TUNNEL VENTILATION

ENHANCEMENT USING EXIT PORTAL DISCHARGE

INTRODUCTION

I make this submission having read the “Initial report on Tunnel Air Quality”, issued by the Advisory Committee on Tunnel Air Quality, July 2014. I have read this document and a number of related technical papers. If I say at the outset that I agree in sbstance with the position, suggestions and approach taken in that document it will allow me to make my point with fewer words.

However, I do so as a now retired Bachelor of Mining Engineering who has held a First Class Certificate of Competency as a Mine Manager, with relevant experience in underground collieries and hard rock mines. Some of that time was spent as a ventilation engineer with specific responsibility for monitoring and maintaining ventilation to multiple worksites in a large multi level mine with numerous ventilation routes.

I have attended numerous information nights, public meetings, air quality forums and briefings organized by NorthConnex. I have over the past several months downloaded and read relevant parts of the NorthConnex EIS document and much other NorthConnex information as well as literature about tunnel ventilation, management of emissions, health effects in tunnel and near tunnel, pollution dispersion modeling, fan specifications and stack pollutant management around road traffic tunnels, coal fired power plants etc.

In the executive summary at page ii, the Advisory Committee states: -

1. Provide information and make recommendations on the assessment and management of portal emissions to improve ventilation system efficiency, reduce overall environmental impacts and provide appropriate protection of the air quality for tunnel users and the community in the vicinity of the tunnel portals.

This should include exploring the potential for:

a. optimising portal design on new tunnel projects to maximise dispersion and minimise impacts through the use of physical or computer models (eg wind tunnels or computational fluid dynamics)

b. an investigation of the potential for partial portal emissions at an operating Sydney tunnel without increasing nearby residents' exposure to vehicle emissions.

My submission is that the NorthConnex project is the place to explore and prove all of the propositions put in the initial report. The necessary commitment needs to be made at the commencement of detailed design for construction to follow.

Attached diagram 1 illustrates a general arrangement for ventilating a tunnel via a ventilation connection to the surface in the vicinity of the traffic exit portal.

UPCAST FAN CASE

In the existing NorthConnex proposal this is an upcast shaft topped by a fan and stack to exhaust and disperse

$Q_{\text{(upcast)}} = Q_{\text{(piston + jet fan flow in the body of the tunnel)}} + Q_{\text{(incoming at the tunnel portal to prevent portal exhaust)}}$

In the NorthConnex proposal case then, if the main tunnel flow $Q_{\text{(piston + jet fan flow in the body of the tunnel)}}$ is, say, 100%, and portal intake $Q_{\text{(incoming at the tunnel portal to prevent portal exhaust)}}$ is, say, 10% then the fan capacity $Q_{\text{(upcast)}}$ needs to be 110%, to put the fan size in perspective for the upcast case.

DOWNCAST FAN CASE

An alternative arrangement is for the shaft and fan arrangement to provide downcast air to the tunnel with discharge of both the main tunnel flow and the downcast air flow through the portal.

$Q_{\text{(portal discharge)}} = Q_{\text{(piston + jet fan flow in the body of the tunnel)}} + Q_{\text{(downcast)}}$

In the modified alternative downcast case then, if the main tunnel flow $Q_{\text{(piston + jet fan flow in the body of the tunnel)}}$ is, say, 100%, and the fan capacity $Q_{\text{(downcast)}}$ is, say, 30% then the portal outflow along with the departing traffic $Q_{\text{(portal discharge)}}$ will be 130%, to put the fan size in perspective for the downcast case.

THUMBNAIL COMPARISONS

1. The upcast model requires a fan sized and powered to handle 110% of the main tunnel flow compared to just 30% for the downcast model, and
2. the total volume of air into which emissions are diluted is 110% for the upcast model and 130% for the downcast model, expressed in terms of the main tunnel flow amount.

If it works, and there seems to be an overwhelming case for the fact that it will, it will save a lot of lot of energy, and the pollution that's created with it in a coal fired power station.

These are illustrative calculations for comparative purposes only but they do point the way.

There will be many better equipped people than I and are already in the project who are up to speed on current fan and air flow data and how to use it in calculations

DOWNCAST TUNNEL DISCHARGE

I don't know the detail of how NorthConnex will connect their upcast extraction shaft / tunnel to the road tunnels. In my diagram 1 I've shown a peripheral transition around the circumference of the tunnel (excluding the roadway). In the same diagram I've shown that peripheral transition fitted with louvres to direct the air toward the adjacent discharge and traffic exit end of the tunnel. Diagram 2 is less relevant but does indicate how air can be distributed around and into the tunnel following delivery by a downcast fan. In an upcast proposal the louvres shown in Diagram 1 would, of course, have to be more or less neutral or facing at least slightly into the main tunnel and air flow. The air gathered up in the transition would flow through the connection and out through the upcast fan.

VENTURI EFFECT OF DOWNCAST TUNNEL DISCHARGE

Hopefully no one will see the item illustrated in attachment “140909 Venturi airmover.pdf” on the NorthConnex project. Something more modern and fashionable is illustrated in attachment “140909 Venturi airmover.pdf”, but both items do more or less the same thing. A modest amount of air is introduced at elevated pressure into a periphery of the device around an open centre and directed in the forward direction. This results in substantial amounts of air being drawn in from the rear through the open centre to produce a greater combined flow volume.

In the downcast flow case suggested then the 100% of flow in the main tunnel might be increased by a few or perhaps more percent under the influence of the 30% peripherally introduced forward directed air so that flowing out of the portal might be safely said to be 130% plus. On a quiet night with the tunnel closed for maintenance it might be possible to achieve sufficient ventilation along the tunnel length for maintenance purposes by running the downcast fan alone.

RECOMMENDATION

Most importantly, the NorthConnex ventilation proposal that I've seen and had explained, and criticized, on a number of occasions should proceed and not be allowed to be replaced by sub optimum arrangements that provide false hope and cold comfort but little or no improvement at extraordinary cost.

I am not aware of what sort of main surface fan NorthConnex will use but it almost has to be able to be run in a way that provides a variable airflow, controlled together with the jet fans in the tunnel, by conditions in the tunnel. Some fans are easier to run in reverse with acceptable results than others. If that's too fussy or impossible with the originally installed fans then there is a case for commissioning the NorthConnex project in its currently proposed form for ventilation together with a capacity for using engineered in capacity to modify or temporarily replace the surface mounted fans so that they become a variable flow rate downcast fan of generally lower overall capacity for test purposes.

What can be done during design and construction in relation to all the items detailed in the Advisory Committee's Initial Report page ii point 1 including sub paras a) and b) would need to be included in the project program in anticipation of the test work.

I believe that this approach will get the project completed as now envisaged and still allow all of the Advisory Committee's aim in relation to tunnel ventilation to be achieved.

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9 September 2014

RELATED ATTACHMENTS

A - 140909 ASSISTED PORTAL DISCHARGE (Includes Diagrams 1 & 2)

B - 140909 Venturi airmover.pdf

C - 140909 dyson heater fan.pdf