Application of IBM’s Corporate Ventilation Process at a Semiconductor Facility

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IBM - Burlington Overview

Site mission
- Technology Development
- Manufacturing semiconductor devices
- Manufacturing masks for semiconductor mfg.
- Wafer test
IBM - Burlington Overview

- 725 acres
- Population ~ 6000
- Total floor space = 3.5 M square feet
- Clean room space = 500 K square feet
- Exhaust ~ 900 K CFM
- Exhaust drops ~6000
- Manufacturing tools ~3220
Overview of IBM’s Ventilation Process

Objective
- Specifies the minimum IBM ventilation requirements for the protection of employee health from airborne contaminants.

Scope
- Addresses local and dilution exhaust ventilation excluding HVAC which is covered by the Indoor Air Quality (IAQ) process.
Overview of IBM’s Ventilation Process (cont.)

Roles and Responsibilities specified for

– Equipment Engineering
– Equipment Maintenance
– Facilities Engineering and Maintenance
– Line management
– Global Well-being Services (Safety/IH)
Overview of IBM’s Ventilation Process (cont.)

Process elements

- General exhaust requirements at IBM sites
  - Control airborne contaminants to acceptable levels.
  - Systems compatible with exhaust effluent
  - Mixing of process effluents may not create safety, operational or environmental issue
Overview of IBM’s Ventilation Process (cont.)

- Safety concerns take precedence over energy conservation and contamination control.
- Critical ventilation systems fed by emergency power
- Exhaust ventilation system designed to protect personnel, equipment and the facility
Overview of IBM’s Ventilation Process (cont.)

- Ventilation Monitoring Strategy
  - System performance monitoring
  - Preventative maintenance
  - Equipment performance
  - System design and operation
  - Communications
Overview of IBM’s Ventilation Process (cont.)

Documentation

- Maintain ventilation records including survey related information
- Review equipment and processes
- Maintain current records of system plans, design and operation
- Specifies duration for keeping maintenance, testing and troubleshooting records
Burlington – Equipment Engineering
Roles & Responsibilities

- Purchase equipment that has been assessed against SEMI S2 and other relevant standards
Install exhaust monitoring devices as needed when equipment is installed
Verify equipment interlocks place tool in safe state when activated.
Burlington – Equipment Maintenance
Roles & Responsibilities

- PM exhaust monitoring devices
- Report marginal exhaust conditions to Facilities
Burlington – Facilities Roles & Responsibilities

- Design & implement ventilation strategy
  - Protect personnel, assets, the facility, the environment
  - Provide continuous operations
    - Stable exhaust
    - Prevent nuisance exhaust alarms by providing operating buffer
  - Energy efficiency
Burlington – Facilities Roles & Responsibilities

- Design and install ventilation system
  - Follow a detailed set of internal standards governing design, construction, installation and commissioning process
Real World Challenges
Assess system performance

- Assess maintenance and performance of exhaust systems (Facilities Maintenance)
  - BTV uses a computerized program to trigger and track PMs on mechanical equipment
  - Operational parameters (e.g. SP, damper position) monitored and computer controlled
Burlington – Facilities Roles & Responsibilities (cont.)

- Periodic inspection tours
  - Maintenance persons receive proper training
- Formal training
- OJT with experienced technician
Burlington – Facilities Roles & Responsibilities (cont.)

- Conduct ventilation surveys
  - BTV surveys open tanks and Silane using tools quarterly & others annually
    - Rational based on regs. & engineering controls
      - OSHA for open surface tanks
      - Extra precaution for Silane tools
      - Additional engineering controls interlocked to place equipment in safe state
Burlington – Facilities Roles & Responsibilities (cont.)

- Training for persons performing surveys
  - Trained/authorized IBM employee
  - Contractors are:
    - Members of Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB)
    - Trained by knowledgeable person familiar with proper procedures
  - BTV NEBB certified contractors
Burlington – Facilities Roles & Responsibilities (cont.)

- Oversee survey methods & equipment
  - Survey methods follow ACGIH Vent Manual, AABC or NEBB
  - Instrumentation calibrated per Mfg’s. method and frequency
    - BTV uses velocity pressure monitoring instruments
Investigate concerns, perform remedial action

- Written procedure for correcting “out of spec” conditions found during exhaust survey
  - Risk assessment / shut down of Priority 1 tools if exhaust < Mfg. Spec.
  - Priority 1 tools rebalanced within one week if exhaust < approved value but > Mfg. Spec. value
  - Lower priority tools balanced within one month
Burlington – Facilities Roles & Responsibilities (cont.)

– Written procedure for addressing customer concerns

- Customer concerns may be due to real safety issues, perceived safety issues or process issues
- Procedure is similar to dealing with “out of spec.” conditions
- Safety/IH is usually involved with safety related issues before Facilities
Document system design & performance

- System designs and plans are documented on CAD files
- Inventory, design specs, survey readings for fans & exhaust drops maintained on database.
  - The data is accessible at the tool drop level
  - It also documents the environmental impact assessment
Burlington – Line Management Roles & Responsibilities

- Investigate concerns & drive remedial action
- Assure employees receive instruction on function, use & limitations of vent system
Burlington – Global Well-being Services Roles & Responsibilities

- Coordinate review of ventilation procedures
- Provide advice and counsel
  - Investigations & remedial action
  - Design & operation
- Develop training for ventilation users
- Maintain IH records (e.g. air sampling)
IBM’s Corporate process provides a framework that meets the diverse needs of our various sites. Sites implement the process autonomously. Our site uses Facilities internal standards and databases to implement the process. Facilities, Manufacturing and IH/Safety integrate activities to assure a safe working environment.
Contact information

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Detour – How SEMI S2 Is Integrated Into The Exhaust Process

– Tool exhaust requirements established as part of SEMI S2 evaluation

- Exhaust must be sufficient to assure emissions
  - < 1% OEL during normal operation
  - < 25% OEL during worst case leak
  - < 25% OEL during maintenance
  - < 25% LFL

- Specify CFM, SP, other relevant parameters
Detour – How SEMI S2 Is Integrated Into The Exhaust Process (cont.)

– Equip. Eng. inputs exhaust requirements into data base
  - Mfg. specs serve as interlock alarm set point
  - adds an exhaust operating buffer = design CFM/SP
– Facilities balances drop to >/= design value
  - Input data to data base
Detour – How SEMI S2 Is Integrated Into The Exhaust Process (cont.)

– GWBS reviews SEMI S2 report & data base
  
  Either approve these data or require revision
  – Approved CFM/SP

– Subsequent surveys must fall within the following range
  
  +/- 15% approved CFM, +/- 30% approved SP
  
  Out of spec conditions trigger exhaust rebalance