Key Studies

- Relevant studies ID’d and interpreted?
- Omissions?
Susceptible Populations

- Appropriately ID’d?
- Other populations that should be considered?
- Are data on infants and children appropriately considered?
Additional Information

- Other critical information that should be considered?
  - Metrics
  - Averaging times
Uncertainties

- Adequate description?
- Adequate treatment?
Exposure Patterns

• Differences in patterns for susceptible populations?
  – Infants
  – Children
  – Others
Executive Summary

- Federal EPA will promulgate $P_{m_{\text{coarse}}}^\text{NAAQS}$ (Hopke).
- Evolution of PM standards.
  - Need to characterize specific components (acids, oxidants, biological activity, ultrafines)
- Include statement about importance of assessing relationship between outdoor and personal exposures.
Executive Summary

- Uncertainties in relationship between PM and personal exposure
Chapter 2 - Introduction

• Federal EPA will promulgate $Pm_{\text{coarse}}$ NAAQS (Hopke).

• Evolution of PM standards.
  – Need to characterize specific components (acids, oxidants, biological activity, ultrafines)
  – Need for integrative approach in standard setting
Chapter 2 - Introduction

• Are Sulfate and PM2.5 standards overlapping?
Chapter 4 - Sources and Emissions

- More systematic speciation needed:
  - Improve assessment of source-receptor relationships.
  - Identify toxic components.
  - Provide data for development of mechanistic hypotheses.
Chapter 5 - Issues on Monitoring

- Adopt continuous PM monitors
  - PM$_{2.5}$ & PM$_{\text{Coarse}}$
- Quartz filters may adsorb organic vapors causing artifacts
  - Fluorocarbon filters?
- Continuous sulfate monitors
- SSI filter-based PM$_{10}$-PM$_{2.5}$ to estimate Pm$_{\text{coarse}}$ may overestimate (loss of labile PM$_{2.5}$)
Chapter 5 - Issues on Monitoring

- Artifacts (e.g. SO$_2$ - H$_2$O$_2$ interactions) need to be better understood.
Chapter 6 - Exposure Assessment

- Spatial variability of PM mass (and components, e.g. PAH, metals) in CA strongly affects personal exposures.
  - Source vs. Receptors
    - Seasonal (photochemical changes)
    - Diurnal
  - Coastal vs. Inland
- Spatial variability also seen in particle size distributions
Chapter 6 - Exposure Assessment

- Outdoor contribution to personal PM can be estimated using \([\text{SO}_4]\)
  
  \[ P_{m_{\text{out}}} = \left( \frac{[\text{SO}_4]_{\text{pers}}}{[\text{SO}_4]_{\text{out}}} \right) \times P_{m_{\text{out}}} \]

- Expand figure captions, presentation of size distributions, inclusion of mass in pie charts.
Chapter 7 - Health Effects

• Influence of chronic effects on acute mortality needs to be discussed more thoroughly.
• New measures of uncertainties for epidemiological outcomes (rather than confidence intervals) should be explored.
• The potential effects of short-term (hourly) excursions should be discussed.
Chapter 7 - Health Effects: Biological Mechanisms

- Explain more clearly how the mechanistic studies entered into the thinking on recommended standards.
- Document uncertainties in mechanistic studies (routes of exposure, doses, etc.), especially where those studies influenced possible standards.
The point should be made that some particles accumulate in the lung (interstitial and plural deposition sites) and are retained for years.

Retained particles that contain toxic components can influence health for extended periods of time.
Chapter 7 - Health Effects: Biological Mechanisms

- Data on 4 major potential mechanisms (lung injury, inflammation, increased blood coagulation, and cardiac arrhythmias) suggest important short term effects.
Overall Approach to Arriving at Recommendations

- Transparent
- Appropriate
- Air Quality Standards supported by scientific rationale?
  - Annual Average PM10
  - Annual Average PM2.5
  - 24-hr Average PM10
  - 24-hr Average Sulfate
PM2.5

- Sufficient or insufficient evidence to develop 24-hr average (or other short-term standard)?
  - 24-hr PM10 adequately protective?
  - Annual average PM2.5 adequately protective?
Chapter 7 - Health Effects (Recommendations for Standards)

- Not clear that the combination of 24-hr PM$_{10}$ and low annual PM$_{2.5}$ standards afford equivalent protection as 24-hr PM$_{2.5}$.
- Strong support for inclusion of a PM$_{2.5}$ 24-hr standard.
- Support annual and 24-hr PM$_{10}$
- Support annual PM$_{2.5}$
- Need better justification of Sulfate standard
Chapter 7 - Health Effects

(Recommendations for Standards)

- Possible bases for short term PM2.5 standards:
  - 10 µg/m³ above minimal annual average in areas where 10 µg/m³ increments are shown to increase morbidity (mortality).
  - A level below the 98th percentile of highest 24 hr values in areas where the 24 hr peaks are shown to increase morbidity or mortality.
Other Research Issues

- 5 yr cycle?
- Gaps in knowledge base?
- Susceptible groups
- Sampling methods
- Coarse vs. Fine
Future Research

• Evaluate regional differences in relationships between PM and gaseous co-pollutants.
• Characterize short-term PM exposures.
• Speciate PM (metals, EC/OC, PAH’s, NO₃).
• Characterize ultrafine exposures (I,O, personal)
  – speciate
  – new monitoring techniques
Future Research

- Panel studies to assess relationship between PM exposure (short-term, daily, personal) and health outcomes.
  - Regional differences
  - Seasonal differences
- Toxicological studies
  - dose-response and chronic studies (with superimposed acute peaks?)
  - CAPs
  - co-pollutants
Future Research

• Chronic toxicology studies using real-world aerosols
• Evolution of PM standards.
  – Need to characterize specific components (acids, oxidants, biological activity, ultrafines)
• Improved assessment of differences between children and adults.
  – Exposures
  – Responses