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ENGINE, EMISSIONS AND VEHICLE RESEARCH DIVISION

ISO 9001 CERTIFIED

FAX: (210) 522-3950

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Mr. Gareth Jones
Senior Atmospheric Scientist – Air Policy, Reform and Compliance
NSW Environment Protection Authority
PO Box A290
Sydney South, NSW 1232
Australia

LOCOMOTIVE TECHNOLOGY CENTER

A Department of SwRI

Mr. Jones;

Thank you for the opportunity to perform a peer review of the report titled "Diesel Locomotive Emissions Upgrade Kit Demonstration Project," prepared by ABMARC. Presented below are my thoughts on the specific aspects of the report where you requested commentary.

1. **Appropriateness of the project design and test procedures.** The project design was appropriate for evaluating the before & after T0+ kits for exhaust emissions. It would have been better to test before and after under more similar ambient conditions, and with more similar run-in times. Some aspects of the test procedures could have been better, specifically fuel flow measurement and following the EPA test sequence. Many places in the report states "in accordance with" 40 CFR Parts 1033 and 1065 – and then several exceptions were noted. This is OK for your project objective, as long as the claim of "in accordance with" is changed to something like "generally following".

2. **Appropriateness of the test equipment** – I am not familiar with the AVL PEMS instrumentation used, but the NOx & PM reductions seem about right for these Tier 0+ kits. Again, broad claims of meeting 1033/1065 are likely a stretch. The two meter fuel flow method, and with the Kral meters, has proven troublesome in our experience, especially at low Notches and at Idle.

3. **Reliability of the results with respect to the emission reductions measured and objective of the project** – For rough verification of the NOx and PM reductions with the Tier 0+ kits, I think you met this objective.

4. **Applicability of the test results to real world operation of the locomotives, and specifically whether locomotives tested in static load test mode operate at the same engine conditions (load and rpm) as they do when operating on the rail network on a throttle notch basis -** I can see where this is a challenge to explain to a public audience. My approach to explaining this is:

    - These are diesel-electric machines (kind of like a hybrid-drive car)
    - Engine speed & power are decoupled from locomotive/train speed

- There are 8 power-producing throttle notches – each one with a predetermined engine speed and power
- The engine in the locomotive can only operate at these pre-determined speed/power set points when in operation
- Explain dynamic brake and why there are big resistive load grids built into the locomotives, and that these can handle the full power output of the engine
- Then how handy it is to be able to throw a switch on the loco and the power that normally would go to the traction motors to propel the locomotive is routed to the dynamic brake grids
- When in self-load, each Notch commands the same speed and power as when the locomotive is in normal operation
- The test results are calculated to simulate real-world throttle-by-throttle usage rate (duty-cycle). In this study, the U.S EPA Line-Haul cycle was used. However, if you have duty-cycle date for NSW operations, you have the data to calculate "NSW duty-cycle weighted" results.

See my notes on the first page of the .PDF file related to AESS (Automatic Engine Start-Stop). If the railroads over there are anything like in North America, extended (unnecessary) Idling is your biggest and most expedient opportunity to reduce exhaust emissions and fuel consumption.

I appreciate the initiative of NSW EPA to improve public health by reducing air pollution from locomotives, and for the opportunity to review your test report. I hope you find my observations useful and constructive. Please let me know if we can be of further assistance.

Regards,

Steven G. Fritz

Steven G. Fritz, P.E.
Manager, Medium-Speed Diesel Engines
Design and Development Department

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