Diesel Exhaust Emissions – proposed Work Exposure Standard

Submission by the Australian Council of Trade Unions to Safe Work Australia

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Introduction

Since its formation in 1927, the ACTU has been the peak trade union body in Australia. There is no other national confederation representing unions. For more than 90 years, the ACTU has played the leading role in advocating in the Fair Work Commission, and its statutory predecessors, for the improvement of employment conditions of employees. It has consulted with governments in the development of almost every legislative measure concerning employment conditions and trade union regulation over that period.

The ACTU consists of affiliated unions and State and regional trades and labour councils. There are currently 39 ACTU affiliates. They have approximately 2 million members who are engaged across a broad spectrum of industries and occupations in the public and private sector.

Workplace exposures to Diesel Exhaust Emissions [DEE] are commonplace - mining, transport, retail and repair work [diesel mechanics] machine manufacturing, mineral and material extraction, quarrying, asphalt making and for individuals exposed to DEE from road traffic e.g. car park attendants, traffic controllers.

The ACTU does not support the Safe Work Australia's assessment *that there are insufficient data to recommend a suitable TWA.*

The ACTU supports the adoption of a WES for DEE, based on elemental carbon, that allows a progressive reduction of the WES to a health based standard. Currently there is no WES for DEE therefore it is reasonable to adopt a phased in approach.

In 2011 Carey et al estimated that about 29% of male workers and 6% of female workers in Australia were exposed occupationally to DEE.

DEE is an important exposure in the Australian workplace and needs appropriate control to an exposure level that aims to protect workers from chronic and acute effects of exposure. Adoption of the SWA proposal will entrench the inactivity in controlling exposures to DEE.

Recommendation

The ACTU supports the adoption of a WES based on elemental carbon:

1. **Mining industry:** Immediate 0.1mgm/m3 with a reduction to 0.05mgm/m3 by 2023.
2. **All other industries:** Immediate 0.05mgm/m3 with a reduction to 0.01mgm/m3 by 2023.

It is important that a WES is adopted, as its absence implies that there is little need for risk control measures.

As noted in a Carex Canada review in December 2019[1]:

> *The absence of an OEL[2] is of particular concern because many occupational disease prevention practices rely on the 'benchmark' that an OEL provides.*

The ACTU does not support the Safe Work Australia's assessment *that there are insufficient data to recommend a suitable TWA.* This is contrary to health data as summarised by Carex Canada:

> *Based on evidence of increased lung cancer risk at very low levels, we recommend that Canadian jurisdictions move towards an OEL based on elemental carbon of 20 µg/m3 [0.02mgm/m3] for the mining industry and 5 µg/m3 [0.005mgm/m3] for other workplaces to protect worker health. The higher OEL recommended for the mining industry takes into account the feasibility of implementation in this industry that will have particular challenges and is meant as an interim target in a staged approach to eventually have one harmonized OEL for all workers.[3]*

The proposal from the ACTU considers the current mining industry guidelines must be made mandatory. The proposal is considerably higher than that recommended by some researchers, who consider that 0.001 mg/m^3 would be more appropriate to prevent excess lung cancer deaths.[4]

Health Effects

The is plenty of evidence of harm:

- International Agency for Research on Cancer (IARC) evaluated DEE as *carcinogenic to humans* (Group 1) and causes lung cancer[5]
- Cancer Council Australia has estimated that every 3 days a person is diagnosed with lung cancer due to exposures to DEE
- Occupational exposure is associated with respiratory inflammation and adverse cardiovascular effects [HCOTN][6]
- Children of women exposed to diesel engine exhaust at work are at a significantly increased risk of brain cancer.[7]

[1] https://www.carexcanada.ca/CAREXCanada_DEE_OEL_REPORT_2019.pdf
[2] Equivalent of Australian WES
[3] https://www.carexcanada.ca/CAREXCanada_DEE_OEL_REPORT_2019.pdf page 3
[4] Vermeulen R, Silverman DT, Garshick E, Vlaanderen J, Portengen L, Steenland K. Exposure-response estimates for diesel engine exhaust and lung cancer mortality based on data from three occupational cohorts. *Environmental Health Perspectives*. 2014:122(2):172-177. doi: 10.1289/ehp.1306880.
[5] International Agency for Research on Cancer. IARC monographs on the evaluation of carcinogenic risks to humans. Diesel and gasoline engine exhausts and some nitroarenes. Volume 105. Lyon, France: IARC, 2014.
[6] Diesel Exhaust Emissions Safe Work Australia 2019
[7] Parental occupational exposure to diesel engine exhaust in relation to childhood leukaemia and central nervous system cancers: a register-based nested case-control study in Denmark 1968-2016. Julie Volk, et al, Denmark and US, *Occupational and Environmental Medicine*, Volume 76, Issue 11, November 2019.

A decrease in exposure level of DEE can lower the risk of lung cancer in exposed workers and recent Danish work indicates it may have a protective effect on the health of children of women exposed to DEE[8].

Need for a WES

Safe Work Australia is proposing a review of additional sources be conducted as a priority at the next scheduled review. The ACTU does not oppose reviews but does not support a delay, to an unspecified date, to consider whether to have a WES for DEE.

In 2012, Lesley Rushton wrote an editorial in the Journal of the National Cancer Institute:

> *These results indicate that stringent occupational and particularly environmental standards for DEE should be set and compliance ensured to have an impact on health outcomes. In the occupational situation, in addition to lower emission and more efficient engines, reduction in DEE can be achieved through: 1) engineering controls such as improved ventilation and regular maintenance of vehicles; 2) improving worker practices such as limiting the number of vehicles, particularly in closed spaces, and turning off engines when not in use; and 3) as a last resort, the use of appropriate respiratory protective equipment. Reduction in the general environment presents more of a challenge, although some of the occupational control measures are also relevant. However, the necessity for such reduction is becoming increasingly apparent and is essential if the health of large numbers of people is not to be compromised.*[9]

The case for a dose response relationship is found in numbers of studies including Silverman et al in 2012:

> *To our knowledge, this is the first report of a statistically significant exposure–response relationship for diesel exposure and lung cancer based on quantitative estimates of historical diesel exposure with adjustment for smoking and other potential confounder.* [10]

Unnecessary delay

The rationale to support a delay in establishing a WES is puzzling.

> *New engine technologies will replace existing engines, impacting on the exhaust components and possibly the toxicological relevance. Given that diesel engine emission composition can vary depending on several factors and there are limited data regarding*

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[8] ibid
[9] Rushton, L. The Problem with Diesel *JNCI: Journal of the National Cancer Institute*, Volume 104, Issue 11, 6 June 2012, Pages 796–797,
[10] Silverman et al, The Diesel Exhaust in Miners Study: A Nested Case – Control Study of Lung Cancer and Diesel Exhaust, J Natl Cancer Inst 2012;104:1 8 –5 154– 868

diesel engine emissions from modern engines (post 2007) in the primary sources, a priority review of additional data sources is recommended at the next scheduled review.[11]

If the technology contains lower levels of particulates, then an exposure standard would be achievable for those engines.

New technology DEEE contains 90% lower mass of particulates and adsorbed mutagenic compounds when compared to Euro I and II engines

- *toxic effects in lung attributable to NO_2 exposures and as such, no tumours or genotoxicity in vivo in 1 yr. mouse and 2 yr. rat study*[12]

The level of DEE measured is the level at which workers are exposed, irrespective of the source e.g. an old or new engine. The source is not the issue, it's the exposures. WES exist for various components of DEE (e.g., benzene, carbon monoxide, oxides of nitrogen), but there is a regulatory gap for limiting exposure to the carcinogenic fraction, which is mainly found in the particulate matter (PM).

Additionally, a recent review[13] challenges the assertion that new engines make an impact on the level of particulate matter:

Exposure to diesel exhaust from both engine classifications was found to cause negative health impacts on the lungs, heart and brain including increased risk of cancer, increased blood pressure, increased risk of thrombosis, neuroinflammation and increased DNA damage. Subjects with asthma, allergy or respiratory disease were more at risk of negative effects caused by diesel exhaust exposure than healthy subjects. Health impacts were found to occur even in studies using exhaust concentrations below the recommended Australian occupational limit of an 8 hour time weighted average (TWA) of 100 µg/m3 of elemental carbon.

In addition, the use of exhaust after-treatment devices had little to no impact on the resulting health effects of diesel exhaust exposure, despite exhaust after-treatment devices such as a diesel particulate filter (DPF) being capable of removing over 90% of diesel exhaust particles by mass. Several studies exposed subjects to exhaust both with and without a DPF equipped and found similar health impacts. Thus "new technology" diesel exhaust emissions can meet occupational limits and still cause adverse health effects. DPF's also preferentially remove elemental carbon from diesel exhaust which limits the feasibility of using elemental carbon as an indication of exhaust exposure.

[11] Page 2 Diesel Exhaust Emissions Safe Work Australia 2019
[12] Ibid Safe Work Australia page 4
[13] Landwehr I et al, Critical review of recent diesel exhaust exposure health impact research relevant to the underground hardrock mining industry, review was supported by the Department of Mines and Industry Resources (Western Australia) and Curtin University

These authors conclude that for mining:

> *Based on the results of these studies, an 8 hour time weighted average diesel exhaust concentration below 50 µg/m3 of diesel exhaust particles, 35 µg/m3 of elemental carbon, is more appropriate in order to limit health effects. In order to meet occupational limits, many diesel engines will need to be equipped with after-treatment technology such as a DPF. This negates the feasibility of using particle mass based limits, especially ones based on elemental carbon. In order to minimise the negative health effects in the hardrock mining industry, alternative methods of measuring exposure to diesel exhaust should be explored. Suggestions include particle number and nitrogen oxides (NOx).*

It is not appropriate to wait until additional data are available before setting a WES. This is particularly important in the Australian context as we have not adopted the European standards for on road diesel vehicles and no evidence has been cited to demonstrate that Australian workplaces have upgraded diesel exhaust engines significantly in the last 10 years. The Australian underground mining industry is investigating new technologies to limit the use of diesel engines, and if that is successful exposures to DEE will be limited due to technological change.

SWA statement at odds with recent reports

The ACTU does not agree with the statement in the SWA Draft Evaluation Report (2019) that "*At present, no appropriate inhalation unit risk exists with which to derive a suitable TWA to protect for carcinogenic effects.*"

Recent Western Australia research noted that:[14]

> *Elemental carbon exposure would however appear to be a <u>reasonable indicator of nanoparticle</u> exposure, and vice versa, implying that; (a) standard EC monitoring methods remain appropriate and (b) nanoparticle monitors are suitable for real-time/operational monitoring of DPM exposure in mines, as the method produces more timely management information* and
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> *Nevertheless, it was found that nanoparticle exposures and EC exposures possessed a reasonable (and more importantly statistically significant) correlation.*[15]

Appropriate WES

The methodology and principles adopted for the current WES review is for adoption of health-based standards.

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[14] http://www.dmp.wa.gov.au/Safety/Reports-16199.aspx
[15] Ibid, pages 6 and 7

The evidence presented by SWA indicates that:

- TWA of 0.011 µg/m³ corresponds to 4 extra lung cancer death cases per 100,000; 40 yr. occupational exposure
- TWA of 1.03 µg/m³ corresponds to 4 extra lung cancer death cases per 1,000; 40 yr. occupational exposure. [16]

The ACTU has been given advice, based on research by Vermeulen et al, that a limit of 0.1 mg/m³ is much too high and results in an unacceptable risk to exposed workers.[17] Their study estimated that at:

- 0.025 mg/m³, there would be an extra 69 cases per 1,000 workers.
- 0.01mg/m³, the estimate was 20 cases per 1,000 workers and at 0.001 mg/m³, there would be an extra 1.7 cases per 1,000 workers.

The WA report notes that:

- *The Finnish Institute of Occupational Health announced, in December 2015, that it was recommending an underground limit of 20 µg/m3. Emissions standards for diesel engines are moving to number-based (as well as mass-based) emissions limits[18].*

Conclusion

The ACTU supports the adoption of a WES for DEE. A less stringent WES needs to be adopted immediately with a phase in of a lower health based standard. Cancer Council Australia estimates an annual burden of 130 lung cancer cases due to DEE. It's time to act and make sure that workers are protected.

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[16] Safe Work Australia 2019 Page 5, HCOTN
[17] Vermeulen R, Silverman DT, Garshick E, Vlaanderen J, Portengen L, Steenland K. Exposure-response estimates for diesel engine exhaust and lung cancer mortality based on data from three occupational cohorts. *Environmental Health Perspectives*. 2014:122(2):172-177. doi: 10.1289/ehp.1306880.
[18] ibid

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