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Macquarie Generation
34 Griffiths Road,
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Attention Mr John Marshall

Dear John

BAYSWATER B ENVIRONMENTAL ASSESSMENT
RESPONSE TO INDEPENDENT REVIEW ON GREENHOUSE GAS ASSESSMENT

Please find attached our response to the Independent Review of the Bayswater B Greenhouse Gas Assessment conducted by Arup (dated 27/10/09)

Regards
WorleyParsons

T. Jones
Senior Consultant

1. INTRODUCTION

Macquarie Generation submitted an Environmental Assessment (EA) in support of a Concept Approval for the proposed Bayswater B Power Station. As part of the process for Concept Approval, the Department of Planning (DOP) sought an Independent Review of particular specialist studies therein. As such, the EA has been reviewed by consultants Arup Pty Ltd in a document dated 27/10/09 ("Independent Review"), in the context of Greenhouse Gas (GHG) emissions.

WorleyParsons has been engaged by Macquarie Generation to provide a response to the Independent Review by Arup.

The following section provides responses to some general issues within the Independent Review. These are followed by sections responding to some specific issues raised by the Independent Review.

2. GENERAL ISSUES

2.1. Economic Considerations

The Independent Review in general has not fully considered GHG within the context of the economic feasibility of the project. The Director General's Environmental Assessment Requirements (EARs) required that the project presented in the EA (despite being concept) should be considered in the context of it being economically viable, operationally feasible and realistic to market considerations. This would ensure that even though the project was to be concept, that it was assessed on a meaningful basis within the context of the reality of how such plant might be built and operated. As such, while the project concept design considered all available technological components and configurations, decisions were required to be made within the context of the above considerations. This meant that some aspects which might be speculated as being more advantageous, had to be discounted on the basis of prohibitive economics, technological limitations or operational practicalities.

In addition, the Independent Review has not fully incorporated the financial context under which Bayswater B is likely to operate. That is, as part of the NSW Government's Energy Reform Strategy, development sites, including Bayswater B, are to be sold to the private sector for future development. The future development and operation of Bayswater B would be carried out by the private sector most likely with debt financing from local and international banks. Unlike projects undertaken by Government organisations, private developers and banks would require lower risk profiles, especially following the global financial crisis. The economic viability of the project is dominated by the need to minimise the initial capital cost of the project and the ability to service the debt. For these reason, the EA considers the following criteria:

- Proven, commercially available technology to minimise plant performance and environmental impacts risk and capital cost,
- Use of manufacturers' standard design plant,
- High capacity factors reflecting Bayswater B would be the most efficient coal or gas fired plant in NSW with significant debt servicing obligations,

- The implications of this project operating in the context of the National Electricity Market.

By not fully considering the economic feasibility in the context of the National Electricity Market and the financial context of Bayswater B, several of the conclusions of the Independent Review are disputed.

2.2. National Electricity Market (NEM)

The Independent Review does not fully recognise the workings of the NEM in relation to the price of electricity sold by a generator. For example long run marginal cost for a power station is not the electricity price in the NEM.

2.3. Information in the Environmental Assessment

Throughout the Independent Review, it is indicated that information (e.g. a methodology to derive an emission performance) was not included in the EA and additional details are said to be required.

The information provided in the EA is considered to be appropriate for the current Concept Approval stage. The scope of the information provided related to the assessment requirements of the Director General and, together with assessment methodologies, was agreed with DECCW during the assessment period.

3. SPECIFIC ISSUES

3.1. Quantification of Greenhouse Gas Emissions (Independent Review Section 2)

This section outlines Macquarie Generation's response to the issues raised in Section 2 of the Independent Review relating to the quantification of GHG emissions.

In Section 2.2.1, the Independent Review notes that the calculations for Scope 1 are not shown to an acceptable level of detail. As noted above, the level of detail provided was in accordance with the EARs and had been discussed with DECCW during the assessment period.

Notwithstanding this, the Independent Review also asserts in this section that the estimates of Scope 1 emissions appear to be acceptable.

In Section 2.2.2, the Independent Review notes that the quantification of Scope 2 emissions is appropriately conservative and that the Scope 2 emissions will be negligible.

The calculation of Scope 3 emissions (Section 2.2.3 of the Independent Review) is considered by the Independent Review to be unacceptable. The calculation of emissions for the coal fired option included in the EA are in accordance with NGER requirements for open cut mining and rail transport. The use of NGERs for the calculation of Scope 3 emissions was discussed and agreed with DECCW during the assessment process.

The Independent Review uses general NSW NGA factors which are less accurate than project specific figures. The EA utilised the approved NGERs methodology, which is based on the fuel characteristics as used at the existing Bayswater plant which are comparable to the anticipated project fuel characteristics. This was believed to be more appropriate for the assessment of the GHG emissions.

The calculation, in the EA, of Scope 3 emissions for the coal fired option requires amendment due to a transpositional error, the fugitive emissions provided in Tables 10-4 and 10-5 of the EA of 281,200 t CO_2-e p.a. should be replaced with 630,000 t CO_2-e p.a. The calculations in the EA showed that the project would contribute an anticipated 2.02% to the national GHG emissions. This change in the calculations changes the predicted contribution to 2.08% (at the start of operations) which is not believed to represent a significant difference.

The calculation of Scope 3 emissions for the gas fired option reflects gas supplies from Queensland coal seam methane extraction, where only minimal extraction and processing emissions occur. Due to a calculation mistake during the assessment, the fugitive emissions provided in Tables 10-4 and 10-5 of the EA of 147,600 t CO_2-e p.a. should be replaced with 360,000 t CO_2-e p.a. The calculations in the EA showed that the project would contribute an anticipated 0.96% for gas. This change in the calculations changes the predicted contribution to 0.99% (at the start of operations) for gas which is not believed to represent a significant difference.

Given that the gas supply is to be sourced from Queensland (ie via the Queensland to Hunter Gas Pipeline as outlined in the EA) the appropriate Scope 3 Emission Factor from Table 37 of the NGERS worksheet is 3.2 as opposed to 15.7 for NSW Natural Gas used in the Independent Review (it is noted that the only currently approved potential source of gas for the proposal is the Queensland source. While it is understood that investigations are currently occurring in respect of gas availability in NSW, there are no currently approved NSW gas supply projects that could meet the demand required for this project).

Fuel usage by construction equipment is included in EA Scope 3 emissions.

As noted in the EA, this is a Concept Application and the calculations undertaken were aimed to be meaningful and based on as accurate a baseline of information as possible, and using a methodological approach discussed and approved by DECCW. This provided an appropriate assessment and results. However, there is to be a detailed design and Project Application stage which would review and update the assessment as appropriate based on the final choice of technology, fuel source and detailed engineering design and construction logistics. At this stage however, the current assessment is believed to be adequate and appropriate on the basis of the current concept design as shown in the EA.

Under section 2.2.4 of the Independent Review, it is note that the total construction and operational GHG emissions includes the most significant emissions.

3.2. Comparison of Predicted Emissions Intensity and Thermal Efficiency (Independent Review Section 3)

3.2.1. Calculation of Capacity Factor (Independent Review Section 3.1)

The Independent Review notes that the methodology for the calculation of thermal efficiency and emissions intensity is appropriate. However, it asserts that the very high capacity factor is likely to underestimate emissions. The Bayswater B plant would not operate at lower capacity factors because of the financial and commercial context of the plant in the NEM.

As the most efficient power station in NSW with low cost fuel but significant debt servicing obligations, this private sector merchant plant would be expected to operate at very high capacity factors for which no efficiency correction is applicable. If high capacity factors were not attained,

Bayswater B is more likely to operate in a two shift regime as prolonged part load operation increases fuel, operating and maintenance costs.

3.2.2. Comparison Against Best Achievable Practice (Independent Review Section 3.2)

The Independent Review states that the Bayswater B gas fired option is not the best achievable practice. In assessing available technologies, factors considered included requirements for proven, commercially available technologies, highest environmental performance, performance in terms of annual sent out output and efficiency at Bayswater B site conditions (compared to design or ISO conditions), capital and operating costs, impact of various plant configurations and equipment options.

As noted above, the EARs required the project to be conceptualised on a realistic basis. As such, the design presented in the EA is deemed to represent a more realistic and practical model of the proposed power station. The Independent Review has assumed a series of technical aspects which are not believed to represent economic feasibility of the available technologies. Some of those specific factors are outlined in more detail below.

Gas Fired Option

In nominating the H class gas turbines as the best achievable practice, the Independent Review has not considered:

- Only two manufacturers produce H class gas turbines, so competitive tendering is limited,
- H class gas turbines are not proven technology with only limited service hours,
- F class machines currently incorporate many features of H class machines and have comparable performance,
- H class gas turbines have a higher pressure ratio than F class machines, increasing gas compressor auxiliary demand,
- The small capital cost differential between the developmental H class gas turbines and proven F class gas turbines,
- The use of exotic materials and coatings increases the maintenance cost of H class gas turbines.

Performance comparisons for Bayswater B between the GE 109H and Siemens SCC5-4000F combined cycle plants with air cooled condensers indicate the annual sent out thermal efficiency for the F class gas turbine plant is equivalent to the H class plant, contrary to claims made in the Independent Review.

Coal Fired Option

The Review also asserts that the coal fired technology is not the best achievable practice. In nominating the Theoretical High Efficiency Thermal Design as best achievable practice, the Independent Review has not considered:

- The impact of the disproportionately higher capital cost associated with additional feedwater heaters and larger air cooled condensers,

- The major impact of capital cost on project economic viability,
- The increased auxiliary loads associated with larger air cooled condensers,
- Reduced sent out electricity due to larger auxiliary loads.

Based on the above considerations, the Independent Review assessment regarding H class gas turbines and high efficiency thermal design, while theoretically representing high efficiency performance, does not consider the Director General's EARs that require that the project be conceptualised on a practical operational basis to underpin a reasonable and meaningful suite of technical assessments.

3.2.3. Comparison with Current NSW Greenhouse Gas Intensity Average (Independent Review Section 3.3.2)

The Review states that the use of the NSW pool co-efficient is not an acceptable representation of the current NSW average emissions. It was agreed with the DOP and DECCW that the assessment methodology involving the Greenhouse Gas Abatement Scheme pool coefficient be used for the purposes of EA reporting and comparison of Bayswater B emissions intensity with NSW average intensity.

3.2.4. Comparison Against National Emissions (Independent Review Section 3.4)

The Independent Review states that the national comparison does not represent the worst case. Comparisons between Bayswater B and national (and NSW) emissions can only be based on calculations reflecting known information and reasonable assumptions. The Independent Review assertion includes factors that are speculative which does not provide a sound basis for assessment or its verification. It is believed that the EA assessment is based on current and reasonable assumptions that therefore can be replicated and verified.

The EA adopted the national GHG emissions growth rate provided by the Commonwealth Department of Climate Change (DCC) of 1.6% p.a. which did not include the impact of the CPRS. The EA does not endeavour to forecast the impact of the CPRS on national GHG emissions in light of the uncertainties involved. In view of approach used in the EA, Bayswater B would be expected to operate at high capacity factors for much of its service life and emissions would be a small percentage of the large national total.

The Independent Review assumes that the Federal Government's CPRS is implemented and achieves nominated future reductions in electricity demand and emissions. In this carbon constrained market, it is unlikely Bayswater B would continue operating with high capacity factors (as assumed by the Independent Review) and instead would adopt a lower capacity factor, two shift operating regime. At the end of its service life (say 2054), the plant may operate with only 20% capacity factor given a high cost of CO_2. As a result, Bayswater B emissions might be a similar proportion of national emissions to those shown in the Environmental Assessment.

Comments regarding the EPBC Act are noted. The project has been referred to the Commonwealth Department of Environment, Water Heritage and the Arts (DEWHA) and is awaiting determination. However, while it is appreciated that the Act is under review, GHG emissions are not currently a trigger.

3.3. Measures to Reduce and/or Offset Emissions (Independent Review Section 4)

Section 4 of the Independent Review deals with measures to reduce or offset GHG emissions. The EA for Bayswater B has been prepared for Concept Approval purposes only. Measures to reduce and/or offset emissions are matters for the final Project Approval process to address.

3.3.1. Solar Thermal Augmentation (Independent Review Section 4.4)

Macquarie Generation has contributed capital to a world first application of solar thermal technology at its Liddell Power Station to produce renewable energy. The Liddell Solar Thermal facility is experimental in nature and its commercial viability is not yet proven. Whilst valuable experience has been gained, the capital cost is very high for a limited return as the Hunter Valley sunlight conditions are very marginal for solar energy purposes. Macquarie Generation supported by significant government (renewable energy) funding, is considering expanding the current plant to be able to better assess its solar thermal performance and assist with the industry development. This expanded plant is likely to cost in excess of $9 million and deliver less than 0.25% of the energy produced by one of Liddell's four generating units.

Solar augmentation is currently not viable for Bayswater B. While the EA indicates shading is an issue, with the site being some 100 m lower than surrounding hills, other issues considered include:

- High capital cost. The capital cost of Liddell solar thermal augmentation would be at least five times more expensive than the main plant on an annual continuous output basis. This is in line with the high capital cost reported for new solar thermal plants being built (eg the 50 MW Andasol plant in Spain). Economic feasibility is threatened by high capital expenditure and low capacity utilisation and therefore energy output more so than by other cost parameters,
- Insufficient data is available to properly project future operating and maintenance costs at this time,
- Solar Thermal plants require very large areas of land if they are to produce significant output. Available land area for augmentation is limited with Saltwater Creek and tributaries and existing vegetated areas quarantining much of the site, while sloping topography impacts other areas.

3.3.2. Biomass Co-Firing (Independent Review Section 4.4)

For Bayswater B, the conceptual design is based on the selection of proven, commercially available technologies and manufacturers' standard reference design power plants in order to minimise capital cost and plant performance risks. The inclusion of biomass co-firing would increase the capital costs of the plant. It would involve the use of non standard technology and undoubtedly degrade the value of plant suppliers' performance guarantees.

Contrary to the claims made in the Independent Review, the quantity of saw mill residue and vegetable oil co-fired at Bayswater and Liddell was less than 1% by mass due to limited supplies of biomass and plant performance issues. Furthermore biomass had to be sourced from distances up to 300 km incurring prohibitive transport costs. An additional concern was the increasing use of diesel fuel consumed (with associated GHG emissions) for the transport of the biomass.

Macquarie Generation does not currently fire biomass at Bayswater and Liddell due to the impact the low energy fuel has on plant output, the high cost of transport and handling which makes it uneconomic and concerns about the sustainability of outcomes.

The lack of available locally sourced biomass and its high cost make biomass co-firing not viable for Bayswater B. It is understood that the future availability of sawmill waste is threatened as a result of the declining native timber hardwood industry. The specific energies of softwoods are significantly lower resulting in little if any useful heat release.

3.3.3. Carbon Capture and Storage (Independent Review Section 4.5)

The comments made in the Independent Review are noted. It is emphasised again that given the technology is not commercially available it is impossible to provide meaningful estimates of cost and potential timing of implementation at this time. As a result, the EA proposed a mechanism of review which DECCW has recommended be every three years.

3.4. Evaluation of Project under the CPRS (Independent Review Section 5)

The EA for Bayswater B has been prepared for Concept Approval so only basic assessment has been included. This was also in accordance with the Director General's EARs. Evaluation of the project under the CPRS would be provided by the project developer as part of the final Project Approval. Details concerning the proposed power station and more information on the impact of the CPRS would be available by then, however there are some reservations concerning the level of assessment that is practical and reasonable.

The Independent Review analysis incorrectly asserts that there is enough publicly available information which would support a much more comprehensive review of the impacts of the CPRS. A more comprehensive review is more appropriate to be undertaken when detailed and confirmed information is known, rather than the current speculation. Notwithstanding this, it is believed that the level of detail presented meets the Director General's EARs.

The Independent Review does not consider the practical operation of the NEM. There is currently a significant level of uncertainty about the impact of the CPRS on electricity prices. The long run marginal cost of a project for example only provides part of the information to determine commercial viability.

In order to fully assess the impact of CPRS on Bayswater B, detailed analysis and modelling of both costs and electricity prices in the NEM would be needed under numerous scenarios. At this stage:

- There is insufficient certainty about the CPRS for a useful assessment, particularly as the project is only at concept stage,
- Such assessment is far more relevant to the final project developer,
- The technology of CCS is not yet defined such that cost and performance are uncertain. As a result any current analysis is not helpful.

Prepared by: T. Jones

Reviewed by: W Lambert.