Shelmerdines
Consulting Engineers

REPORT

on

MECHANICAL AND ELECTRICAL SERVICES

for the

PROPOSED NEUROSCIENCE RESEARCH PRECINCT

at

BARKER AND EASY STREETS RANDWICK

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1.0 INTRODUCTION

It is proposed to establish a Neuroscience Research Precinct within the Prince of Wales Hospital Locale, on the site of the existing Prince of Wales Medical Research Institute.

Stage 1 of the project has currently been approved and provides temporary accommodation while stages 2A to 2D of the Neuroscience Resrach Precinct are constructed.

Stage 2A comprises a 6 level building at the corner of Barker and Easy Streets, Randwick.

Stage 2B and 2D comprise future stages to the North and West of Stage 2A and are to be constructed as demand requires.

This report provides and overview of the mechanical and electrical services that would be considered for this project.

The staged construction will influence the services design because each building would need to be “self contained” in terms of major plant.

2.0 MECHANICAL

2.1 HEATING VENTILATION & AIR CONDITIONING (HVAC)

General

Generally all research areas and occupied compartments within the management, administration and amenities areas require comfort air conditioning without humidity control, appropriately zoned to reflect facade orientation, internal occupancies, intensity of use and assessed demand.

Dedicated air conditioning systems would be provided for the following:

- Areas with a non–typical outdoor air requirement.
- Laboratories.
- Offices/Clinics.
- Various departments within the Animal House.
- Auditorium.
- MRI

Separate or supplementary air conditioning systems would be provided for areas with high heat load or special containment requirements.

Authorities

Generally, the design of the mechanical and electrical services would following the recommendations of AS2243 Safety in Laboratories (Parts 1 to 10 inclusive), and AS/NZS 2982 Laboratory Design and Construction.

Smoke control and stair pressurisation systems, where required by the building Code of Australia, would be designed in accordance with AS1668–1:1998 “Fire and smoke control in multi–compartment buildings”.

Mechanical ventilation systems would be designed in accordance with AS1668.2–1991 “Mechanical ventilation for acceptable indoor air quality”.

Hours of Operation

Unless otherwise noted standard hours of operation for all occupied areas are deemed to be 7.30 – 18.00. The controls for the mechanical plant would be configured accordingly.

Areas that require 24 hour conditioning include:

All cold and constant temperature (CT) storage rooms and laboratories, freezer rooms, dedicated computer rooms, server and router accommodation and all animal holding rooms.

2.2 GENERAL PRINCIPLES

Segregation of Air Supplies

The air handling systems must be designed so that reticulated air from the laboratories will not be utilised in non laboratory occupancies (this does not include offices within laboratory areas).

Recirculation of Conditioned Air - Laboratory Spaces

The design of air handling in the facility would account for the nature of the work performed in the laboratories. Despite the provision of fume cupboards and biosafety containment, chemical and/or microbiological contaminants may be produced. Consequently, consideration will be given for the laboratory portion of the facility to operate on 100% outdoor air. Where recirculation of laboratory air is acceptable this would be limited to 50% of supply air.

The following minimum outdoor air quantities, based on supply air, will apply:

Labs	–	50%
Offices	–	20%
Animal House	–	100%
PC3 Labs	–	100%

Temperature

All habitable spaces within the facility will need to be temperature controlled, and the air conditioning systems would be designed to achieve:

- Summer Temperature Set-Point:
  - 22 Degrees Celsius
  - Tolerance +/- 1.5 Degrees
- Winter Temperature Set-Point:
  - 22 degrees Celsius
  - Tolerance +/- 1.5 Degrees

Humidity Control

Upper limit humidity control (dehumidification) only would be provided except for the Animal House which requires full humidity control for all areas occupied by animals.

Zoning

The control of temperature would be suitably zoned to account for varied heat loads from personnel, solar penetration and equipment.

After Hours Use

In after hours periods, when the air handling unit supplying an area is ‘off’, the system would be able to be turned on by users who need to work in that area.

Heat Loads From Scientific Equipment

The air conditioning system would be capable of handling:

- 50W/m^2 in General Laboratory Occupancies
- 150W/m^2 in Refrigerator/Large Equipment Rooms

Air Velocity & Turbulence

The velocity and turbulence of supply air will need to be especially considered in relation to the location of:

- weighing balances
- The 'face' of biological safety cabinets and fume cupboards

and in each ease, the velocity of room air must be less than 0.1m/sec and be free of turbulence.

Relative Pressurisation

Nominal pressure differentials would be maintained between certain areas and surrounding rooms/corridors, as indicated below:

- Airlocks should be positively pressurised.
- Corridors adjacent to PC2 Laboratories would be positively pressurised.
- PC2 Laboratories would have an inflow of air.

Ventilation/Exhaust

Air from certain areas/equipment must be collected as near as practicable to the point of production and be fully exhausted. These areas include:

- Autoclave Plant and above Autoclave doors
- Dark Rooms
- Contaminated waste, radiation waste and chemical waste stores
- Exhaust from equipment in laboratories and special suites.

Cool Rooms, Freezer Rooms & Constant Temperature Rooms

Room conditions would be monitored by the Building Management System (BMS).

These rooms need not be regarded as habitable spaces with regard to the supply of outdoor air. However, occupied constant temperature rooms at near ambient temperature would be supplied with outdoor air.

Room for Freezers/Centrifuges

These rooms will need to be air conditioned continuously.

Special consideration would be given to the removal of heat exhaust from the freezer room in the event of failure of normal air conditioning operation.

PC3 Laboratories

The Genetic Manipulation Advisory Council (Australia) requires room-containment of certain biologically hazardous materials and procedures. The level of containment required is designated 'PC3'. The PC3 laboratories will require:

- Negative Pressurisation
- An Entry Chamber
- HEPA Filtration of Exhaust Air
- No Exchange of Air with Other Laboratory Spaces

- Special consideration regarding room construction methods to provide an air–tight seal.

2.3 UNTEMPERED AIR SUPPLY

Untempered variable volume systems would deliver outside air to air handling systems throughout the buildings.

2.4 OFFICE AIR CONDITIONING ON LABORATORY FLOORS

Office air handling units would be floor mounted in a fan room located adjacent to each laboratory. Return air would be collected from corridor or circulation spaces. Outside air would be supplied from the untempered air supply in each fan room. Each system would incorporate ventilation (free–cooling) cycles and variable volume diffusers.

2.5 OFFICE AIR CONDITIONING ON ADMINISTRATION FLOORS

For administration floor air conditioning consideration would be given to ducted, above ceiling variable refrigerant volume heat recovery systems.

2.6 LABORATORY AIR CONDITIONING

It is probable that laboratory air conditioning would comprise 100% outdoor–air systems with variable volume temperature control. Air handling units would be located in the roof plantrooms.

2.7 AUDITORIUM AIR CONDITIONING

The Auditorium will have non-typical outside air requirements due to the high population density and, as a consequence, would be served by separate air handling plant.

A “micro climate” system where air is supplied through or under the seats may be viable for fixed tiered seating otherwise a conventional over-head supply system, preferably with low level exhaust/return air would be appropriate.

Energy saving opportunities such as variable outdoor air (to match the population) would be considered.

2.8 THERMAL PLANT

Refrigeration plant would comprise high efficiency, low noise air–cooled chillers on the roof of each building to suit the proposed construction stages.

Heating plant would comprise high efficiency gas–fired boilers located in roof plantrooms.

2.9 BUILDING MANAGEMENT SYSTEM

A proprietary Building Management System would be provided to monitor and control all building engineering services. The system would cover all HVAC plant and equipment, air flows, filter performance, fume and other exhaust systems, hot and chilled water, gases reticulation, Cold, Freezer and Constant Temperature rooms. The system would be programmable with graphics interfaces for full zone control and incorporate facilities for external monitoring and energy conservation (eg adjustable control points, nigh set backs) and be capable of expansion.

2.10 LABORATORY EXHAUST SYSTEMS

Exhaust Ventilation

Certain utility rooms, and stores require only mechanical exhaust ventilation.

Exhaust Hoods

Generally provision of a canopy only, appropriately gathered to provide a non-turbulent flow to the exhaust duct. Hoods would be fabricated from 316 stainless steel.

In the Central Sterilising Area dedicated 316 stainless steel exhaust hoods would be provided over the Autoclaves. The footprint of the equipment will determine the size of the hoods.

Spot Exhausts

Individual spot exhaust points would comprise a 150mm dia flexible duct with a manual control damper, terminating in an expanded 'scoop' 350mm dia. The flexible arm would have a vertical and horizontal range of approximately 2m.

Hoods and Spot Exhaust Extraction Systems

Hoods and Spot Exhausts would be mechanically extracted individually or ganged into a common exhaust duct. With any ganged system each point would be capable of isolation.

2.11 FUME CUPBOARDS

The type, number, size and location of these units in the research laboratories has not been determined.

The viability of special low airflow high containment fume cupboards would be evaluated.

3.0 AIR QUALITY

3.1 GENERAL

Indoor Air Quality

The minimum outdoor air content for the laboratory areas would be 50% of supply air and consideration would be given to increase this to 100%.

Outdoor air intakes would be strategically located with respect to exhaust discharges to ensure acceptable indoor air quality.

Outdoor Air Quality

Exhaust air discharge locations would be strategically placed to ensure effective dispersion.

All potentially contaminated exhaust discharges would be treated, if required, to ensure safe and effective dilution when discharged to atmosphere. Cooling towers are not proposed because of the Legionella risk to the nearby Hospital.

Space provisions would be made in the Animal House exhaust system for the installation of odour absorbing (activated carbon) filters.

3.2 STACK HEIGHTS

The following exhaust discharges would occur at roof level:

- Warm air from air–cooled chillers
- Laboratory Exhaust Systems
- Gas heater flues
- PC–3 laboratory exhaust (HEPA filtered)
- Fume cupboards (HEPA filtered where required)
- Animal House Exhaust (with provision for future odour removal if required)

Based on previous studies with fume cupboard stack heights of approximately 6 metres above the roof, a small percentage (probably less than 1%) of the exhaust air would be present at ground level and may re–enter the building via outdoor air intakes.

One method of reducing recirculation is to increase stack heights above the aerodynamic wake of the building but this is rarely done for aesthetic reasons and in this instance the hight of the stacks would have to be well above future building stages which is clearly undesirable.

The proposed approach would be to examine the dilution of exhaust air and compare this with acceptable exposure limits.

If the dilution is not sufficient the addition of fume scrubbers or filters may be employed.

The need for a Computational Fluid Dynamic Study of the exhaust fume dispersal patterns to confirm concentrations of exhaust air at outside air intakes, ground level and with respect to the adjacent buildings would be considered.

4.0 LABORATORY AND INDUSTRIAL GASES

4.1 GENERAL

The provision of laboratory gases would be examined during the detail design stage and the following design approach would be used:

- Whenever practical, engaged cylinders will be housed external to the areas they serve.
- Automatic cylinder change-over manifolds will be provided where remote cylinders are used.
- Cylinders would be housed in vandal-proof enclosures protected from sunlight.
- Ring mains will be used where practical for all reticulated gases.

4.2 COMPRESSED AIR

If justified by demand a central compressed air plant would be provided. The plant would comprise duty and stand-by oil free compressors, refrigerated or desiccant dryers, filters and air receivers.

4.3 VACUUM SYSTEM

A central vacuum plant would be provided if justified by demand, otherwise local vacuum pumps or compressed air operated ventuiri suction outlets would be provided.

4.4 NITROGEN AND OXYGEN

Nitrogen and oxygen would be reticulated to the laboratories from bulk storage tanks or cylinder manifolds.

5.0 ELECTRICAL

5.1 GENERAL

The electrical design would incorporate the following features:

- Electrical supply substation.
- Main switchboards.
- Standby generator.
- Submains to each DB, services panel etc. including 25% spare capacity for future expansion.
- Distribution to outlets via main cable route down corridors. Similar for data cabling.
- Lighting by T5 high efficiency lamps generally. Miniature fluorescent lamps in core areas for toilets, corridors, etc to comply with Section J of the BCA.
- Emergency/EXIT lighting throughout – monitored by computer to reduce maintenance costs.
- Automation system (eg. C–Bus) to control lighting and A/C according to occupation (office only).
- Earth leakage protection to all general power and lighting circuits.
- Each work station to have a triple data point and 2 double GPO.
- Provision for future flexible layouts by using ducting systems and accessible ceiling spaces.
- Power connections to specialised items of plant.
- Provision for additional/changes to power and data to work spaces.
- Security system incorporating access control system.
- Data system to be connected to UNSW system.

5.2 SUBSTATIONS

Separate kiosk substations will be required for each major construction stage (Stages 2A, 2B and 2D).

5.3 MAIN SWITCHBOARDS

Separate main switchboards will be required for each stage as for the substations.

The main switchboards will be of the free standing sheet metal cubicle type and incorporating circuit breakers for the control of incoming and outgoing supplies.

The switchboards will also house an automatic transfer switches to control the operation of the standby diesel generator and to automatically connect the essential loads to the generator supply in the event of failure of the Supply Authority supply.

5.4 POWER FACTOR CORRECTION EQUIPMENT

Power factor correction equipment will be installed within the main switchrooms and connected to the supplies to improve the building power factor and reduce energy usage and cost.

5.5 DIESEL GENERATOR

A standby diesel generator will be provided to serve the essential building and laboratory loads. The generator will be rated at a nominal 350kVa.

The generator will be located in a dedicated plantroom. The room would be treated to prevent the noise of the generator causing disturbance to the building occupants or neighbours.

An underground fuel storage tank with a capacity of 5000 litres will be installed to serve the generator. This tank will provide for approximately fifty (50) hours running at full load.

The engine exhaust will be discharged above roof level.

It is proposed that the following equipment be provided with emergency power.

- Selected or all fume cupboards.
- PC3 lab supply and exhaust fans.
- Animal House supply and exhaust fans.
- Constant temperature rooms.
- Freezers.
- BMS and equipment alarm systems.
- Laboratory special exhaust systems.
- Selected laboratory equipment.
- 30% of laboratory power outlets.
- 50% of lighting.
- Essential building services.

5.6 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

Two UPS systems will be supplied. One system will be installed in the Computer Room and dedicated to the computer equipment.

The second system will be housed in a room adjacent to the Main Switchroom and will serve:

- Discrete outlets serving fume cupboards, biohazard and laminar flow hoods in PC2 & PC3 Tissue Culture and several individual specialist instruments to be confirmed.
- Specific temperature control plant associated with the nominated equipment.

A segregated fire rated reticulation system will be provided to reticulate the UPS power to the laboratories.

Each UPS will be of the solid state type and will incorporate sealed lead acid batteries sized to operate the load equipment for ten (10) minutes in the event of failure of the mains supply.