Fall Occupational Safety & Health Committee

Wednesday, October 9
IGCC Industrial Hygiene Considerations

James Gartland, Duke Energy
IGCC Background

- IGCC - Integrated Gasification Combined Cycle
  - IGCC plant is a clean coal plant
    - Heats coal to create Syngas
      - Does not actually burn the coal itself
    - Syngas is used as fuel in combined cycle combustion turbine
  - Compared to regular pulverized coal:
    - Lower air emissions
    - Less use of water
    - Less solids generated
    - Higher efficiency than a conventional
  - Located in Edwardsport, IN
  - IGCC plant recently came on line
Why Do a Qualitative Risk Assessment?

- New technology
  - New processes
  - New risks

- Determine and rank IH risks that may occur during:
  - Operations
    - Chemical additions
    - Off-gas releases (e.g. Hydrogen sulfide)
    - By-products (e.g. coal residues, sulfur products)
    - Physical hazards (e.g. heat stress, noise)
  - Maintenance
    - Residues (e.g. metal residues like arsenic)
    - Welding/cutting (hexavalent chromium, nickel)
Program Design

- Program design based on AIHA’s “A Strategy for Assessing and Managing Occupational Exposures”
Qualitative IH Process

Phases

- Four primary phases
  - Basic Characterization
  - Exposure Evaluation
  - Prioritization
  - Exposure Management
Qualitative IH Process Flow

1. Basic Characterizations
2. Exposure Assessment
3. Prioritization
   - Acceptable Exposure
     - Periodic Reassessment
   - Uncertain
     - Further Information Gathering
   - Unacceptable Exposure
     - Control
   - Further Information Gathering
Qualitative IH Process
Basic Characterization

- Identify job tasks/work activities with similar exposures
- Identify health risks/exposures for each identified job task
Qualitative IH Process
Basic Characterization

- Similar Exposure Groups (SEG)
  - Top down and representative approach
  - Top down
    - Group as many people together as possible
    - For IGCC, task based SEG

- Identifying hazards
  - For a given SEG identify all occupational health hazards
Limitations

- Completeness of hazard identification
  - Limited by:
    - Accuracy of interviews
      - Addressed by
        - Reality check of final rankings
        - Re-interviews with key personnel
        - Assumption that hazards similar at all facilities

- Exposure evaluation ranking
  - Limited by:
    - Accuracy of interviews
    - Professional judgment of HS professionals
Basic Characterization

- Reviewed plant
  - Process flow diagrams
  - Job Hazard Analyses (JHA)
  - EPCRA reports
  - Chemical inventory
  - Organizational chart
  - List of primary system engineers/equipment owners
Basic Characterization

- Performed site visit to collect information
  - Plant walk-through
  - Interviews with key system engineers and equipment owners
    - Discussed primary equipment in plant system flow diagrams
    - Focused on potential for hazardous exposures during operations and maintenance
  - Interviews with selected plant operators and specialists
    - Chemistry
    - Environmental
Basic Characterization

- Divided sections by existing plant operations areas
  - Example: Coal handling, Gasification, Acid Gas Removal, etc.

- Subdivided primary processes within operational areas
  - Example: Radiant Syngas Cooler, Condensate Heater, etc.

- Identified primary tasks for both operations and maintenance

- Identified health hazards for each process
Exposure Evaluation

- For each combination of area, process, task and hazard created a rating:
  - Health Rating – Based on PEL or professional judgment (e.g. heat level)
  - Exposure Degree Rating – Add both:
    - Exposure Rating – Based on degree of control
    - Frequency Rating – How often does exposure potentially occur?
  - Potential Health Risk Rating – Health Rating X Exposure Degree
  - Uncertainty Rating – Based on certainty (e.g. Guessed exposure)
  - Information Gathering Priority
    - Potential Health Risk Rating X Uncertainty Rating
Prioritization

- Within each operations area
  - Sort descending Information Gathering Priority
  - Do a ‘reality check’ and adjust ratings

- After completing first pass, send the draft spreadsheet to the plant for operation section leaders to review/comment

- Integrate plant input

- Finalize priority listing
Exposure Management

- Utilizing the final prioritized spreadsheet
  - Determine highest health hazard potential in each operations area
  - Create a multi-year sampling plan for these hazards which include:
    - Designation of whether hazards are outage or regular operations/maintenance
    - Recommended sampling protocols
    - Recommended number of samples

- Annually review results and adjust sampling plan as needed
Questions?
Case Study:
Ethylene Glycol Contamination in Potable Water

Dee Ward, Alabama Power Company
The Call

Kitchen staff noted unusual water:
• Odor
• Color

Immediate Actions:
• Cooking and cleaning with bottle water
• Call to Building Services
AHU

Building Water Supply

Main water

Supply

Return

Makeup water

80 psi

Chiller Unit
One Problem ... now what?

- Local water leak investigation
- ... leads to another problem
  - Water contamination
- ... leads to discovery
  - Failure in prior Construction
Solutions

- Test, purge, clean, retest
- Install backflow prevention
- Manual addition of make-up water
- Replaced EG with PG

Problem Solved?
Potable water sources disconnected and tested

All non-detect, except one ....

Filter leading to ice machine – 0.0425%
Ethylene glycol - Toxic?

- Most common chemical agent responsible in deaths reported to US Poison Control Centers (2003)
  - No deaths from unintentional exposure
  - 4% of unintentional cases resulted in moderate or major effect (2000-2002)
- Half Life: 3.5 – 8 hr; most symptoms are acute:
  - Nausea, Vomiting, Dizziness, Intoxicated feeling, Headaches, Slurred speech
- Asymptomatic to .... seizures, coma, renal damage, cardiovascular collapse

What was dose? Was there a toxic dose?
Resources

- Practice Guideline: Ethylene Glycol Exposure: an Evidence-Based Consensus Guideline for Out-of-Hospital Management
  - Caravati, et. al
    Clinical Toxicology: 43:327–345, 2005
    Copyright D Taylor & Francis Inc.
    ISSN: 0731-3810 print / 1097-9875 online
    DOI: 10.1080/07313820500184971

APPENDIX 4
Triage Algorithm for Ethylene Glycol Ingestion*

Is a self-harm, malicious, abuse or misuse intent suspected? YES → refer to emergency department.

NO ↓

Is patient symptomatic? (e.g., lethargic, dizzy, vomiting) YES → refer to emergency department.

NO ↓

Did patient ingest a potentially toxic dose? YES → refer to emergency department.

1. For “concentrated” products (>20%):
   - Child (age < 6 years): more than a witnessed taste or lick?
   - Adult: one “swallow” (10-30 mL) or more?

2. For very dilute solutions (<20%):
   - More than calculated mL/kg toxic dose (Formula 2)?

3. An unknown amount, unknown concentration, or unable to estimate maximum amount ingested?
  
  NO ↓

Is a child’s home situation of concern (e.g., family/caregiver seems unreliable)? YES → consider referral to emergency department.

NO ↓

Observe at home by caregiver; consider follow-up call in 1 to 2 hours to verify dose assessment and clinical status.

*Assumes no alcohol was co-ingested and time since exposure has been less than 24 hours. Asymptomatic patients with exposures more than 24 hours old can be observed at home by caregiver.
Potential toxic dose (mL/kg) = \( \frac{0.6 \text{ L/kg}}{20 \text{ mg/dL}} \times \frac{1}{\text{product concentration} \times 1.12} \) = 10.7 / \text{product concentration} (%).

Potential toxic dose @ 0.0425% = \( \frac{10.7}{0.0425 \%} = 252 \text{ mL/kg} \)

Undiluted ice, for adult:  
125 lb (57 kg) = 4364 mL = 14.4 L = 3.8 gal  
150 lb (68 kg) = 17136 mL = 17.1 L = 4.5 gal  
200 lb (91 kg) = 22932 mL = 22.9 L = 6.0 gal
Communications

“... at concentrations known to be present ... would require ingestion of several gallons of undiluted ice to reach minimum toxic level .... Considered to pose extremely low health risk.

... experienced any symptoms following consumption of ice ... please notify supervisor” and medical.
A First

- Oral Exposure
- Calculate Dose
- Trump
Lessons Learned
Earplug Attenuation Validation As Part of a Hearing Conservation Program

David Friedman, CIH, MSPH, ARM
Luminant
MSHA regulates noise exposure in 30 CFR Part 62 & OSHA does in 29 CFR 1910.95

- Both MSHA and OSHA have 8-hr time-weighted average (TWA) PEL of 90 dBA and AL of 85 dBA
- Both regs say if employee noise exposures > the Action Level they must have annual audiograms and training, etc.
- Both regs say if employee noise exposures > the PEL they must wear hearing protection
- MSHA requires dual hearing protection if 8 hr TWA > 105 dBA
OSHA vs. MSHA

- OSHA allows employers to apply feasibility test to determine if admin or engineering controls can be used to reduce employee exposures to below the PEL – “When employees are subjected to sound levels exceeding those listed in Table G-16, feasible administrative or engineering controls shall be utilized”

- OSHA - Feasibility test is economic or technological

- MSHA does not allow feasibility test. A citation will be issued if the miner has a noise exposure > PEL despite the use of PPE and a fully-compliant hearing conservation program with audiograms, training, etc.

- MSHA requires the use of engineering and/or admin controls
Hearing Protection Equipment

• The most common types of hearing protection equipment are ear plugs and ear muffs.

• The protection they provide varies based on the type, model and how well they fit in an individual’s ear canal.
Noise Reduction Ratings

• Hearing Protection Equipment typically comes with a Noise Reduction Rating (NRR) that is on the box or individual container.

• The NRR is calculated by the manufacturer in a lab setting by measuring the noise that goes through the hearing protection device that is worn by a mannequin.
• NRRs don’t account for the difference in ear canal shapes and sizes and how well the hearing protection device is worn.

• Hearing protection devices should be selected so that when they are properly worn the actual noise exposure (in the inner ear) is less than 90 dBA.

• For example – outside noise level is 100 dBA, NRR is 18 so 100 – 18 = 82 dBA (in inner ear)
Applying the NRR

- MSHA doesn’t give much guidance on how to use the NRR in the selection of hearing protection equipment.

- OSHA (in 29 CFR 1910.95) has 2 methods to apply the NRR in selecting hearing protection equipment
  - Method #1 (mandatory) – subtract 7 from the NRR; i.e. TWA – (NRR-7) = exposure level;
  - Method #2 (recommended) – subtract 7 from NRR and divide by two; i.e. TWA –((NRR-7)/2) = exposure level
- These NRR adjustments are to account for noise frequency variations and improper fitting of hearing protection equipment
3M Earfit Evaluation System

• The 3M Earfit Evaluation System measures how much noise attenuation an individual receives when wearing a 3M earplug.
• The system generates noise from a speaker and uses microphones located directly outside the wearer’s ear and inside the ear plug to measure how much noise gets through the earplug.
• The computer program runs the test at several noise frequencies and calculates a personal attenuation value - this tells us how much noise protection a wearer is actually getting.
3M Earfit Evaluation System

- The personal attenuation rating allows us to determine if the employee has adequate noise protection from the work environment.

- The ear fit system also helps train employees on how to properly wear earplugs and demonstrates the value of wearing them.

- The test only takes a few minutes and the data can be stored in the program or a printout can be put in the employee’s file for documentation.
3M Earfit Evaluation System
3M Earfit Evaluation System - Report

Extended Report

Employee Name: Johnny Burke
Test Date: 2013-08-02
Company Name: Luminant BB Mine
Farfield, TX, UNITED STATES

Test Information

<table>
<thead>
<tr>
<th></th>
<th>Left</th>
<th>Right</th>
<th>Binaural</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAR (dBA)</td>
<td>25.47</td>
<td>31.47</td>
<td>25.47</td>
</tr>
</tbody>
</table>

Protection Sufficiency:
- Unable to compute

Computation of Protection Sufficiency:
- Unable to compute since employee exposure not entered

Computation of Protection Maximum:
- Company Exposure Limit + Sound Power = Protected Maximum

*3M recommends using the PAR minus the variability value to predict user protection. Variability values include a combination of user fitting variability, variation in the user's noise spectrum, and also the measurement variability itself.

Values shown are the average of all ranked values in each ear.

System Information

Technician Name: David Friedman
Technician Code: PRM0230
Software Version: 3M-4.16.0

The speaker and microphones in each EARFIT Validation System should be calibrated at least every 24 months by the 3M Repair and Calibration Center.

Speaker Serial Number: 6723
Last Calibration: 2013-08-04
Microphone Serial Number: 9441

Notes
3M Earfit Evaluation System - Report
Benefits of Attenuation Evaluation

- Verification that PPE is providing sufficient protection.
- Demonstrates to employees the benefits of wearing hearing protection and shows them how to wear it properly.
- Part of the employee-retraining and refitting that is required after a confirmed STS.
Use of EarFit Validation System in a HCP

- Luminant is going to first test employees with high noise exposures to measure their attenuation to ensure they are getting adequate noise protection.
- Eventually all employees included in the HCP will be tested.
- Possibly presenting attenuation data to MSHA to have them recognize PPE as a control measure against noise exposure.
IH Roundtable Discussion

Group Discussion
Break
IH Round Table Discussion (cont.)
Silica Update

Gary Hatcher, American Electric Power
Pluses and Deltas

Group Discussion