Presentation Outline

◆ LBNL Past & Current Work
  ■ Wide Collaboration
  ■ Funding – Scopes
  ■ Goals
  ■ Collective Input

◆ Activities/Accomplishments
  ■ Draft procedures and reviews
  ■ Methods
  ■ Results
  ■ Industry acceptance

◆ Key Issues
  ■ Additional parameters – uniformity, leak, acoustics
  ■ Airflow rate measurements
  ■ FFU positions
  ■ Baseline

◆ Recommendations to/from IEST
LBNL Past Work

- ITRI/AMCA/Suppliers involvement
- Need: Unbiased, Third-party Standard
- IEST involvement

- Funding Awarded to LBNL for FFU development and incentive program
Current Work
- Industry Collaborations

- Sematech
- Silicon Valley Manufacturers Group
- ITRI (Industrial Technology Research Institute, Taiwan)
- Air Movement and Control Association (AMCA)
- ASHRAE
- IEST (mini-environment, fan-filter units)
Current Work
- Funding (Scopes)

- California Energy Commission
- Industrial Technology Research Institute (ITRI)

Scopes
Energy/Airflow perspective
Current Work
- Goals

- Issue a standard test procedure. FFU’s performance can be measured by the standard test and will have a basis for “apples to apples” comparisons and owner specification.
  - Focus on energy/airflow while IEST is developing a more comprehensive procedure

- Assist utility in using the procedure to establish baselines for incentives
Current Work
- Collective Input to LBNL project

- Suppliers
  - Filtration Group, Envirco, Huntair, Cleanpak, Airguard, ...
  - + You

- End-users
  - Bayer, Asyst Technologies, Motorola, Intel
  - Consultants – Air Tech Intl., Rumsey
  - Utility

- Third-parties
  - AMCA/ITRI
  - PAC – LBNL/CEC
  - IEST Contamination Control Division
  - Sematech
LBNL Activities/ Accomplishments

- Attended the first IEST WG36 meeting in November 2003

- Issued procedure drafts
  - An outline for comments in January 2004
  - 1st draft for comments in February 2004
  - 2nd draft for comments in April 2004

- Received supportive review comments

- Planning PAC meeting in May 2004
Methods

- Airflow control: booster fan & damper
- Airflow measurements: nozzles, hoods
- FFU orientation: vertical & horizontal

Example:
Metrics

- FFU Total Pressure Efficiency (%)
- Energy Performance Index - W/cfm
Results
- Pressure vs. Airflow Velocity

![Graph showing pressure rise vs airflow speed for different FFUs.]

- FFU Pressure Rise (Pa)
  - 0
  - 100
  - 200
  - 300
  - 400
  - 500
  - 600
  - 700

- Airflow Speed at FFU Exit (m/s)
  - 0.0
  - 0.1
  - 0.2
  - 0.3
  - 0.4
  - 0.5
  - 0.6
  - 0.7
  - 0.8

- FFU001
- FFU002
- FFU003
- FFU007
- FFU009
- FFU010
- FFU011
- FFU013
- FFU018
- FFU027
Results
- Total Pressure Efficiency
Results

- FFU Energy Performance Index

W/ cfm @ 0.5” Pressure
Results

- FFU Energy Performance Index

W/ cfm @ 70 fpm Face

EPI (W per m³/min)

Percentile

0% 20% 40% 60% 80% 100%
Industry Acceptance

- Presented/distributed draft procedures & results on Sematech Workshop

- A paper on test procedure and results received excellent peer-reviews and will appear in the Journal of the IEST 2004

- A paper abstract built upon the LBNL standard testing was accepted by STS: ISM (Innovative Semiconductor Manufacturing), and the full paper will be presented at SEMICON West 2004 in SF

- LBNL is working with utilities to formulate incentive programs for purchasing efficient FFUs
Key Issues

- Additional parameters
  - Uniformity
  - Leak
  - Sound/Acoustics

- Airflow rate measurements

- FFU positions

- Baseline
Recommendation to I EST WG Efforts

- Use the LBNL procedure as a starting point or at least use it as a reference
- Expand to include acoustics, uniformity, etc.
- Measurement methods of airflow rates
  - Accuracy is vital while easy to be mistaken
  - Must correctly report accuracies, e.g., 5%
  - Horizontal vs. vertical – need more data
Airflow measurement

Nozzle or Hood?

A Comparison of Test Methods
AMCA Test VS Velgrid Calculated

Source: Sematech workshop on minienvironment and FFU, April 2004
Produced by J. Hill, Cleanpak International
Airflow measurement
Vertical or horizontal?

Testimony: No difference for airflow rates

Source: Sematech workshop on mini-environment and FFUs, Austin, April 2004
Input needed

- CA utility is interested in using the LBNL procedure to establish baselines for incentives
- FFU manufacturers encouraged to volunteer their units for testing
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