

CASA Plume Rise Procedure

A Modellers Perspective

CASANZ Workshop – Sydney, 7th November 2008

Methodology

Industry with new stacks are required to report if:

The “average vertical velocity exceeds 4.3 m/s at the aerodrome Obstacle Limitation Surface or at 110 metres above ground level anywhere else”

The current Guideline requires assessment by:

- TAPM v2.
- 5 years of meteorology.
- Meteorological data may be assimilated into TAPM.
- Suggested inner grid of 3 km.
- A further sub 3-km nested grid may be added at the users discretion provided it is not less than 800m.

Required output are statistics of plume rise heights and plume width amongst other things.

The guideline allows for screening methods to be used but is lacking in detail.

Case Study

Modelling a open cycle gas turbine (high exhaust temp of 550 deg C and exit velocity 40 m/s)

Modelling was originally done several years ago using TAPM v2.

The result was a maximum height of 1050m.

This occurred for an hour with a section of the boundary layer <0.1 m/s.

Plume hit the top of the boundary layer?

Remodelled several years later with TAPM v3.07 where the max predicted was now 850m predicted on another hour on another day and year?

Following communication with CASA, CASA came to some “agreement” that it was better to use a 99.99th percentile approach. I.e. the 0.876 hour in a year or over 5 years the 4.4th highest . Therefore it is approximately the 5th highest in 5 years approach.

Using both TAPM v 2 and v3 the predicted 99.99th percentile were about 805m.

Specific Issues

Procedure for screening (non TAPM) approach is not well defined

The Guidelines State:

“8.6 Exhaust plumes from minor industries would not normally require the sophistication of TAPM as their plumes tend to dissipate within 10m above the stack height. However, exhausts stacks located within the take off and approach areas of an aerodrome, and in close proximity to a runway, would still need to be addressed. In this case the standard plume rise equations should be adequate.”

Section 9.1 to 9.4 talk about models such as AUSPLUME and that they “can provide the basis for estimating the potential effects on aviation”.

It then states in Section 9.4 “... a worst case plume rise is typically evaluated by assuming calm conditions”

The question is, what are calm conditions? If AUSPLUME can be used, the winds can't be below 0.5 m/s and certainly not 0.0 m/s. Alternatively are they referring to the equation by Briggs for calm conditions which is quite different? What wind profile is to be used. None?

Specific Issues- TAPM method

- The results are sensitive to the version of TAPM. With TAPM v 4 predicting more frequent lower wind speeds at the surface will this change the outcomes of assessments obtained using past versions of TAPM?
- TAPM has no lower wind speed limit internally. Can this create an unrealistically low wind speed if run over 1 or 5 years?
- Are the predictions sensitive to the inner grid size? Is 3km too large?
- What is the benefit of using 5 years data for predicting calm conditions?
- Should we be using the lowest wind speed predicted in 5 years?
- Multiple plume merging. One study by Katestone (2003) indicates that the approach of TAPM may be too simplistic.
- How realistic are these predictions anyway? They are at the extremes in terms of predicted wind speeds and at the extreme applicability of the equations.

Proposed Way Forward

1) Need clarification on the screening procedure with defaults specified for wind speed and wind profile exponent (if any) and the equation to be used to predict the maximum likely plume rise.

Possibly could provide a simple spreadsheet or table for single plumes or even multiple plumes

2) Should a 99.99 percentile criteria or even lower percentile be proposed?

3) Do we need 5 years of data? A 99.99 percentile could be used for either 1 or 5 years.

5) Are the TAPM parameters specified in the guideline appropriate?

Minimum grid size, data assimilation?

6) Suggest a review of the criteria of 4.3 m/s which has never been justified.

7) Suggest that a CASANZ letter be written to CASA to request a full review and/or suggest changes as above.