	1.53	1.48	1.761
L2	76	77.8	92.4		S(MVA)	1.47	1.46	1.78
L3	77	78.2	94.3		Q(MVAr)	0.05	0.04	0.2

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	19	19.4	34		P(MW)	0.39	0.376	0.612
L2	19	19.3	32		S(MVA)	0.39	0.39	0.63
L3	20	20	33.8		Q(MVAr)	0.02	0.01	0.12

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	34	34	50.8		P(MW)	0.62	0.634	0.809
L2	33	33	49.7		S(MVA)	0.61	0.63	0.81
L3	32	32.5	50.5		Q(MVAr)	0.02	0.03	0.13

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1					P(MW)			
L2					S(MVA)			
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		kVA	Live	Average	Maximum
L1	250	270			L1	69.7	62.26	
L2	303	273			L2	73.35	67.43	
L3	300	285			L3	71.53	66.29	
						214.58	195.98	

	Live	Average
MVA	0.2146	0.196

Industrial Units - Clamp Tests

Unit 1 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Insignigicant - not remeasured

Industrial Units - Clamp Tests

Unit 2 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Insignigicant - not remeasured

Industrial Units - Clamp Tests

Unit 3 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Meter not located

Industrial Units - Clamp Tests

Unit 5 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Meter not located

21st December, 2023

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	75	74.8	87.8		P(MW)	1.38	1.386	1.633
L2	72	71.6	85.8		S(MVA)	1.4	1.39	1.65
L3	71	71.3	86.2		Q(MVAr)	0.11	0.12	0.3

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	74	74.9	90.5		P(MW)	1.43	1.434	1.699
L2	75	74.5	89.7		S(MVA)	1.44	1.47	1.72
L3	75.5	75.1	90.6		Q(MVAr)	0.09	0.07	0.26

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	19	18.1	31.9		P(MW)	0.35	0.352	0.583
L2	18.7	18.1	31.1		S(MVA)	0.36	0.35	0.61
L3	20	18.5	32.2		Q(MVAr)	0.01	0.01	0.1

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	28	38.7	40.3		P(MW)	0.55	0.543	0.76
L2	28	27.5	39.7		S(MVA)	0.54	0.55	0.77
L3	29	28.2	39.7		Q(MVAr)	0.01	0.02	0.14

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	Included in Below Generator Loads				P(MW)	Included in Below Generator Loads		
L2					S(MVA)			
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	382.4	360.6			S1	85.21	87.57	109.7
L2	391.7	369.3			S2	86.7	89.55	110.9
L3	390.1	375.3			S3	89.2	91.48	114.6
						261.11	268.6	335.2

	Live	Average
MVA	0.261	0.269

Industrial Units - Clamp Tests

Unit 1 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 2 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 3 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 5 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

04th January, 2024

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	70	70.8	85.1		P(MW)	1.31	1.3171	1.571
L2	67	68	82.1		S(MVA)	1.32	1.33	1.59
L3	68	69.3	82.7		Q(MVAr)	0.06	0.08	0.28

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	73	72.2	85		P(MW)	1.34	1.36	1.598
L2	73	71.5	84		S(MVA)	1.34	1.34	1.61
L3	73	71.3	83.3		Q(MVAr)	0.02	0.02	0.41

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	16.6	17.5	102.4		P(MW)	0.32	0.326	0.576
L2	16	16.8	129.4		S(MVA)	0.32	0.33	1.95
L3	17.1	17.4	79.6		Q(MVAr)	0	0.01	1.5

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	34	33.4	39.8		P(MW)	0.65	0.641	0.74
L2	33	33.3	38.7		S(MVA)	0.65	0.64	0.75
L3	34	34	39.7		Q(MVAr)	0.04	0.04	0.11

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	Included in Below Generator Loads				P(MW)	Included in Below Generator Loads		
L2					S(MVA)			
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	ACCESS DENIED				S1	ACCESS DENIED		
L2					S2			
L3					S3			
						0	0	0

	Live	Average
MVA		

Industrial Units - Clamp Tests

Unit 1 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 2 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 3 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 5 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

11th January, 2024

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	82	83.4	97		P(MW)	1.56	1.567	1.801
L2	81	80.7	93.7		S(MVA)	1.56	1.58	1.81
L3	83	82	94.3		Q(MVAr)	0.08	0.09	0.28

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	87	86	96.9		P(MW)	1.65	1.682	1.851
L2	87	84.1	96.8		S(MVA)	1.64	1.63	1.86
L3	87	85.7	98.2		Q(MVAr)	0.04	0.05	0.39

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	23	20.5	34.3		P(MW)	0.49	0.411	0.627
L2	24	21	33.5		S(MVA)	0.5	0.49	0.65
L3	25	20.9	35		Q(MVAr)	0.06	0.02	0.13

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	40	41.5	53.1		P(MW)	0.77	0.789	0.988
L2	40	41.2	51.8		S(MVA)	0.8	0.77	1
L3	40	41.7	52.9		Q(MVAr)	0.05	0.04	0.16

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	Included in Below Generator Loads				P(MW)	Included in Below Generator Loads		
L2					S(MVA)			
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	ACCESS DENIED				S1	ACCESS DENIED		
L2					S2			
L3					S3			
						0	0	0

	Live	Average
MVA		

Industrial Units - Clamp Tests

Unit 1 - Amps-Live	
L1	11
L2	26
L3	15
Averaged Total	17.4
kVA	12.041

Unit 2 - Amps-Live	
L1	31
L2	25
L3	20
Averaged Total	25.4
kVA	17.577

Unit 3 - Amps-Live	
L1	Access not Possible
L2	
L3	
Averaged Total	
kVA	

Unit 5 - Amps-Live	
L1	Meter Not Found
L2	
L3	
Averaged Total	
kVA	

Industrial Estate Rounded/Estimated	Unit 1	Unit 2	Unit 3	Unit 5	Total
	12	18	13	20	63

Dental Wing SS13 - 400V

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	690	665	1180		P(MW)	0.45	0.559	0.604
L2	600	632	1540		S(MVA)	0.457	0.455	0.621
L3	630	605	1370		Q(MVAr)	0.006	0.005	0.19

Normanby SS16 - 400V

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	473	464	1190		P(MW)	0.31	0.311	0.519
L2	410	424	1310		S(MVA)	0.325	0.313	0.549
L3	420	437	1280		Q(MVAr)	0.01	0.012	0.18

800kVA Tx

Link Building

MD - 71.5kW/72.6kVA

CCU SS6

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	360	400			MW	0.231		0.705
L2	340	400			MVA	0.234		0.708
L3	330	400						

1.5MVA Tx

17th January, 2024

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	82	83.4	95		P(MW)	1.6	1.571	1.789
L2	79	79.2	91		S(MVA)	1.6	1.59	1.8
L3	83	82.7	93.7		Q(MVAr)	0.13	0.11	0.27

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	88	88.7	98.6		P(MW)	1.7	1.704	1.892
L2	88	87.8	99		S(MVA)	1.7	1.72	1.9
L3	92	90.5	100		Q(MVAr)	0.05	0.06	0.19

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	20	20.7	37.7		P(MW)	0.4	0.398	0.692
L2	20	20.8	36.7		S(MVA)	0.41	0.39	0.71
L3	20	20.7	37.4		Q(MVAr)	0.01	0	0.14

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	44	42.5	52.8		P(MW)	0.82	0.814	1.009
L2	43	41.5	53.7		S(MVA)	0.82	0.84	1.002
L3	44	42.6	53		Q(MVAr)	0.06	0.06	0.17

Average	Maximum	Average	Maximum
83.4	95		
79.2	91		
82.7	93.7		
245.3	279.7	85	93
88.7	98.6		
87.8	99		
90.5	100		
267	297.6	89	99
20.7	37.7		
20.8	36.7		
20.7	37.4		
62.2	111.8	21	37
42.5	52.8		
41.5	53.7		
42.6	53		
126.6	159.5	42	53
		237	282

Current/Phase @ 11kV

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	Included in Below Generator Loads				P(MW)	Included in Below Generator Loads		
L2					S(MVA)			
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	290.3	285.3			S1	Readings Not Available		
L2	284.1	274.5			S2			
L3	305.8	296.7			S3			
						0	0	0

	Live	Average	
MVA		0.206	Calculated

Industrial Units - Clamp Tests

Unit 1 - Amps-Live	
L1	20
L2	18-24
L3	11
Averaged Total	18.3
kVA	13.2

Industrial Units - Clamp Tests

Unit 2 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests

Unit 3 - Amps-Live	
L1	23-30
L2	30-45
L3	15-24
Averaged Total	33
kVA	23.8

Industrial Units - Clamp Tests

Unit 5 - Amps-Live	
L1	Meter Not Found
L2	
L3	
Averaged Total	
kVA	

Industrial Estate Rounded/Estimated	13	Construction Site 18	24	20	Total 75

25th January, 2024

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	72	74.6	100		P(MW)	1.35	1.41	1.86
L2	70	73.1	93.7		S(MVA)	1.39	1.4	1.87
L3	72	74.6	97.2		Q(MVAr)	0.11	0.12	0.27

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	78.5	74.1	103.4		P(MW)	1.56	1.434	1.989
L2	80	74	102.2		S(MVA)	1.55	1.55	2
L3	79	73.8	104.5		Q(MVAr)	0.05	0.03	0.21

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	18.5	17.4	33.7		P(MW)	0.35	0.34	0.631
L2	18	17.4	32.5		S(MVA)	0.33	0.33	0.65
L3	18	18.1	35.2		Q(MVAr)	0	0	0.15

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	30	29.8	51.6		P(MW)	0.54	0.558	0.985
L2	29.4	29.2	50.6		S(MVA)	0.54	0.54	0.99
L3	28	28.2	52.5		Q(MVAr)	0.02	0.03	0.14

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	Included in Below Generator Loads				P(MW)	Included in Below Generator Loads		
L2					S(MVA)			
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	175	356			S1	47.71		
L2	175	356			S2	40.08		
L3	175	356			S3	43.3		
						131.09	0	0

	Live	Average
MVA	0.121	0.246

Industrial Units - Clamp Tests	
Unit 1 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests	
Unit 2 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests	
Unit 3 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Units - Clamp Tests	
Unit 5 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	

Industrial Estate Rounded/Estimated	Unit 1	Unit 2	Unit 3	Unit 5	Total
	13	18	24	20	75

02nd February, 2024

HV1

RFA1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	73	72.7	87.4		P(MW)	1.37	1.356	1.637
L2	70	70	84.5		S(MVA)	1.38	1.36	1.65
L3	72	70.4	85.2		Q(MVAr)	0.05	0.07	0.25

RFA2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	80	81.1	89.5		P(MW)	1.5	1.531	1.697
L2	80	80.5	90.3		S(MVA)	1.5	1.49	1.71
L3	80	80.4	89.8		Q(MVAr)	o.06	0.05	0.43

HV2

RFB1

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	18	17.8	32.6		P(MW)	0.35	0.343	0.604
L2	17	17.7	31.8		S(MVA)	0.36	0.36	0.63
L3	18	18.4	33.9		Q(MVAr)	0	0.01	0.13

RFB2

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	29	29.3	43		P(MW)	0.51	0.543	0.796
L2	27	28	41.6		S(MVA)	0.51	0.52	0.8
L3	27	28.6	42.1		Q(MVAr)	0	0.01	0.12

Energy Centre

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1					P(MW)			
L2	Included in Below Generator Loads				S(MVA)	Included in Below Generator Loads		
L3					Q(MVAr)			

Generator Loads

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1			355.4		S1	Readings not available		
L2	Readings not available		342.2		S2	There is a clear issue with this		
L3			341		S3	meter		
						0	0	0

	Live	Average
MVA		0.246

Figure carried over from last week

Industrial Units - Clamp Tests	
Unit 1 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	
Industrial Estate Rounded/Estimated	13

Industrial Units - Clamp Tests	
Unit 2 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	
	18

Industrial Units - Clamp Tests	
Unit 3 - Amps-Live	
L1	
L2	
L3	
Averaged Total	
kVA	
	24

Industrial Units - Clamp Tests		
Unit 5 - Amps-Live		
L1		
L2		
L3		
Averaged Total		
kVA		
	20	Total 75

Carried from previous week

Link Building	81.4kW	82.4kVA

SS10/UNIT 6

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	80				MW	0.0544		0.1425
L2	80				MVA	0.0547		0.143
L3	80							

Set up of the meter is questionable as this load appears low given the duty requirement

Unit 4 Fed From Unit 6

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	19				MW	0.011		0.0724
L2	19				MVA	0.014		0.0752
L3	19							

Dental Wing SS13

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1	450	452	1.18		P(MW)	280	292	623
L2	390	413	1.54		S(MVA)	285	295	636
L3	380	402	1.37		Q(MVAr)	21	26.7	199

Bessemer Wing - Clamp Test	
SR/3B Essential Supply - Amps-Live	
L1(Br)	190
L2(Blk)	190
L3(G)	175
Averaged Total	185
kVA	128

Bessemer Wing - Clamp Test	
SR/3B N/E Supply - Amps-Live	
L1	77
L2	70
L3	95
Averaged Total	80.7
kVA	55.85

Bessemer Wing - Total	
SR/3B Supplies - Live	
L1	267
L2	260
L3	270
Averaged Total	266
kVA	184

Units 7 & 8 - Clamp Test	
TC1/A Switchboard - Amps Live	
L1(Br)	
L2(Blk)	
L3(G)	
Averaged Total	
kVA	

Units 7 & 8 - Clamp Test	
TC1/A Switchboard - Amps Live	
L1	
L2	
L3	
Averaged Total	
kVA	

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1					MW			
L2					MVA			
L3								

AMPS	Live	Average	Maximum		POWER	Live	Average	Maximum
L1					MW			
L2					MVA			
L3								

KINGS COLLEGE HOSPITAL DENMARK HILL - PROJECTED ELECTRICAL LOAD DEMAND

FUTURE SITE LOAD FORECAST - MVA

AREA/LOCATION	Calculated MVA	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040		NOTES
Trust MV System Load - Average + 2% annual Creep. Excl existing EC	3.974	3.974	3.974	4.05	4.13	4.21	4.29	4.38	4.47	4.56	4.65	4.74	4.83	4.93	5.03	5.13	5.23	5.33	5.44	5.55	
Existing Dental/DS Load Decommissioned Load removed	0.455																-0.455	-0.455	-0.455	-0.455	
Existing Generator Panel/EC Load	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24												This is the existing Veolia energy Centre load
GJW load - (From HH metering) + 2% annual Creep	0.65																				Removed from calculation- see note 1 below
Existing Link Building Load	0.073																				
Link Bld Redevelopment	1.133											1.133	1.133	1.133	1.133	1.133	1.133	1.133	1.133	1.133	
Link Building Energy Centre (Ex CHP & Gas Boiler Decommissioning)	6.88				Design & Enabling		Construction		6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	6.88	Transition & Recommended 33kV/13MVA Supply Capacity Availability
Dental & DS Building Redevelopment, Buildings A1, A2 & B	1.085																0.326	0.577	1.085	1.085	
Dental Energy Centre	0.68																0.68	0.68	0.68	0.68	
Normanby Site Development Phlebotomy, & Pharmacy	0.081								0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	0.081	
Normanby Site Development Willofield 2	0.112							0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	0.112	
Nueroscience Bld Load Decommissioned	0.015							-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	-0.015	NOTIONAL - Estimated
Haematology Building Development & New SS10	0.43					0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	
Existing Industrial Estate Load - U's 1,2, 3 & 5	0.063																				
Industrial Units 5, 4 & 3 Redevelopment	0.202													0.202	0.202	0.202	0.202	0.202	0.202	0.202	NOTIONAL - Estimated
Industrial Units 2 & 1 Redevelopment	0.129														0.129	0.129	0.129	0.129	0.129	0.129	NOTIONAL - Estimated
Industrial Unit 6 Load Decommissioned	0.054					-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	-0.054	
Industrial Unit 4 Loads Decommissioned	0.013														-0.013	-0.013	-0.013	-0.013	-0.013	-0.013	NOTIONAL. Currently served from U6/Tx10
Units 7 & 8 - Building D Development	0.31															0.31	0.31	0.31	0.31	0.31	
Existing Units 7 & 8 Load Decommissioned	0.053															-0.053	-0.053	-0.053	-0.053	-0.053	NOTIONAL - Estimated
Additional Modular Theatres - South	0.35					0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	Load based on 2021 Orpington modular provision - 176kV per Theatre
Bessemer Wing - 9 Storey Replacement	0.699																			0.699	
Existing Bessemer Wing Load Decommissioned	0.184																		-0.184	-0.184	NOTIONAL - Estimated
Trust Electric Vehicle Charging	0.194						0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194	0.194	Distributed across various load centres
South Road Imaging Sub Station	0.2			0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Anticipated Total Load		4.214	4.214	4.49	4.57	5.376	5.65	5.837	12.888	12.738	12.828	14.051	14.141	14.443	14.659	15.016	15.667	16.018	16.452	17.261	
Load @ 0.9 Site Wide Diversity						4.84	5.1	5.25	11.6	11.5	11.55	12.65	12.73	13	13.19	13.52	14.9	15.22	15.63	16.37	

UKPN Agreed Supply Capacity MVA	4.00
EC CHP Electrical Capacity MVA	4.2
UKPN Plant Capacity MVA	7.6
Independent UKPN Supplies	
Notional Load Figures	

TARGET TIMELINE FOR 80% REDUCTION IN CARBON

NET ZERO CARBON

End of current Veolia EC contract

End of Veolia EC extension contract

End of GJW PFI contract (July 37)

	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
Minimum Standby supply capacity to cater for part/total CHP generating loss - MVA	4.5	4.5	4.5	5	5.5	6	6												
Proposed UKPN agreed supply capacity - MVA	5	5	5	5	6	6	6	13	13	13	14	14	15	15	15	16	17	17	18
Existing Firm Supply Capacity	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4

Limit of Existing MV Plant Capacity Exceeded

33kV supply required from this point onward

NOTES

1 GJW currently recieves energy via an independent UKPN supply service. This is not anticipated to change in the near future due to the PFI operating contract implications.Trust already purchase the energy for this building. Removed from site wide electrical load calculations model. Consideration can be given to connecting to Trust MV sytem at PFI contract end, but not essential or recommended.

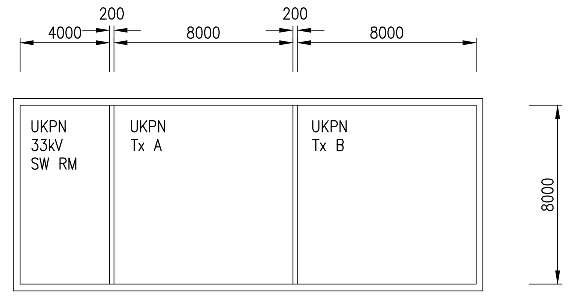
	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041	
GJW anticipated yearly increase/crease		0.663	0.676	0.69	0.704	0.718	0.732	0.747	0.762	0.777	0.793	0.809	0.825	0.841	0.858	0.875	0.892	0.91	0.923	

Appendix D

Energy Centre, (South) Plant Layout Proposals

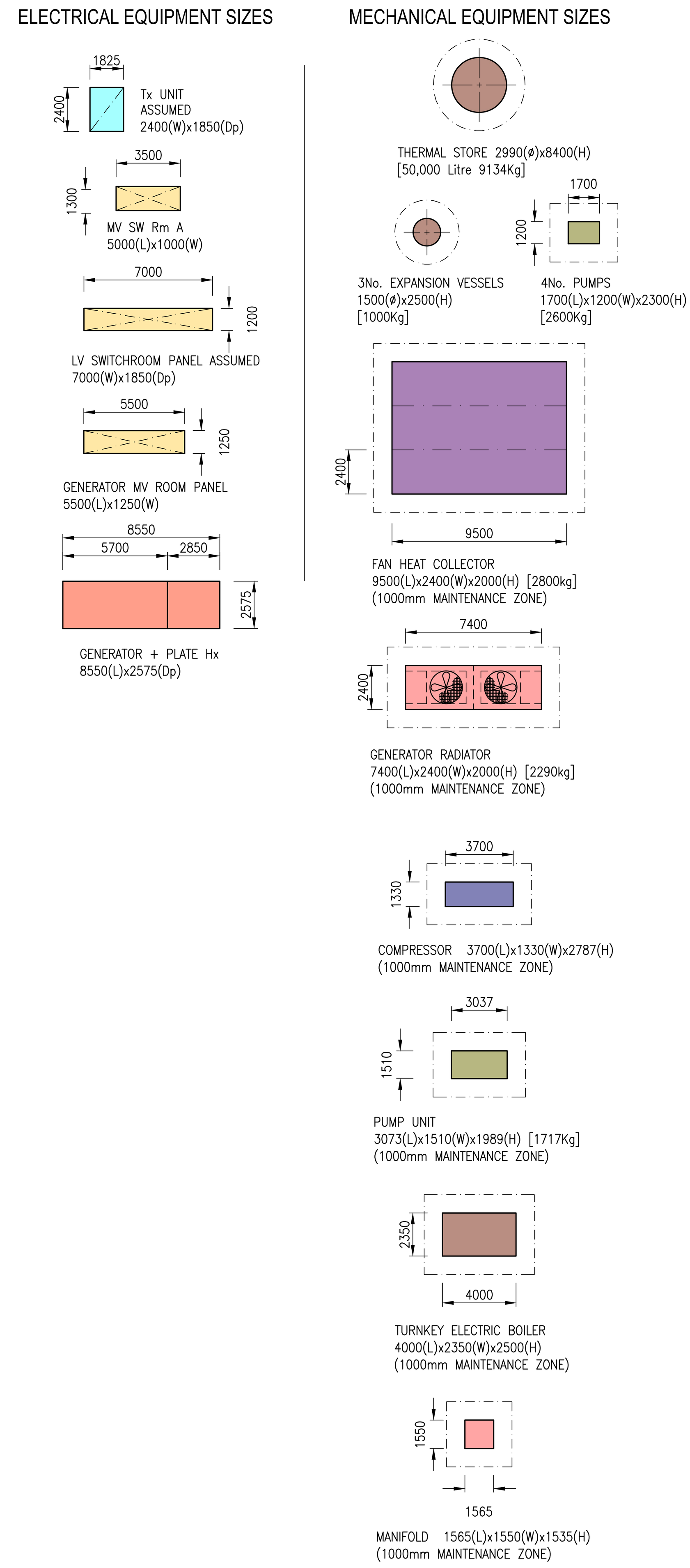
DO NOT SCALE

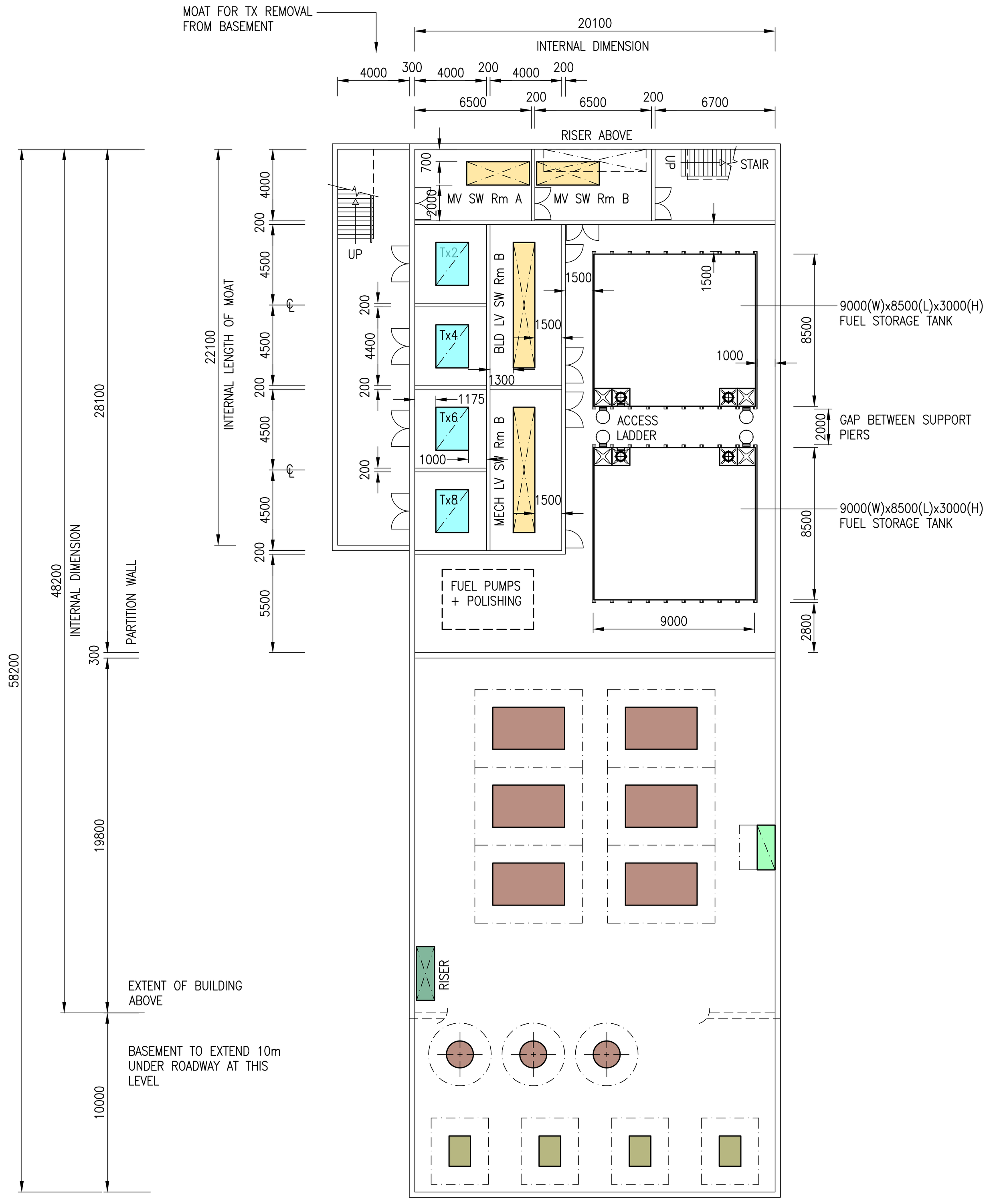
INDICATIVE LOCATION PLAN
SCALE 1:250



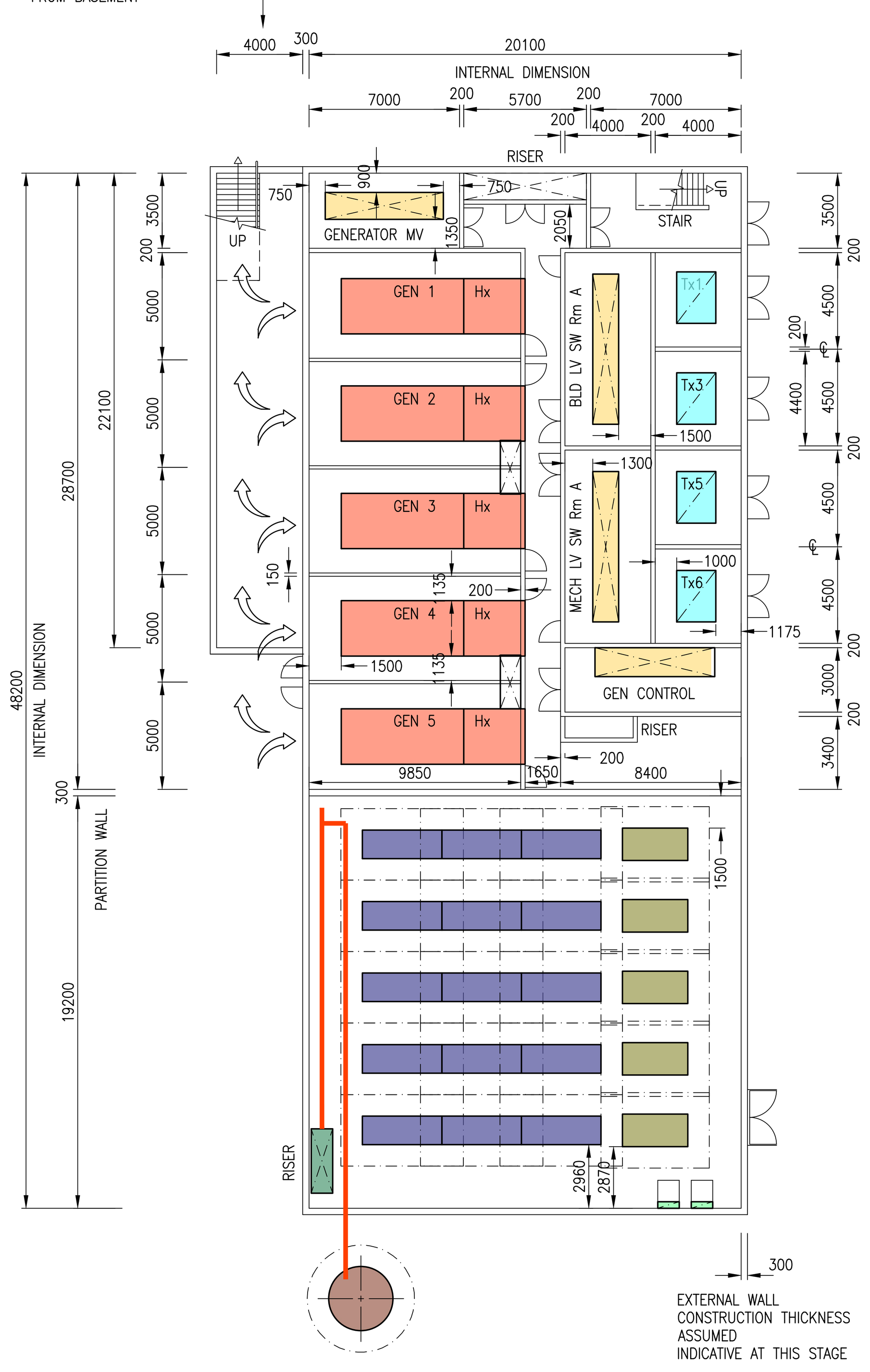
UKPN LAYOUT

ROOF LEVEL

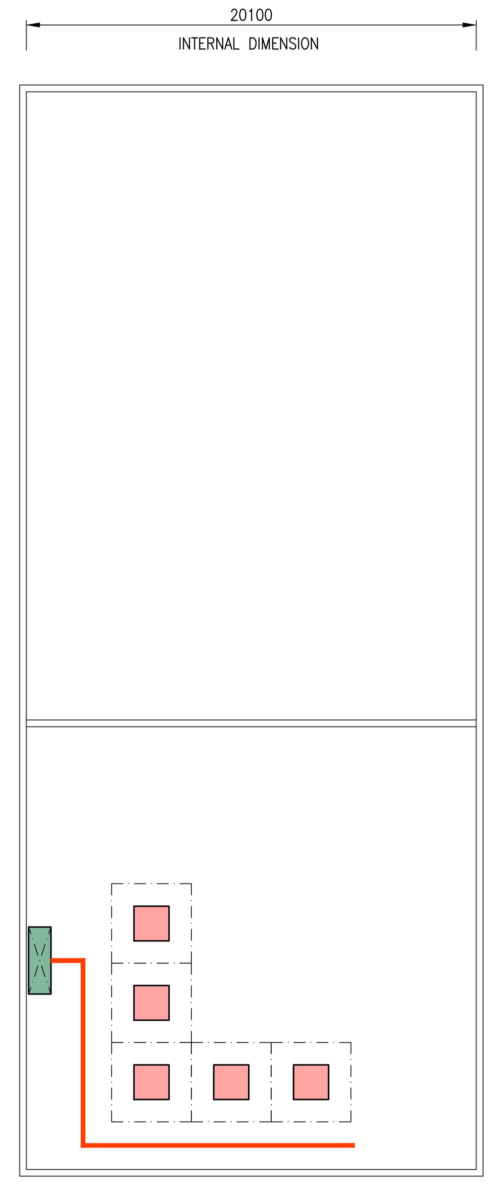




BASEMENT LEVEL



GROUND FLOOR LEVEL



LEVEL BELOW ROOF

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION STAGE 2 DESIGN

TITLE: MECHANICAL SERVICES ENERGY PLANTROOM LAYOUT

SCALE @ A0: 1:200	CHECKED: CWH		APPROVED: PW
PROJECT No: 70096113	DESIGNED: CWH	DRAWN: CAD	DATE: FEB 2024

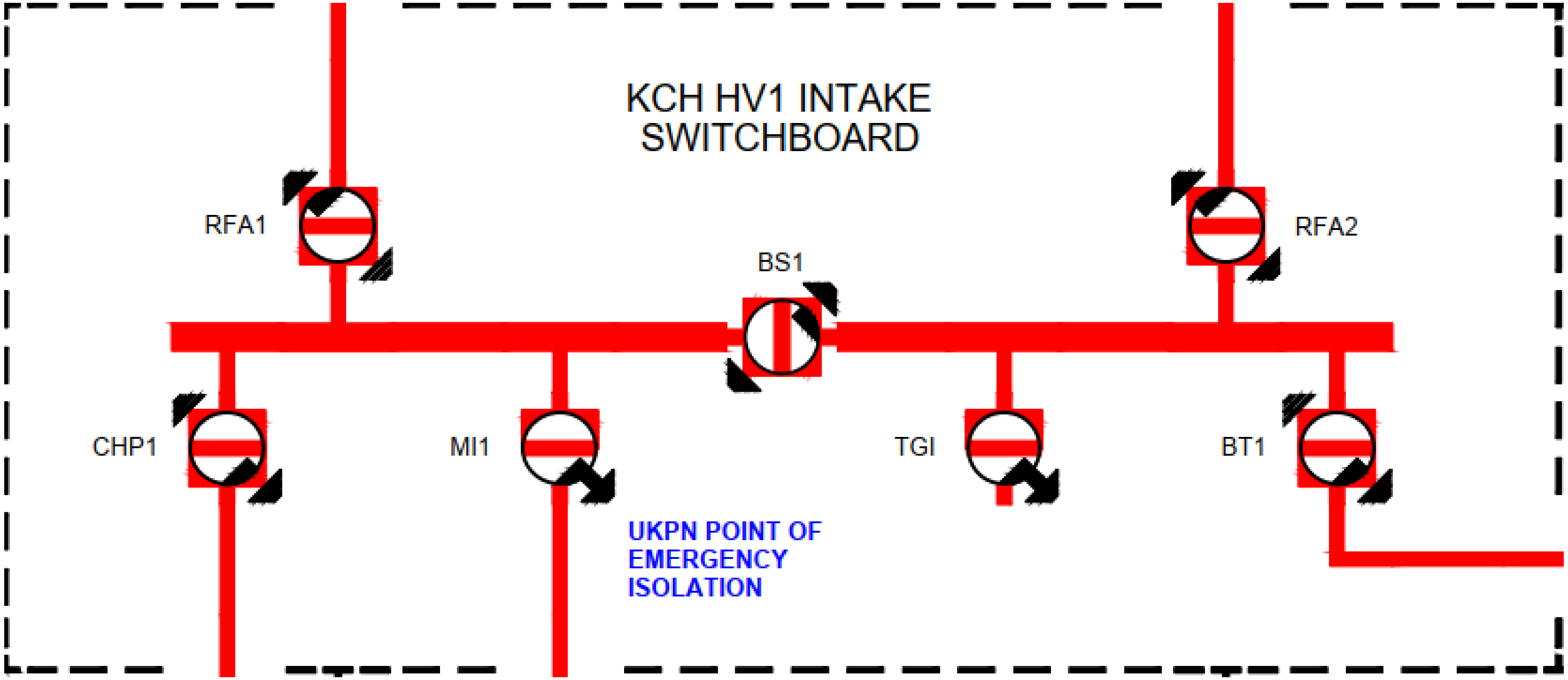
DRAWING No: KCH113-WSP-DMK-ZZ-DR-M-5001 REV: -

Appendix E

Schedule of Existing Electrical Distribution Equipment

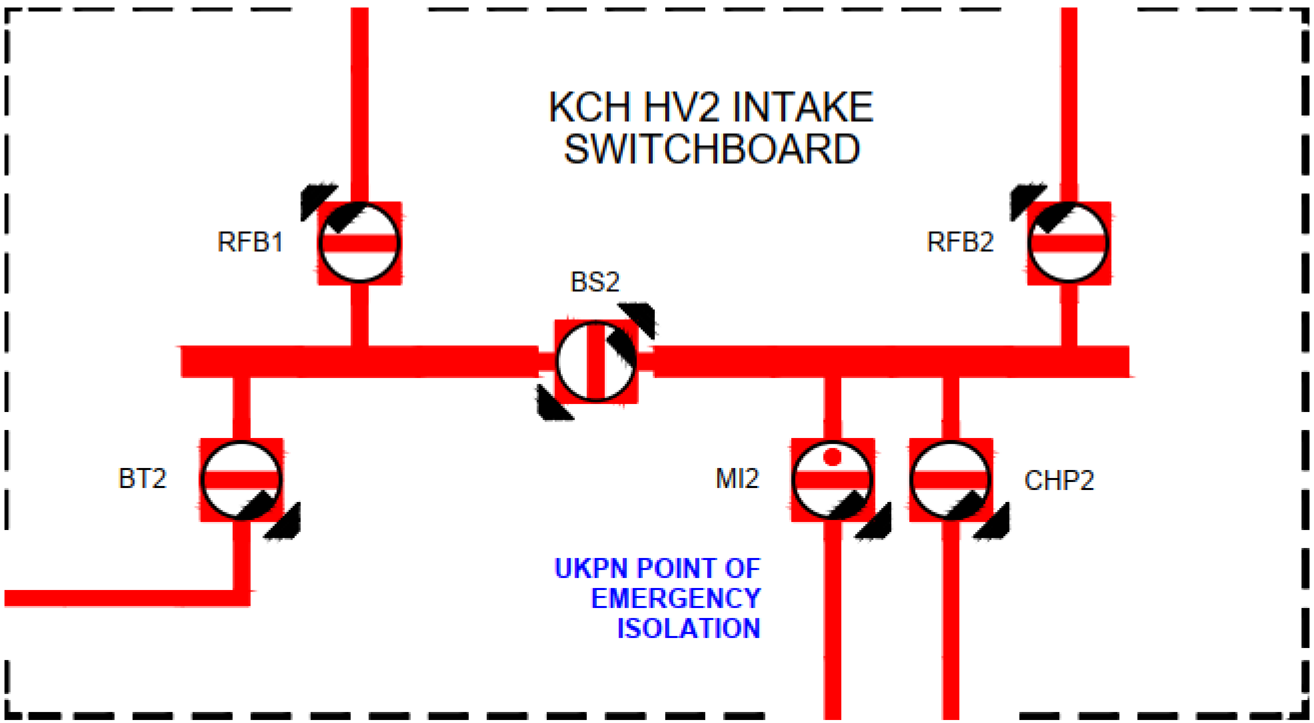
SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Intake Substation HV1 KCH Room Reference ISM0G002 (Old Ref GSP0P003)

Column Number	1	2	3	4	5	6	7	8
Label/Function	**CHP1**	**RFA1 (TC2A)**	**MI1**	**BS1**	**TG1** Spare (was MI2)	**RFA2 (SS 1A)**	**BT1**	
Description	VCB	SF_6 CB	SF_6 Switch	SF_6 CB	SF_6 Switch	SF_6 CB	VCB	
Maker	HSS	HSS	HSS	HSS	HSS	HSS	HSS	
Switchgear Type	VMV 12/6/25	HG12	HG12S/1	HG12	HG12S/1	HG12	VMV 12/6/25	
Serial Number (Chassis where withdrawable)	91409601/1	136692	136691	136690	136693	136694	91409601/1	
Rating Busbars Amps	1250	TBA	TBA	TBA	TBA	TBA	1250	
Rating Sw/CB: Amps	630	630	630	630	630	630	630	



SWITCHGEAR AND TRANSFORMER SCHEDULE **LOCATION: Intake substation HV2** **KCH Room Reference ISM01002**

Column Number	1	2	3	4	5	6	7	8
Label/Function	**Future**	**BT2**	**RFB1 (TC2B)**	**BS2**	**MI2**	**EC2**	**RFB2 (SS16)**	**Future**
Description		VCB VC6-P1S	VCB VC6-P1S	VCB VC6-P1B	VCB VC6-P1S	VCB VC6-P1S	VCB VC6-P1S	
Maker		Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	
Switchgear Type		Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo	
Serial Number (Chassis where withdrawable)		101746201	101746203	101746251	101746249	101746247	101746245	
Rating Busbars Amps		1250	1250	1250	1250	1250	1250	
Rating Sw/CB: Amps		630	630	630	630	630	630	

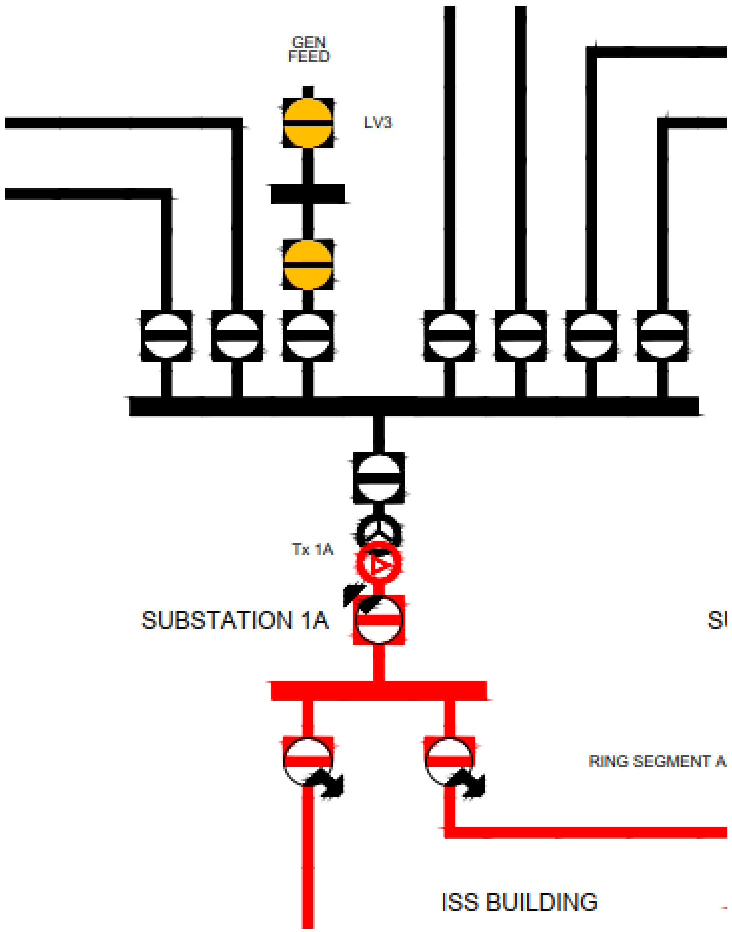


SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Substation 1A KCH Room Reference GSP0P006

Column Number	1	2	3		4			
Label/Function	**KCH 11 kV switchroom**	**None**	**TC1B**		**LV 1A ACB**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		3 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster2				Loadline Z frame			
Maker	Yorkshire Switchgear (Now Schneider)				Dorman Smith			
Serial Number	SR2J94236				18347281-1			
Year	1994				1994?			
Rating Busbars Amps	630	630	630		1600			
Rating Sw/CB: Amps	630	200	630		1600			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2008	Schneider	ONAN	11,000	433	Dyn11	1,000	4.63	1-5	2	492kg	2,650kg	PDV, BC, TC, JL, LL, SG, SBR	100568244	None

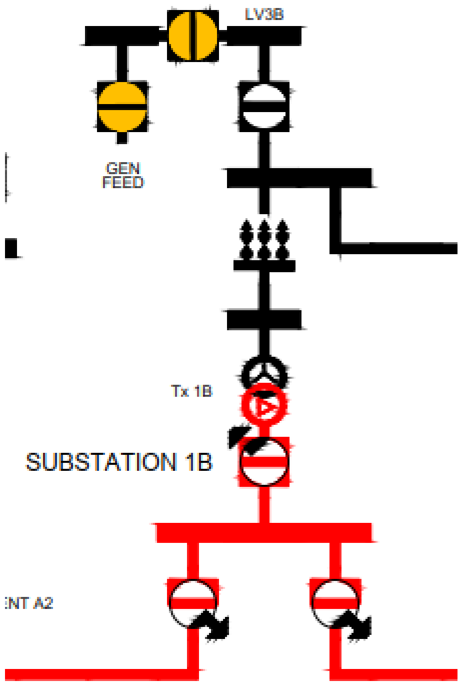


SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Substation 1B KCH Room Reference GSP0P007

Column Number	1	2	3		4			
Label/Function	**TC1A**	**TC1BTx**	**RF to SS10**		**Transformer Links**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		Manual links			
Switchgear Type	SF_6 RMU Ringmaster RN2-T1/21				SAIF			
Maker	Merlin Gerin (Now Schneider)				Schneider (Merlin Gerin)			
Serial Number	SR3M05390							
Year	2005							
Rating Busbars Amps	630	630	630					
Rating Sw/CB: Amps	630	200	630					

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2006	Schneider	ONAN	11,000	433	Dyn11	1,000	4.6	1-5	3	945L	2,850kg	PDV, BC, TC, LL, JL, SG, SBR	GL23175	None

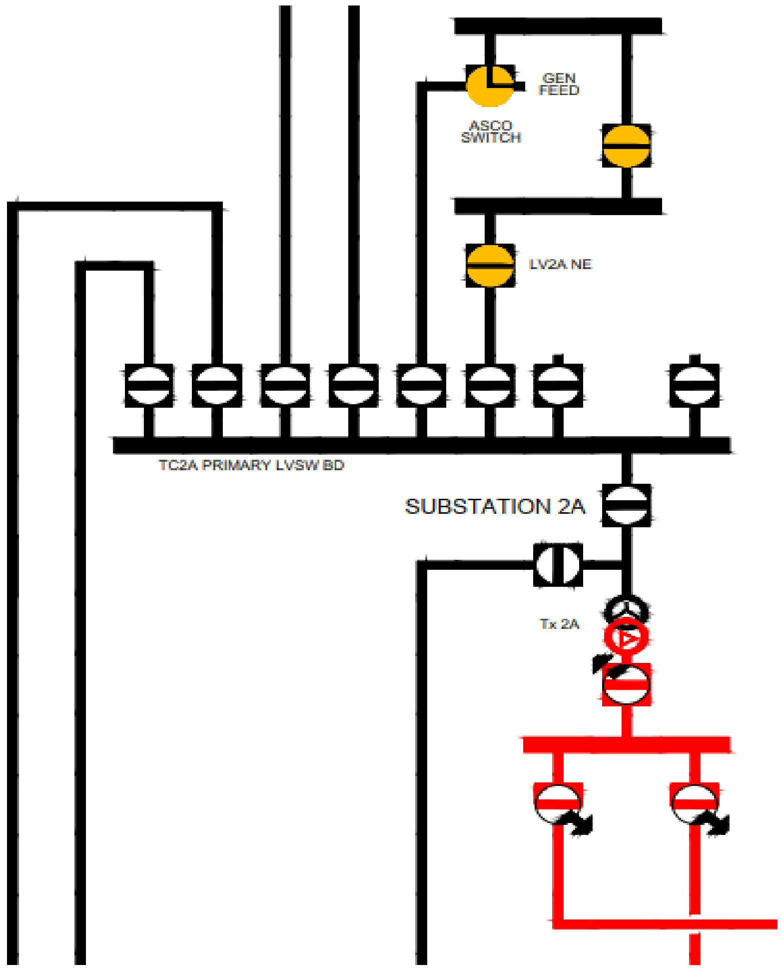


SWITCHGEAR AND TRANSFORMER SCHEDULE **LOCATION: Substation 2A** **KCH Room Reference HMC0B085**

Column Number	1	2	3		4			
Label/Function	**Admin TC7**	**TC1BTx**	**KCH 11 kV Sw Rm**		**LV 1A ACB**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		3 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster 2				Loadline Z frame			
Maker	Yorkshire Switchgear				Dorman Smith			
Serial Number	SR2B95085				1835958			
Year	1996				1996?			
Rating Busbars Amps	630	630	630		1600			
Rating Sw/CB: Amps	630	200	630		1600			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2003	Schneider	ONAN	11,000	433	Dyn11	1,000	4.58	1-5	1	670kg	2,900kg	PDV, BC, TC, LL, JL, SG, SBR	DL8227	None

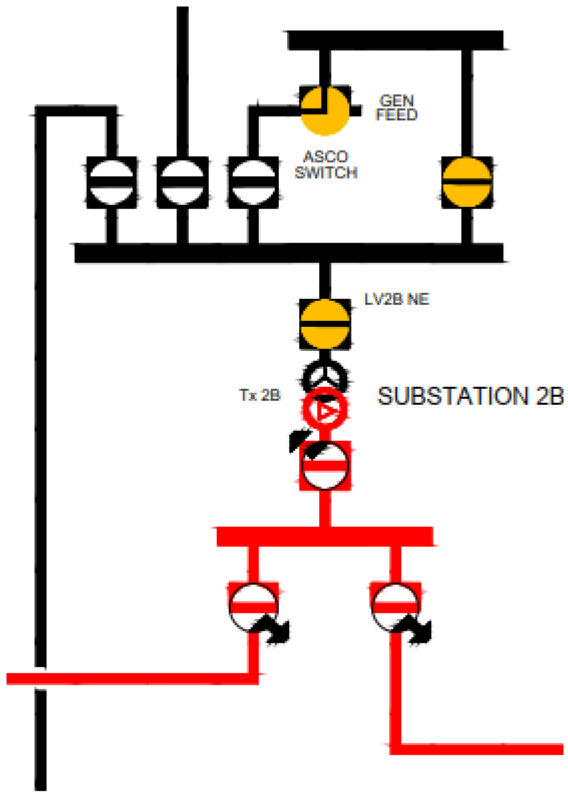


SWITCHGEAR AND TRANSFORMER SCHEDULE **LOCATION: Substation 2B** **KCH Room Reference HV HMC0B013 LV HMC0G0??**

Column Number	1	2	3		4			
Label/Function	**Ring B to SS11**		**Ruskin 11 kV interconnect**		**Tx 2B Incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		4 pole MCCB			
Switchgear Type	SF_6 RMU Ringmaster RN2-T2/21				NT16-H2			
Maker	Schneider				Schneider			
Serial Number	10218371				TBA			
Year	2015				2015			
Rating Busbars Amps	630	630	630		1600			
Rating Sw/CB: Amps	630	200	630		1600			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2015	Schneider	KNAN	11,000	433	Dyn11	1,000	4.72	1-5	2	1,038kg	4,400kg	PDV, BC, TC, LL, JL, SG, FTI, SBR	102147942	None

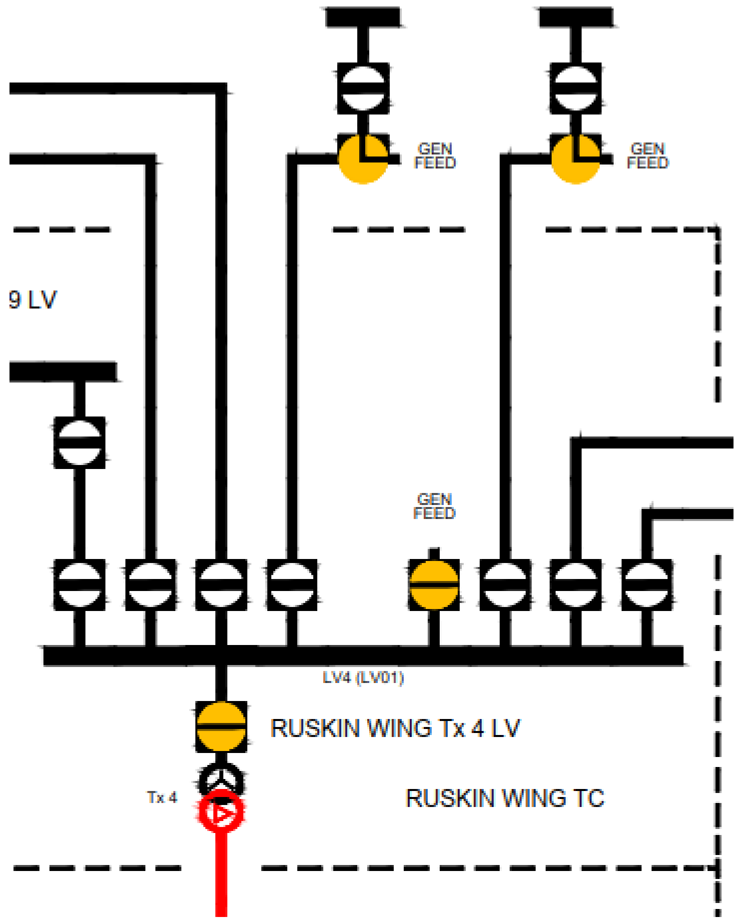


SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Transformer No 4 KCH Room Reference RUS0B041

Column Number	1	2	3		4			
Label/Function					**Tx 4 Incomer in room RUS0B029**			
Description					4 pole ACB			
Switchgear Type	Tx 4 fed from CE2 SF_6 circuit breaker in Ruskin wing interconnect switchboard				AR325S			
Maker					Terasaki			
Serial Number					TBA			
Year					TBA			
Rating Busbars Amps					2,500			
Rating Sw/CB: Amps					2,500			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2015	Schneider	ONAN	11,000	415	Dyn11	1,500	5.35	1-5	2	1,435 L	5,250kg	PDV, BC, TC, LL, JL, SG, FTI, WTI, SBR	1954373 4074/1	None

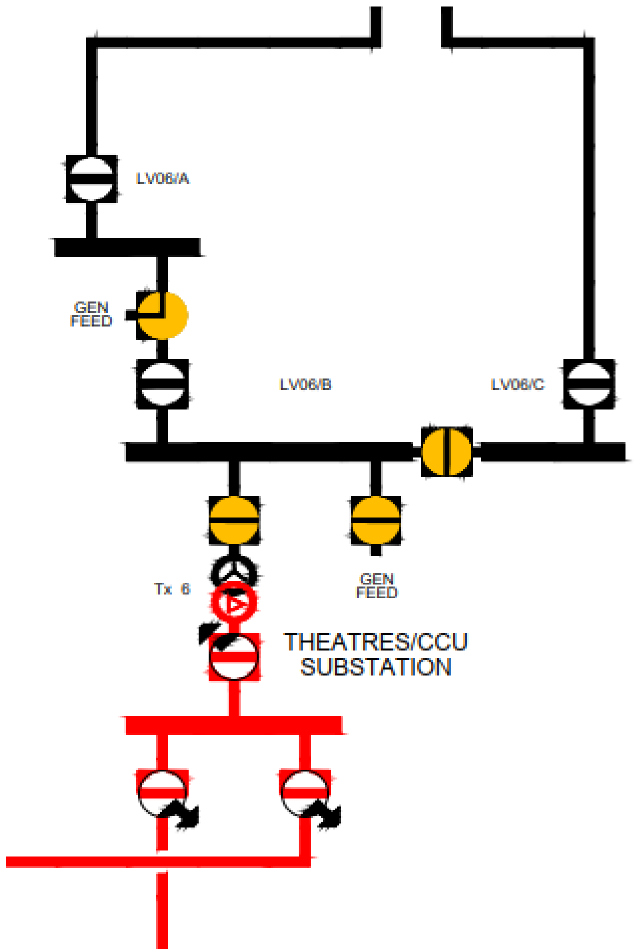


SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Substation 6 Theatre Block KCH Room Ref HV RUS0G141 LV RUS0G078

Column Number	1	2	3	4	5	6	7	8
Label/Function	**Substation 10**	**Local Tx**	**Interconnect Switchboard**		**LV02 Tx incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		4 pole 2,500 A ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2C T2/21				AR325S withdrawable ACB			
Maker	Schneider				Terasaki			
Serial Number	102528179							
Year	2016/07				2017			
Rating Busbars Amps	630	630	630		2,500 A			
Rating Sw/CB: Amps	630	200	630		2,500 A			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2016	Wilson Power Solutions	KNAN	11,000	415	Dyn11	1,500	5.48	1-7	4	1,150kg	5,550kg	PDV, BC, TC, JL, LL, SG, FTI, SBR, FTI. WTI	5010079/6676	None

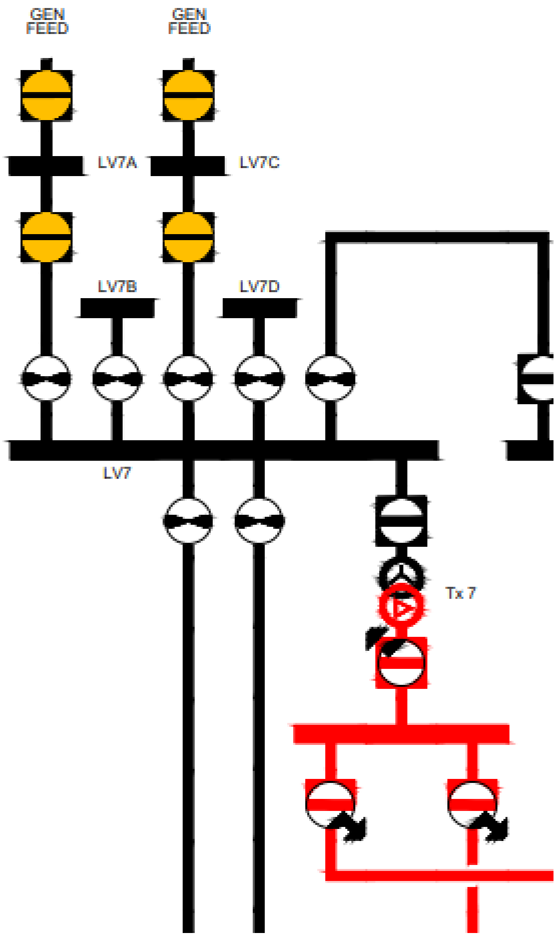


SWITCHGEAR AND TRANSFORMER SCHEDULE   LOCATION: Substation 7   KCH Room Reference HMNB0B012

Column Number	1	2	3		4			
Label/Function	**TC 2A**		**TC 8**		**ACB**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		3 pole fixed ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2-T1/21				M20H1			
Maker	Merlin Gerin (Now Schneider)				Schneider (Merlin Gerin)			
Serial Number	SR2J95390							
Year	1995				TBA 1995?			
Rating Busbars Amps	630	630	630					
Rating Sw/CB: Amps	630	200	630		1,600			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	1995	Merlin Gerin	ONAN	11,000	433	Dyn11	1,000	4.49	1-5	1	715 L	2,750kg	PDV, BC, TC, LL, JL, SG,SBR, FTI Not connected	LC71411	None

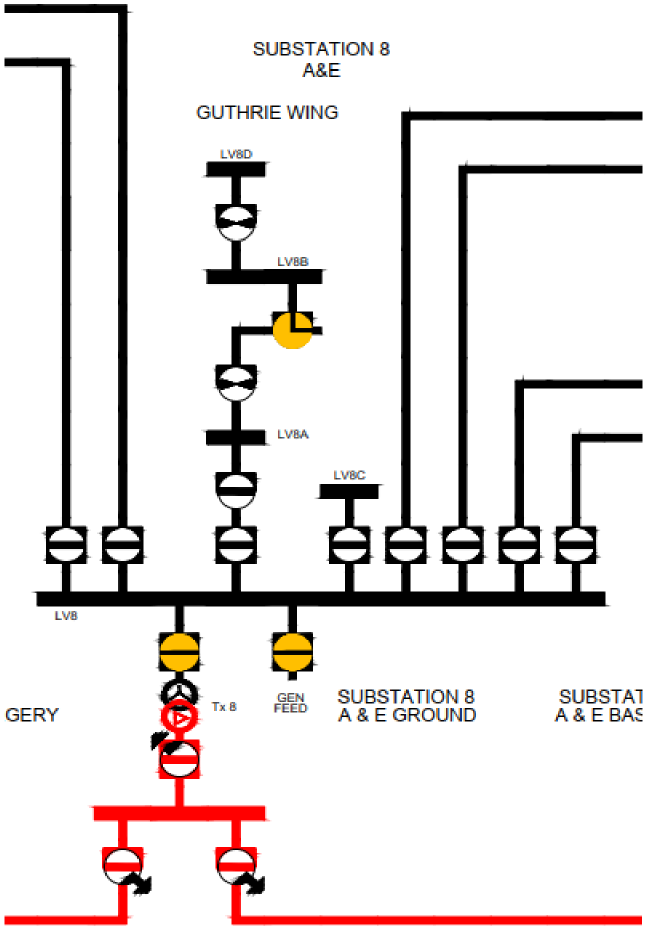


SWITCHGEAR AND TRANSFORMER SCHEDULE   LOCATION: Substation 8   KCH Room Reference GUE0G003

Column Number	1	2	3		4			
Label/Function	**TC 7**		**Tx 9**		**MCCB**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		4 pole withdrawable MCCB			
Switchgear Type	SF_6 RMU Ringmaster RN2-T1/21				NS1600N			
Maker	Merlin Gerin (Now Schneider)				Schneider			
Serial Number	SR2B91206							
Year	1994				2011			
Rating Busbars Amps	630	630	630					
Rating Sw/CB: Amps	630	200	630		1,600			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2011	PDT	KNAN	11,000	415	Dyn11	1,000	4.67	1-7	3	1,250 L	4,200 kg	PDV, BC, TC, LL, JL, SG, SBR, FTI	1712837/1159	None

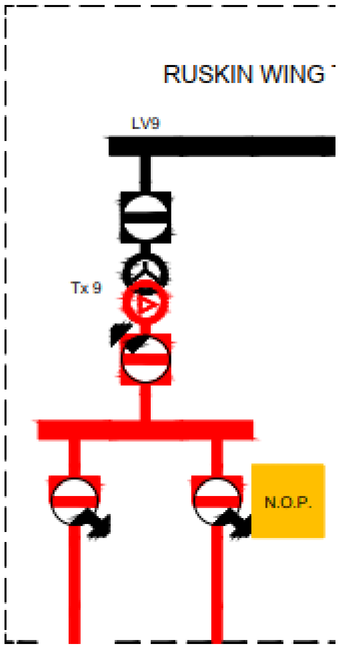


SWITCHGEAR AND TRANSFORMER SCHEDULE Tx 9 LOCATION: Transformer Chamber 4/9 KCH Room Reference RUS0B041

Column Number	1	2	3		4			
Label/Function	**TC8**		**Ruskin Interconnect**		**LV 9 ACB in room RUS0B043**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2C T1/21				NW16H1C			
Maker	Merlin Gerin				Schneider			
Serial Number	SR3F03256				TBA			
Year	2003				TBA			
Rating Busbars Amps	630	630	630		1600			
Rating Sw/CB: Amps	630	200	630		1600			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2003	Schneider	ONAN	11,000	433	Dyn11	800	4.40	1-5	2	735kg	2,820kg	PDV, BC, TC, LL, JL, SG, SBR	DL8227	None

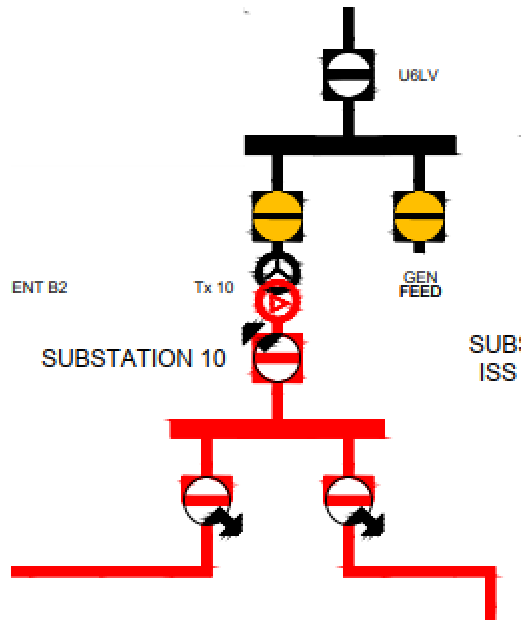


SWITCHGEAR AND TRANSFORMER SCHEDULE   LOCATION: Substation 10   KCH Room Reference CH60G044 MV CH60G014 LV

Column Number	1	2	3		4			
Label/Function	**TC 1B**	**Local Tx**	**TC6**		**Tx incomer in room CH0G014**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		4 pole MCCB			
Switchgear Type	SF_6 RMU Ringmaster RN2C T2/21				NS1600N			
Maker	Schneider				Schneider			
Serial Number	100357366R				3569482			
Year	2007				2011			
Rating Busbars Amps	630	630	630		1600			
Rating Sw/CB: Amps	630	200	630		1600			

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	1987	South Wales Tx	ONAN	11,000	433	Dyn11	800	4.79	1-5	1	570 L	3.150kg	PDV, BC, TC, JL, LL, SG, SBR	104952	None

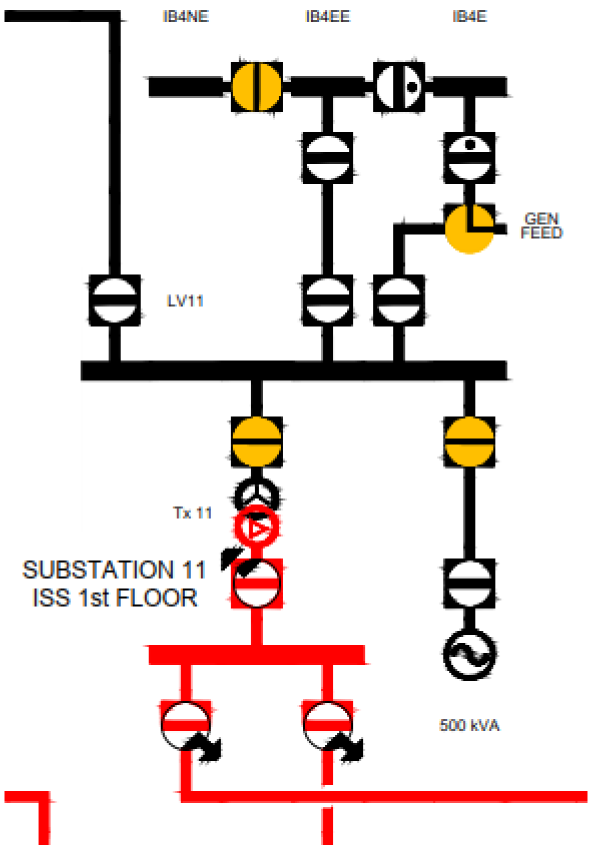


SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Substation 11 - 1st floor ISS KCH Room Ref ISM01001

Column Number	1	2	3	LV Cubicle 3	LV Cubicle 2	LV Cubicle 1
Label/Function	**TC 2B**	**Local 1,250 kVA Tx**	**HV2 RF B1**	Outgoing	Outgoing	**LV11 Tx incomer/Generator Incomer**
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	Cubicle 3	Cubicle 2	4 pole ACBs
Switchgear Type	SF_6 RMU Ringmaster RN2C T2/21			NSX	NSX400N	NW20H1/NW08H1
Maker	Schneider			Schneider	Schneider	Schneider
Serial Number	101745594					**PP1330110477/?**
Year	2013			2013	2013	2013
Rating Busbars Amps	630	630		2,000	2,000	2,000
Rating Sw/CB: Amps	630	200	630	Varies	Varies	2,000/800

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2013	Schneider	KNAN	11,000	415	Dyn11	1,250	5.29	1-7	3	1,088kg	4,750kg	PDV, BC, TC, JL, LL, SG, FTI, SBR	101774131	None

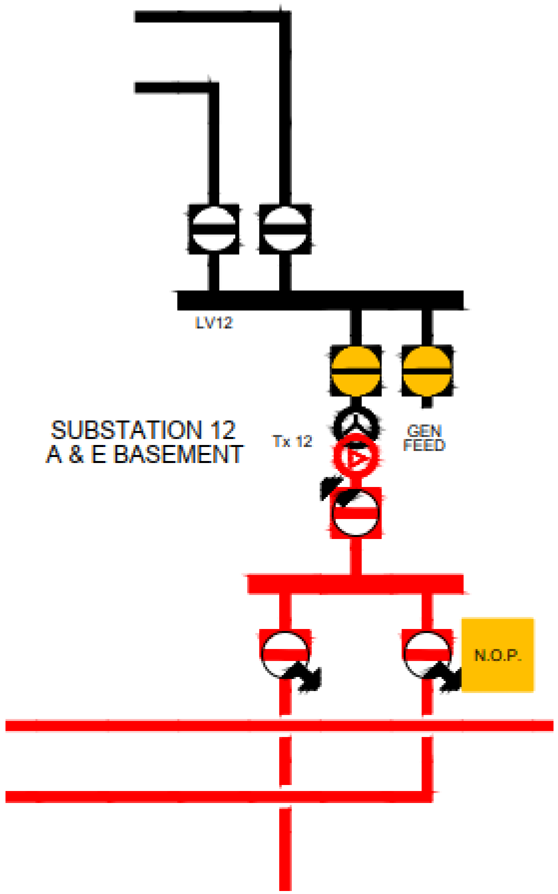


SWITCHGEAR AND TRANSFORMER SCHEDULE **LOCATION: Substation 12 Denmark Wing Basement** **KCH Room Ref DNK0B004**

Column Number	1	2	3	LV Cubicle 10	LV Cubicle 11
Label/Function	**Ruskin Wing Interconnect**	**Local 1,500 kVA Tx**	**SS 13 Dental**	**LV12 Tx incomer**	LV 12 Generator incomer
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	4 pole ACB	4 pole ACB
Switchgear Type	SF_6 RMU Ringmaster RN2D-T2/21			MTZ2-M25H1+ Micrologic 5.0X	MTZ1-12-H2
Maker	Schneider			Schneider	Schneider
Serial Number	103862798			???	???
Year	2021/04			**2021**	**2021**
Rating Busbars Amps	630	630	630	2,500 A	1,250 A
Rating Sw/CB: Amps	630	200	630	2,500 A	2,500 A

Transformers

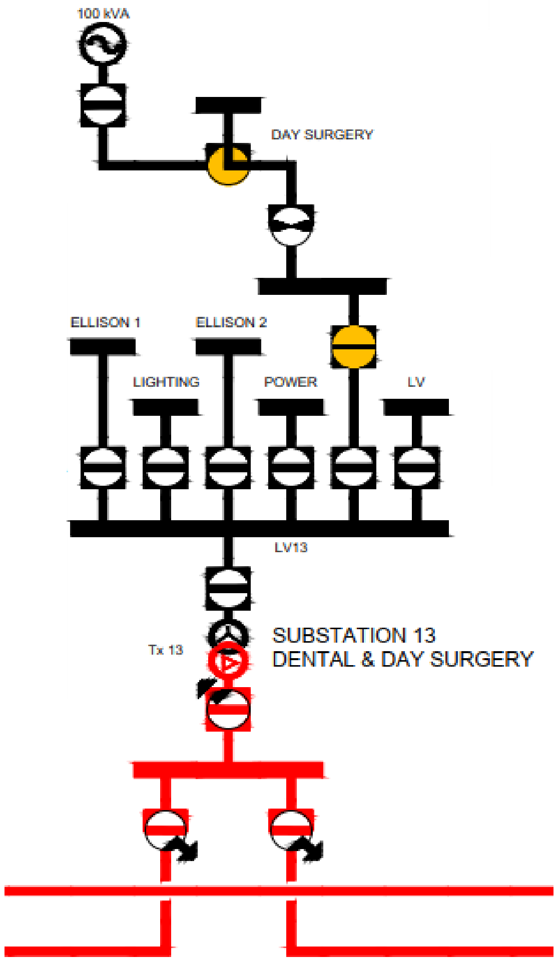
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2021	Schneider	KNAN Midel	11,000	415	Dyn11	1,500	5.39	1-6 -7.5%+5%	3	1,402kg	5,942kg	PDV, BC, TC, JL, LL, SG, FTI, WTI, SBR, PRD	5172710 (11109)	None



SWITCHGEAR AND TRANSFORMER SCHEDULE **LOCATION: Substation 13 Dental School** **KCH Room Ref GSPOP043 MV GSPOS044 LV**

Column Number	1	2	3	4	5	6	7	8
Label/Function	**TC 12 A&E Basement**	**Local 1,500 kVA Tx**	**SS 16 Normanby**		**LV13 Tx incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2C T2/21				MTZ2 H1 2500 A + Micrologic 6.0X			
Maker	Schneider				Schneider			
Serial Number	103958466				?			
Year	2021/08				2021			
Rating Busbars Amps	630	630	630		2,500 A (50 kA 1 Second) 2 x 80 x 10 mm			
Rating Sw/CB: Amps	630	200	630		2,500 A			

Transformers														
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
A	2021	WPS	KNAN	11,000	415	Dyn11	1,500	5.49	1-7	4	1,455 l	? kg	PDV, BC, TC, JL, LL, SG, FTI, WTI, SBR	5179816	None

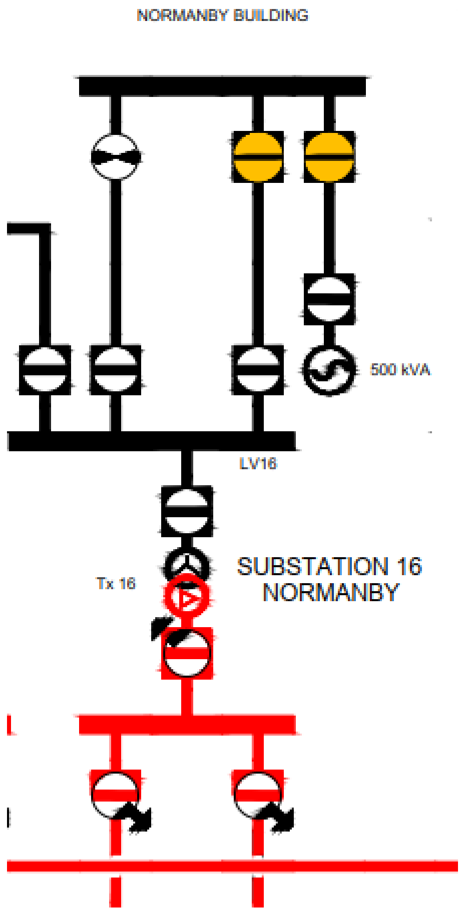


SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Substation 16 Normanby Building KCH Room Ref GSP0P045 MV NOR0B002 LV

Column Number	1	2	3	4	5	6	7	8
Label/Function	**TC 12**	**Local 8000 kVA Tx**	**HV2 RF B2**		LV16 Tx incomer			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch		4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster 2				MTZ1 12-H2 + micrologic 6.0X			
Maker	Yorkshire Switchgear				Schneider			
Serial Number	SR2F92077				?			
Year	1992				2021			
Rating Busbars Amps	630	630	630		1,250 A 1 x 12 mm x 60 mm			
Rating Sw/CB: Amps	630	200	630		1,250 A			

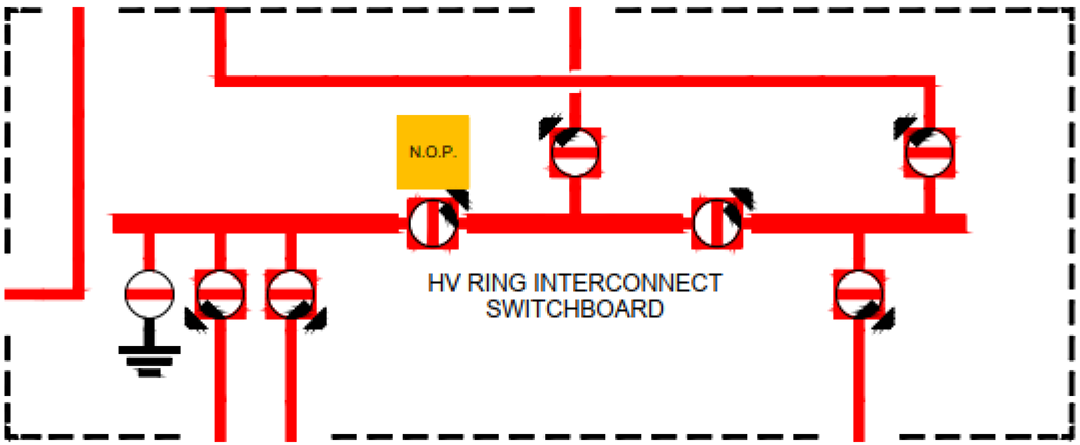
Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
A	2021	Best/ Slaters	KNAN	11,000	433	Dyn11	800	4.93	1-6	3	590kg	3,53t	PDV, BC, TC, JL, LL, SG, FTI, WTI, SBR	78064	None



SWITCHGEAR AND TRANSFORMER SCHEDULE LOCATION: Ruskin Wing 11 kV Interconnect Switchboard KCH Room Reference RUS0B032

Column Number	1	2	3	4	5	6	7	8
Substation Reference	**Bus bar earth**	**Ring to TC 2B**	**Ring to TC 12**	**B/C LHS**	**Tx 4**	**B/C RHS**	**Ring to TC 6**	**Tong to TC 9**
Switchgear Type	SE6-E1/21	CE6-T4/21	CE6-T4/21	SE6-B1/21	CE2-T2/21	SE6-B1/21	CE6-T4/21	CE6-T4/21
Maker	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider
Serial Number	101985796	101985278	101985279	101985794	101985277	101985795	101985280	101985281
Rating Busbars Amps	630	630	630	630	630	630	630	630
Rating Sw/ CB: MVA / Amps	630	630	630	630	200	630	630	630

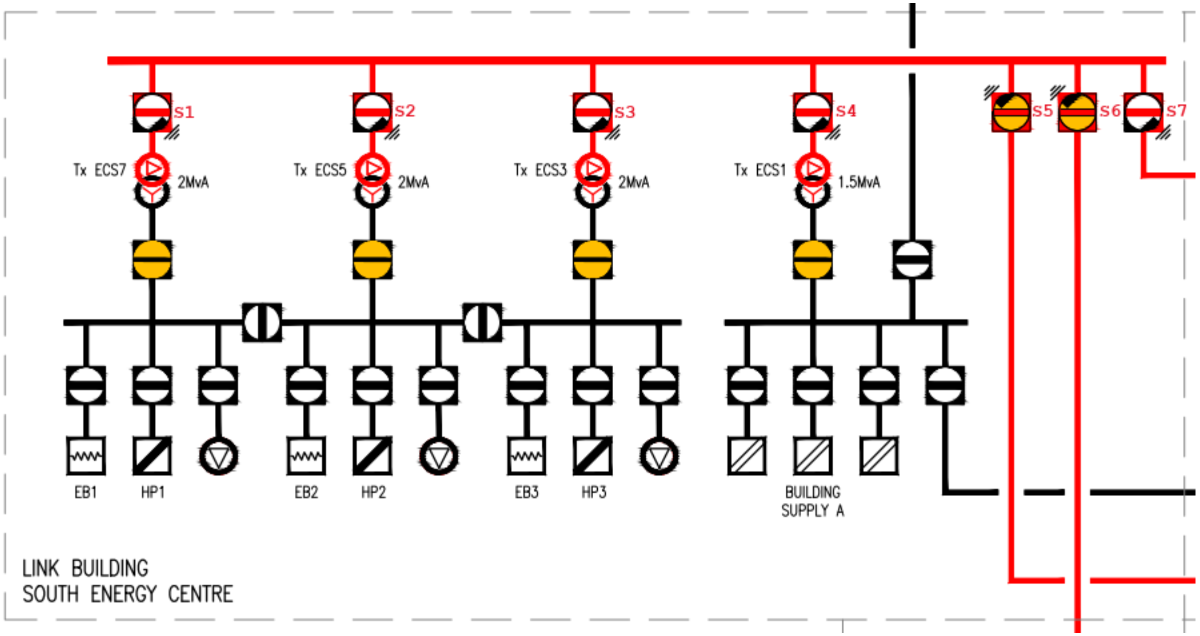


Appendix F

Schedule of Proposed Electrical Distribution Equipment

SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 4   LOCATION: New South Energy Centre MV Switch Panel Section 1

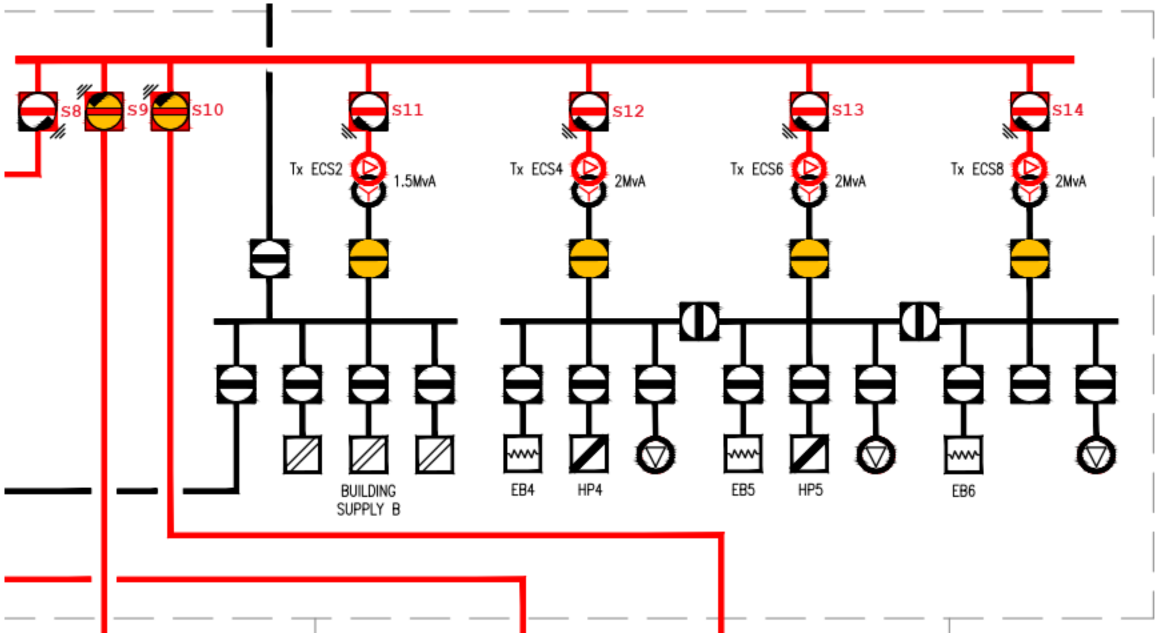
Column Number	1	2	3	4	5	6	7	8
Label/Function	S1 -Tx ECS7	S2 – Tx ECS5	S3 – Tx ECS3	S4 – Tx ECS1	S5 – G4	S6 - UKPN	S7 – S8	
Description	VCB	VCB	VCB	VCB	VCB	VCB	VCB	
Maker	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	
Switchgear Type	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	
Serial Number (Chassis where withdrawable)								
Rating Busbars Amps	630	630	630	630	630	630	630	
Rating Sw/CB: Amps	200	200	200	200	630	630	630	



Transformers														
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
Tx ECS7	N/A	Wilsons	KNAN	11,000	433	Dyn11	2000								
Tx ECS5	N/A	Wilsons	KNAN	11,000	433	Dyn11	2000								
Tx ECS3	N/A	Wilsons	KNAN	11,000	433	Dyn11	2000								
Tx ECS1	N/A	Wilsons	KNAN	11,000	433	Dyn11	1500								

SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 4   LOCATION: New South Energy Centre MV Switch Panel Section 2

Column Number	1	2	3	4	5	6	7	8
Label/Function	**S8 – S7**	**S9 - UKPN**	**S10 – G5**	**S11 – Tx ECS2**	**S12 – Tx ECS4**	**S13 – TxECS6**	**S14 – Tx ECS8**	
Description	VCB	VCB	VCB	VCB	VCB	VCB	VCB	
Maker	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	
Switchgear Type	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	Genie Evo VC6	
Serial Number (Chassis where withdrawable)								
Rating Busbars Amps	630	630	630	630	630	630	630	
Rating Sw/CB: Amps	630	630	630	200	200	200	200	



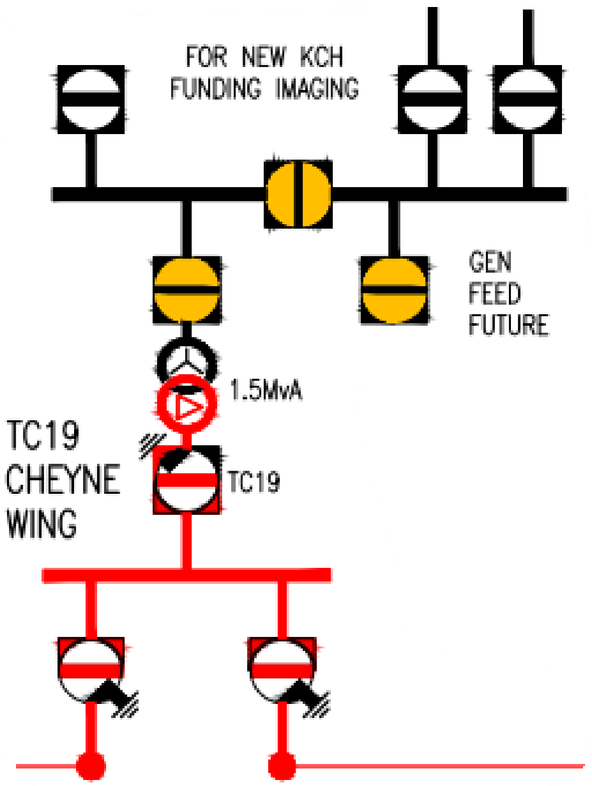
Transformers															
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
Tx ECS2	N/A	Wilsons	KNAN	11,000	433	Dyn11	1500								
Tx ECS4	N/A	Wilsons	KNAN	11,000	433	Dyn11	2000								
Tx ECS6	N/A	Wilsons	KNAN	11,000	433	Dyn11	2000								
Tx ECS8	N/A	Wilsons	KNAN	11,000	433	Dyn11	2000								

SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 1 LOCATION: New Cheyne Wing Sub Station TC19

Column Number	1	2	3	4			
Label/Function	**TC11**	**Tx19**	**Phase 1 - TC2B** **Phase 7 – TC21**	**LV19 Incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2d-T2S			Automatic			
Maker	Schneider			Schneider			
Serial Number							
Year				N/A			
Rating Busbars Amps	630	630	630	2500			
Rating Sw/CB: Amps	630	200	630	2500			
Automation	Motorised	Motorised	Motorised				
	Easergy T300 OVR Remote Control						

Transformers

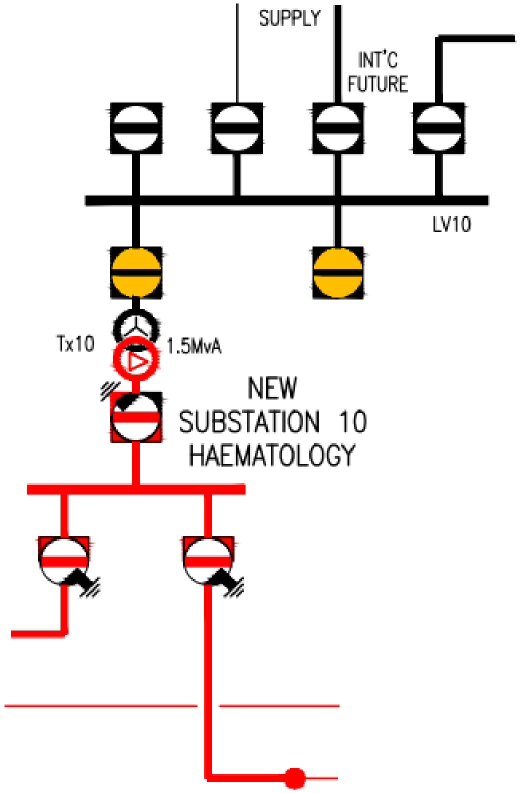
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
Tx19		Wilson	KNAN	11,000	433	Dyn11	1,500								



SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 2 LOCATION: New Haematology Sub Station TC10

Column Number	1	2	3	4			
Label/Function	**TC1B**	**Tx10**	**TC6**	**LV10 Incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	4 Pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2d-T2S			Automatic			
Maker	Schneider			Schneider			
Serial Number							
Year							
Rating Busbars Amps	630	630	630	2500			
Rating Sw/CB: Amps	630	200	630	2500			
Automation	Motorised	Motorised	Motorised				
	Easergy T300 OVR Remote Control						

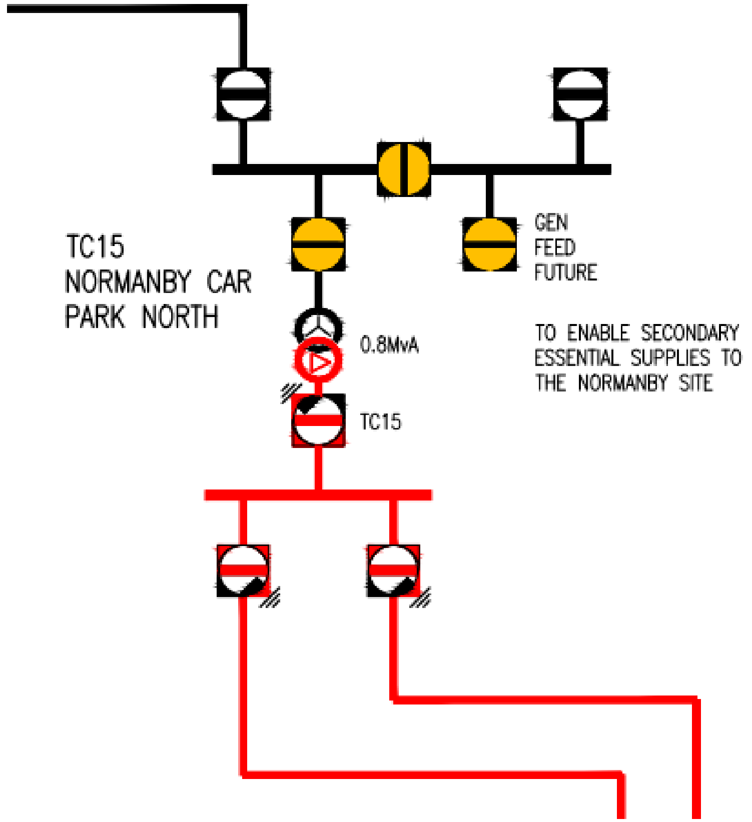
Transformers															
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
Tx10		Wilsons	KNAN	11,000	433	Dyn11	1,500								



SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 3 LOCATION: New Normanby Sub Station TC15

Column Number	1	2	3	4			
Label/Function	**TC16**	**Tx15**	**Phase 3 HV2 RFB2 Phase 5 TC20**	**LV15 Incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2d-T2S			Automatic			
Maker	Schneider			Schneider			
Serial Number							
Year							
Rating Busbars Amps	630	630	630	2500			
Rating Sw/CB: Amps	630	200	630	2500			
Automation	Motorised	Motorised	Motorised				
	Easergy T300 OVR Remote Control						

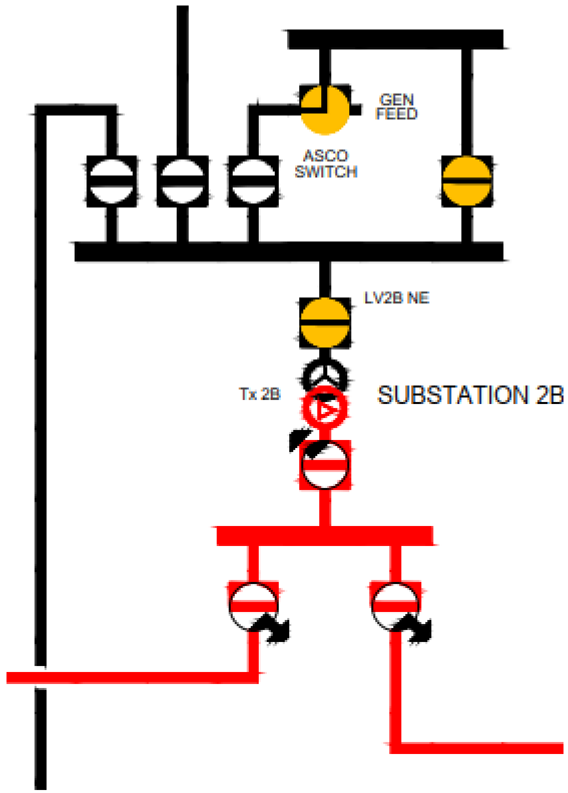
Transformers															
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
Tx15		Wilsons	KNAN	11,000	433	Dyn11	1,500								



SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 5 LOCATION: New Business Units 7 & 8 Sub Station TC20

Column Number	1	2	3	4			
Label/Function	**HV2 RFB2**	**Tx20**	**TC15**	**LV20 Incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2d-T2S			Automatic			
Maker	Schneider			Schneider			
Serial Number							
Year							
Rating Busbars Amps	630	630	630	2500			
Rating Sw/CB: Amps	630	200	630	2500			
Automation	Motorised	Motorised	Motorised				
	Easergy T300 OVR Remote Control						

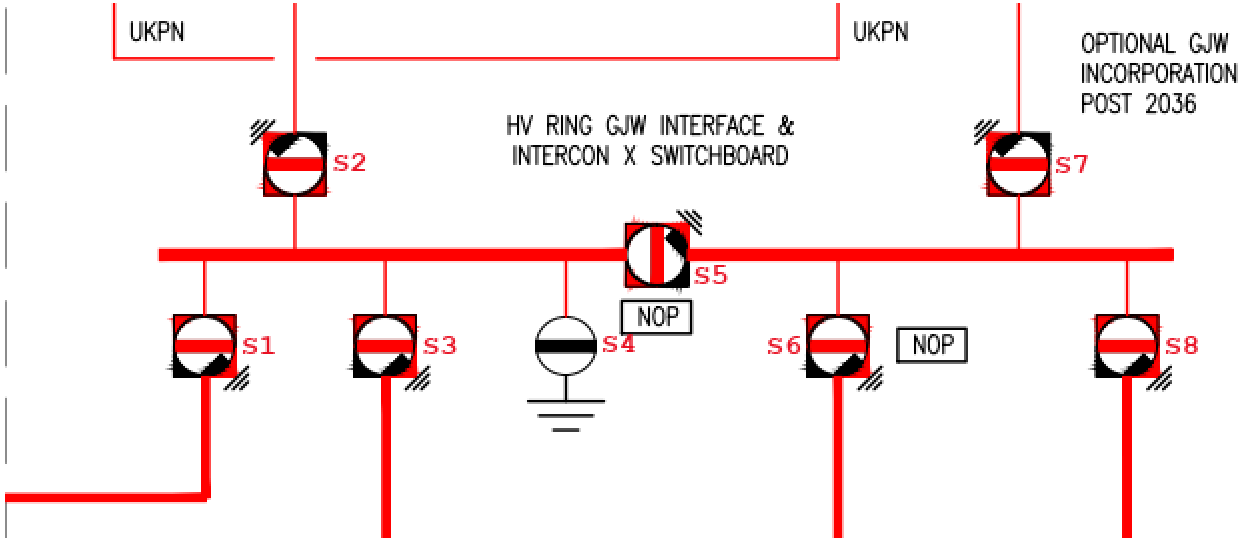
Transformers															
Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
Tx20		Wilsons	KNAN	11,000	433	Dyn11	1,500								



SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 5 LOCATION: Golden Jubilee Wing Interconnection Switch Panel - OPTION

Column Number	1	2	3	4	5	6	7	8
Label/Function	**S1 – TC13**	**S2 – GJW RMU1**	**S13 – TC16**	**S4 Earth Switch**	**S5 – Bus Coupler**	**S6 – Tx7**	**S7 – GJW RMU2**	**S8 – Tx7**
Description	SF_6 Switch	SF_6 CB	SF_6 Switch	SF_6 Switch	SF_6 BSS	SF_6 Switch	SF_6 CB	SF_6 Switch
Maker	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider
Switchgear Type	CE6 T4/21	CE2 T2/21	CE6 T4/21	SE6 E1/21	SE6 B1/21	CE6 T4/21	CE2 T2/21	CE6 T4/21
Serial Number (Chassis where withdrawable)								
Rating Busbars Amps	630	630	630	630	630	630	630	630
Rating Sw/CB: Amps	630	200	630	630	630	630	200	
Automation	Motorised	Motorised	Motorised	Motorised	Motorised	Motorised	Motorised	Motorised
	Easergy T300 OVR Remote Control							

Out Door Switch Panel

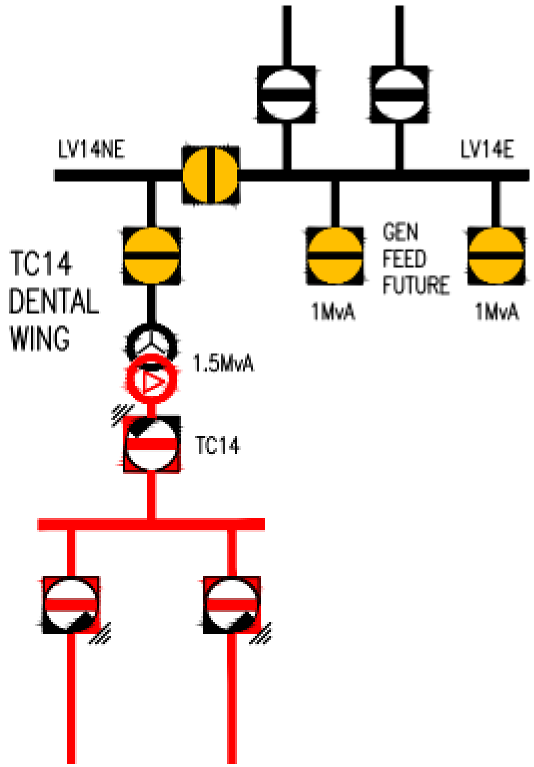


SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 6 LOCATION: New Dental & Day Surgery Bld Secondary Sub Station TC14

Column Number	1	2	3	5	6	7	8
Label/Function	**TC13**	**Tx14**	**TC12**	**LV14/NE incomer**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2d-T2S			Automatic			
Maker	Schneider			Schneider			
Serial Number							
Year							
Rating Busbars Amps	630	630	630	2,500			
Rating Sw/CB: Amps	630	200	630	2,500			
Automation	Motorised	Motorised	Motorised				
	Easergy T300 OVR Remote Control						

Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
	2016	Wilson Power Solutions	KNAN	11,000	415	Dyn11	1,500	5.48	1-7	4	1,150kg	5,550kg	PDV, BC, TC, JL, LL, SG, FTI, SBR, FTI. WTI	5010079/6676	None

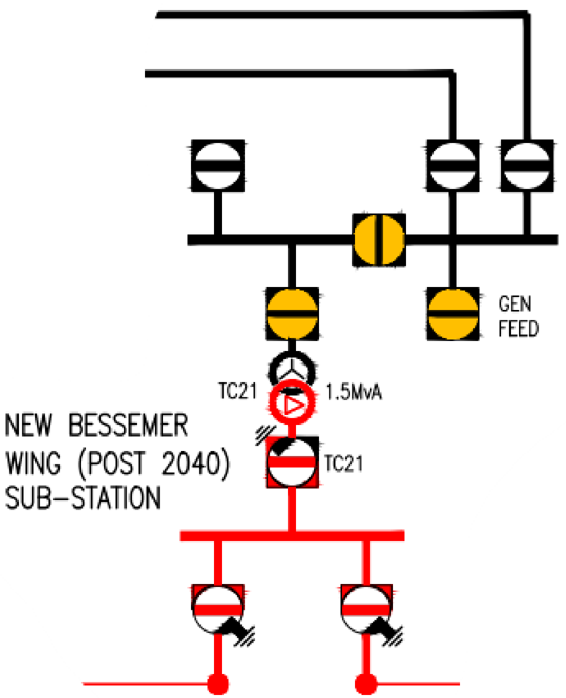


SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 7 LOCATION: New Bessemer Wing Sub Station TC21

Column Number	1	2	3	4			
Label/Function	**TC19**	**Tx21**	**TC2B**	**ACB**			
Description	LH SF_6 Switch	SF_6 CB	RH SF_6 Switch	4 pole ACB			
Switchgear Type	SF_6 RMU Ringmaster RN2d-T2S			Automatic			
Maker	Schneider			Schneider			
Serial Number							
Year							
Rating Busbars Amps	630	630	630	2,500			
Rating Sw/CB: Amps	630	200	630	2,500			
Automation	Motorised	Motorised	Motorised				
	Easergy T300 OVR Remote Control						

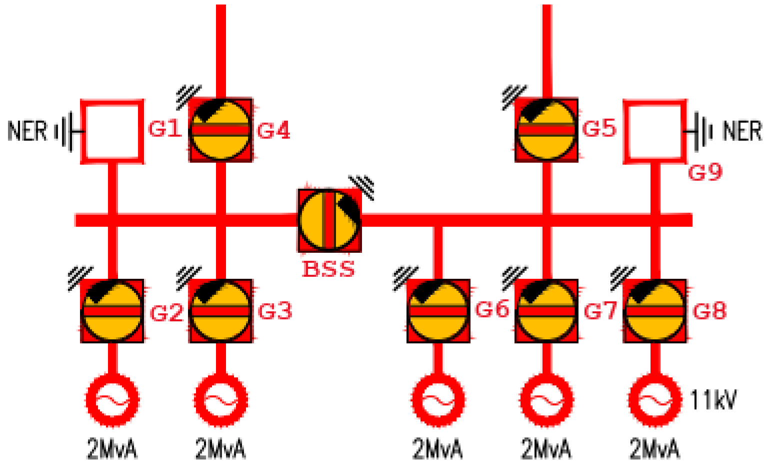
Transformers

Ref	Year	Make	Type	Primary Volts	Sec. Volts	Vector Group	kVA	%Z	Tappings	Setting	Fluid Cap'y	Wt Kg	Fittings	Serial Number	Label
Tx21		Wilsons	KNAN	11,000	433	Dyn11	1,500								



SWITCHGEAR AND TRANSFORMER SCHEDULE: Phase 4 New South Energy Centre LOCATION MV Generator Switch panel

Column Number	1	2	3	4	5	6	7	8	9	10
Label/Function	**G1 - NER**	**G2 -Gen 1**	**G3 -Gen 2**	**G4 -ECS1/5**	**Bus Coupler**	**G5 - ECS2/10**	**G6 – Gen 3**	**G7 – Gen 4**	**G8 – Gen 5**	**G9 - NER**
Description	VCB	VCB	VCB	VCB	Switch	VCB	VCB	VCB	VCB	VCB
Maker	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider	Schneider
Switchgear Type	Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo	Genie Evo
Serial Number (Chassis where withdrawable)										
Rating Busbars Amps	1250	1250	1250	1250	1250	1250	1250	1250	1250	1250
Rating Sw/CB: Amps	1250	200	200	630	630	200	200	200	630	1250

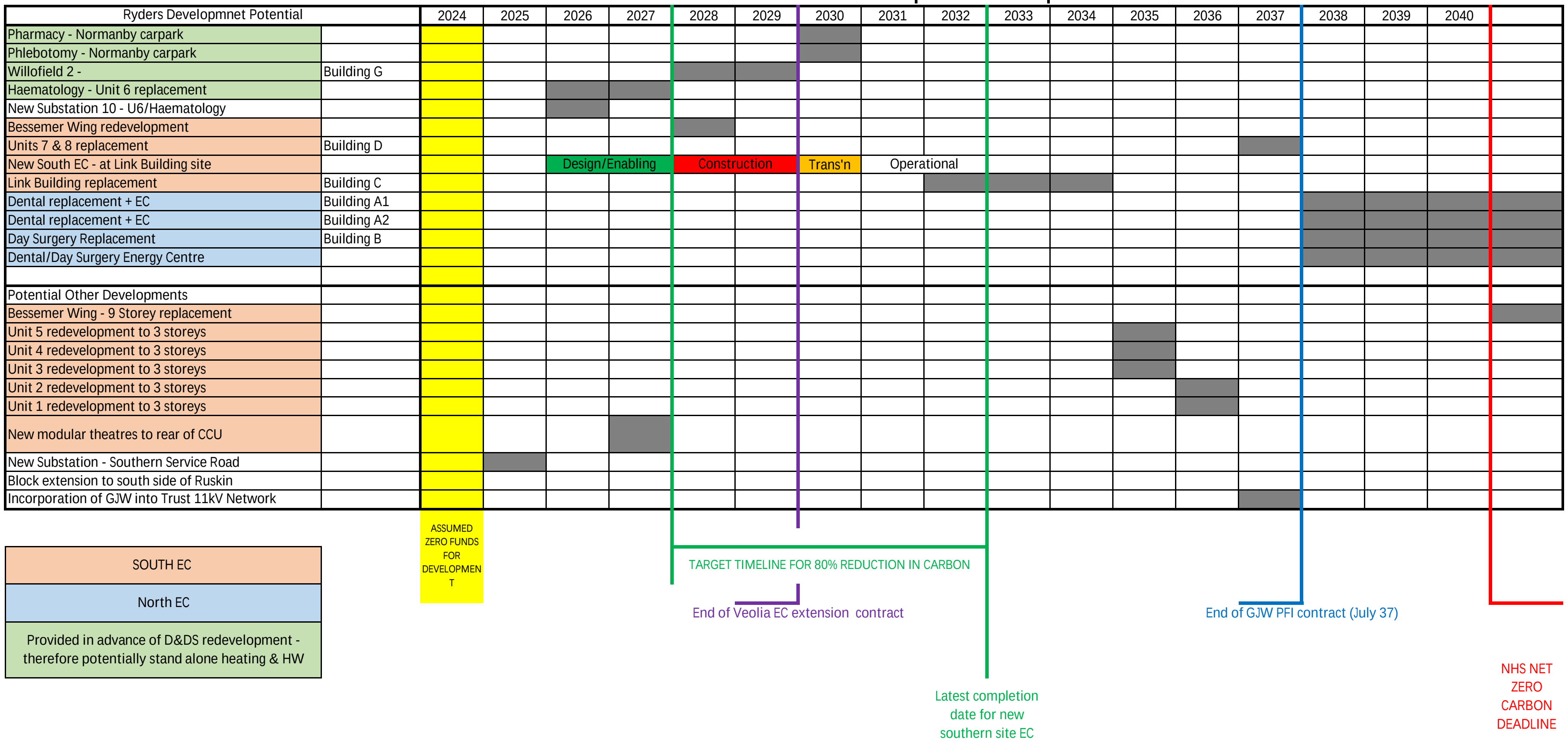


TRUST ENERGY CENTRE.
11kV GENERATOR HOUSE

Appendix G

Outline Sequence & Programme Proposal

KCH Denmark Hill PotentialRedevelopment Sequence



Appendix H

Project Risks

KCH Denmark Hill: Decarbonisation Preliminary Risk Schedule

Key Project Risks

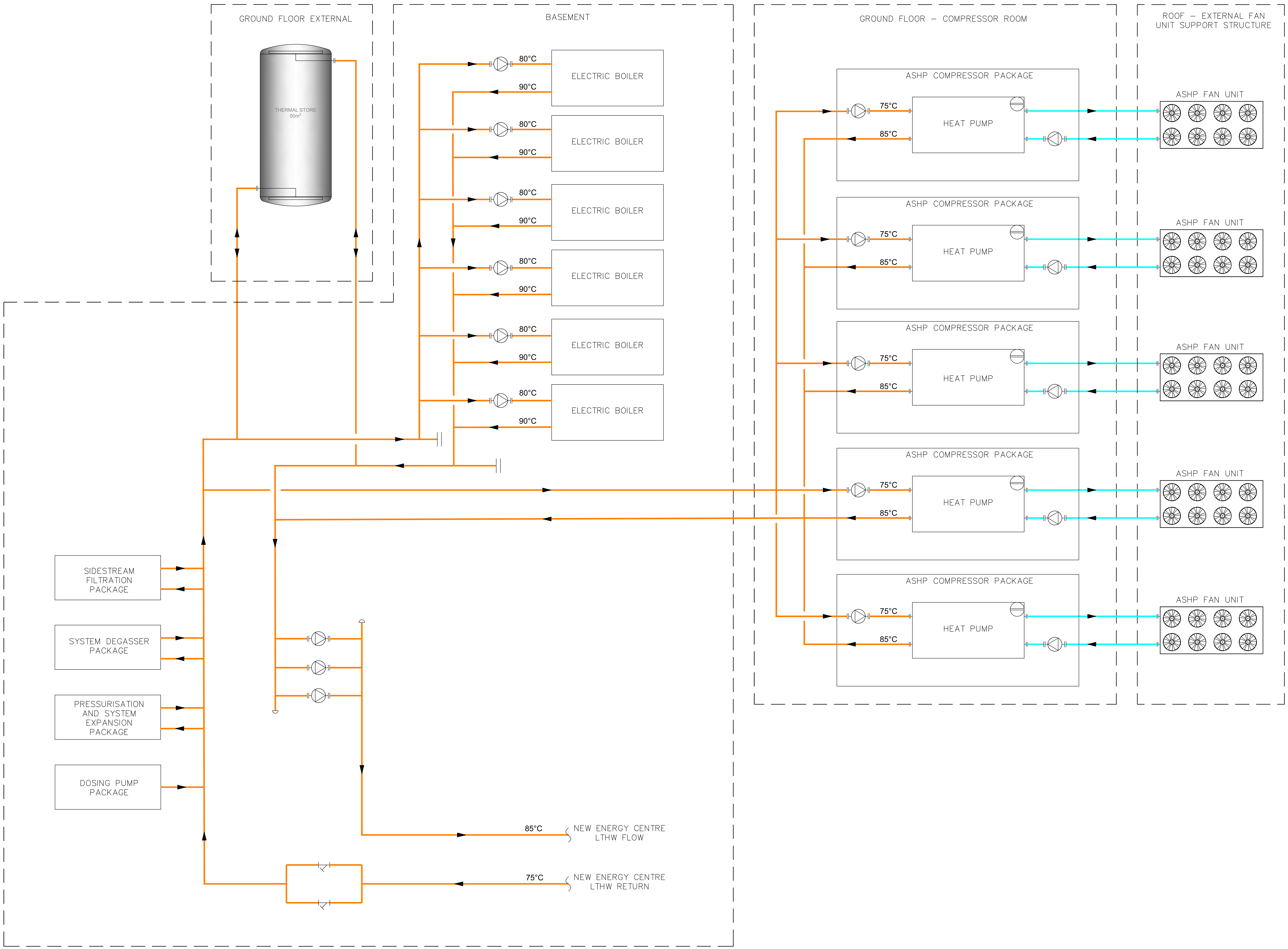
- **Unavailability of clinical masterplan to guide/steer site development master plans.** Currently no clinical master plan exists linking the Kings College Health Partner hospital sites. This is understood as a requirement to steer individual site redevelopment master planning. If this becomes available this could significantly change the current development thinking for Denmark Hill and with it the parameters and associated load profiles for the site heating and electrical energy demands
- **Un-resolved/incomplete site development/master/plan**. The existing Ryders DCP document is limited in detail, essentially due to the absence of an overarching clinical master plan and does not provide sufficient detail on development purpose and utilisation. In addition, the report excludes potential development areas that have been previously explored by the Trust for the DH site and some newer proposals. As a fully developed master plan becomes available this could significantly change the current development thinking for Denmark Hill and with it the parameters and associated load profiles for the site heating and electrical energy demands
- **The current Ryders DCP document, not cognisant of decarbonisation requirements**. The current Ryders DCP document makes no provision for the new energy centre requirements proposed in the 2023 Decarbonisation Plan. The proposed plant spatial requirements for these energy centres will be significant and will impact on the new building development design thinking and available space.
- **On time availability of green/renewable electrical energy from UKPN/National Grid.** Real net zero carbon can not be achieved until such time as the grid generating/supply system are fully decarbonised and utilising renewable energy generation sources.
- **Changes in site development/master/planning.** Significant site development master plan changes could impact the heat energy and electrical distribution infrastructure design proposals in terms of system overall architecture, load requirements, plant sizes and spatial requirements.
- **Lack of clarity in relation to KCH land titles and deeds for key development zones.** There are a number of utility services providers located on site, most significantly, UKPN, who are understood to have buried service wayleaves, plant space leases and personnel and vehicular access rights. The requirement to maintain these may have an impact on the current outline development proposals covered in the Ryders DCP document, in particular around the Link building redevelopment zone.
- **Lack of clarity in relation statutory provider wayleaves and access – UKPN/TFL/Openreach services routes through site.** There may be critical historical spaces and access routes that have to be maintained that will impact on the master planning detail and ultimately the infrastructure services detailed design.
- **Existing buried infrastructure risks.** Know existence of key utility distribution infrastructure routed across DH site that will impact on future building developments, notably:-
    - UKPN EHV cable routes
    - Transport for London 22kV cables traversing north section of Dental Wing site.
    - National Grid major EHV cable tunnel routed below site traversing east to west.
- **Limited DNO, (UKPN) lack of network capacity.** Inability of UKPN to meet proposed electrical supply demand increases in line with decarbonisation plan/program due to combined demand impact of other large local consumers – (KCL/SLAM) etc is a concern, as well as the ongoing

Trust/WSP/UKPN negotiations there should be joined up and coordinated discussions between all key users and the DNO.

- **Non-alignment of ongoing public realm planning and site development plans** – currently understood as separate “On Hold” project limited to the Bessemer Road demise. This needs to be expanded and inclusive of vehicle traffic management requirements. Also needs to consider the impact of proposed new developments on the traffic management plan.
- **Risk of Central Government funding not being available for the project. Government policy change.** Clear funding portals are not yet identified, which may impact the initial early decarbonisation planning process and early detailed design.
- **Insufficient continuity of project staff - loss of knowledge**. Project knowledge and completion will be impacted loss of key Trust and consultancy staff. This risk will increase as the project time scales are extended.
- **Decarbonisation and site masterplan project leadership.** Suitably empowered and experienced Trust staff not available for engagement with consultant team. Gap in senior management. Delayed decision making will slow up the decarbonisation process. Key contact points at Trust & local authority, (board level) not identified – Decarbonisation & Master planning lead required at board level for both sites to push progress.
- **Unknown local planning conditions** and support for redevelopment master plans. Will not be known until after submittal of current ongoing site development master plan for DH.
- **Change in statutory requirements**. Changes triggered by significant external events (e.g. Grenfell disaster, Corona virus etc) will greatly impact site development master plan requirements.
- **Enabling Works requirements.** Potential magnitude of enabling and civil works required for decarbonisation planning in order to limit impact on existing hospital services. Will include utility diversions as well as Trust managed infrastructure assets. Possible delays and services interruptions to be managed.
- **Existing building stock condition & Fit for Purpose risks**. Suitability of existing (oldest) building stock at DH to be redeveloped economically in line with clinical and energy efficiency requirements. Limited thermal performance risks, structural integrity risks, limited access risks to be ascertained on a building-by-building basis.
- **Unavailability of Link building for advanced development of new south Energy Centre**. Can this building be decanted and demolished in sufficient time.
- Risk of low thermal performance of existing building stock where lack of funds does not allow for building fabric upgrades. This will add to the overall energy system load and carbon footprint.
- **Condition and quantity of existing buried services**. Services below existing access roadways making further buried services installations, (in particular large pipework networks) impossible.
- **New infrastructure design development timescale**. Insufficient time allocation resulting in potential delays in meeting decarbonisation deadlines. A firm program to be agreed.
- **New/existing infrastructure systems integration**. Phasing of switchover from existing heat supply to new low carbon heat supply. Insufficient time allocation resulting in poor system performance, poor internal conditions, impact on patients and daily clinical operation.

Appendix I

Energy Centre Mechanical Schematics Layouts



DO NOT SCALE

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENT AND DRAWINGS PROVIDED BY WSP.
2. THE DRAWING INDICATES THE DESIGN INTENT FOR THE WORKS.
3. PROPOSED SCHEMATIC IS INDICATIVE ONLY. FINAL SCHEMATIC IS SUBJECT TO FURTHER DESIGN AND DEVELOPMENT.

LEGEND:

LTHW PIPEWORK

WATER/GLYCOL PIPEWORK

REV	DATE	BY	DESCRIPTION	CHK	APP
P01	15/03/2024	MB	PRELIMINARY ISSUE	JR	AC

DRAWING STATUS: S2 - FOR INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION STAGE 2 DESIGN

TITLE: MECHANICAL SERVICES STAGE 1 DESIGN ENERGY CENTRE SCHEMATIC

SCALE @ A0:	CHECKED:		APPROVED:
NTS	JR		AC
PROJECT No:	DESIGNED:	DRAWN:	DATE:
70096113	JR	MB	15.03.2024

DRAWING No: KCH113-WSP-DMK-ZZ-DR-M-5010 REV: P01

Appendix J

Mechanical Distribution Plans

DO NOT SCALE

BACKGROUND DRAWING INFORMATION

FILENAME	ORIGINATOR	DESCRIPTION	REV	DATE REC'D
GENERAL SITE PLAN	–	GROUND FLOOR GA	–	12-01-2024

LEGEND:

MAIN STEAM LINE

ROOF STEAM LINE

BACKROAD STEAM LINE

REV	DATE	BY	DESCRIPTION	CHK	APD
P01	**/02/2024	SR	ISSUED FOR INFORMATION	PS	PW

DRAWING STATUS: INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT: KINGS COLLEGE HOSPITAL NHS TRUST

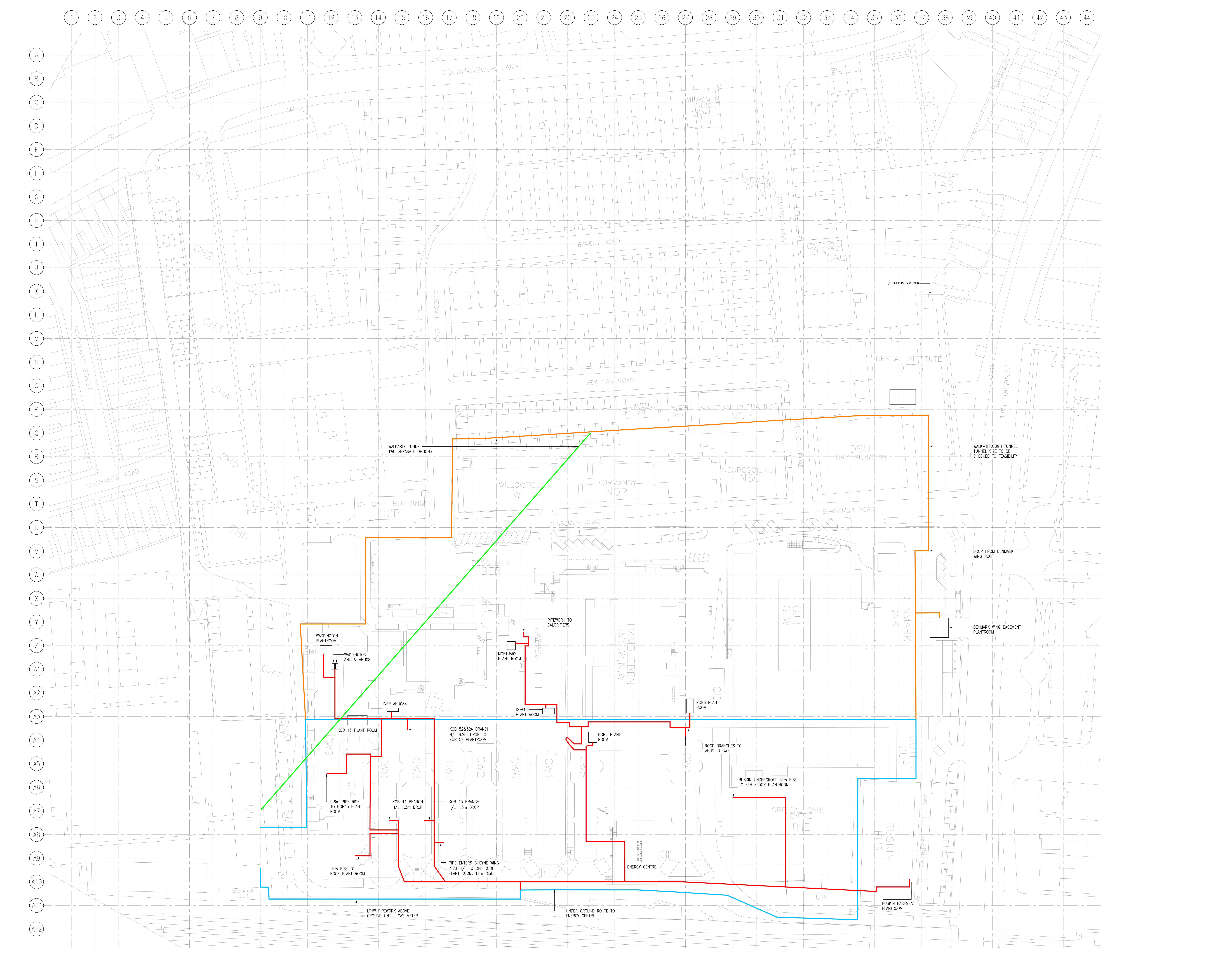
ARCHITECT: -

PROJECT: KINGS COLLEGE HOSPITAL DENMARK HILL DECARBONISATION STAGE 2 DESIGN

TITLE: MECHANICAL SERVICES EXISTING STEAM DISTRIBUTION SITE LAYOUT

SCALE @ A0: 1:500	CHECKED: PS		APPROVED: PW
PROJECT No: 70096113	DESIGNED: SR	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-GF-DR-M-5001 REV: P01



DO NOT SCALE

BACKGROUND DRAWING INFORMATION

FILENAME	ORIGINATOR	DESCRIPTION	REV	DATE REC'D
GENERAL SITE PLAN	-	GROUND FLOOR GA	-	12-01-2024

LEGEND:

- LOCAL BRANCHES
- LTHW SOUTH LOOP
- LTHW NORTH LOOP
- ALTERNATIVE LTHW NORTH LOOP

REV	DATE	BY	DESCRIPTION	CHK	APD
P01	**/02/2024	SR	ISSUED FOR INFORMATION	PS	PW

DRAWING STATUS:
INFORMATION

WSP House, 70 Chancery Lane, London, WC2A 1AF, UK
T+ 44 (0) 207 314 5000, F+ 44 (0) 207 314 5111
wsp.com

CLIENT:
KINGS COLLEGE HOSPITAL
NHS TRUST

ARCHITECT:
-

PROJECT:
KINGS COLLEGE HOSPITAL
DENMARK HILL DECARBONISATION
STAGE 2 DESIGN

TITLE:
MECHANICAL SERVICES
PROPOSED LTHW DISTRIBUTION
SITE LAYOUT

SCALE @ A0: 1:500	CHECKED: PS		APPROVED: PW
PROJECT No: 70096113	DESIGNED: SR	DRAWN: CAD	DATE: FEB 2024

DRAWING No: KCH113-WSP-DMK-GF-DR-M-5001
REV: P01

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