

Request to be heard?: Yes

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**Affected property:**

**Attachment:** Automated\_Tunn

**Comments:** JJ Tunnel Cleaning Australia currently cleans more than 80% of Australia's automotive tunnels. We were the first Australian company to design and build a truck mounted mechanised tunnel cleaning system, used in all our tunnel contracts. We continue to review and innovate our cleaning methodology. The Automated Tunnel Cleaning System (ATCS) is a result of this innovation and a world first, registered & patented in Perth by JJ Cleaning Australia Pty Ltd. It increases tunnel cleaning efficiency, significantly enhances safety, and meets capital investment return requirements of the tunnel owner/operator. It requires a larger initial capital investment but much lower ongoing cleaning costs. After nearly two years of working with JJ Cleaning on the development of the cleaning system, Transurban included the ATCS as a required delivery to be met by tenderers in the Western Distributor project. Key drivers of their acceptance of the system were its Return on Investment (ROI) and significantly increased safety for tunnel patrons and operators, virtually eliminating injury or death of a driver hitting slow/stationary cleaning vehicles and workmen. Melbourne was to be the world leader by implementing this technology into its newest tunnel. For more than 6 months JJ Cleaning worked closely with each of the tenderers to provide the necessary support and information to enable the inclusion in each of their tenders. At the 11th hour a decision was made to exclude this and other tunnel services in order to get within the final target cost. Initial estimates of our cost were \$12-15m. The benefits of the ATCS within the EES themes are: Transport - The implemented system enables the tunnel operators to keep all lanes open reducing congestion and significantly enhancing vehicle safety by removing virtually stationary machines from the tunnel. Physical Environment -All cleaning chemicals are collected in the Tunnel settlement tanks so as not to contaminate groundwater or ecology. Cleaning frequency is increased resulting in significantly longer tunnel wall panel life expectancy. Higher wall panel reflectivity lowers overall electricity costs. Human health - Reduced carbon build up on panels increases air quality. Automating cleaning removes the risk of having workmen in congested tunnel traffic. We believe the safety benefits alone justify the inclusion of the ATCS, and its removal is a loss to all users of the tunnel. We seek partial or full funding from EES to facilitate the implementation of this service.

Thank you for the opportunity to submit our proposal through this platform. We look forward to your response.

## TUNNEL WALL WASHER

### ADVANTAGES and DISADVANTAGES

25 January 2017

Rev 0

#### 1. Requirement for Tunnel Wall Washing

Road tunnels and vehicle underpasses require a specific level of luminance through the tunnel. To minimise the amount of lighting required (and hence the cost of installation, maintenance and operation including reduced energy consumption) the walls of the tunnel are used to reflect light from the overhead luminaires. During tunnel operation, vehicle emissions, diesel fume, and road grime, accumulate on the panel surface reducing the reflectance from the panel walls. These deposits can also be aggressive and acidic which can adversely affect the appearance and longevity of the wall panels.

The most cost-effective way of maintaining the required levels of reflectivity for adequate lighting performance is to keep the architectural panels clean. This requires frequent washing and therefore, cleanliness of the tunnel walls is a constant factor in road safety. Keeping the panels free from grime and acidic deposits also has the added benefit of enhancing the panel's life.

#### 2. Current Cleaning Practice

Historically, tunnel wall washing was undertaken by a number of workers on foot with brushes. This was the methodology originally used for the M5East (in Sydney) for example. However, the current methodology for cleaning the architectural lining in road tunnels requires the use of a specially fitted vehicle (a truck) equipped with tanks containing water and surfactant, and with scrubbing brushes attached to an articulated arm. As the truck travels beside the architectural lining, the truck driver (the operator) moves the articulated arm so that all parts of the architectural lining are washed.

As the truck is operated manually, communication and control from the Freeway Control Centre (FCC) occurs only via communication with the operator by radio.

##### a. Problems

Issues associated with a vehicle mounted cleaning system are:

- i. Tunnel cleaning operations can only be undertaken safely in conjunction with traffic management using either a rolling, single lane, or full tunnel closure. This can present significant traffic management costs on closure. Depending on external issues, this can also present political issues related to the timing of the tunnel closure.
- ii. Use of a truck mounted washing system impedes traffic flow which presents an inconvenience to the public and can represent a loss of toll revenue.
- iii. It presents limitations to the timing and hence potentially the frequency of tunnel wall washing. This could result in a road safety risk as the tunnel lighting is adversely impacted, and in operational costs (power consumption) to maintain adequate tunnel lighting.
- iv. Having tunnel staff (the truck operator) within the tunnel presents a potential safety risk for both tunnel staff and the general public (tunnel users).

- v. Cleaning costs will increase in direct proportion to the cost of wages.
- vi. Tunnel wall washing would be sequential (unless multiple machines were used). This means that any one tunnel tube would be impacted for twice the duration of a single wall washing period (one period for each tunnel wall).

### **3. Autonomous Tunnel Cleaning System (ATCS)**

The ATCS describes the complete tunnel cleaning system which consists of four cleaning units with their associated equipment and infrastructure. One cleaning unit, and its associated equipment and infrastructure, is required for each architectural panel wall (two per tunnel tube). Each cleaning unit comprises a number of elements, the principal one of which is the cleaning module which runs on two rails, one located on top of the Concrete Traffic Barrier (CTB), and one above the level of the top of the architectural panel. During operation, the cleaning modules do not impinge on the normal traffic envelope, including the kinematic envelope from normal vehicle bounce and movement.

The cleaning module has tanks containing water and surfactant. The surfactant usage concentration is low (approx 1:100) and therefore the surfactant tank only needs to be filled after a number of wash cycles. The surfactant tank is filled at the ATCS “home” position which is located in the cut and cover, outside the northern daylight portal, and beyond the “working width” of the tunnel profile.

Fill points for the cleaning module are located every 240m along the length of the tunnel, and at the “home” position. The cleaning module is charged at the “home” position, and is able to refill the water tank if required when it reaches a fill point. The amount of water used and the traverse speed of the unit is directly related to the amount of grime on the wall panel, which is influenced by the frequency of wall washing adopted. Each fill point has a solenoid valve which is connected to the Plant Management and Control System (PMCS). The cleaning module communicates to the PMCS to advise the solenoid valve to operate when it is in position.

Each cleaning module is able to be communicated to from the FCC.

During operation, the cleaning module uses brushes to scrub the architectural panels as it traverses the tunnel. An on-board camera allows the cleaning operation to be supervised from the FCC to ensure that cleaning is satisfactory and to adjust the rate of advance or other parameters as required. (The camera may also allow other issues in the tunnel to be identified and inspected). When the cleaning module reaches the southern end of the tunnel, the cleaning operation is complete, and the unit returns to the “home” position at the northern portal. The traverse speed of the cleaning unit can be varied depending on the amount of grime on the panel walls. It is expected that the cleaning cycle traverse speed will be 3 kph. The return travel speed will be at 7 kph. Allowing for refilling the water tank at every fill point (i.e. every 240m) the complete cleaning cycle is expected to take approximately 1 hour and 35 minutes.

#### **a. Problems and Benefits**

Issues and benefits associated with an ATCS are:

- i. No requirement for lane or tunnel closure to operate the ATCS. However, it is recommended that the cleaning modules be operated at times of low traffic volume e.g. during night time operations. This results in no disruption to traffic flow or adverse effect on tolls.
- ii. Cleaning intervals can be optimised to reduce lighting power consumption and prolong wall panel life.

- iii. Wall washing can be completed in a single cycle as cleaning modules can be refilled during cleaning operations.
- iv. Enhanced safety for tunnel staff. No tunnel staff are required within the tunnel envelope.
- v. Panel cleaning operations are undertaken remotely from the FCC.

#### 4. Comparison of Vehicle Mounted Cleaning System v ATCS

Item	Issue	Vehicle Mounted System	ATCS
1	Tunnel closures	A rolling, single lane, or full tunnel closure is required. This can present significant traffic management costs.	Tunnel closures not required.
2	Impact on traffic flow	Impedes traffic flow & toll revenue.	No impact.
3	Safety	Potential safety risk for both tunnel staff and the general public (tunnel users).	No tunnel staff within tunnel envelope & elimination of ultra-slow moving cleaning vehicles in closed lane.
4	Cleaning intervals	Limitations on the timing and potentially the frequency of tunnel wall washing.	Cleaning intervals can be optimised and can occur at operator discretion.
5	Operation costs	Power consumption could increase if tunnel walls are not routinely cleaned. Impacted by any increase in the cost of wages.	Power consumption can be optimised.  No operator wages impact.
6	Cleaning duration	Tunnel wall washing would be sequential i.e. one wall of each tunnel washed and then the other wall washed (unless multiple machines were used) which extends tunnel closure period and wall washing duration.  If washing truck needs refilling with water, washing duration is extended.	Wall panels could be washed simultaneously, reducing cleaning duration.  Refilling with water occurs automatically.
7	Control	No remote control. Requires operator on board washing truck. Communications with operator are via radio.	ATCS modules operation is fully automatic & controlled from the FCC.

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