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REPORT

on

EnergyAustralia

Environmental Assessment for Stage 2A(i) of the

CITY EAST ZONE SUBSTATION

33 Bligh St Sydney

Prepared for: Lowy Institute for International Policy
31 Bligh St
SYDNEY NSW

Prepared by: **Prof A. Baitch** FIEAust, CPEng

18 August 2010
Ref: 10551/1

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APPENDIX

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1 INTRODUCTION

This report was prepared by Prof Alex Baitch, Principal of BES (Aust) Pty Ltd (and Visiting Professorial Fellow at the University of Wollongong) (hereinafter referred to as BES). The report was prepared on behalf of the Lowy Institute for International Policy (hereinafter referred to as the Lowy Institute).

The Lowy Institute occupies and owns the property at 31 Bligh St Sydney. This is a property of heritage significance. The Lowy Institute worked closely with Investa, the previous owners of the adjoining property at 33 Bligh St Sydney, to develop a design which resulted in Council approval for the redevelopment of the property. This redevelopment treated the front entrance to the property in Bligh Street in a sensitive way and made the Lowy Institute building a feature of the entrance area and an integral part of the Richard Johnson Square.

Investa has sold this property to EnergyAustralia who propose to redevelop the site as a new City East Zone Substation complex. The design developed by EnergyAustralia's design team results in a bulky "feature-less" front façade when viewed from Bligh St which detracts from the site lines from Bligh St and Hunter St of the Lowy Institute Building.

BES has been engaged by the Lowy Institute to investigate the options that may be open to EnergyAustralia to modify the design in order to set back the front facade of the proposed development such that the Lowy Institute Building can be featured in any redevelopment of the 33 Bligh St site.

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2 QUALIFICATIONS AND EXPERIENCE

My qualifications to provide this opinion are set out in my CV in Appendix A.

I am Principal of BES (Aust) Pty Ltd. I established my consulting practice following an extensive career in the electrical engineering industry to provide expert consulting services. I have a Masters degree in Engineering Science in Electrical Engineering and a Master of Business Administration in Technology Management. I have in excess of 40 years experience in the electrical industry. I was appointed Visiting Professorial Fellow at the University of Wollongong, School of Electrical, Computer and Telecommunications Engineering in 2003.

I have extensive experience and expertise in the field of electrical distribution and utilisation. I have been in my own consulting practice in the field of electrical distribution and utilisation since 1993. I am a Fellow of Engineers Australia, a Senior Member of the Institute of Electrical and Electronic Engineers, a Fellow of the Australian Institute of Energy and an Associate Member of the Institute of Arbitrators and Mediators Australia.

Amongst various other roles, I am Chairman of Standards Australia Committee EL043 on High Voltage Installations which published the new and revised Australian Standard AS2067 “Substations and High Voltage installations greater than 1kV ac” and a member of the parallel International Electrotechnical Commission (IEC) committee MT4 which is responsible for the production of the IEC standard IEC 61936 “Power Installations greater than 1kV ac”.

I have had extensive experience in the design and layout of high voltage installations over the years including the detail design of zone and distribution zone substations. I am a level 3 Accredited Service Provider as a Designer of electrical distribution systems in NSW.

In addition, as set out in the attached CV I am involved in a range of other electrical industry activities. I have been actively involved in the highly respected technical activities of the International Council on Large Power Systems (CIGRE). In this regard I am a member of the Australian Panel AP C4 System Technical Performance (Power Quality and Insulation Coordination) and am Convenor of Australian Panel AP C6 Distribution Systems and Dispersed Generation. I am Convenor of the CIGRE International Working Group WG C6.09 Demand Side Response. I have published many technical papers and presented lectures on a range of subjects both in Australia and internationally on a range of matters in the field of electricity distribution.

During my period as consulting engineer from 1993 to date, I have been engaged to undertake a wide variety of assignments in the power distribution and utilisation field.

Accordingly, I believe that I am well qualified to address the issues in this matter.

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3 FACTS AND ASSUMPTIONS

This report has been prepared in the context of the following Facts and Assumptions:

1) In April 2008, Sydney City Council granted consent to Investa at 20 - 26 O'Connell Street Sydney for the upgrade of Richard Johnson Square and the provision of Public Art works. The works involved Demolition of the existing commercial buildings on the site known as 'Kindersley House', and construction of a 205m high commercial building comprising 28,032sqm of FSA over 26 commercial levels; basement level parking for 41 vehicles and provision of a ground floor through site pedestrian link and 168sqm of retail space. This development occupies 33 Bligh St Sydney and 20-22 and 24-46 O'Connell St Sydney and is referred to as 33 Bligh St..

2) In September 2009, the then Minister for Planning, Hon Kristina Keneally, under the Environmental Planning and Assessment Act 1979 determined to approve a Concept Plan submitted by EnergyAustralia for the Sydney CityGrid Project as a Major Project under Part 3A of the Environmental Planning and Assessment Act 1979. The approval determined that various remaining components of the Sydney CityGrid Project require further environmental assessment under Part 3A of the Act. One of these components was identified as Stage 2A being the construction and operation of the City East Zone Substation in the vicinity of Phillip, Bent, Bligh and O'Connell Streets.

3) EnergyAustralia has entered into an agreement with Investa for the purchase of 33 Bligh St and is now seeking Project Approval for the City East Zone Substation under Part 3A of the EP&A Act in the following stages:

    a. Stage 2A (i) involves the demolition of the existing building on the site (Kindersley House) and subsurface construction works. This includes a building envelope for the subsequent development of the site; and

    b. State 2A (ii) involves construction and operation of the City East Zone Substation and the associated commercial tower located above the substation. This involves detailed consideration of the built form of the development at the site and is intended to refine the building envelope presented in Stage 2A(i).

4) The Environmental Assessment has been prepared by GHD Pty Ltd on behalf of EnergyAustralia.

5) The Lowy Institute owns the adjoining property sandstone building of heritage significance known as the NSW Club House building (31 Bligh Street).

6) At a meeting with EnergyAustralia on 13 August 2010, I was briefed by representatives of EnergyAustralia with respect to the detail of the proposed concept design that EnergyAustralia is preparing for the building in order to understand the scale and size of the proposed development

and to understand the requirements of the proposed building envelope. In particular, the focus was on understanding what options may exist for reducing the proposed building envelope to ensure that the proposed development did not adversely impact on the Lowy Institute's adjoining property. Although the detailed layout of the various building floors was provided to me on a confidential basis, the layout of the transformers within the building is pivotal for consideration of the issues in this report and is not treated as confidential. A copy of the proposed layout of Floor level 5 is shown in Appendix B and is referred to as the EA Proposal.

7) For the City East Zone Substation, EnergyAustralia proposes to establish a 132kV / 11kV zone substation consisting of:

   a. Five (5) 132kV 50 MVA rated transformers to achieve an output capability of 200 MVA under emergency conditions when two (2) of the transformers are out of service (referred to as (N-2) security of supply conditions). (The transformers are expected to be gas insulated transformers (utilising SF6 gas) rather than the traditional oil filled transformers)

   b. Five (5) sets of 132kV SF6 insulated switchboards consisting of two of 132kV feeder circuit breakers and one 132kV transformer circuit breaker

   c. Three 11kV Switchrooms each with a large number of 11kV feeder circuit breakers to supply the "triplex" 11kV distribution network supplying the various distribution substations in the areas serviced by this substation. The 11kV switchboards are interconnected to be configured as two large ring buses with automatic switching to select various configurations of transformers under a range of operating conditions.

   d. Control room for housing the various control panels associated with the zone substation

   e. A Distribution Centre

8) The 132kV cables come into the site via a tunnel which is proposed to be constructed as a stub tunnel from the proposed City East Cable Tunnel which is described in the Sydney CityGrid Project Concept Plan.

9) The transformers are proposed to be installed via an access service road into the building via O'Connell St at the O'Connell St level. They are large units with a total weight of perhaps 90 tonne each.

10) The concept design also provides for the provision of tenant parking for the associate commercial development above the proposed substation. This will incorporate a driveway access also off O'Connell St but separate to that of the transformer access.

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11) The NSW proposed Metro railway line passes through part of the site at some depth. The building structure is required to be accommodating the future development of the Metro railway. Accordingly, bridging structures need to be incorporated into the design to straddle any future Metro railway line.

12) The N-2 security standard of supply is a licence obligation that EnergyAustralia is required to satisfy for the supply to the City CBD area as determined by the Department of Energy and Water. EnergyAustralia is required to achieve this level of security of supply by 2014. EnergyAustralia's present licence obligation is to achieve N-1 level of security.

13) In the present concept designs for the building, EnergyAustralia is allowing a space of approx 11.00 m x 10.00 m floor area for each transformer with a distance between floor and ceiling within the transformer area of 12.6 metre.

14) The 132kV switch-room is positioned above each transformer with a 132kV bushing through the floor of the 132kV switch-room into the space above the transformer. An air-insulated section of busbar joins the transformer to the 132kV switchgear bushing. EnergyAustralia do not propose to utilise 132 kV SF6 insulated busbars for these connections.

15) The five transformers are installed into separate modules which are next to each other and along the length of the transformer access driveway. The 132kV switchgear is located immediately above the transformer. The 11kV output from the transformer goes down through the two car park floors below and the 11kV switch-room floor into the cable room. The cables then are directed to the relevant transformer switch panel within the cable room.

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4 OPINION

I have been asked to express an opinion as to the possible options for altering the arrangement that has been proposed by EnergyAustralia for the layout of the substation.

In my opinion, there are a number of options that could be considered to produce a development which would resolve the issue of the impact on the Lowy Institute building. These are considered below.

I have tried to examine the option of the transformers being positioned at a lower level in the basement of the building. Although this is not a totally impossible option, the challenges to be met are high. It would require the establishment of a large hatch area and very substantial crane as part of the building structure to lower the large transformers (total weight approx 90 tonne) onto skids which can then be skated into position at the lower levels. This would require considerable space. Accordingly, I have concluded that while probably not impossible, it is not an option that would be put forward as a feasible option.

As the connection between the 132kV switchgear and the transformer is via an air insulated connection the height of the room for the transformer is 12.6m to accommodate the connection. The 132kV connection could be via an SF6 insulated busbar. This would result in a more compact configuration and potentially reduced height. Admittedly it would require additional isolation and earth and test facilities. An insulated busbar arrangement has been utilised by Transgrid at Haymarket. This would impact on a range of philosophical issues for EnergyAustralia to adopt this newer technology. Use of SF6 insulated busbars has not been included in any of the options.

Diagrams for the following options are included in Appendix B. The diagrams only concentrate on the location of the large transformers with access from O'Connell St.

1) BES Option 1 Adjustment of front facade position

In the EA Original proposal, the area between the transformer bay and the front facade of the building from the Bligh St level up to the top of the substation is utilised for stairs and ventilation vents. In BES Option 1, the front facade is moved back right up to the transformer bay of the area between the existing 5th transformer. The basement area can be fully utilised.

With respect to the equipment layout on the floors above, the space can be rearranged to accommodate the available room and would involve some minor rearrangements. Apart from the transformer areas which are relatively tight, the other requirements should be able to be adequately accommodated elsewhere.

There would be not be any need for any significant rearrangement of the basement levels, apart from stair access etc as that can be mostly the same as the EA Proposal.

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2) BES OPTION 2 Reduction in transformer module space

In BES Option 2, the space allocated for the transformer may is reduced lengthwise by 1 metre from 11 m to 10 m such that the overall length of the transformer bays is reduced by 5 metre. In conjunction with the rearrangement of Option 1, the front facade of the building can be brought back significantly. To ensure that the transformers fit, the EA transformer specification will need to specify this constraint. The space for earthing transformers should be found elsewhere if they cannot fit into the transformer module.

Although EnergyAustralia have advised that the size of the transformers is unknown and the cooling arrangement of the transformers is different to that of other installations which may have consequences with respect to the total volume of the transformers, in my opinion, this is a matter that can be addressed. As transformers of this nature are essentially custom designed (or at least adapted) there are many ways of ensuring that the transformer is able to fit within a given space. Given the available height of the room and given that the EA Proposal allows additional space for the earthing transformers, I am confident that a practical solution can be achieved with a slightly small transformer enclosure.

With this option there would be some consequential changes to the physical orientation of some of the plant in the rooms above the transformer in particular. However, in my opinion, it should be able to be achieved satisfactorily.

3) BES Option 3 Rearrangement of Transformer positions and access driveways

This option involves a more significant rearrangement of the location of the transformer bays, the access road and the overall cabling arrangement of the building. In BES Option 3, the Transformer Access Road is relocated such that 4 transformers are on one side of the access road which comes in from O'Connell St and the 5th transformer on the other side. In order to accommodate vehicular access to the car park levels, the position of the basement car park access off O'Connell St would need to be repositioned such that it is moved to the northern boundary.

As the EA Proposal shows the lifts spread along the full length of the northern boundary, BES Option 3 would require a rearrangement of the lifts for the building. This would result in the clustering of the lifts towards the Bligh St end of the building. It would create a more useable space at the Bligh St frontage of the building which could be used to establish a significant entrance foyer for the commercial part of the building. It could facilitate the incorporation of attractive architectural features to the front entrance of the building, create the site lines to the Lowy Institute building and overall be both a more attractive development and potentially more commercially viable.

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Accordingly, instead of a having a long narrow lift lobby as presently proposed. This may allow the front of the building and the lobby area to be developed in a more attractive manner and make it more commercially viable.

There are however, some issues that would need to be addressed in the electrical design of the building to be able to accommodate this option.

The rearrangement of the transformer access road would result in respositioning the 132kV cable risers which are located towards the centre of the building along the line of the transformers in the EA Proposal, to cable risers closer to the southern property boundary in the case of four of the transformers and to the northern property boundary for the fifth transformer. As a result attention would have to be paid to any remedial action that can be taken with respect to the electric and magnetic fields associated with the 132kV cables.

Similarly, the 11kV cable risers from the transformer to the 11kV cable floor would have to be positioned in a similar adjoining position and thus attention would have to be paid to the electric and magnetic fields associated with the 11kV cables to ensure that the field strengths are below acceptable levels.

The issue of electric and magnetic field strengths is an issue that needs to be addressed in the overall design of the installation in any case due to the large concentration of cables, heavy currents and high voltages that are present, even with the EA Proposal.

The rearrangement of the transformers would have consequential changes and impacts on the layout of all the floors and the location of equipment. The equipment layout in the basement level would not necessarily require significant change, although there may be some benefits in some rearrangement.

In my opinion, all three options are viable and could be achieved. There is no doubt that BES Option 3 would involve the greatest challenge while BES Option 1, appears to be the easiest to implement.

There is no doubt many more options that could be contemplated which could utilise creative concepts to produce a design that could be sympathetic to the design objectives of the Bligh St / Richard Johnson Square precinct.

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5 CONCLUSION

A review has been undertaken of the design of the EnergyAustralia proposed 132kV / 11kV zone substation at 33 Bligh St Sydney. Three alternative design options have been identified that could be adopted to minimise the impact of the proposed development on the Lowy Institute building at 31 Bligh St Sydney which is identified as having heritage value.

Prof Alex Baitch

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Appendix A Curriculum Vitae

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CURRICULUM VITAE

a) NAME: Prof Alex Baitch

B.E. (Syd), M.Eng.Sc. (NSW), MBA(TechMgt), AIAMA, SMIEEE, FIEA, F.I.E.Aust, CPEng

b) EDUCATION:

- Bachelor of Engineering (Electrical) University of Sydney (1966-69)
- Master of Engineering Science (Electrical) University of NSW (1970-73)
- APESMA Master of Business Administration (Technology Management) Deakin University (1989 - 1994)
- Toshiba Corp "International Management Training Course" Tokyo 1990

c) PROFESSIONAL AFFILIATIONS

- Member of the Association of Consulting Engineers Australia
- Fellow of the Institution of Engineers Australia
- Chartered Professional Engineer, Electrical College
- Registered on the National Professional Engineers Register (NPER)
- Senior Member Institute of Electrical and Electronic Engineers (USA)
- Fellow Australian Institute of Energy
- Associate Member Institute of Arbitrators & Mediators Australia
- Member Electric Energy Society of Australia
- Individual and Collective Member CIGRE (International Council on Large Power Systems)

d) POSITIONS HELD

- 2003 – present Visiting Professorial Fellow, University of Wollongong
- 1993 – Present Principal BES (Aust) Pty Ltd
- 1999 – 2002 Manager Network Capability and Manager System Development Integral Energy
- 1990 – 1993 General Manager Toshiba International Corp, Industrial Division
- 1980 – 1990 Technical Director and General Manager Holec Pty Ltd
- 1969 – 1980 Engineer, Prospect Electricity (roles in most technical branches)
- 1965 – 1969 Cadet Engineer, Prospect County Council

e) PROFESSIONAL EXPERIENCE

Alex Baitch has had more than 40 years experience in the electricity industry, private industry and consulting. He has extensive experience in the electricity industry, the national market and electrical distribution and utilisation, including variable speed drives, UPS systems and power quality. He has been an Accredited Assessor, Australian Building Greenhouse Rating Scheme that is being managed by the NSW Dept Environment and Climate Change, is a Level 3 Service Provider (design of transmission & distribution works) that is being managed by the Ministry of Energy and Utilities and a member of IPART's Technical Services Panel associated with the NSW Greenhouse Gas Abatement Scheme. He is Convenor of the CIGRE Australian Panel AP C6 on Distribution Systems and Dispersed Generation, a member of the CIGRE International Study Committee SC C6 and convenor of its International Working Group WG C6.09 on Demand Side Response. He is also a member of CIGRE Australian Panel APC4 which deals with a range of Technical Issues of the electricity industry, particularly in the area of Power Quality. He has been a member of a number of International CIGRE Working Groups in the areas of Power Quality (TC8, TC77) and HV installations (TC99). He is Chairman of Standards Australia Committee EL43 High Voltage Installations. He is a Visiting Professorial Fellow at the University of Wollongong, School of Electrical, Computer and Telecommunications Engineering.

e) PROFESSIONAL ACTIVITIES

Extensive involvement in professional engineering activities through activities of the Engineers Australia over the period 1982-present, including Chairman National Committee on Electric Energy, Chairman College of Electrical Engineers, National Vice President, Councillor representing Sydney Division and Electrical College and Excellence Awards. He presently represents Sydney Division on Engineers Australia National Congress and is a Councillor of Engineers Australia with the role of National Vice President Education and Assessment.

e) PUBLICATIONS

Numerous lectures and refereed papers presented at conferences by IBC, Engineers Australia (EA), Electric Energy Society of Australia (EESA), Energy 21C, International Conference on Research in Electricity Distribution (CIRED), International Council on Large Electric Systems (CIGRE), Australian Electrical and Electronic Manufacturers Association (AEEMA), Institute of Electrical & Electronic Engineers (IEEE) , etc. Lectures presented at University of Wollongong, ESAA Summer Schools, etc.

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Appendix B Substation Transformer Layout Options

EA PROPOSAL (Aug 2010)

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BES OPTION 1 Adjustment of front façade position

BES OPTION 2 Reduction in transformer module space

BES OPTION 3 Rearrangement of Transformer positions and access driveways

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