AOPA AUSTRALIA | RECREATIONAL AVIATION AUSTRALIA | AIR SPORT AUSTRALIA CONFEDERATION | SAAA

UNITED UNDER THE COMMON GOAL OF ACHIEVING THE HIGHEST LEVELS OF AVIATION SAFETY

11 June 2021:
Sent electronically via email

The Hon. Rob Stokes, MP
52 Martin Place
SYDNEY NSW 2000

Risk to the Safety of Aviation at Shellharbour Airport

Dear Minister Stokes

Our organisations collectively write to you to express our deep concern about the risk that the conditionally approved Tallawarra B project poses to the safety of aviation at Shellharbour Airport.

Energy Australia have been working towards building an Open Cycle Gas Turbine (OCGT) power plant at Tallawarra since 2010. One of the main complexities associated with this proposal is that it poses a risk to aviation safety at the Shellharbour airport.

The Civil Aviation Safety Authority (CASA) recommended modelling has shown that every OCGT unit studied in the period since 2010 would pose a significant risk to the safety of aviation. Energy Australia are now seeking full approval for an OCGT unit with the addition of a mechanical diffuser on the stack in order to reduce the impact to airport users.

The following is relevant in understanding the level of concern we collectively have regarding the risk this proposal might pose to the safety of aviation at Shellharbour Airport:

- The assessment consultant that the proponent used for all assessments since 2010 confirmed to Energy Australia in writing that a mechanical diffuser on the stack will not sufficiently reduce the plume velocity because the primary driver of vertical velocity is thermal, which the mechanical diffuser does not address. Energy Australia subsequently changed plume modelling consultants.

- Every plume rise assessment completed for Tallawarra till recently has been fully transparently documented and shared with NSW Department Infrastructure, Energy and Environment, CASA and Shellharbour City Council. The parties were able to consult sufficiently to demonstrate that each unit assessed posed a significant risk to the safety of aviation. No data at all on the proposed mechanical solution has been shared with anybody in the aviation community, with the airport owners or the local community that will be affected by this despite requests from Shellharbour City Council and the Aircraft Owners and Pilots Association of Australia (AOPA). We call upon yourself to intervene to ensure the transparency demonstrated previously is honoured in relation to the assessment of the proposed mechanical solution.

Under Civil Aviation Safety Regulation 139.180 (1)(b) CASA may determine in writing that a proposed object, such as an OCGT, may pose a hazard to aircraft operations.

Based on earlier CASA advice, Energy Australia needed to ensure that the Critical Plume Velocity (CPV) was

no greater than 6.1m/s at 700ft. CASA has now advised your department on 29 March 2021 that they are unable to determine:

- Whether the condition of CPV 6.1m/s at 700ft is met as CASA intended, and;
- Based on the modelling, whether the proposal will cause a risk to the safety of aviation.

The unique nature of this new proposal is defined by proposing to build an OCGT in the vicinity of, and within the circuit of an aerodrome. As such, this calls for the use of engineering solutions to effectively control the vertical velocity of the plume to enable the CASA determined criteria of a CPV of 6.1m/s at 700ft to be met.

CASA's existing guidance material on plume rise assessments does not consider the modelling required for this proposal as previous developments of this nature have not needed engineering controls to manage the vertical plume velocity as they were generally located sufficiently outside of the circuit area of an aerodrome.

CASA has recommended to the Department that an independent modelling assessment be undertaken. Our organisation's support and encourage this independent assessment. We further encourage the sharing of all data associated with independent assessment.

Furthermore, should the project proceed, due to the possible significant risk to aviation, and the fact that this novel approach requires use of alternate modelling, we recommend that the plume characteristics be actually measured as part of the commissioning process. We are aware of an independent international company competent to conduct such activity and are able to supply these details should you require them.

Our organisations are concerned that there is a very strong chance of a fatal accident occurring in the circuit of Shellharbour Airport should this project proceed without an appropriate independent assessment to ensure to the best of our collective ability that the project does not pose a risk to the safety of aviation.

We commend the above actions to you.

Yours Sincerely

Benjamin Morgan CEO Aircraft Owners and Pilots Association	Matt Bouttell (Jun 11, 2021 16:16 GMT+10) Matt Bouttell CEO Recreational Aviation Australia	Grahame Hill President Air Sport Australia Confederation	Tony White (Jun 13, 2021 08:45 GMT+8) Tony White President Sports Aircraft Association of Australia

Enclosure

Attachment A	Organisation Introductions
Attachment B	CASA letter to DPIE 29/3/21
Attachment C	CASA Tallawarra B Power Station Project, dated 27 March 2020
Attachment D	DPIE Aviation Impact Assessment, dated 2 April 2020
Attachment E	Political Donations
Attachment F	Jacobs Technical Memorandum

CC: Ms Pip Spence, Mr. Graeme Crawford, Mr. Rob Walker, Mr. Mike Young, Mr. Jonathan Hanton, Mr. Julian Turecek, Mr. Carey McIntyre.

Attachment A - Organisation Introductions

AOPA AUSTRALIA

The Aircraft Owners and Pilots Association of Australia (AOPA) are the largest general aviation member-based organisation in Australia. We speak as the unified voice for general aviation, representing thousands of members from each state and territory of Australia. The AOPA team exists to protect and grow the general aviation industry through education, training and advocation.

RECREATIONAL AVIATION AUSTRALIA

RAAus is Australia's largest Civil Aviation Safety Authority (CASA) Approved Self-administering Aviation Organisation (ASAO) and is responsible for administering ultralight, recreational and Light Sport Aircraft (LSA) operations. With more than 10,000 members, we train and certify pilots, flying instructors and maintainers, register a fleet of over 3,200 aircraft, oversee the operations of 194 Flight Training Schools around the country and support almost 50 Aero Clubs.

AIR SPORT AUSTRALIA CONFEDERATION

The Air Sport Australia Confederation (ASAC) is the peak national body of Australia's national air sport organisations. ASAC member organizations membership averages over 83,000 active air sport members and operate aircraft numbering in the hundreds, from regional airports.

SAAA

The SAAA is a community of approximately 1100 aviation enthusiasts, assisting each other to build, maintain and operate sport aircraft safely.

Australian Government
Civil Aviation Safety Authority

AIR NAVIGATION, AIRSPACE AND AERODROMES

File Ref: F17/8039-27

29/3/2021

Mike Young
Executive Director
Energy, Resources and Compliance
NSW Dept of Planning, Industry and Environment
Locked Bag 5022
Parramatta NSW 2124

Dear Mr Young

Tallawarra B Gas-Fired Power Station Project

I refer to your request dated 16 March 2021 for comment on the review conducted by GHD of the submission from Energy Australia (EA) on the above project.

Background

In January 2021, NSW DPIE sought CASA's advice on EA's December 2020 Plume Rise Assessment report.

The report stated that The Air Pollution Model (TAPM) cannot be used to model the plume rise from the proposed project. This report is based on the use of a plume dispersion device (PDD) with a different indicative design to that of the February 2020 report.

EA instead used computational fluid dynamics (CFD) modelling and advised that the plume average velocity at 700 FT above mean sea level (AMSL) is 4.9 m/s.

On 4 February 2021, CASA advised NSW DPIE that it is unable to provide any comments on the validity of CFD modelling as it is a highly specialised and complex subject and CASA does not have the specialist expertise to assess these matters.

CASA advised that:

- the EA Report did not include a plume cross sectional analysis at 700 FT AMSL.
- the plume cross sectional analysis at 1000 FT AMSL indicated that the modelling was based on wind affected conditions whereas the 99.9th percentile plume rise would be expected to occur under calm conditions; and
- we do not believe that the CFD results need to be averaged in a manner equivalent to TAPM.

CASA therefore recommended that NSW DPIE should conduct a verification and validation exercise on the CFD methodology, the assumptions used and the outputs of the model.

CASA also recommended that NSW DPIE should satisfy itself that the indicative PDD design is feasible in practise and that an option maybe to obtain confirmation from the manufacturer to this effect.

Discussion of NSW DPIE letter dated 16 March 2021

CASA has examined the letter from NSW DPIE and the GHD review report.

The GHD report's findings are discussed in the Summary section and CASA's comments follow:

GHD- key conclusions	**Comments on the conclusions**
Using CFD for the modelling of plume rise was reasonable given the complex near field flow physics and model limitations of the standard model	This is correct. As the proponent has decided to use the 'Plume dispersion device 'CASA advised in its letter that CFD modelling was appropriate.
The selected meteorological condition for the CFD modelling is representative of worst-case plume rise conditions	This is not correct. We advised NSW DPIE worst case plume rise conditions occur in calm winds. The wind speed applied in the CFD modelling is significantly higher than would be expected for worst case conditions. As GHD correctly noted, "*the wind speed between 200 and 300 metres (660 to 980 FT) for the CFD model are higher than those in the top ranked conditions.*" Figure 4 of the GHD report indicates that between 200 and 300 metres in height, the CFD model used wind speed inputs of approximately 2.5 m/sec. Figure 4 also shows the wind speed used in the CFD model for the critical 700 FT altitude is significantly higher than the wind speed that should have been used. The wind speed inputs that should have been used as revealed by Figure 4 are consistent with previous modelling at Tallawarra which indicates that winds of

	0.3m/sec and lower would occur approximately 0.11 % of the time for heights between 656 FT and 984FT.
The use of the adopted top hat equivalent velocity calculation methodology is not valid for this plume emission when CFD modelling is used	This is correct.
There is a lack of assessment guidance information provided by CASA for assessments involving nonstandard models such as CFD	This is correct. No aviation safety regulator, including CASA and FAA have provided or developed such guidance. This is because there has never been a case where CFD modelling was used. CFD modelling was required in this case because of the proposed use of a PDD. The PDD is proposed only because the proponent wishes to site an OCGT plant near Shellharbour Airport. CASA's experience is that proponents normally design stacks so that gaseous efflux is discharged vertically for environmental reasons. Accordingly, CASA's current and previous Advisory Circulars (ACs) on this topic have provided adequate guidance to proponents. CASA is reviewing the plume rise AC at this time and this issue will be considered during this process.
Based on the assumptions underlying the CASA plume rise assessment methodology, compliance with the CASA specified default 6.1 m/s critical plume velocity has been demonstrated.	This is not correct. The outputs of the modelling are based on the use of wind speeds that are at least five times greater than what would be expected at 700 FT to produce the 99.9th percentile plume. When wind speeds of this magnitude are used as inputs in modelling instead of the calm winds that would be expected at this altitude, the outputs would incorrectly produce outputs showing lower plume velocities. Please refer to Attachment A which is an extract from a paper prepared by experts from Katestone Environmental which expands on the above point with examples.

The determination of safe aircraft operations nearby power station is needed to be made by aviation specialists and CASA. Such a determination is beyond the scope of this peer review and any plume rise model output	This is correct. CASA did not expect the review to make a call on determining the safety of aircraft operations. CASA has set the acceptable threshold as 6.1m/sec at 700FT in this case.

Other matters - recommendation to verify and validate the CFD methodology

CASA had recommended that NSW DPIE should conduct a verification and validation exercise on the CFD methodology.

GHD states that:

'no model files were supplied or inspected with regards to model setting implementation. The required time frame for this review meant that CFD model file inspection could not occur. It is assumed that stated CFD model settings were implemented correctly'.

GHD's examination of the CFD model was limited to model parameters such as solver settings, domain size and mesh resolution.

CASA therefore advises that the recommendation was not addressed in the manner we envisaged.

Other matters - GHD commentary – 's 8.6 General comment'

GHD states that complying with the tabulated value determined using a model should not be used as the only method of determining safe aircraft operations near a facility with a significant plume rise and instead aviation specialists should make this determination considering factors other than just a single number output of a computer model.

CASA agrees with this assessment.

Other matters - GHD commentary – 's 11.1 Screening Tool'

GHD states that 'TAPM is clearly defined in the CASA Advisory Circular (2019) as a "screening tool" '.

This statement is incorrect.

The Advisory Circular defines TAPM as The Air Pollution Model derived by the CSIRO.

GHD also states that a screening tool is meant to quickly identify situations that may pose an issue so that steps can be taken to mitigate the issue such as by redesign of a power station discharge or designating the area to be protective airspace (sic). This is also incorrect.

The screening tool will identify if there is a potential issue and if one is identified, then a full plume rise assessment will be sought. It is on the basis of the full plume rise assessment that CASA will determine whether mitigation is required, whether the risk is such that it cannot be mitigated and in cases where risk can be mitigated, the applicable options.

Other matters - GHD commentary – 's 11.2 Method performance'

GHD states that the maximum vertical velocity value of 10.7m/s is not stated but is left to the educated reader to interpret from Figure 8 in Katestone (2020).

This statement is incorrect.

The Katestone report states that at 1000FT, the maximum vertical velocity is 13 m/s.

Other matters - GHD commentary – 's 11.3 Plume edge definition'

GHD states that it is not clear how the edge of the plume was determined from the CFD modelling results.

CASA agrees with GHD.

Other matters - GHD commentary – 's 11.3 Plume edge definition'

GHD states that reporting of the maximum CFD estimated plume velocity and equating half of its value to the critical plume velocity (sic) is a very simple approach that is likely to be conservative and removes the need to define the plume edge.

CASA agrees with GHD and will accept half the maximum CFD derived plume velocity as the plume velocity for that altitude.

Other matters – potential plume rise specifications in the contract between EA and GE-Clough

Given the issues CASA has raised with the findings of the GHD review and the wind speed inputs to the CFD model, we consider it would be premature to provide any comments at this time.

Conclusion and next steps

CASA notes that the wind speeds inputs to the CFD model for the critical 700 FT altitude appear to be at least five times higher than in the conditions that would result in the 99.9th percentile plume rise.

This means that the maximum plume velocity CFD model outputs for the 700 FT altitude presented to CASA are likely to be significantly lower than if realistic wind speed inputs had been provided.

It is essential that the CFD model should be re-run with realistic wind speed inputs reflecting calm conditions before CASA can provide definitive advice to NSW DPIE.

Given the importance of the continued safety, regularity, and efficiency of operations at the airport of NSW's third largest city, CASA can commission an independent plume rise assessment using the CFD model provided NSW DPIE reimburses all costs.

The complexity of this proposal is driven by the proponent's decision to site it at a location that affects aircraft operations at Shellharbour Airport. As NSW DPIE is aware, there are several power plants of greater capacity than Tallawarra B for which CASA has been able to finalise its assessment very quickly because they are sited at locations with little impact on aircraft operations.

For example, CASA is aware of the proposal for an 850 MW power plant at Port Kembla and our preliminary view is that it is highly unlikely that the plant will create unacceptable risks to the safety of aircraft operations. Since January 2021, we have been working closely with NSW DPIE on the Kurri Kurri proposal for a 750 MW power plant and we expect to provide final advice in April 2021. In contrast, the 300 MW Tallawarra B proposal has been under consideration since 2010.

As Shellharbour Airport is required by CASA to monitor its airspace for infringements of the Obstacle Limitation Surfaces by gaseous effluxes greater than 4.3 m/s, this letter is copied to the operator, Shellharbour City Council.

CASA is aware of the importance of adequate power generating capacity to the national economy and the record shows that we provide considered and thorough responses to planning authorities such as NSW DPIE whenever our advice is sought on major projects with potential aerodrome safeguarding issues.

It is in this spirit that CASA makes the offer to commission an expert review that will provide certainty to NSW DPIE, the proponent, and the aviation industry.

CASA draws your attention to the long lead times required by the proponent to complete their technical papers. For example, the GHD review showed that EA commenced the CFD modelling exercise of the PDD in January 2020 before CASA was asked for comment on the plume rise assessment report on the stack top plume diffuser design in March 2020.

I look forward to a response so that we can finalise our advice to NSW DPIE as soon as practicable.

Yours sincerely

Brad Parker
Acting Branch Manager

cc Mr Carey McIntyre, CEO, Shellharbour City Council

4. Illustrative examples

The simplest cases assume identical sources with stack separation d operating in a neutral and unbounded atmosphere with uniform conditions. For the Spillane approach, Table 2 gives the resulting plume-average vertical velocities for the cases with $V_{exit} = 38.9$ m/s, $h_s = 35$ m, $F = 2300$ m^4/s^3 and N = 1 and separately N = 2 with d = 25 m.

The heights experiencing threshold exceedances are dramatically reduced going from calm to light winds. The TAPM approach for single plumes gives similar results if some allowance is made for an initial displacement offset z_0 (Figure 2).

Table 2: Plume average vertical velocities (m/s) for uniform calm and light wind conditions in a neutral atmosphere

Height	Calm		$u_e = 1.5$ m/s		$u_e = 3$ m/s	
	Single	Double	Single	Double	Single	Double
100	12.2	12.2	9.0	9.3	6.9	8.3
200	7.8	9.2	5.5	7.0	3.6	5.1
300	6.5	8.0	4.4	5.8	2.6	3.9
500	5.3	6.6	3.2	4.5		2.8
700	4.8	6.0	2.6	3.7		2.2
1000	4.1	5.2				

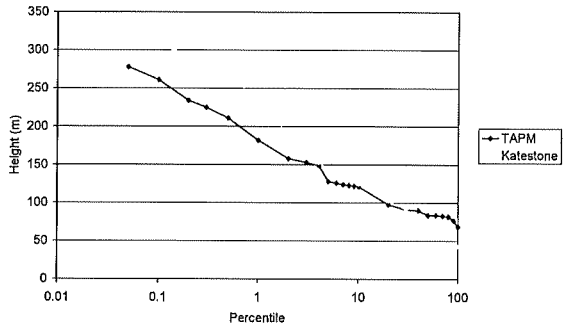

Figure 2: Comparison of methodologies for plume height calculations for a 5 year period.

5. Meteorological modelling

Meteorological inputs are critical for a reasonable treatment of risk, especially for near-calm conditions at stack-top and above. Unfortunately, it is these very conditions under which near-surface measurements (together with stability-dependent profile laws) or TAPM-like prediction methodologies are likely to be poor indicators of actual conditions, at least for inland sites (Jackson et al 2003). Presumably this quandary lead CASA to recommend the TAPM approach. If measurements are available from a nearby 30-100 m tower, we would recommend their use unless TAPM results are carefully tuned to the appropriate surface conditions.

Recent project work near Williamtown Airport gave a comparison of five years of hourly TAPM results with available balloon and 30 m tower measurements. The main conclusions were:

- Moderate interannual variability in the actual and predicted occurrence of light winds at 30 m and above.
- TAPM tends to underpredict the frequency of occurrence of very light winds (< 1 m/s) compared to tower observations (typically 1.2 - 3.5% compared to 5.7 - 14.9%).
- For available balloon profiles, TAPM overpredicted the frequency of very light winds at 600 m and 900 m agl.
- Very few measurements are available in the crucial 100-500 m height range.

6. Synthetic approaches

The Spillane approach has been adapted to take in the TAPM wind profile conditions. Figure 3 compares the cumulative probability distributions for critical heights (where the in-plume average velocity drops below 4.3 m/s) obtained by using either the TAPM wind predictions or the interpolated measured winds, for the case of two 35 m high, 54 m separated combined-cycle units of total capacity over 800 MW. Close agreement is obtained.

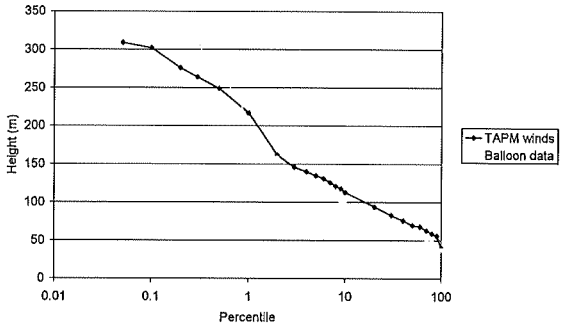

Figure 3: Comparison of Spillane plume height calculations for TAPM - generated and measured winds.

Australian Government
Civil Aviation Safety Authority

NATIONAL OPERATIONS & STANDARDS

CASA Ref: EF10/1648-2

27 March 2020

Mr Mike Young
Executive Director
Energy, Resources & Compliance
NSW Planning, Industry & Environment
Locked Bag 5022
Parramatta NSW 2124

Dear Mr Young,

Tallawarra B Power Station Project

Aviation Impact Assessment

Thank you for seeking CASA's advice on the Aviation Impact Assessment (AIA) dated February 2020 provided by Energy Australia (EA) for the Tallawarra B Power Station Project.

CASA has reviewed the AIA for a possible revised design of the Tallawarra B development and notes that the final power plant design parameters have not been presented by EA to CASA at this time.

Condition 6.1 of the Project Approval requires confirmation from CASA that it agrees with the recommendations and conclusions of the AIA, in the context that aviation risks can be managed to an acceptable level of safety. It is noted that the final design parameters of the Tallawarra B Project have not been detailed in the AIA. Instead, the AIA refers to possible options to achieve a critical plume velocity of 6.1 metres/second at or below 700 feet AMSL. The AIA also refers to several risk control measures that could be implemented to reduce the risk to aviation activities. The AIA review also includes information and data related to the affected aerodrome that for the most part is independent of the final power plant design.

CASA's advice is based on statements that a number of engineering solutions are available in the final design to reduce the impact of the plume on aviation activity to an acceptable level of safety supported by other mitigators as detailed in the AIA Without an acceptable engineering solution, the AIA indicates that the preferred OCGT option will result in an unacceptable risk to the safety of aviation.

If the final design ensures a plume of no more than 6.1 m/s at or below 700 feet AMSL, all mitigation measures and the inclusion of a plume symbol on aeronautical charts are implemented, as listed in the AIA Section 10, the risk to aviation is considered to be at an acceptable level of safety.

If the final design proposed in the future achieves a plume velocity of no more than 6.1m/s at or below 700ft AMSL then CASA would have no objections and would consider there to be an acceptable level of safety.

CASA advises that if the final critical plume velocity is no more than 6.1 metres/second at or below 700 feet AMSL then there would be an acceptable level of safety. Based on the available information, if the final design does not change appreciably and meets the critical plume velocity of no more than 6.1 metres/second at or below 700ft AMSL, CASA would not need to reassess the final design. Should the design change substantially, or if NSW Planning requests it, CASA will consider and provide advice in the future based on the final design.

Yours sincerely,

Chris Monahan
Executive Manager
National Operations & Standards

NSW GOVERNMENT | Planning, Industry & Environment

Mr Julian Turecek
Tallawarra B Project Director
EnergyAustralia

By email: Julian.Turecek@energyaustralia.com.au

2 April 2020

Dear Mr Turecek

Tallawarra B Power Station Project - Aviation Impact Assessment

I refer to your report, titled *Tallawarra B OCGT Aviation Impact Assessment*, dated 13 February 2020 (the report), which was prepared to satisfy condition 1.6 of the Tallawarra B Power Station project (the project) approval to demonstrate that operation of an open cycle gas turbine (OCGT) plant would not have an adverse impact on aviation safety. This is within a risk-based context such that an acceptable level of aviation safety risk can be achieved.

The Department notes that you have consulted with Shellharbour City Council and Civil Aviation Safety Authority (CASA) in preparing the report, as required by condition 1.6 of the project approval, as well as with the Aircraft Owners and Pilots Association of Australia (AOPA Australia).

The Department has received advice from CASA on the report advising that the aviation risks could be managed to an acceptable level if (see attached):

- the final critical plume velocity (CPV) is no more than 6.1 metres/second at or below 700 feet above mean sea level (AMSL); and
- all mitigation measures and the inclusion of a plume symbol on aeronautical charts are implemented, as listed in Section 10 of the report.

The Department has carefully considered the report, the advice from CASA, submissions from Shellharbour City Council and AOPA Australia, and is satisfied that an OCGT plant could be operated such that there would be an acceptable level of aviation safety risk. Accordingly, the Secretary has approved the report subject to:

- prior to construction, Energy Australia providing a report to the satisfaction of the Planning Secretary, confirming that the final design of the OCGT would meet a CPV of no more than 6.1 metres/second at or below 700 feet AMSL; and
- prior to operations, Energy Australia providing a report to the satisfaction of the Planning Secretary confirming that all the mitigation measures and the inclusion of a plume symbol on aeronautical charts have been or would be implemented (noting that some measures can only be implemented after operations have commenced), as listed in Section 10 of the report.

If you wish to discuss the matter, please contact Steve O'Donoghue, Director Resource Assessments on 0477 345 626.

Yours sincerely

Mike Young
Executive Director - Energy, Resources & Compliance
as delegate for the Planning Secretary

Political donations disclosure statement

NSW GOVERNMENT
Department of Planning

Office use only:

Date received: ___/___/___

Planning application no. _____

This form may be used to make a political donations disclosure under section 147(3) of the *Environmental Planning Assessment Act 1979* for applications or public submissions to the Minister or the Director-General.

Please read the following information before filling out the Disclosure Statement on pages 3 and 4 of this form. Also refer to the 'Glossary of terms' provided overleaf (for definitions of terms in *italics* below). Once completed, please attach the completed declaration to your planning application or submission.

Explanatory information

Making a planning application or a public submission to the Minister or the Director-General
Under section 147(3) of the Environmental Planning and Assessment Act 1979 ('the Act') a person:

(a) who makes a *relevant planning application* to the Minister or the Director-General is required to disclose all *reportable political donations* (if any) made within the *relevant period* to anyone by any *person with a financial interest* in the application, or

(b) who makes a *relevant public submission* to the Minister or the Director-General in relation to the application is required to disclose all *reportable political donations* (if any) made within the *relevant period* to anyone by the person making the submission or any *associate of that person*.

How and when do you make a disclosure?
The disclosure to the Minister or the Director-General of a *reportable political donation* under section 147 of the Act is to be made:

(a) in, or in a statement accompanying, the relevant planning application or submission if the donation is made before the application or submission is made, or

(b) if the donation is made afterwards, in a statement of the person to whom the relevant planning application or submission was made within 7 days after the donation is made.

What information needs to be included in a disclosure?
The information requirements of a disclosure of reportable political donations are outlined in section 147(9) of the Act.

Pages 3 and 4 of this document include a Disclosure Statement Template which outlines the information requirements for disclosures to the Minister or to the Director-General of the Department of Planning.

Note: A separate Disclosure Statement Template is available for disclosures to councils.

Warning: A person is guilty of an offence under section 125 of the *Environmental Planning and Assessment Act 1979* in connection with the obligations under section 147 only if the person fails to make a disclosure of a political donation or gift in accordance with section 147 that the person knows, or ought reasonably to know, was made and is required to be disclosed under section 147.

The maximum penalty for any such offence is the maximum penalty under Part 6 of the *Election Funding and Disclosures Act 1981* for making a false statement in a declaration of disclosures lodged under that Part.

Note: The maximum penalty is currently 200 penalty units (currently $22,000) or imprisonment for 12 months, or both.

Glossary of terms (under section 147 of the *Environmental Planning and Assessment Act 1979*)

gift means a gift within the meaning of Part 6 of the *Election Funding and Disclosures Act 1981*. Note. A gift includes a gift of money or the provision of any other valuable thing or service for no consideration or inadequate consideration.

Note: Under section 84(1) of *the Election Funding and Disclosures Act 1981* gift is defined as follows:

gift means any disposition of property made by a person to another person, otherwise than by will, being a disposition made without consideration in money or money's worth or with inadequate consideration, and includes the provision of a service (other than volunteer labour) for no consideration or for inadequate consideration.

local councillor means a councillor (including the mayor) of the council of a local government area.

relevant planning application means:

a) a formal request to the Minister, a council or the Director-General to initiate the making of an environmental planning instrument or development control plan in relation to development on a particular site, or
b) a formal request to the Minister or the Director-General for development on a particular site to be made State significant development or declared a project to which Part 3A applies, or
c) an application for approval of a concept plan or project under Part 3A (or for the modification of a concept plan or of the approval for a project), or
d) an application for development consent under Part 4 (or for the modification of a development consent), or
e) any other application or request under or for the purposes of this Act that is prescribed by the regulations as a relevant planning application,

but does not include:

f) an application for (or for the modification of) a complying development certificate, or
g) an application or request made by a public authority on its own behalf or made on behalf of a public authority, or
h) any other application or request that is excluded from this definition by the regulations.

relevant period is the period commencing 2 years before the application or submission is made and ending when the application is determined.

relevant public submission means a written submission made by a person objecting to or supporting a relevant planning application or any development that would be authorised by the granting of the application.

reportable political donation means a reportable political donation within the meaning of Part 6 of the *Election Funding and Disclosures Act 1981* that is required to be disclosed under that Part. Note. Reportable political donations include those of or above $1,000.

Note: Under section 86 of *the Election Funding and Disclosures Act 1981* reportable political donation is defined as follows:

86 Meaning of "reportable political donation"

(1) For the purposes of this Act, a reportable political donation is:
  (a) in the case of disclosures under this Part by a party, elected member, group or candidate—a political donation of or exceeding $1,000 made to or for the benefit of the party, elected member, group or candidate, or
  (b) in the case of disclosures under this Part by a major political donor—a political donation of or exceeding $1,000:
    (i) made by the major political donor to or for the benefit of a party, elected member, group or candidate, or
    (ii) made to the major political donor.

(2) A political donation of less than an amount specified in subsection (1) made by an entity or other person is to be treated as a reportable political donation if that and other separate political donations made by that entity or other person to the same party, elected member, group, candidate or person within the same financial year (ending 30 June) would, if aggregated, constitute a reportable political donation under subsection (1).

(3) A political donation of less than an amount specified in subsection (1) made by an entity or other person to a party is to be treated as a reportable political donation if that and other separate political donations made by that entity or person to an associated party within the same financial year (ending 30 June) would, if aggregated, constitute a reportable political donation under subsection (1). This subsection does not apply in connection with disclosures of political donations by parties.

(4) For the purposes of subsection (3), parties are associated parties if endorsed candidates of both parties were included in the same group in the last periodic Council election or are to be included in the same group in the next periodic Council election.

a person has a financial interest in a relevant planning application if:

a) the person is the applicant or the person on whose behalf the application is made, or
b) the person is an owner of the site to which the application relates or has entered into an agreement to acquire the site or any part of it, or
c) the person is associated with a person referred to in paragraph (a) or (b) and is likely to obtain a financial gain if development that would be authorised by the application is authorised or carried out (other than a gain merely as a shareholder in a company listed on a stock exchange), or
d) the person has any other interest relating to the application, the site or the owner of the site that is prescribed by the regulations.

persons are associated with each other if:

a) they carry on a business together in connection with the relevant planning application (in the case of the making of any such application) or they carry on a business together that may be affected by the granting of the application (in the case of a relevant planning submission), or
b) they are related bodies corporate under the *Corporations Act 2001* of the Commonwealth, or
c) one is a director of a corporation and the other is any such related corporation or a director of any such related corporation, or
d) they have any other relationship prescribed by the regulations.

Political Donations Disclosure Statement to Minister or the Director-General

If you are required under section 147(3) of the Environmental Planning and Assessment Act 1979 *to disclose any political donations (see Page 1 for details), please fill in this form and sign below.*

Disclosure statement details

Name of person making this disclosure	Planning application reference (e.g. DA number, planning application title or reference, property address or other description)
Ken Macpherson	07_0124

Your interest in the planning application (circle relevant option below)

You are the APPLICANT **YES / NO** No OR You are a PERSON MAKING A SUBMISSION IN RELATION TO AN APPLICATION **YES / NO** Yes

Reportable political donations made by person making this declaration or by other relevant persons

** State below any reportable political donations **you have made** over the 'relevant period' (see glossary on page 2). If the donation was made by an entity (and not by you as an individual) include the Australian Business Number (ABN).*

** If you are the **applicant** of a relevant planning application state below any reportable political donations that you know, or ought reasonably to know, were made by any persons with a financial interest in the planning application, OR*

** If you are a **person making a submission** in relation to an application, state below any reportable political donations that you know, or ought reasonably to know, were made by an associate.*

Name of donor (or ABN if an entity)	Donor's residential address or entity's registered address or other official office of the donor	Name of party or person for whose benefit the donation was made	Date donation made	Amount/ value of donation
Energy Australia Pty Ltd 99086014968	Level 33 385 Bourke St Melbourne 3000	Liberal Party of Australia(Vic Division)	27/02/2014	$30,000
Energy Australia Pty Ltd 99086014968	Level 33 385 Bourke St Melbourne 3000	Australian Labour Party	30/1/2014	$11,000
Energy Australia Pty Ltd 99086014968	Level 33 385 Bourke St Melbourne 3000	Australian Labour Party (Vic Branch)	29/07/2013	$1550
Energy Australia Pty Ltd 99086014968	Level 33 385 Bourke St Melbourne 3000	Liberal Party of Australia (Tas Branch)	30/1/2014	$2000

Please list all reportable political donations—additional space is provided overleaf if required.

By signing below, I/we hereby declare that all information contained within this statement is accurate at the time of signing.

Signature(s) and Date 17/12/15

Name(s)

Ken Macpherson, Head of Reputation EnergyAustralia

Cont...

Political Donations Disclosure Statement to Minister or the Director-General

Name of donor (or ABN if an entity)	Donor's residential address or entity's registered address or other official office of the donor	Name of party or person for whose benefit the donation was made	Date donation made	Amount/ value of donation
Energy Australia Pty Ltd 99086014968	Level 33 385 Bourke St Melbourne 3000	Australian Labour Party (SA Branch)	18/2/2014	$1000

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Subject	**Plume Rise and Options to Reduce GT Exhaust Velocity and Temperature**
Attention	Bill Smith, Justin Courmadias
From	Matt Davies, Ian Fletcher
Date	31 August 2018
Copies to	Shane Lakmaker, Eamonn Morrissey

1. Background

Energy Australia (EA) is proposing adding a further open cycle class gas turbine unit(s) (OCGT) at the Tallawarra Power Station site. The additional units are referred to as Tallawarra (B). The unit(s) are planned initially as an open cycle peaker, allowing for future conversion to a combined cycle gas turbine (CCGT) plant.

Tallawarra is located near the Illawarra Regional Airport, which caters for light aircraft, as well as ultralights/microlights.

EA has two preferred development scenarios as follows:

- Scenario 1 – a single 300 MW F-class GT, for example a GE 9F.05
- Scenario 2 – two 150 MW E-class GTs, for example 2 x GE 9E.04

Plume rise modelling has been undertaken for these scenarios including consultation with CASA, AsA, Shellharbour City Council and the Illawarra Regional Airport. The results of plume rise modelling and the consultation is detailed in the Jacobs report Plume Rise Assessment Report – Tallawarra B OCGT dated 6 July 2018. This report presented plume rise modelling results for the above scenarios, which are reproduced in Table 1.

Table 1 – Scenario 1 and 2 Plume Rise Modelling Results

	Height at which plume vertical velocity falls below 6.1 m/s (m AHD)		**Height at which plume vertical velocity falls below 10.6 m/s (m AHD)**	
Scenario	**Maximum (99.9th percentile)**		**Maximum (99.9th percentile)**	
1) 1 x GE9F.05	387m	1270ft	112m	367ft
2) 2 x GE9E.04	395m	1296ft	121m	397ft

CASA originally approved this plume rise with the establishment of a Danger Area (DA) above the GT stack(s) for management of any aviation impacts when considering both instrument flight rules (IFR) where the benchmark critical plume velocity (CPV) was 6.1 m/s and visual flight rules (VFR) where the benchmark CPV was 10.6 m/s.

Then in a letter to EA dated 23 July 2018 CASA advise they have revised their previous advice and that the plume should be managed through an engineering solution (diffuser, plenum, larger diameter stack) to ensure plumes reduce to below 6.1 m/s by 1031 ft AMSL. For reference the 99.9th percentile

plume velocity at 1031ft AMSL for Scenario 1 is 6.9 m/s and for Scenario 2 is 7.0 m/s. These velocities are achieved for the reference design of the GTs without any engineering controls to reduce plume velocity.

CASA do not offer the reason for changing their advice, other than saying a plume velocity of 6.1 m/s should be used when determining potential plume rise turbulence impact on aircraft, and that this velocity generates moderate turbulence for aircraft and is considered hazardous to the safety of aviation.

CASA have previously advised they are revising their plume rise assessment procedures as set out in AC 139-5(1) - Plume Rise Assessments (CASA, 2012), with critical plume velocities (CPVs) to be informed by the Bureau of Meteorology (BoM). The Bureau of Meteorology document, 'Hazardous weather phenomena – Turbulence', defines turbulence intensity according to the perceived effect on aircraft and occupants, as outlined in Table 2.

Table 2 – BoM Turbulence Classifications

Turbulence Intensity	Vertical gusts		Aircraft Reaction
Light	5-19 ft/s	1.5–5.8 m/s	Momentary slight erratic changes in attitude and/or altitude. Rhythmic bumpiness.
Moderate	20-35 ft/s	6.1–10.7 m/s	Appreciable changes in attitude and/or altitude. Pilot remains in control at all times. Rapid bumps or jolts.
Severe	36-49 ft/s	11.0–14.9 m/s	Large abrupt changes in attitude and/or altitude. Momentary loss of control.
Extreme	> 50 ft/s	>15.2 m/s	Very difficult to control aircraft. May cause structural damage.

It can be seen that a velocity of 6.1 m/s is the low end of moderate turbulence and the definition of the aircraft reaction states that the pilot remains in control at all times. Given this definition it is unclear why CASA think this equates to being hazardous to the safety of aviation.

It is also noted that the 99.9th percentile plume velocity at 1031ft AMSL for Scenario 1 being 6.9 m/s and for Scenario 2 being 7.0 m/s are also at the lower end of the moderate turbulence range, where there is no pilot loss of control.

2. Plume Rise Influencing Factors

Plume rise is determined by two factors:

- Momentum flux (i.e. flow/velocity), and
- Buoyancy flux (i.e. temperature)

Plume rise modelling for this project has indicated that, after a distance of several diameters from the stack, buoyancy is the dominant factor. This is consistent with plume rise theory.

3. Engineering Options to Reduce Plume Rise

3.1 Overview

This section discusses options to reduce the velocity and temperature of the exhaust discharge from an F class OCGT.

3.2 Temperature Reduction

The exhaust temperature of the GT can be reduced by:

- Dilution of the exhaust with air
- Dilution of the exhaust with water
- Firing the gas turbine at a lower temperature

These are discussed in detail below:

3.2.1 Dilution of the exhaust with air

For the GE9F.05 dilution with fresh air to bring the temperature down by 150 deg C to 494 deg C would increase the stack volumetric flow, so while the fresh air reduces the stack exhaust temperature, the additional mass flow means the volumetric flow and stack velocity increases (for a 7.5 m diameter stack the velocity increases from 39.4 to 44.4 m/s).

Plume rise modelling for a lower exhaust temperature has been undertaken and the 99.9th percentile plume velocity at 1031 ft AMSL is 6.8 m/s, reduction of only 0.1 m/s compared to the base case scenario without any controls.

3.2.2 Dilution of the exhaust with water

Spraying water into the exhaust will reduce both the stack temperature, and velocity. The challenge with this option is to ensure the spray-water is fine enough to fully evaporate prior to discharge from the stack (less than 1 second residence time). This will require very high pressure sprays to obtain ultra-fine droplets (<10µm) to evaporate before discharge to atmosphere, and possibly a higher stack to ensure evaporation is complete before dispersion to atmosphere.

Any increase in stack height would counter reduced plume rise and as such this option is not considered any further. Additionally, this option would require between 80 and 160 tonnes per hour of fresh water to be injected into the exhaust. This is not considered a sustainable use of water.

3.2.3 Firing the gas turbine at a lower temperature

This will reduce the output and efficiency of the gas turbine, and less output will affect the overall project economics as EA will have less installed capacity to draw on for the same capital cost.

No reliable exhaust flow data could be sourced for this option and given its impact on project economics is not considered any further.

3.3 Velocity Reduction

Reducing initial plume velocity is often considered a relatively simple means of reducing plume rise as this can be done by increasing the stack diameter. It is noted, however, that reducing the velocity without reducing the flow will not change the overall plume momentum which is driver for overall plume rise.

CASA advised that a diffuser or plenum could be used. With an exhaust flow greater than 1700 m^3/s a diffuser would be unrealistically oversized and as stated above would not reduce overall plume momentum.

To confirm the impact of reduced velocity from an increasing stack diameter, this is considered as follows.

3.3.1 Increasing the stack diameter

Increasing the stack diameter from 7.5 m to an arbitrary 20 m diameter stack would reduce the stack tip velocity from 40 m/s to 5.5 m/s. A downside to this option is that the stack height will likely need to be increased to reduce flow stratification, and will require an induced pressure drop to ensure this occurs. Despite this it will be difficult to ensure an even velocity profile at the stack exit.

With a low exit velocity and higher stack height, the EPA would require that NOx impacts to be reassessed to assure that impacts are no greater than originally assessed and approved. A higher stack would somewhat offset any increased air quality impacts from a lower velocity, but as stated above increasing the stack height will counter the aim of lower plume rise to some degree. Additionally, the silencer would have to be located in a horizontal section of duct prior to the stack.

Increasing the stack diameter will result in a highly customised stack design without precedent, and it may be difficult to find a designer / contractor willing to take on such a project.

Plume rise modelling for the GE 9F.05 has been undertaken with a 20 m diameter stack, with the stack height remaining at 40 m. The modelling gives a 99.9th percentile plume velocity of 6.8 m/s at 1031 ft AMSL a reduction of only 0.1 m/s compared to the base case scenario without any controls. This confirms the influence of buoyancy and momentum flux which are the same for both scenarios. Given this is an increase in velocity compared to the velocity at the stack tip, the result is not particularly intuitive.

A review of the plume rise model (TAPM) explains:

> In the vertical direction, particle position is updated using
>
> $$\frac{d\sigma_{particle}}{dt} = \dot{\sigma} + \dot{\sigma}' + \dot{\sigma}'_p,$$
>
> where
>
> $\sigma_{particle}$ is the particle position in terrain following coordinates,
> $\dot{\sigma}$ is the mean ambient vertical velocity,
> $\dot{\sigma}'$ is the perturbation of vertical velocity due to ambient turbulence,
> $\dot{\sigma}'_p$ is the perturbation of vertical velocity due to plume rise effects.

This suggests vertical velocity can change / increase with perturbations due to ambient turbulence and plume rise effects.

3.4 Alternative GT Options

Another possible alternative is to choose a different gas turbine model that meets EAs requirements but has lower plume rise, e.g. as may be achieved by lower exhaust flow and temperature. A possible alternative is the GE 9F.04. This has a slightly lower output than the 9F.05 and exhaust temperature and flow are each reduced by approximately 10%.

Plume rise modelling has been undertaken for the 9F.04 and it has a 99.9th percentile plume velocity of 6.7m/s at 1031 ft AMSL. This is a reduction of only 0.2 m/s compared to the base case scenario without any controls.

4. Summary

This technical memo has investigated possible means of reducing plume rise by engineering options and GT alternatives.

The engineering options have targeted reducing plume temperate and flow, the key operational parameters that influence plume rise drivers of buoyancy and momentum flux.

Based on the plume rise modelling undertaken as part of the initial assessment and for the options considered here, it is estimated that to achieve a plume velocity of 6.1 m/s at 1031 ft AMS an exhaust temperature of 400-430 deg C at an approximate stack flow of 1300 m^3/s would be needed. None of the potential engineering solutions of GT alternatives outlined here can achieve these exhausts temperatures and flows.

letter to MP stokes - please sign

Final Audit Report 2021-06-13

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