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# Face dust levels at deep-cut underground coal mines



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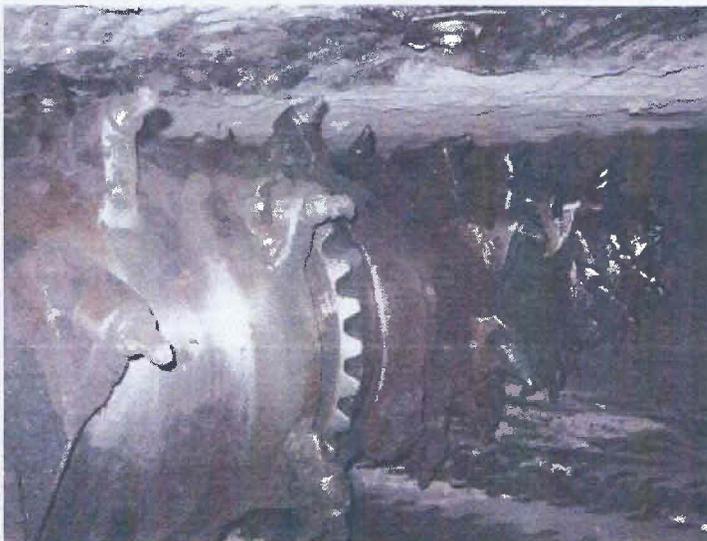


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## Prevalence of deep-cut mining

- 800 continuous miner units
- 70% using deep-cut mining
- 560 deep-cut mining units



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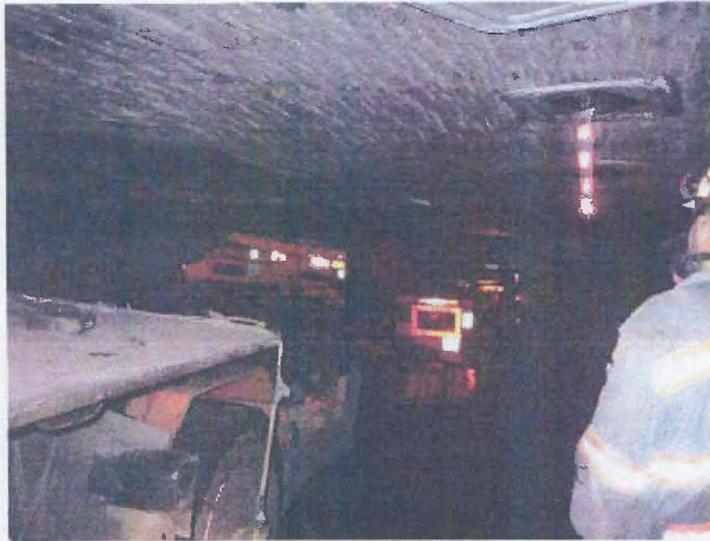


## Objective of study

Compare face dust levels:

\*First 20-ft of advance (regular cut)

\*Second 10-ft to 20-ft of advance (deep cut)



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## Deep-cut surveys

- 6 underground dust surveys:  
KY, WV, IL, VA, UT
  - 3 – Blowing face ventilation
  - 2 – Exhausting face ventilation
  - 1- Blowing/Exhausting face ventilation



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## Dust monitoring equipment

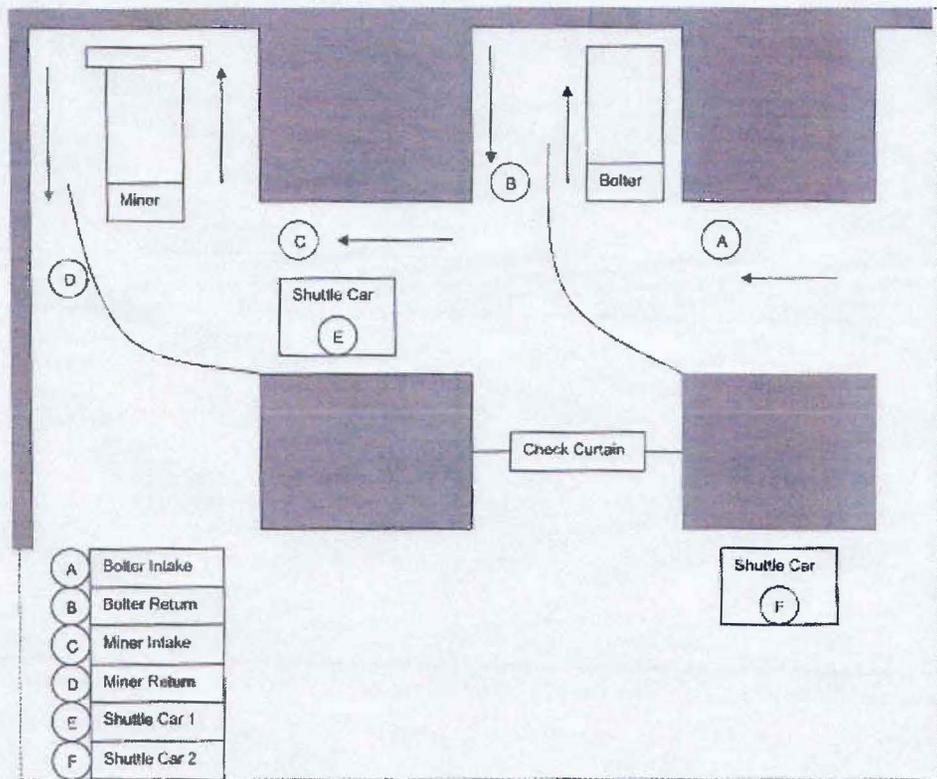
- Area sampling
  - Gravimetric
    - 2 – MSA Elf Sampling pumps w/ Dorr-Oliver 10-mm cyclones & 37-mm filters
  - Instantaneous
    - 1 – Thermo MIE personal Data Rams
- Locations
  - Intake & return continuous miner
  - Intake & return roof-bolter
  - Shuttle cars



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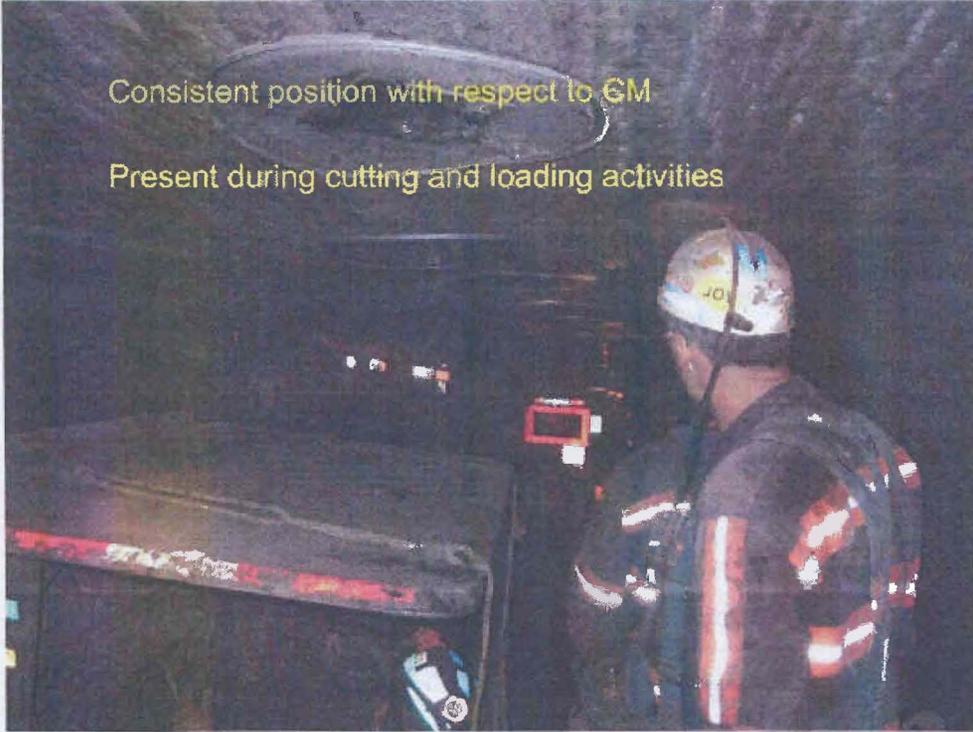
# Plan view of area dust sampling



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# Shuttle car sampling

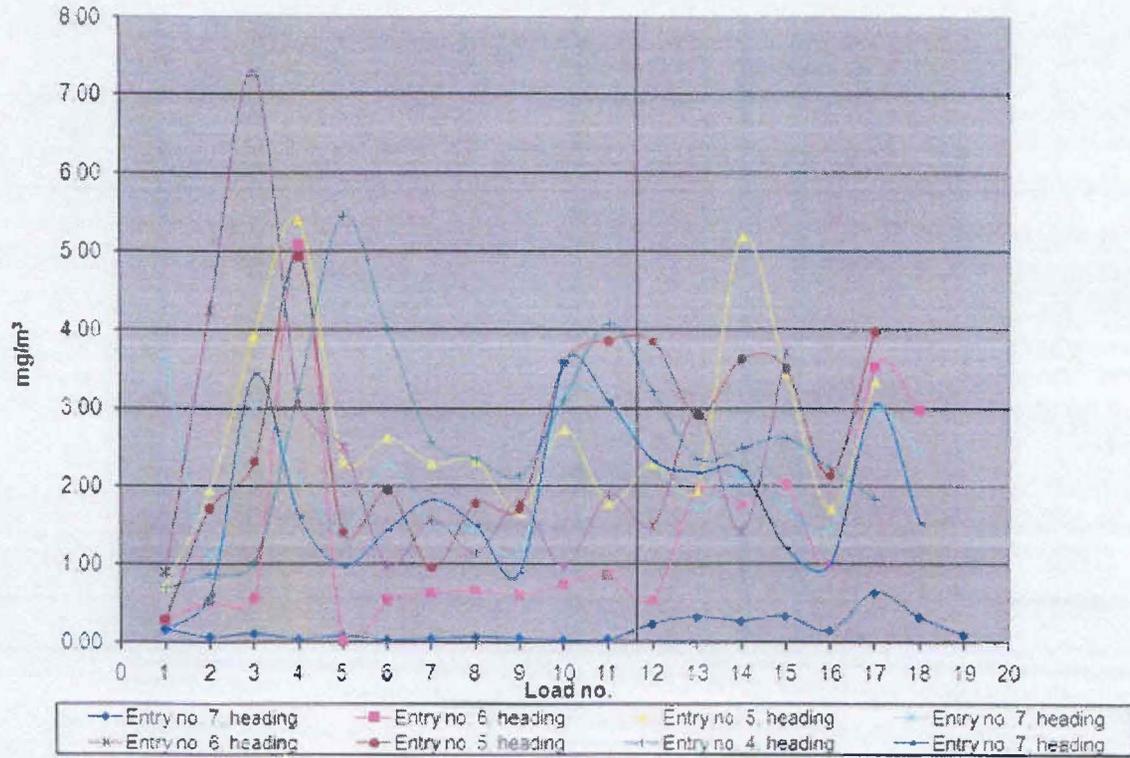


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## Example data from one mine

Shuttle car cab dust levels at the face (blowing, heading)



## Dust monitoring equipment

- Person wearable dust monitors
  - TEOM Series 3600/3700 Personal Dust Monitors
- Locations
  - Continuous miner operators
  - Roof-bolter operators



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## Continuous miner

- Scrubber airflow
  - Beginning of cut
  - 20 ft into cut
  - 40 ft into cut
- Curtain airflow
- Curtain setback

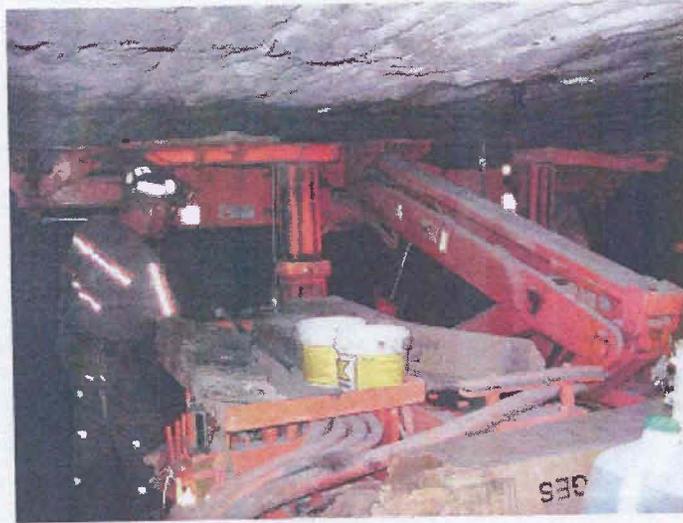


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## Roof bolter

- Dust collection system suction pressure
  - Beginning of cycle
  - End of cycle
- Curtain airflow
- Curtain setback

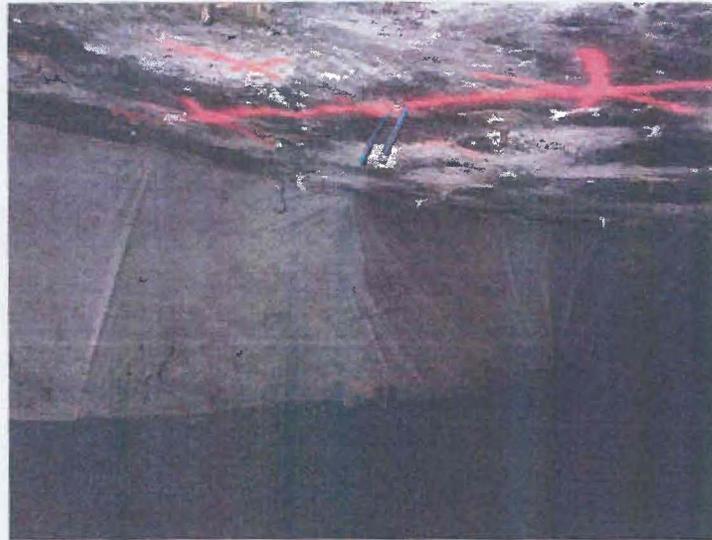


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### Exhausting face ventilation mines

- 3 mines
- 14 cuts
- Curtain airflows 5,100 to 21,500 cfm
- Scrubber airflows 4,800 to 14,200 cfm
- 82% of cuts curtain exceeded scrubber airflow
- Curtain setbacks 30 to 50 ft
- Operator positioned at or outby curtain mouth



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## Exhaust curtain shuttle car results

Average dust level regular cut when at face= 0.20 mg/m<sup>3</sup>

Average dust level deep cut when at face= 0.35 mg/m<sup>3</sup>

Not Statistically Significant

10 of 14 cuts experienced no significant change in dust levels during cut

4 experienced 0.2 to 0.4 mg/m<sup>3</sup> higher dust during the deep cut due to use of on-curtain side cab\*

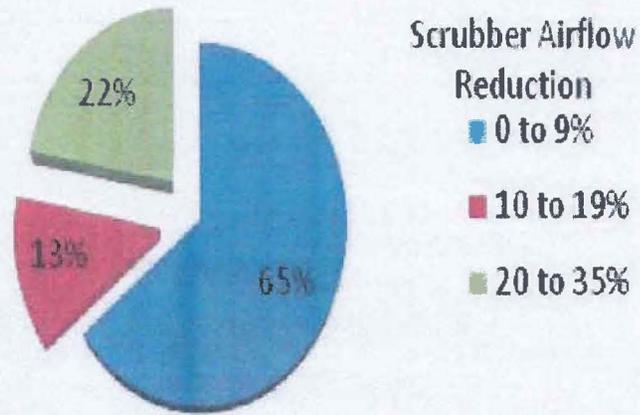
Mines with larger scrubbers had lower dust\*

\*Also confirmed by laboratory studies

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### Percentage of Cuts with Scrubber Airflow Reduction



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## Blowing face ventilation mines

- 4 mines
- 18 cuts
- Curtain airflows 5,400 to 18,000 cfm
- Scrubber airflows 5,100 to 11,100 cfm
- Average curtain-to-scrubber airflow ratio 0.93 (scrubber on)
- Curtain setbacks 30 to 50 ft
- Operator positioned at curtain mouth



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## Blowing curtain shuttle car results

Average dust level regular cut when at face = 1.96 mg/m<sup>3</sup>

Average dust level deep cut when at face = 2.32 mg/m<sup>3</sup>

Not Statistically Significant

13 of 18 cuts experienced no significant change in dust levels during cut

1 experienced higher dust during the deep cut possibly due to improper curtain to scrubber airflow ratio (curtain airflow almost twice scrubber airflow)

1 experienced higher dust during deep cut due to change in shuttle car route

2 experienced higher dust for unknown reasons

1 experienced lower dust due to operator positioning

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### Results no-curtain cuts

- Initial entry development beyond last open crosscut

- 3 mines

- 15 cuts

- 9 of 15 cuts shuttle car dust levels significantly lower during deep cut

- 0.46 mg/m<sup>3</sup> during regular cut

- 0.15 mg/m<sup>3</sup> during deep cut

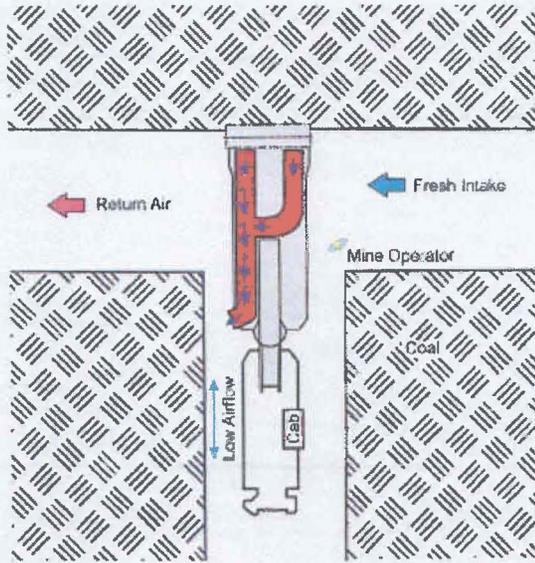


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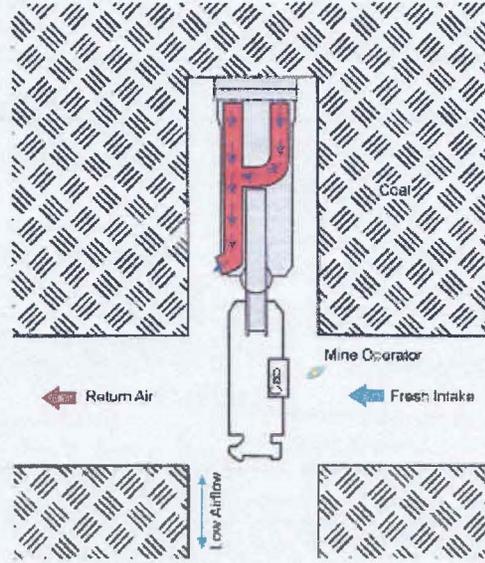


# No-curtain ventilation

Start of cut



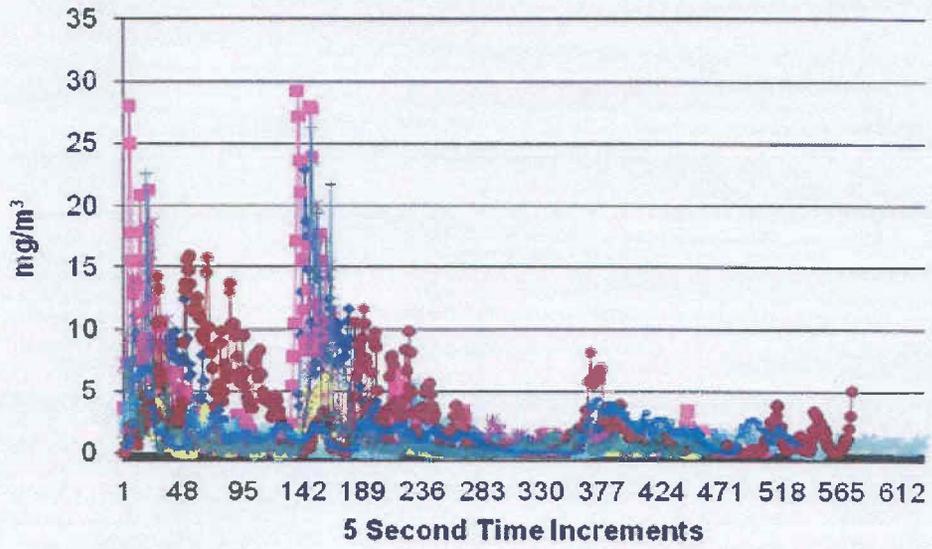
End of cut



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### Miner Return Dust



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## Combining all shuttle car data

- 47 cuts
- Exhausting, blowing and no-curtain
- 0.96 mg/m<sup>3</sup> regular cut
- 1.04 mg/m deep cut
- Not statistically significant

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## Other Results

Statistically Significant (85% CI) Changes in Dust Levels at Other Positions  
from Regular to Deep Cut Depth

	Mine A	Mine B	Mine C	Mine D	Mine E	Mine F
Miner Operator	None	None	None	None	-	None
Miner Generated	None	None	None	Lower	None	None
Bolter Operator	None	None	None	None	None	None
Bolter Generated	None	None	None	None	None	None

All daily average dust concentrations measured at the bolter and miner operator positions were less than 2.0 mg/m<sup>3</sup>

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## Results roof bolting operations

- 0.40 mg/m<sup>3</sup> during regular cut

- 0.58 mg/m<sup>3</sup> during deep cut

- No difference in dust levels regular-cut vs. deep-cut

- Rooms ventilated with average airflow of 5,800 cfm reduced exposures by 0.56 mg/m<sup>3</sup>

- Dust accumulation effect was observed if curtain was not periodically advanced with bolter



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## No blocking sprays used at surveyed mines

- body mounted
- 2 or 3 hollow cone sprays per side
- 15 degree orientation away from body
- 2 ft outby scrubber inlet
- 2 ft above ground
- significantly reduce dust on blowing and exhausting faces
- slab cut



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## Conclusions and observations

- Use of extended-cut practices did not hinder dust control efforts on the bolter and miner faces at the surveyed mines
- All surveyed mines had good curtain and scrubber airflows
- 30 to 50 ft curtain setback distances
- Operator located at mouth of curtain on blowing faces and parallel to or outby curtain mouth on exhausting faces
- For exhaust faces, use off-curtain side shuttle car cabs
- For blowing faces, curtain-to-scrubber airflow ratio of 1.0 before activation of scrubber
- 20-mesh scrubber screens require back-flushing each cut
- Industry could further benefit from use of blocking sprays
- Ventilate and advance curtain on bolting faces

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