When I'm working on a problem,
I never think about beauty. I think
only how to solve the problem. But
when I have finished, if the solution
is not beautiful, I know it is wrong.
Richard Buckminster Fuller

Mechanical Engineering
Lighting Design
Sustainable Design
Electrical Engineering

Copenhagen
London
Sydney
Hong Kong
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MECHANICAL ENGINEERING

STEENSEN VARMING

Blacktown Hospital – Stage 2 State Significant Development (SSD) Report

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1.0 Introduction

Blacktown Hospital Campus is currently undergoing major construction upgrades including the refurbishment to parts of the existing hospital that was constructed in the year 2000.

The upgrades are being carried out in two stages and they are Stage 1 Clinical Services Building (CSB) and Stage 2 Acute Services Building (ASB). Stage 1 CSB construction was completed in 2015 and it is now currently in operation.

Steensen Varming has been engaged by HI to prepare a SSD report that outlines the proposed mechanical, medical gas and the pneumatic air tube systems. For stage 2, works include the new Acute Services Building (ASB), Atrium and the refurbishment works to the existing hospital.

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2.0 Executive Summary

The Stage 2 ASB works include the followings:

1. The construction of a new nine (9) storey acute services building including a new atrium.
2. The refurbishment to parts of the existing hospital.
3. The new stage 2 ASB chilled and condenser water systems, plus related integration works with the Stage 1 CSB Central Energy Plant (CEP).

The new Stage 2 ASB (approx. 40,000sqm) will consist of the following areas:

- Level 1: Plantrooms including Electrical Switch Rooms, UPS, Mechanical plantrooms and Hydraulic pump rooms
- Level 2: Emergency Department, Satellite Imaging, Forensic, PECC, Reception
- Level 3: Twelve (12) Operating Theatres (four (4) are shelled with future proofing), Stage 1 Recovery, Preoperative, Discharge, Offices Staff and Change rooms
- Level 4: Plantrooms, SSD, Shared offices and SSD
- Level 5: ICU
- Level 6: Birthing IPU wards
- Level 7: Maternity IPU wards
- Level 8: South: IPU wards (North wards are shelled for future fitout)
- Level 9: Roof Plantroom

A new atrium is to be constructed in the north east corner of Stage 2 ASB which will interconnect with Stage 1 CSB and the existing hospital. Stage 2 ASB will provide air conditioning to the atrium; however, the fire and smoke exhaust systems will be extended from Stage 1 CSB.

The existing building refurbishment works will include the followings:

Level 1: Kitchen Expansion, Biomed relocation, linen and laundry modifications
Level 2; Endoscopy Operating Theatre and Recovery fitout
Level 3: Ambulatory Care, new MRI fitout, Administration fit-outs
Level 4: IHU fitout

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2.1 Stage 2 ASB Central Energy Plant

A new plantroom will be constructed under another contract that will house the new Stage 2 ASB chilled water plant. The power source for the new chilled water plant will be provided from a new 1500 KVA step down transformer installed into the existing Stage 1 CSB.

New cooling towers will be located on the roof of Stage 1 CSB adjacent to the existing towers. The Stage 1 CSB existing condenser water pipes will be extended from the capped isolation valves to the new cooling towers.

2.2 Stage 2 ASB Proposed System

The proposed types of systems serving Stage 2 ASB include the followings:

- Chilled Water
- Heat Rejection
- Low Temperature Heating Water
- Process Cooling Water
- Steam Plant
- Constant Volume Multi Zone with face and by-pass dampers Air Handling Units (AHU) serving clinical areas
- Variable Air Volume Multi Zone AHU serving non-clinical areas
- Constant Volume Single Zone Air handling Units
- Hygienic type Operating Theatre Air Handling Units
- Multi Split DX or Variable Refrigerant Flow (VRF) System serving the Comms Rooms
- Humidification System serving the MRI rooms
- Mechanical Ventilation Systems
- Laser Fume Exhaust system
- SHM System
- Heat Recovery Unit
- Low Temperature Refrigeration and Cool Room system
- Pneumatic Air Tube system
- Compressed Air system
- Medical Vacuum system
- Medical Air system
- Bulk Oxygen system
- Bottled Gases (O2,NO2,TA)

2.3 Energy Performance

In order to meet the mandatory 10% energy reduction target, compared to a reference Deemed to satisfy building, we would recommend the following for the new systems:

- Provide a high efficiency water cooled centrifugal chiller;
- Face and by pass dampers on MZU does not require any reheat
- VAV systems for single zone AHUs
- Improve fan energy by a minimum of 10% when compared to the NCC minimum DTS requirements;
- Improve lighting efficiency by a minimum of 20% when compared to NCC minimum DTS requirements;
- Improve the roof insulation as stated in Section 3.5

The recommendations provided above are based on schematic design for mechanical, architectural, electrical, and lighting. As the design develops and more is known about the systems and required services, the reference model will be updated to capture additional details.

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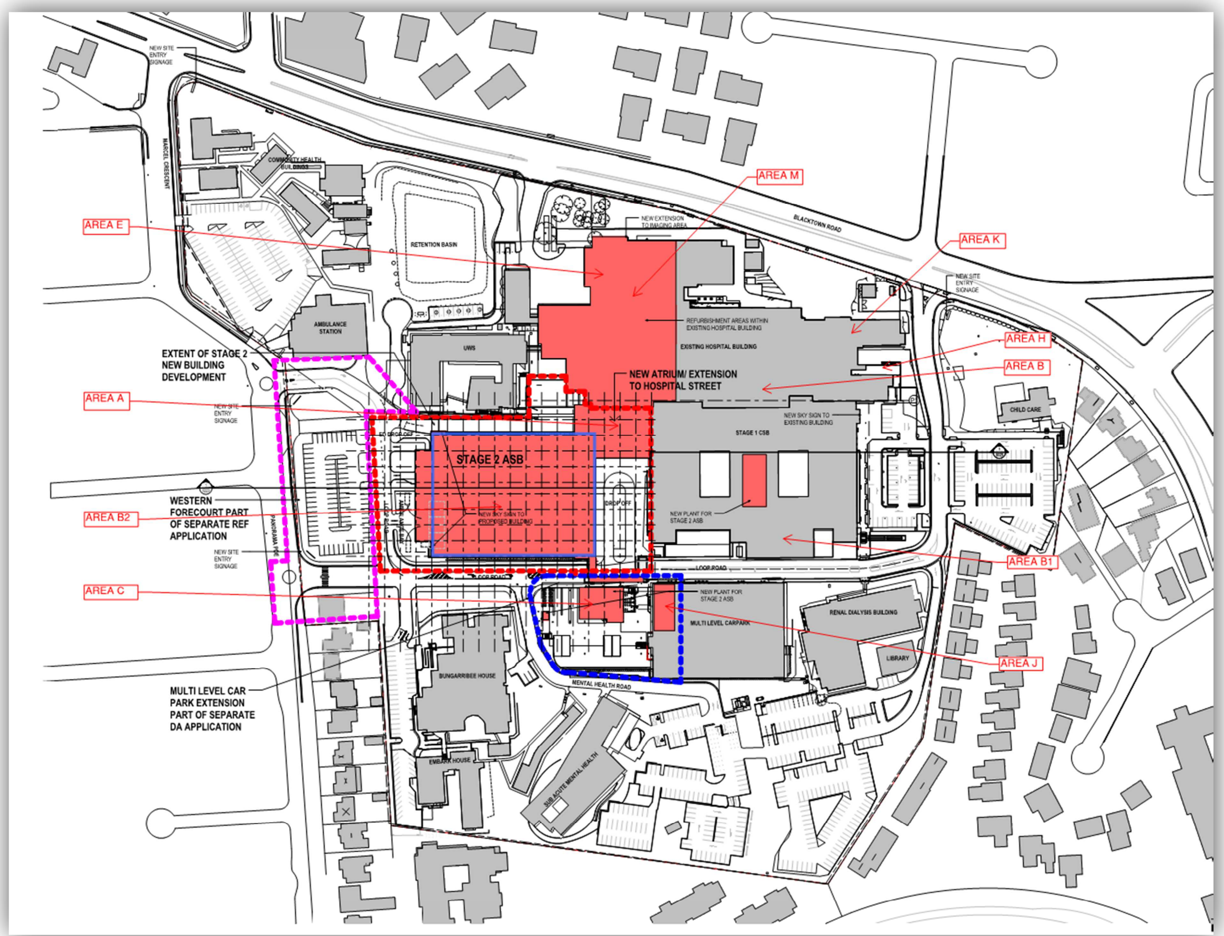
3.0 Site Overview

3.1 Site Description

The Stage 2 ASB works include the new Acute Services Building, the new atrium and the refurbishment works in the existing building main hospital.

Works in scope are related to the following areas:

- Atrium (Area A)
- Stage 1 CSB site (Area B1)
- Stage 2 ASB (Area B2)
- BR Site (Area B)
- Central Energy Plant and Tunnel works (Area C)
- Level 1 Kitchen, Freezer, Biomed, Plating (Area K)
- Level 2 Endoscopy Operating Theatres and Recovery (Area E)
- Level 2 Administration (Area E)
- Level 3 Ambulatory care, MRI & CT scanning (Area M)
- IHU Department (Area H)
- New Chiller Location (Area J)



Site Plan

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4.0 System Descriptions

4.1 Chiller Water System

A new water cooled chiller will be provided and integrated with the Stage 1 CSB chillers. This combined system will provide chilled water to both Stage 1 CSB & Stage 2 ASB buildings. The chilled water at 7°C will be reticulated from the CEP via the underground service tunnel and connect to new secondary chilled water pumps located in the tunnel under croft to a new low lost decoupling header.
The chilled water will then be reticulated to the stage 2 ASB via a service tunnel located at level 2. This new decoupling low lost header will also be used to combine the Stage 1 CSB and Stage 2 ASB chillers to serve the Stage 1 buildings.

4.2 Low Temperature Heating Water System

New high efficiency gas fired Low Temperature Heating Water boilers will be located on the level 9 roof plantroom and will provide heating water to all Air Handling Units, Fan Coil Units and to the Domestic Hot Water system via plate heat exchangers. The boiler flues will terminate 3m above the roof line however the flues will be design to accommodate a dilution fan to allow flues to discharge through the external wall to accommodate the future expansion.

4.3 Heat Rejection Plant

The heat rejection plant will be located on the roof of Stage 1 CSB roof adjacent to the exiting cooling towers. The new pumps will reticulate condenser water from the CEP new chiller to the new towers via the existing Stage 1 CSB piping network. Modification and extension to the balance line will be required so that the towers can function as one system.

4.4 Steam Plant

A new steam generating plant located on the level 9 roof plantroom and will provide dry steam via insulated steel pipework and to serve level 4 sterilizing equipment. All condensate waste will be returned piped back to the steam boiler feed tank. The boiler flues will terminate 3m above the roof line however the flues will be design to accommodate a dilution fan to allow flues to discharge through the external wall to accommodate the future expansion

4.5 Air Handling Unit

The following principles have been implemented and followed for the schematic design of the New Acute Services Hospital. Actual system zoning and plant locations have been developed and are included as part of the scheme design stage drawings.

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Air Handling Systems proposed:

a. Design will enable use of Multi Zone Constant Volume AHU for critical area where constant pressure is to be maintained to reduce the risk of cross infection
b. Multi Zone units variable volume single zone rooms control areas variable control of air flow either by variable speed motor controls or step controls on smaller units for non-critical areas
c. All operating theatres will be provided with hygienic type AHU that will operate on full 100% OA and will have inbuilt HRU (run around coils) humidifiers and controls
d. Modulating outside air economiser dampers will be included on all significantly sized air handling plant.
e. Air handling plant will employ air filters that help the reduction of mandatory minimum fresh air quantities particularly in high population areas. Air filters will be made accessible for servicing and shall employ manometers with indicator lamps to ensure adequate frequency of cleaning or renewal. Terminal HEPA filtration will be provided within operating theatres and sterile stock rooms / set up areas.
f. Isolation rooms shall have separate air handling fan coil units and separate exhaust systems. Outside Air will be ducted to each unit from the façade or intake plenum.
g. Separate localised air conditioning plant shall be provided for rooms with unusually high heat gains or intermittent operation, i.e. meeting rooms.
h. The following sample departments shall have separate air handling plant:
   - Isolation Rooms
   - Operating Theatres
   - Emergency department, Waiting and Triage
   - Imaging (FCU's)
   - Birthing
   - IPU wards
   - Forensics
   - PECC
   - ICU Pods 1,2,3,& 4
   - SSD loading, unloading,
i. Zoning of all air-conditioning systems shall acknowledge different dynamic loads and conditions likely to occur due to;
   - External glazing and wall materials
   - Roofs and suspended floors
   - Hours of operation
   - Clinical or process functions
   - Internal heat gain from people, lights, equipment.
   - No reheating
j. Good access for maintenance away from clinical and in-patient spaces.
k. Provision for excluding dust from plant room areas and air intakes by seals around entry doors and roughing filters behind intake louvres.
l. Type N Isolation will have a dedicated exhaust system with duty stand by exhaust fans. The exhaust fans will be located in the roof fan room above duct riser and will discharge 3m above the roof line.

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5.0 Back Up Power Supply

Code requirements do not require that any mechanical equipment is connected to an essential supply to maintain temperature requirements to the wider facility.

The only mechanical items of plant connected to an essential supply are the followings:

- Isolation room fans
- Operating Theatre Air Handlinh Unit fans
- ICU
- All essential fans that operate in fire mode
- Medical air and suction plant
- One (1) steam boiler

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6.0 ESD Initiatives

This section provides a summary of the ESD initiatives captured in the mechanical services design to satisfy the EIS requirements for a State Significant Development which have been based on;

7.0 NSW Health Guidelines;
8.0 Section J requirements;
9.0 Schedule 2 of the Environmental Planning and Assessment Regulation 2000; and
10.0 Other ESD initiatives

Executive Summary

Our main objectives are outlined below:

11.0 Incorporate good design and management initiatives to encourage sustainable practices during the construction and operation;
12.0 Achieve a high level of Indoor Environment Quality, to promote the health and wellbeing of building occupants;
13.0 Achieve high levels of energy performance above the baseline standard to reduce environmental and economic impacts associated with excessive energy use;
14.0 Consider specific energy initiatives that will bring real recurrent savings to the project

The design as a minimum will comply with the energy efficiency requirements of Section J of the National Construction Code.

We are considering the following ESD initiatives, in the design of the building:

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Mechanical Services

The following mechanical services initiatives are being considered for this project:

1. Energy efficient FCU's with EC/DC motors where possible;
2. Pre-tempering of outdoor air with relief using air to air heat exchangers will be used where appropriate;
3. The use of efficient refrigerants that have low ozone depletion potential and low global warming potential;
4. Maximise efficiency of full and part load performance of HVAC systems;
5. Incorporation of passive conditioning techniques where applicable, to reduce the overall air conditioning loads. Techniques to be considered include:
   15.0 Shading of windows to prevent solar penetration in summer but allow passive heating in winter
   16.0 Building thermal mass and insulation combinations where possible
   17.0 High performance building envelope
6. The air-conditioning system is designed to either shut down or be set to a wider temperature control band, when a spaces is unoccupied;
7. Dedicated secondary CHW and HHW circuits to ensure the hospital has future means to interrogate and apportion building energy use;
8. High efficiency water-cooled chiller selected to give the optimum coefficient of performance;
9. The use of a FCU's system in parts of the building where the functionality concluded that this was the best fit;
10. The use of variable speed drives on all appropriate fan and pump systems, coupled with high efficiency motors;
11. The use of high efficiency equipment such as chillers with environmentally friendly refrigerants such as R134a and R407c and high coefficients of performance and ECDC motors on FCU' equipment;
12. Outside air economy cycles on all appropriate air handling systems;
13. Multi-zone face-by-pass air handling units designed to provide the minimum amount of heating or cooling to zones, thus minimising the possibility of reheating;
14. A fully automated Building Monitoring and Control system to schedule and optimise plant to maximise efficiency;
15. Fully modulating gas boilers. This will allow the boilers to perform at high efficiencies during low load conditions.