UNSW BIOLOGICAL SCIENCES PROJECT STAGE 2

KENSINGTON CAMPUS, RANDWICK

ESD RESPONSE TO SSD

(APPLICATION NUMBER: SSD 7865)

REPORT

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EXECUTIVE SUMMARY

EMF Griffiths has been engaged as the ESD Consultants for Stage 2 of UNSW Biological Sciences Project at the University of New South Wales.

The following report is to provide a response to the Secretary's Environmental Assessment Requirements of:

"Include a description of the measures that would be implemented to minimise consumption of water and energy use of the building."

At this point in time, there are a number of firm commitments with respect to reduction in consumption of energy and water, as well as further initiatives currently under consideration.

These initiatives are as follows:

Committed Initiatives

Energy

- Lighting Efficiency – 15% improvement on BCA requirements.
- Power Factor Correction.
- Automated lighting controls.
- Extensive metering and monitoring systems.
- Demand control ventilation (DCV).
- Low Load Chiller.
- Heat Recovery.
- High efficiency chillers – COP 7+ with a minimum operation of COP 4.
- High efficiency pump and fan motors.
- Low pressure drop pipework and ductwork systems.
- Boilers with efficiency >90%.

Water

- Low Flow Water Fixtures.
- Bore Water Reuse.
- Extensive metering and monitoring systems.
- High water efficiency appliances.

In addition, the following initiatives have been targeted for further evaluation:

Initiatives for Further Consideration

- Peak load management.
- Energy efficient equipment purchasing policies.
- Lighting efficiency – 30% improvement on BCA requirements.
- Photovoltaic power generation.

SECTION 1 INTRODUCTION

EMF Griffiths has been engaged by Multiplex as the ESD Consultants for Stage 2 of the Biological Sciences Project at the University of New South Wales, Sydney.

The purpose of this report is to provide a response to the SSD:

"***Ecologically Sustainable Development (ESD)***

Detail how ESD principles (as defined in clause 7(4) of Schedule 2 of the Environmental Planning and Assessment Regulation 2000) will be incorporated in the design and ongoing operation phases of the development.

Demonstrate that the development has been assessed against a suitably accredited rating scheme to meet industry best practice. Include a description of the measures that would be implemented to minimise consumption of resources, water (including water sensitive urban design) and energy."

The initiatives and targets are in accordance with the:

- Design Brief Volume 3.1 Version 3.2 dated June 2014
- Building Code of Australia (BCA) Section J

1.1 BUILDING OVERVIEW

Stage 2 of the Biological Sciences Project at UNSW is a refurbishment of the existing Building D26 including the lower ground floor and seven floors above ground level. The project comprises of:

- Laboratories;
- Specialty rooms associated with the lab equipment and materials;
- Workspaces;
- Teaching labs; and
- Animal House

The building is located at the top of campus off Botany St between Stage 1 of the Biological Sciences Project and the Wallace Wurth Building.

Figure 1: Concept Image of the Biological Sciences Building – Stage 2 (North West)

1.2 WHAT IS ESD?

ESD, or environmentally sustainable design, has been described as:

'....using, conserving and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased'

An integrated approach to ESD, whereby all design team members are aware of the incremental effect of their actions on the overall project, is by far the most effective path to achieving a strong ESD outcome. Active systems can be implemented to enhance a building's performance, but unless the fundamentals have been addressed, the optimum outcome cannot be assured.

Buildings consume 32% of the world's resources, including 12% of the world's fresh water and up to 40% of the world's energy. Buildings also produce 40% of waste going to landfill and 40% of air emissions.

The best way to enhance a building's sustainability performance is to optimise its passive design attributes. In this way, energy required to heat, cool, light and ventilate the building is reduced and the work required from the building's active systems is reduced.

1.3 AIM

The University recognises and values the following principles:

- minimising greenhouse gas emissions;
- minimising natural resource consumption;
- using sustainably resourced materials;
- minimising other adverse impacts on the environment;
- maximising amenity, health, wellbeing and enjoyment for people;
- maximising sustainability research and learning opportunities; and
- future proofing for later sustainability opportunities and constraints.

Above all, the approach recognises the precautionary principle in that where practical measures are taken to avoid serious or irreversible damage to the environment. It also assess the environmental consequences of the options.

These shall form the basis of sustainability initiative evaluation.

SECTION 2 ENERGY SAVING INITIATIVES

The energy consumption of a building can amount to its largest environmental impact. Sustainable design techniques focus on reduction of energy consumption by energy efficient practices, passive design and cleaner energy production/renewable energy to reduce CO_2 emissions to the atmosphere.

The benefits of an energy efficient building are reduced operating costs, a healthier indoor environment, reduced liability and recognition of being environmentally responsible.

2.1 LIGHTING

The project is committed to a 15% improvement, with a target of 30% improvement, upon the Building Code of Australia (BCA) – Section J6 limits for lighting efficiency in the non-laboratory spaces.

2.1.1 Fluorescent Lighting

Fluorescent lighting is generally cost effective due to its energy efficiency and long life. The energy efficiency is further increased by using fluorescent lamps with electronic ballasts. T5 tubular fluorescent lamps with electronic ballasts are about 20% more efficient than the standard T8 lamps with conventional ballast.

2.1.2 LED Lighting

LED (light emitting diode) lighting is a relatively new (for general lighting) and a very energy efficient technology which is developing all the time. LED lighting is equal to or greater than the efficiency of fluorescent lighting and has the added benefit of close to unity power factor and very long life. LED lighting comes in many shapes and forms and will work over a wide variety of voltages including AC and DC. Due to the nature of the light emitted LED is most appropriate for task lighting rather than ambient lighting: a 1 Watt LED lamp as a desk lamp would do the same job as a 7 Watt fluorescent lamp.

2.1.3 Occupancy / Motion Sensors

The installation of occupancy sensors or timed lighting for areas which have intermittent occupancy of the space, e.g. toilets, cupboards, lecture spaces will reduce energy usage.

Lighting in large areas will be split into smaller areas with separate switching, to illuminate only the required area.

2.2 POWER FACTOR CORRECTION

Power Factor correction to attain a Power Factor (PF) of at least 0.9 will be provided.

2.3 METERING AND MONITORING SYSTEMS

2.3.1 Sub-Metering

Metering and sub-metering in itself does not save energy, but it is the fundamental tool to enable building tuning and energy management. If accurate trend data across the building's various systems is readily accessible, patterns can be observed that can inform energy management strategies. For example, an energy spike late at night might suggest that there is a rogue timeclock schedule bringing on plant at inappropriate times. By comparing results month to month and week to week, over time the building's energy use can be managed down the most efficient minimum.

Extensive metering shall be provided and connected to the UNSW BACNet – EMACS system.

2.3.2 Building Management System (BMS)

A BMS system will be provided to allow the building energy use to be controlled and analysed from a single point.

2.4 DEMAND CONTROLLED VENTILATION

One aspect of a healthy internal environment is the appropriate provision of outside air. Best practice states that 7.5 l/s/person is the minimum necessary to maintain a comfortable internal environment but the project is aiming for an enhanced ventilation rate of 11.25l/s/person.

Demand controlled ventilation senses the level of CO_2 in the space and modulates the outside air rate in order to ensure a maximum concentration of CO_2, but also allows for the reduction of the flow rate when the occupancy within the space is reduced, thus reducing the system fan and cooling energy. Demand controlled ventilation is being provided as a significant energy efficiency initiative.

2.5 LOW LOAD CHILLER

Incorporating a low load chiller can significantly reduce the energy consumption of a chilled water system. Rather than relying on a chiller or set of chillers that operate throughout the load range, incorporating multiple chillers that are staged to match the building load based on their most efficient operation results in reduced energy consumption and therefore running costs.

A chiller's optimum performance is usually between 50% - 100% of total capacity, therefore if there was a single chiller covering the buildings total load, then during low load operation, <30% of total capacity, the chiller would be operating with a less than ideal COP, requiring more energy. However, if a low load chiller was incorporated then the larger chiller could turn off at ~30% of the building load and allow the low load chiller to take over. It would be sized to be operating at ~ 90% chiller load at a corresponding ~30% building load, therefore benefitting from its optimum COPs.

A low load chilled sized at approximately 20% of the peak is to be provided.

2.6 HEAT RECOVERY

Heat recovery can occur in various different manifestations, although in all cases its main aim is to recover or utilise heating/cooling that would otherwise be wasted.

Air to air heat recovery – a heat recovery plate or rotary wheel is built into the AHU and engaged should certain parameters be met in terms of internal and external air temperatures, enthalpy or relative humidity.

Air to water then water to air heat recovery is the essence of a run-around coil system. A plate heat exchanger is placed within the exhaust air path and recovers heat from the air, transferring it to the medium (water/refrigerant) within the closed run-around loop. The water is then pumped to a second plate heat exchanger in the supply air path and pre-heats the supply air.

Water to air heat exchange – Another form of the water to air heat recovery is that of a condenser water loop pre-heating the incoming supply air. The return condenser water temperature can be around 35°C, therefore passing this through a plate heat exchanger in the supply air path when a heating component is required both reduces the heating plant load and extracts heat away from the condenser water loop prior to it returning to the cooling towers. This does however require a building that exhibits a simultaneous heating and cooling load. Depending on the design of the system a heat exchanger could also be incorporated between the condenser water loop and the hot water loop depending on the associated flow and return temperatures.

In all instances, heating and cooling recovery can be obtained at an indicative rate of around 65% efficiency. However, in most instances this will occur at a cost in fan/pump energy. Heat exchangers are usually placed in the supply and/or exhaust air stream, therefore increasing the external static pressure of the system, which increases the duty on the fan. Where a medium such as water is used to transfer the recovered energy a pump is usually required to distribute that medium around the loop.

Heat recovery is to be included in the design for the animal holding areas and will be analysed further for all other areas.

2.7 AIR-CONDITIONING

The first step is to design the air-conditioning system to suit the conditions. As equipment generally runs at peak efficiency when running at capacity, oversized equipment will waste energy running at reduced capacity for the majority of its life. If the system is undersized the risk is that it will not cope with peak demand. The air-conditioning system should be flexible enough to run efficiently with variable load and to absorb some future expansion in the size of the facility.

The project is targeting the following as a minimum:

- electric water cooled chillers to run for the majority of the time with a COP greater than 7 and never go below 4;
- minimum motor efficiency of 90% for fans and pumps with a rated power above 2kW;
- select pipework based on 150% of the load;
- zero ODP refrigerants;
- water boiler efficiency > 90%;
- metering to be connected to the UNSW BACNet – EMACS system; and
- independent commissioning agent managing operational tuning.

SECTION 3 WATER CONSERVATION INITIATIVES

Water is a precious resource in Australia, with regular drought conditions imposing water use restrictions on all water users. Subsequently, the price of purchasing potable water is rising and future increases are anticipated.

It is essential to explore all opportunities to limit potable water consumption, including water efficient practices and non-potable water use.

3.1 WATER SAVING INITIATIVES

The project is targeting the following as a minimum:

- The following WELS rated plumbing equipment will be provided;
  - Toilets – 4 Star;
  - Hand Basins – 5 Star;
  - Showers - 3 Star with flow restrictors to 7.5l/s;
  - Dishwashers – 3.5 Stars;
- Bore water use;
- Reduction in water use for fire water testing either through;
  - Providing isolation valves or shut-off points for floor-by-floor testing;
  - The fire protection system does not expel water for testing;
  - There is sufficient temporary storage for a minimum of 80% of the routine fire protection system test water and maintenance drain-downs, for re-use on site;
- Specialist equipment such as for sterilisation or similar to be within 25% of industry best practice;
- Water metering systems; and
- Maximising runs of flow return loops thereby reducing dead legs, thereby reducing water wasted while awaiting the arrival of hot water.

3.2 BORE WATER

Bore water is a natural resource however it is not treated so can only be used for some application to decrease the demand on potable water. Bore water is already available on site and is used for cooling towers, irrigation and flushing systems for other sites around the University. All upper campus bore water is treated for pH correction only.

SECTION 4 INITIATIVES FOR FURTHER CONSIDERATION AND ANALYSIS

The following describes additional ESD measures under consideration.

4.1 PEAK LOAD PERFORMANCE MANAGEMENT

Incorporating measures to reduce the building peak energy demand by 15%.

There are a number of strategies that can be employed to manage the peak load of the building:

1) Incorporating efficient design elements, such as high performing facade, high efficiency mechanical and electrical services.
2) Employing load shedding strategies and variable setpoint algorithms in order to modulate the building's energy demands through the BMS.
3) Adding storage capacity so as to displace the peak loads on the building to off-peak times.

Further analysis will determine the appropriate mix and size of technologies to achieve the targeted 15% reduction in electrical peak demand.

4.2 PURCHASING STRATEGIES FOR HIGH EFFICIENCY FFE EQUIPMENT

A minimum performance requirement should be placed upon all electrical equipment specified for the development in line with the Australian Government's energy rating labelling scheme. This would be applicable to, but not limited to, the following items:

- Refrigerators (4.5 Star).
- Freezers (4.5 Star).
- Dishwashers (4.5 Star).
- Computer Monitors (3.5 Star).
- Televisions (4 Star).

4.3 PHOTOVOLTAIC SYSTEM

A roof mounted photovoltaic system to offset peak electrical demand is under consideration. The roof layout has been adjusted to maximise the output from the system. If a system is not installed within this project, the roof will be configured to enable ease of installation in the future.