If a building becomes architecture, then it is art. Clearly, if a building is not functionally and technically in order, then it isn't architecture either – it's just a building.
Arne Jacobsen

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STEENSEN VARMING

Att. Andy Nixey
Department of Planning and Environment
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Dear Mr Nixey

Sydney August, 2019
Ref. No. 14702.PL.M.03

Joe Martin
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This letter is in regard to the design change in selection of heat rejection systems serving the Sydney Modern development cooling systems and a subsequent letter to a previous response issued 'Ref.No.14702.PL.M.02 dated May 3rd, 2019'.

The previous letter of response provided basic rationale and technical benefits to the change of heat rejection. This letter will cover the further clarifications requested by the 'City of Sydney' (CoS) in letter Ref 'R/2014/13/D'.

This response also addresses the items raised at a meeting held with the CoS at their offices on the 19th July 2019, held to discuss the items of concern to the CoS.

The Clarifications sought by CoS are as below with descriptive responses provided.

Driving Forces in change of heat rejection system

In the initial selection process for heat rejection systems a full and thorough, staged evaluation process was carried out. The assessment criteria accounted for weighting to the AGNSW's critical requirements.

The paramount criterion for the Gallery is the ability of the mechanical system to maintain conditions to the critical display areas. The possible options of heat rejection were analysed and it was deemed that the optimal solutions for the Gallery were sea water, or water based cooling towers to provide the stable condenser water temperatures and reliable systems required.

Following full lifecycle analysis of the Cooling Towers and Open loop and closed loop sea water systems the analysis resulted in the open loop sea water system and cooling towers equally providing the best outcomes.

It was decided to move forward with the open loop sea water system on the basis that whilst having a far higher capital cost, it had the benefit of negating any impact on the building envelope.

It should be noted that in the analysis the payback period was calculated at 41 years so the decision made was not aimed at a short financial gain.

Following detailed design development some of the highlighted issues prevalent in the sea water system, design began to develop and resulted in a conclusion that made the move back to cooling towers within the new building envelope a more optimal solution for the gallery. Some of the rationale are listed and detailed:

Safety/Maintenance
The Sea water remote plantroom created a confined space with risk of water deluge. This provided a safety risk to Gallery staff. In addition, the plantroom required a mobile hoist system to replace large pieces of equipment which posed a safety risk. Upon deciding that a cooling tower option would be an optimal solution a detailed study was carried out to ascertain the best location for the heat rejection plant. The final location as detailed within the Architectural drawings provides an ideal location for plant with direct access from below to the loading dock ensuring ease of plant replacement. In addition, the safe access of maintenance staff is now a far better outcome with a readily accessible plantroom with compliant access and maintenance

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space. It should also be noted that the plantroom will provide a well-ventilated space with no health risks to maintenance staff working within the space.

Capital Cost
Upon detailed investigation through design development the capital cost associated with the Sea water plant became inhibitive. This cost was mainly associated with the excavation works for the pipework to the sea and services diversions below ground. The cooling towers proved a far simpler installation, utilising existing planned excavation and far shorter condenser water pipework distances required. With the energy consumption difference of the two systems being almost negligible the capital cost eliminates the sea water system as a feasible financial solution.

Ongoing Maintenance Cost
The ongoing maintenance costs for the sea water system is higher than the cooling tower alternative, with regular maintenance to heat exchangers and chemical treatment systems requiring an additional maintenance plan to the existing one operating at the Gallery. The requirement for maintenance being carried out in an enclosed space also adds to the costs and complications for the Gallery. The Gallery already have a rigorous maintenance regime for their existing building cooling towers and in moving to the inclusion of cooling towers to the new building they can simply extend this regime.

Reliability of a critical system
The Cooling tower solution provides a more reliable system to the Gallery with fewer points of failure and the systems are standard across Sydney. With the sea water, whilst redundancy was designed in, there were a number of points within the system that could fail and with age become more unreliable (historically this is the heat exchangers). The cooling towers are standard and simple systems with a high reliability, additionally the equipment is all standard to the Sydney market so maintenance staff are comfortable with working on it and parts are readily available locally.

Please refer to Steensen Varming response letter 'Ref.No.14702.PL.M.02 dated May 3rd 2019' for a list of technical benefits of the cooling towers as a source of heat rejection over the sea water open loop system.

The below numbered sections are in direct response items raised by the CoS in their letter Ref 'R/2014/13/D'.

1. **Health and Safety**

The discharge will be approx. 5-6°c higher than the air entering and almost saturated, so approximately 98%. This would mix quickly with the air so would only be perceived in the close vicinity of the point of discharge. The air will be discharging at approx. 5m/s but it is not located at a point congregation or a shaded area so there will not be people standing adjacent to the grille. On a typical day, standing or walking on the fire egress path directly adjacent to the grille will feel like warmer humid air passing by vertically and is in no way a health concern for person passing by.

Importantly, it should be noted that there is no legionnaires risk to maintenance workers and the public through the selection of closed loop cooling towers. This means the air being discharged vertically through the grille will be warm air only

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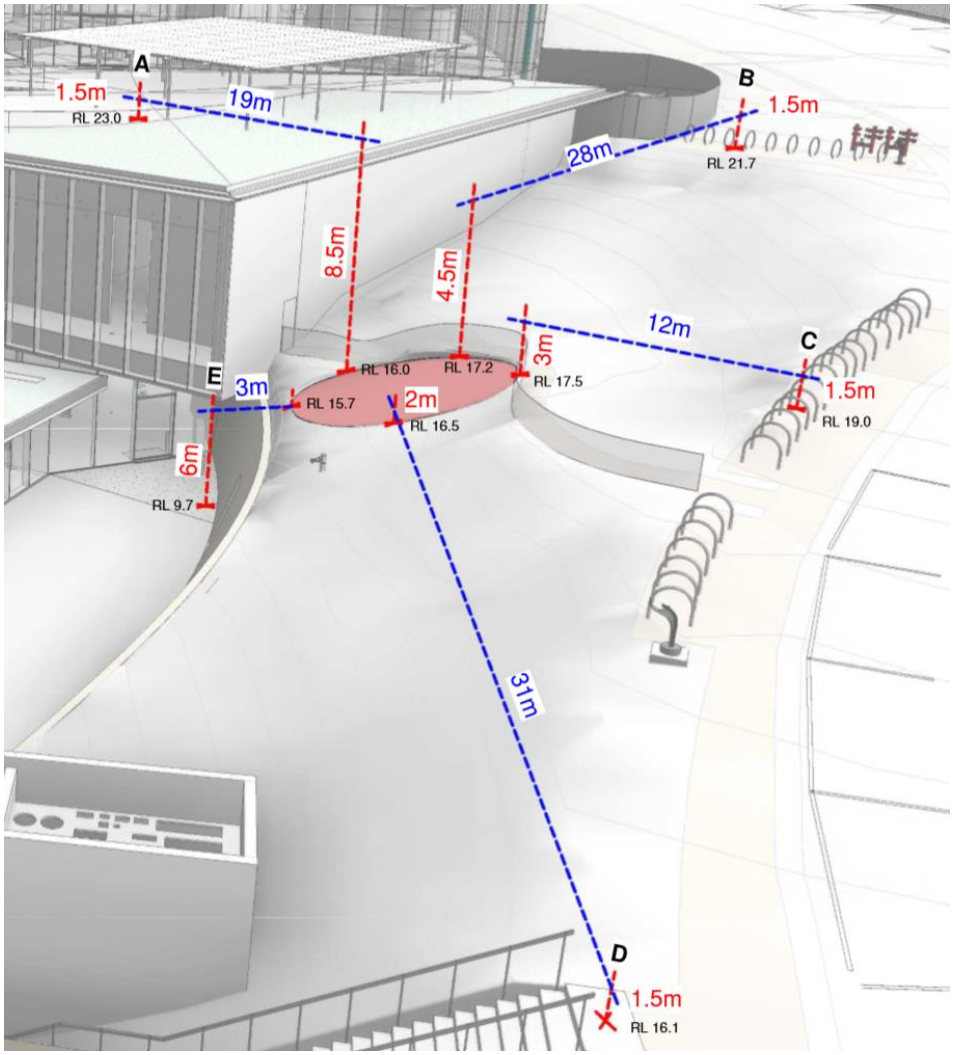
from the cooling towers that will not have passed across a bath of standing water as it would with an open loop cooling tower.

When investigating possible locations for siting the cooling towers the perceived discharge and air movement around the grille was carefully considered. The grille is located far enough from any point of busy thoroughfare and place of congregation to ensure that the exhaust is not a health or nuisance to the public or users of the building. The below image has been produced by Architectus to show the proximity of the grille to places of public and Gallery use.



Points A through to D are all sufficiently far enough away in the horizontal plane to ensure there will be no perceived sensation from the cooling tower discharge. Point E is only 3m in the horizontal plane but sufficiently far below in elevation to ensure the discharge will not be physically perceived as the warmer air will be rising.

It should be noted that there is a fire escape door leading to a pathway which passes adjacent to the grille. This will only be used in emergencies and will act only as a pathway and not a place for congregation. If someone is evacuating the building

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using this path, they will likely experience a warm air flow from the grille as they pass however, this will not be any health risk to people passing the grille and is simply warmed air.

As an additional note, it was raised at the meeting with the CoS as to the protection of the plantroom and cooling towers from debris. There is to be a balustrade around the grille preventing anyone walking across it. The main source of debris will therefore be leaves and litter. To prevent these both creating a maintenance issue and possibly impacting the operations of the cooling system. To prevent this there shall be a mesh net placed beneath the grille to capture any debris which can then be collected as part of a maintenance regime.

2. Ecologically Sustainable Development

Based on a water balance model carried out by Arup, approximately 6,400m3 of rainwater will be collected at the B4 tank over the catchment area, this does not include evaporation and overflow losses. Once treated, this will amount to approximately 5,400m3/year of cooling tower make up water, the rest will be used for irrigation.

Please note however, this is not the green star building requirement which I understand is simply to have 200m3 rainwater tank volume installed for the project.

Additionally, the CoS planning requirement is to reduce site building rainwater discharge by 77%, this is outlined in the hydraulic and fire services specification.

The rainwater harvesting system will serve the new cooling towers with water in addition to the existing cooling towers on the existing building, there will however, be a non rainwater harvesting connection for additional top up.

Compliance with AS/NZS 3666
The CoS letter refers to the requirement of the cooling towers system to comply with AS/NZS 3666.1:2011 Air Handling and water systems of buildings – Microbial Control Part 1: Design, Installation and commissioning.

The letter specifically refers to the recommendations for siting the cooling towers and the risk of legionnaires disease which the City regularly assist with cases.

Regarding the recommendations for the location of the plant, the standard states the cooling towers *'be located away from occupied areas, pedestrian thoroughfares, air intakes (including lift shafts), building opening and trafficable areas'*. We would note that as detailed within this letter the area surrounding the cooling towers is not a public thoroughfare and only an egress path. We believe that due to the use of the egress path, it's minimal use and the system design detailed below, the design is not in conflict with AS/NZS 3666.1:2011.

Regarding the risk of legionnaires, we would see that through the selection of the cooling towers and associated design, the risk is negligible. As detailed, we have selected closed loop cooling towers and not open loop. Closed loop system will typically run dry for much of the year and at a very minimum discards the water within the system every 24hrs, thus there is no standing water for legionella to develop within.

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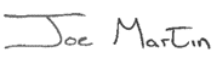
Whilst closed loop systems have testing for water quality to comply with AS/NZS 3666.3:2011, they do not typically have a microbial treatment built into them as the risk of legionella is not deemed to present a risk.

It should also be noted that whilst their application in the industry and the possible risk of legionella build up in closed loop and open systems is drastically different, the AS 3666 standards do not differentiate and the purposes for the recommendations are not pertinent to both systems. This is the same for the water treatment and microbial control to the two different systems.

Conclusion
Following the design development and subsequent conclusion that cooling towers within the building envelope provide the optimal heat rejection system for the Gallery we believe that the proposed location and detailing provide the best solution for a heat rejection serving the mechanical cooling system serving the Sydney Modern development and provide a safe system with no health risk to the public or the staff of the Gallery.

Kind regards



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