Your details and background

(Please leave blank if you wish to remain anonymous)

1. Name or organisation

BHP

2. Email used to log into Engage

[redacted]

Questionnaire

If you are commenting on particular aspects of the expert report, please identify the particular sections or pages concerned. Your response should, where possible, provide evidence to support your statement.

Summary Position - BHP

At BHP, we recognise that activities at our operations can impact the health of our people. We set clear mandatory minimum controls to manage and protect the health and wellbeing of our employees and contractors. For more than a decade BHP has set occupational exposure limits (OELs) for our most material exposures based upon scientific evidence. In some cases, this has resulted in lower limits than the regulatory requirements, and for others, such as diesel particulate matter (DPM), a significantly lower limit than regulations presently require.

Following on from the classification of diesel exhaust exposure as a Group 1 carcinogen by the International Agency for Research on Cancer in 2012, there was a growing body of evidence from international regulators, eminent scientists and scientific institutions recognising the health risk posed by diesel exhaust exposure at levels found in many underground work environments. As a result of this, in 2015, BHP made a commitment to manage diesel exhaust to as low as technically feasible and no higher than 0.03mg/m^3, a significant reduction from the previous OEL of 0.1mg/m^3. This was also based on independent expert health advice on the risk of development of lung cancer in workers exposed to diesel exhaust over extended periods.

In addition to a significantly lower OEL, BHP also:

- publicly committed to a five-year target to achieve a 50 per cent reduction in the number of workers potentially exposed to a number of substances, including DPM by FY2022. Collectively, the considerable efforts by our underground operations has resulted in significant reductions of DPM exposure year on year. A 10 fold reduction in the number of workers with exposures potentially exceeding this level[1] has been achieved during the last 5 years, with a commitment for continuous improvement ongoing; and
- provided strong support and sponsorship to the International Council on Mining and Metals (ICMM) Innovation for Cleaner, Safer Vehicles.

Our work to reduce emissions from diesel exhaust has included:

[1] Discounting the protection afforded by use of respiratory protective equipment.

- promoting operational and technological innovations and partnering with Original Equipment Manufacturers (OEMs) which has been key to finding solutions such as accelerating the availability of Battery Electric Vehicles; and

- multiple interventions introduced at BHP's underground operations, which are subject to continual improvement as new technology becomes available. These include optimising exhaust particulate filters; improvements in emission based maintenance on diesel machines; introduction of low diesel particulate matter emission engine packages; and real time monitoring to verify effectiveness of controls.

This overview seeks to demonstrate, from BHP's experience in the mining industry, the enablers and time, effort and resources needed in order to make a significant and sustainable improvement with respect to DPM exposures. A holistic approach supported by OEMs and technology solutions must be the cornerstone for any significant reduction in exposures. A reduced OEL alone is not enough to sustainably achieve significant reductions.

1. Do you support the proposed workplace exposure standard (WES) for diesel particulate matter (DPM) to protect workers from the adverse health effects of exposure to diesel engine emissions (DEE)?

   ○ Yes

   ◉ No

2. What are your reasons for your response to Question 1? Please provide evidence or information to support your response.

BHP is committed to the sustainable reduction of DPM. Whilst BHP supports exposures being as low as reasonably practicable (and no higher than 0.03mg/m^3), the proposed WES of 0.015mg/m^3 should be viewed as aspirational, particularly in circumstances where:

- the current workplace exposure standards for airborne contaminants do not include specific exposure standards for DPM and where standards are in place (such as New South Wales coal mining (see question 6 for further information) these set a higher allowable limit than that proposed by Safe Work Australia. Any change to the WES should be made with appropriate time for industry participants to manage the change safely in the context of other relevant factors (as summarised below);

- the limitations in broader industry will impact on the ability of organisations to meet such a target (including the need for additional technology solutions) (see questions 4 and 5 for further information); and

- for the reasons set out below by reference to BHP's work in this area, a different approach (being the relevance of epidemiological data) than that taken by the Safe Work Australia expert review should be considered.

Different approach to expert review

The Safe Work Australia expert review focused on the lowest observed affect level of chronic inflammation of the nasal mucous membrane with no progression over a 5 year period in a human exposure study in non-smoking customs officers who regularly travelled in diesel fuelled trains and demonstrated chronic inflammation of the nasal mucous membrane with no progression over a 5 year period compared to customs office workers. Due to the timeframe requirements for this submission the primary study was not reviewed in detail, but this study did indicate a LOAEC (lowest observed adverse effect concentration) significantly below NOAEC (no observed adverse effect concentration) in other controlled human studies presented and it would be worth the Safe Work Australia expert providing further rationale to support this decision.

A different approach was taken in the BHP independent expert review which put more weight on the relevance of epidemiological data. The review, undertaken by the Institute of Occupational Medicine (IOM), considered relevant literature on the exposure-response relationships for DPM and lung cancer in 2015 with an update undertaken in 2021 to include information on what relevant additional studies may have been published since the previous report, with a view to concluding whether the strength of evidence for an exposure-response relationship between DPM and lung cancer was now greater, lesser or unchanged. These independent expert reviews focused on the nested case-control study in a cohort of miners in a Diesel Exhaust in Mines Study (DEMs) reported by Silverman et al (2012)[2] and a meta-analysis by Vermeulen et al (2014)[3] that included the Silverman et al study and two studies in truckers. They concluded that these studies were both well conducted epidemiological studies that used the same general approach to reconstruct past exposures. Several alternative approaches to the analysis of DEMS have been proposed and re-analyses with modifications have been reported, the key issues raised concerned adjustment for radon and the use of CO in estimation of historical exposures. The experts' opinions was that they do not result in a material change in the strength of evidence for an association between diesel engine exhaust and lung cancer.

The methods used by these studies to estimate exposure to diesel engine exhaust are generally accepted by the scientific community and are widely applied in studies that are used to inform the development of exposure-response curves. Reported exposure-response relationships suggest that exposure to DPM is associated with a marked elevation in lung cancer risk at relatively low levels of exposure. The levels of exposure and subsequent risk are aligned with the developed WES outlined in Table 7-1 of the Safe Work Australia expert review by regulatory bodies when they used these same epidemiological data sets.

So whilst BHP acknowledged there is uncertainty as to the reliability of the estimated exposure in the absence of a clear threshold level of exposure for the risk of development of lung cancer risk, BHP made a commitment to manage diesel exhaust to as low as technically feasible and no higher than 0.03 mg/m^3, a significant reduction from the previous OEL of 0.1 mg/m^3.

[2] Silverman DT, Samanic CM, Lubin JH, Blair AE, Stewart PA, Vermeulen R, Coble JB, Rothman N, Schleiff PL, Travis WD, Ziegler RG. The diesel exhaust in miners study: a nested case–control study of lung cancer and diesel exhaust. Journal of the National Cancer Institute. 2012 Jun 6;104(11):855-68.

[3] 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 Feb;122(2):172-7.

In deciding the level at which to set an OEL, BHP looked to the views of experts including those summarised above, considered what our existing levels of exposure were and are and the opportunities for exposure reduction. This is the focus of our DPM exposure reduction work which recognises the importance of reducing and ultimately eliminating diesel use from our underground mines.

Broader considerations

As previously mentioned, BHP has been a strong supporter of the ICMM Innovation for Cleaner, Safer Vehicles (ICSV) DPM reduction work. The ICSV initiative has developed a maturity framework and associated guidance (see here) outlining the steps required to ultimately achieve DPM elimination. The framework considers Mine Design (ventilation circuits, supportive infrastructure), Operations (fleet management, exposure monitoring) and Technology (DPM production reduced at engine, DPM emission reduced at tailpipe, DPM exposure reduced at operator). The framework reinforces that a holistic approach supported by collaboration with OEMs, technology suppliers, regulators and others is necessary to achieve significant DPM exposures. More information can be found in response to questions 4 and 5.

The OEL should be set low enough to drive an overall reduction in exposure to DPM and to lead to a meaningful reduction in cumulative exposure across the exposed population. Ideally, a long-term programme of planned reductions in the OEL should be in place in order to ensure ongoing improvement in exposure control and an associated reduction in risk.

3. Is there an alternative WES to DPM as respirable elemental carbon, or additional WES that should be considered to protect workers from DEE? Please provide evidence or information to support your response.

BHP's position for a DPM OEL is as low as reasonably practicable but no higher than 0.03mg/m^3. The proposed WES of 0.015mg/m^3 should be viewed as aspirational. Our reasons for this are summarised above in question 2.

4. What changes would you need to make in your workplace (over and above any controls currently in place) to ensure workers and others at the workplace are not exposed to levels of DPM above the proposed WES?
    a. Please include in your response:
        i. a description of the control measures currently in place at your workplace(s) to minimise exposure of workers and others to DEE.
        ii. details of any costs to implement the WES for DPM (e.g., upgrade of ventilation systems in area X, costing approximately $XXX).

BHP has implemented numerous controls to support reduction in exposure to DPM. Current controls at BHP's underground operations include but are not limited to the following:

- Ventilation design and management
- Restricting the number of vehicles entering specific areas
- Low emission engine upgrades
- Diesel particulate filters to reduce DPM emissions

- Emissions testing schemes
- Trial of hybrid and electric equipment
- Real time DPM monitors to provide more timely information on exposure levels to enable review of work practices and additional controls where required
- Use of respiratory protective equipment including Powered Air Purifying Respirators (PAPR)

At this stage it is too difficult to detail costs associated with implementing the proposed WES of 0.015mg/m^3 for DPM, however, significant work across industry globally would need to occur more broadly, including in particular to accelerate implementation of electrification and retrofitting upgrading of diesel fleets.

As discussed earlier, ICMM members through the ISCV initiative are working in partnership with OEMs to promote operational and technical innovations to minimise the negative impacts of DPM in underground mining operations. The previously referenced ICMM maturity framework summarises the technical requirements for mine design, operational controls and technology that need to be in place in order to reach level 4 (i.e. 'ambition' level) and level 5 (i.e. zero DPM emissions) which are the levels that would likely need to be reached in order to comply with the proposed WES. Many of the technical requirements for level 4 and 5 are only possible with the support of OEMs and the development of third party innovations.

Given the investment and lead time needed for electrification and/or automation, a number of interim controls would need to be considered including:

- Increased ventilation requirements (including design)
- Further restrictions to the number of diesel-powered vehicles entering specific areas
- Modification of engines and exhausts with new technology
- Integration of power supply design and infrastructure to support electrification
- Increased reliance on respiratory protective equipment
- Increased compliance monitoring
- Note - prior to implementing new DPM control technologies studies are required to validate their effectiveness and in the case of coal operations ensure they are safe to use in underground atmospheres.

In addition, surface mining operations would need to undertake further review and analysis to determine if additional controls are needed, for example in enclosed vehicle maintenance workshops.

5. Is there additional evidence or information that you think should be considered?

Yes and we outline this below:

ICMM's Innovation for Cleaner Safer Vehicles

The ICMM bring together a third of the global metals and mining industry, along with key partners to drive leadership, action and innovation for a safe, just and sustainable world. ICMM's Innovation for Cleaner, Safer Vehicles (ICSV) initiative (see ICMM - Cleaner & Safer Vehicles) brings together the world's leading mining companies and the largest OEMs to collaborate in a

non-competitive space to accelerate the development of a new generation of mining vehicles and improve existing ones. Launched in October 2018, the ICSV initiative has three ambitions responding to some of the mining industry's biggest safety, health and environmental performance challenges, which include Diesel Exhaust Ambition: ICMM members are collaborating with OEMs to promote technical innovations that minimise the operational impacts of diesel exhaust by 2025.

This is a CEO-led initiative that is a model of collaboration and the convening power of ICMM is important to achieve these ambitions. ICMM members represent approximately 30 per cent of the global metals market, with over 650 assets in more than 50 countries, offering a critical mass for change that creates market pull. This significant representation of industry can speak with an aligned voice, on aligned objectives with OEMs and third-party technology providers, sending them strong signals on mining companies' requirements and on what is needed to accelerate development and adoption of technology across the industry. In turn, this builds the widespread confidence needed to accelerate the level of innovation investment required to scale up commercial solutions for the mining industry to meet the initiative's ambitions. This innovation will benefit the entire mining industry. 'Early-adopters' of the technologies will motivate others, leading to an industry shift towards cleaner and safer mining vehicles. Despite all of the efforts to date, a number of challenges exist with respect to implementation of this framework across the mining industry globally. Examples relating to equipment include technology, maintenance, aftertreatment and reliability and performance. Examples relating to environmental conditions include elevated temperatures and supply chain constraints.

These challenges require collective problem solving and efforts are currently underway to progress work in these areas. Again this is provided to help illustrate what it practically takes to effect meaningful and sustained change when addressing worker health.

6. Are there any additional comments you would like to make? (free text box with option to upload an attachment)

Technical measurement capability

Based on the current reporting limit from the laboratory, we do not at this stage anticipate there to be significant challenges with the technical measurement capability, however, this does assume that an appropriate sampling time/rate has been used to collect sufficient volume to minimise potential impacts on results interpretation and uncertainty.

In the mining industry, adjustments to the exposure standard are needed to take into account extended shifts so is even more important to ensure that the sampling time and rate is sufficient to overcome potential measurement issues.

Regulatory requirements/guidelines for DPM exposures

Some of the jurisdictions where BHP operates currently have regulatory requirements or guidelines for DPM exposures, for example:

- NSW - NSW was the first mining jurisdiction in Australia to implement an exposure standard for diesel particulate matter. The exposure standard of 0.1mg/m^3 for diesel

particulate matter, measured as elemental carbon (link here and see section 39 of the *Work Health and Safety (Mines and Petroleum Sites) Regulation 2014*).

- QLD – as of February 2023 the Queensland Coal Mining Health and Safety Advisory Committee (CMSHAC) endorsed a 50% reduction in the existing Diesel Particulate Matter (DPM) limit from the current 0.1mg/m^3 to 0.05mg/m^3, with a 12 month phase-in period. The limit will remain a guideline at this point, though the Regulator will require data reporting and compliance to risk-based reduction in accordance with the ALARA principle in the legislation.

The Safe Work Australia proposal would reflect a significant change from the position presently in place for mining as set out above.

Summary

In summary, whilst BHP supports exposures to be as low as reasonably practicable (and no higher than 0.03mg/m^3), the proposed WES of 0.015mg/m^3 should be viewed as aspirational. The exposure standard should be set low enough to drive an overall reduction in exposure to DPM and to lead to a meaningful reduction in cumulative exposure across the exposed population. Ideally, a long-term programme of planned reductions in the WES should be in place in order to ensure sustainable improvement in exposure control and an associated reduction in risk.