

20 and 65, reaching a maximum of 9.0 mg-yr/m³ upon retirement at age 65. Between ages 65 and 80, the accumulated reduction in dust exposure remains at an estimated average of 9.0 mg-yr/m³, but (as also explained previously) the benefit in terms of both simple CWP and PMF risk continues to increase.

The first row of Table VI-1 presents the reductions in risk expected among affected DO miners who work at an MMU exhibiting a pattern of recurrent overexposures. For this group of miners, the calculation at an average lifetime of 73 years shows that bringing dust concentrations down to no more than the applicable standard on each shift would:

- Reduce the combined risk of simple CWP and PMF;
- Reduce the combined risk of simple CWP and PMF by 24.4 cases per 1000 affected DO miners;⁸
- Reduce the combined risk of simple CWP (category 2 and 3) and PMF by 15.5 cases per 1000 affected DO miners;
- Reduce the risk of PMF by 7.6 cases per 1000 affected DO miners.

When the dust concentration measured for the DO exceeds the applicable standard, measurements for at least some of the other miners in the same MMU may also exceed the standard on the same shift, though usually by a lesser amount. Furthermore, although the DO represents the occupation most likely to receive the highest exposure, one or more of these other miners may be exposed to even higher concentrations than the DO on some shifts. Therefore, the second category of affected miners addressed in Table VI-1 is the population of NDO faceworkers other than those working in roofbolter DAs (who are addressed as a separate, third category).

(2) NDO Miners

This category covers all faceworkers other than the DO, except those roofbolters for which a separate DA dust standard has been established. (Roofbolters not coming under a DA standard are included in the NDO category.) To estimate how NDO miners (other than those subject to a DA standard) would be affected by the proposed rules, MSHA examined the results from all valid dust samples collected by MSHA in underground MMUs during 2001 (MSHA, data file:

Insp2001.zip). Within each MMU, MSHA typically takes one sample on the DO and, on the same shift, four or more additional samples representing other occupations. In 2001, there was an average of 1.0 NDO measurement in excess of the standard on shifts for which the DO measurement exceeded the standard.⁹ For non-DO measurements that exceeded the standard on the same shift as a DO measurement, the mean excess above the standard was approximately 0.6 mg/m³.¹⁰

Combining these results with the 19.3 percent rate of excessive exposures observed for the DO on individual shifts, it is reasonable to infer that, at the MMUs under consideration, an average of 1 other miner, in addition to the one classified as DO, is currently overexposed on at least 19 percent of all production shifts. In 2001, the mean of the highest dust concentration reported for any NDO miner on sampled shifts was 1.08 mg/m³. Over the course of each working year, the reduction in exposure expected for such miners as a result of implementing the proposed rules is 0.12 mg-yr/m³ (*i.e.*, 19.3 percent of one year, times 0.6 mg/m³).

To assess the reduction in risk expected from eliminating all single-shift exposures for these NDO miners, MSHA again applied the Attfield and Seixas models to miners who begin working at age 20 and retire at age 65, assuming lifetimes of 65, 73, and 80 years. This time, however, the resulting decrease in predicted prevalence was multiplied by $1.0/6 = 0.167$, to reflect the fact that the assumed rate of overexposure applies, on average, to about one-sixth of the faceworkers not classified as the DO.¹¹

The second row of Table VI-1 contains the risk reductions for NDO miners expected as a result of eliminating all individual shift overexposures. Over an occupational lifetime, the average reduction in risk for simple CWP and PMF combined, and for PMF alone, increases with age. However, the risk reduction at each age is smaller for the affected NDOs than for the affected DOs. This is expected because the estimated probability that a NDO (other than a RB-DA) will, under current conditions, be overexposed on a given shift is only 16.7 percent of the corresponding probability for the DO. For the MMUs under consideration, the predicted reduction in risk for

faceworkers other than the DO who live an expected lifetime of 73 years is: 2.3 fewer cases of "CWP 1+" per thousand affected NDO miners; 1.5 fewer cases of "CWP 2+" per thousand affected NDO miners; and 0.7 fewer cases of PMF per thousand affected NDO miners.

(3) Roofbolter DA (RB-DA) Miners

Because roofbolters are often exposed to higher quartz concentrations than other miners, the applicable dust standard for them is frequently different from the standard applicable to other miners working in the same MMU. Therefore, many roofbolters are classified as working in a "roofbolter designated area" (RB-DA). For purposes of this QRA, such roofbolters were excluded from the analysis of NDO miners presented above. Based on 2001 MSHA and operator data, 194 out of a total 659 RB-DAs met MSHA's criterion for exhibiting a pattern of recurrent overexposures—*i.e.*, dust concentrations exceeded the applicable standard on at least two of the sampled shifts (MSHA, datafile: RBDA2001.ZIP). Valid RB-DA samples were collected on a total of 3477 shifts at these 194 RB-DAs, and the applicable standard was exceeded on 837 of these shifts, or 24.1 percent (95% confidence interval: 22.7 to 25.5). For this 24.1 percent, the mean excess above the standard, as measured for the RB-DA only, was 0.72 mg/m³ (95-percent confidence interval: 0.64 to 0.80).

At these RB-DAs (*i.e.*, those exhibiting a pattern of recurrent overexposures), the mean concentration reported in 2001 was 0.94 mg/m³; so, after 45 years, an RB-DA miner can be expected, if there is no change in current conditions, to have accumulated a total exposure of more than 42 mg-yr/m³. By retirement at age 65, such a miner would be expected to accumulate, on average, 7.8 mg-yr/m³ less exposure if overexposures on all individual shifts were eliminated. (45 years \times 24.1% of 0.72 mg/m³). The third row of Table VI-1 shows the estimated impact of the proposed rules on the risk predicted for RB-DA roofbolters. At age 73, reducing an accumulated total dust exposure of 42 mg-yr/m³ by 7.8 mg-yr/m³ reduces the predicted prevalence of "CWP 1+" by 19.6 per thousand, of "CWP 2+" by 12.1 per thousand, and of PMF by 6.0 per thousand.

⁸ "Affected DO miners" include all miners who work at MMUs with a pattern of recurrent overexposures and who are exposed to dust concentrations similar to the DO over a 45-year working lifetime.

⁹ With 95-percent confidence, on shifts for which the DO measurement exceeds the standard, the mean number of other occupational measurements also exceeding the standard is at least 0.91.

¹⁰ With 95-percent confidence, the mean excess is at least 0.59 mg/m³.

¹¹ There are an estimated 6 NDO miners for each DO miner, and an average of 1.0 of these 6 miners is overexposed. This does not include roofbolters working in designated areas, who are treated as a separate group in the present analysis.