Hearing Conservation Program
Metrics Roundtable

AIHA Conference
Philadelphia
June 2007
Hearing Conservation Program Elements

- How does Alcoa Manage Health Issues?
- Noise Measurement Criteria
  - Inclusion in HCP
- Engineering Noise Control Requirements
- Alcoa Recordable Event
- Hearing Conservation Metrics
How Does Alcoa Manage Health Issues?

Ensure consistent, appropriate management of workplace exposures and health issues worldwide through a comprehensive set of tools:

- **Worldwide Health Standards**
  - Identify minimum requirements
- **Gap Analysis**
  - Identify actions needed to meet Alcoa’s Standards
- **Health Plan**
- **Audits**
- **Metrics/Scorecard**
  - Measure effectiveness of Health Programs
Alcoa Worldwide Hearing Conservation Standard

- International standard for hearing conservation: 100,000+ employees
- Concise standard which address:
  - All elements of a hearing conservation program
- Self Assessment/Audit protocols and Metrics are standardized worldwide
Hearing Conservation Program Elements

- Noise exposure assessments for all jobs using AIHA exposure assessment guidelines
  - 85 dBA exposure limit
  - 5 dB doubling
  - Noise levels in excess of 100 dBA require use of hearing protection regardless of exposure time
  - Hearing Protection required at 85 dBA; double protection at 105 dBA
- Use of engineering controls to reduce noise levels for unacceptable noise exposures to less than 85 dBA
  - Noise Control Action Plans
  - Incremental controls
  - Engineering Standards for new equipment/vehicles
Hearing Conservation Program Elements (cont.)

- Audiometric testing for all individuals working in SEGs where 5% of samples exceed 80 dBA TWA 12 or more days of the year to identify hearing losses due to noise
- Proper selection and use of hearing protection for unacceptable noise exposures
- Employee Training
- Recordkeeping of all work related 10 dB shifts, 10 dB shift with 25 dB loss (OSHA recordable) and hearing impairments (AAO 1979 criteria)
## Identification of Hearing Shifts/Impairments and Reporting Practices

<table>
<thead>
<tr>
<th>Alcoa Criteria</th>
<th>Case Type</th>
<th>Nature of Injury / Illness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hearing impairment:</strong> average loss in either ear of $\geq 25$ dB at 500, 1000, 2000 and 3000 Hz without age correction</td>
<td>Case Type - 1 (or Other Non-Recordable)</td>
<td>Hearing Impairment</td>
</tr>
<tr>
<td><strong>Hearing loss 10 dB (STS):</strong> average loss in either ear of $\geq 10$ dB at 2000, 3000 and 4000 Hz after age correction</td>
<td>Case Type - 1 (or Other Non-Recordable)</td>
<td>10 dB Hearing Shift</td>
</tr>
<tr>
<td><strong>Hearing Shift 10 dB (STS) with 25 dB Hearing Loss:</strong> age-corrected average hearing shift in either ear of $\geq 10$ dB at 2, 3, 4 kHz when compared to baseline, coupled with a $\geq 25$ dB average loss in the same ear at 2, 3, 4 kHz</td>
<td>Case Type - 2 (Medical Treatment or Other Recordable)</td>
<td>10 dB Hearing Shift with 25 dB Hearing Loss</td>
</tr>
</tbody>
</table>
Alcoa Hearing Conservation Metrics

- Worldwide self assessment/audit, metric and scorecard criteria

- New acquisitions are required to meet Alcoa requirements within first year
Alcoa EHS Audit

- All aspects of the Hearing Conservation and Engineering Noise Control Standard are covered
- Plants perform self assessment using detailed protocols based on standard
- Alcoa EHS audit staff perform audits at each location on three year cycle
  - Results reported to management
  - Best practices available company-wide via Alcoa intranet
Alcoa Metrics and Balanced Scorecard Requirements

- Leading and Lagging Indicators
- Reported Quarterly to Business Unit and Corporate Management
  - One and Three year goals
- Exposure Assessments
  - Completion of assessments
  - Assignment into exposure categories
  - Reduction in employees exposed to noise
- Audiometric Test Criteria
  - Tests completed
  - Hearing shifts (10 dB with and without 25 dB loss)
  - Hearing Impairments
Hearing Conservation and Engineering Noise
Control Metrics: 2006-2008

• Exposure Assessment/Controls
  – Exposure Assessments Completion: 95%
  – A 10% reduction in individuals exposed to noise
  – A score of ‘Good’ or Better on HC&ENC Audit/ASAT

• Hearing Loss Criteria
  – Hearing Shifts <1%
  – New Impairments 0%
Beyond Alcoa HC&ENC Metrics: Leading Indicators and Intervention Programs

- Alcoa Hearing Loss Experience
- Early Hearing Loss Indicator
- Audiometric Testing Quality Assurance
- Intervention: doseBuster experience
Alcoa Hearing Loss Experience

Dose Response: (3,4,6 kHz)

Expected (ANSI 3.44)
Observed (with SE)

Annual rate of hearing loss (dB)
Noise Exposure (Leq)
Alcoa Hearing Loss Experience

Dose Response: (2,3,4 kHz)

---

Bar chart showing noise exposure levels and their corresponding number of employees and percentage of employees with STSs.
Hearing Loss Experience: Finding/Recommendations

- Lower rate of hearing loss at higher noise exposures- (effect of better hearing protection?) Good News!
- Greatest degree of hearing loss occurring among employees at lower noise exposure levels
- Fewer employees having hearing tests at lower noise levels-include employees exposed to 80dBA in audiometric testing.
- Possible need to have greater emphasis on hearing loss prevention at lower noise levels- early indicator
Early Hearing Loss Indicators

• Problem: Hearing Shift Criteria are lagging indicators
  – In a study of Alcoa employees: almost 70% of individuals with potentially recordable hearing shifts ALREADY had hearing impairment

• Candidate Early Indicators:
  – 10 dB shift from baseline in avg. 2,3,4KHz (not age-corrected)
  – 15dB shift from baseline (at least one frequency 1-6KHz) confirmed on second test
  – Ten others including:
    • 7dB shift 2,3,4KHz
    • 5dB shift 2,3,4KHz
### Risk of Potentially Recordable Hearing Loss Event Following Early Indicator Metric

#### Probability of Developing an OSHA Recordable Hearing Loss (ORHL) After an Early Indicator (EI)

<table>
<thead>
<tr>
<th>Early Indicator flags (EI)</th>
<th>No. Flagged</th>
<th>Median time to EI (yrs)</th>
<th>Median time to ORHL (yrs)</th>
<th>Years after early indicator 5</th>
<th>Years after early indicator 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 10dB STS (10dB shift in average of 2,3,4KHz)</td>
<td>943</td>
<td>3.9</td>
<td>1.7</td>
<td>21.3</td>
<td>40.9</td>
</tr>
<tr>
<td>2. 10dB STS TWICE (10dB shift in average of 2,3,4KHz)</td>
<td>568</td>
<td>53</td>
<td>1.1</td>
<td>39.9</td>
<td>66.5</td>
</tr>
<tr>
<td>3. AAO (10dB Shift (.5,1,2KHz) or 15dBin (3,4,6KHz)</td>
<td>969</td>
<td>43</td>
<td>1.1</td>
<td>20.8</td>
<td>32.7</td>
</tr>
<tr>
<td>4. 1972 NIOSH Shift (10dB Shift (.5,1,2,3KHz) or 15dB in (4,6KHz)</td>
<td>2779</td>
<td>1.6</td>
<td>4.0</td>
<td>5.9</td>
<td>13.5</td>
</tr>
<tr>
<td>5. 15dB Shift (15dB shift in .5-6KHz)</td>
<td>2234</td>
<td>23</td>
<td>3.3</td>
<td>8.3</td>
<td>16.7</td>
</tr>
<tr>
<td>6. 15dB Shift Twice (15dB shift in .5-6KHz twice)</td>
<td>1229</td>
<td>31</td>
<td>2.3</td>
<td>154</td>
<td>284</td>
</tr>
<tr>
<td>7. 15dB Shift Twice (1-4KHz)</td>
<td>862</td>
<td>40</td>
<td>2.0</td>
<td>22.9</td>
<td>38.3</td>
</tr>
<tr>
<td>8. 10dB Avg 3-4KHz (10dB shift in average of 3 and 4KHz)</td>
<td>1257</td>
<td>30</td>
<td>2.6</td>
<td>14.8</td>
<td>27.7</td>
</tr>
<tr>
<td>9. 15dB Shift 3,4,6KHz (15dB shift in average of 3, 4, and 6KHz)</td>
<td>960</td>
<td>56</td>
<td>0.4</td>
<td>32.2</td>
<td>45.2</td>
</tr>
<tr>
<td>10. Age adjusted 5dB Shift Twice (age adjusted 5dB shift in 2,3,4KHz)</td>
<td>945</td>
<td>25</td>
<td>2.7</td>
<td>21.0</td>
<td>37.6</td>
</tr>
<tr>
<td>11. Age adjusted 8dB Shift Twice (age adjusted 8dB shift in 2,3,4KHz)</td>
<td>457</td>
<td>38</td>
<td>1.1</td>
<td>49.4</td>
<td>73.3</td>
</tr>
<tr>
<td>12. Age adjusted 10dB Shift Twice (age adjusted 10dB shift in 2,3,4KHz)</td>
<td>263</td>
<td>47</td>
<td>0.3</td>
<td>81.9</td>
<td>86.6</td>
</tr>
</tbody>
</table>
Early Indicators: 10 Years

OSHA Recordable Hearing Loss within 10 yrs

- Probability of OSHA recordable
- Years from Early flag

Flagging:
- Flag 1
- Flag 2
- Flag 3
- Flag 4
- Flag 5
- Flag 6
- Flag 7
- Flag 8
- Flag 9
- Flag 10
- Flag 11
- Flag 12
Early Indicator Conclusions

- 10 dB shift (not age-corrected) is reasonable metric for early flag of hearing loss
  - Others can be used but may flag excess numbers

- Should be tracked in all Alcoa Hearing Conservation Programs in addition to Alcoa recordable shift metrics
  - *Criteria adopted by Alcoa in 2006*

- Needs to be accompanied by an individual intervention process
  - Training, fit testing *(Fit Check)*, personal exposure assessment

• Suggested metric: “Better-Worse Statistic” (BW\%)  
  – Used at representative locations worldwide  
  – Tests compared to previous year  
  – 5\textsuperscript{th} or greater audiogram used for each individual  
  – BW\% Statistic calculated for each location by year
ANSI Better/Worse Statistic

15dB Shift (500 - 6K) Better or Worse
Location 2

% of Employees

Year of Hearing Test

ANSI Better/Worse statistic

15dB Shift (500-6K) Better or Worse
Location 1

Year of Hearing Test

% of Employees

Better Worse Analysis Conclusions

- Need for ongoing quality control of testing program
- Need Information Technology support to accomplish
- Proposed Alcoa goal:
  - Better-worse statistic (BW%) less than 30% based on the proposed ANSI guidelines
Intervention: doseBuster ESP (Exposure Smart Protection) Unit

• Alcoa doseBuster USA working relationship
• doseBuster pilot programs at Alcoa locations
• Large program at a single US smelter:
  – >170 units in use over two years
  – Audiometric data, ambient noise dosimetry and dose Buster measurements available
Hearing Loss Experience with doseBuster Users

Mean hearing threshold (2,3, and 4kHz)
Employees using continuous ESP 2002 - 2006 (N=81)

<table>
<thead>
<tr>
<th>Year of test</th>
<th>Mean HTL 2,3,4kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>25.4</td>
</tr>
<tr>
<td>2003</td>
<td>28.3</td>
</tr>
<tr>
<td>2004</td>
<td>29.4</td>
</tr>
<tr>
<td>2005</td>
<td>29.8</td>
</tr>
<tr>
<td>2006</td>
<td>30.9</td>
</tr>
</tbody>
</table>
doseBuster: Alcoa Hearing Loss Experience
Dose Response
Yale NIOSH Grant

- Intervention trial to determine efficacy of ESP technology (vs Fit Check alone)
- 5 year study, 4 Alcoa locations, possible start date: Fall 2007
- Hearing loss in intervention group of volunteers (N=200) will be compared with that of controls (N=400)
- Grant will pay for 200 ESP units, participant incentives, and ongoing analysis of noise exposures and hearing loss rates
- Find more information on whether low noise levels have significant effect on hearing loss (dose response)
Conclusions

• Alcoa has for 10 years had a standard set of HCP Metrics
• More recently established other measures to improve program effectiveness
  – Evaluation of hearing loss experience
  – Early indicator metric
  – ANSI QC
  – doseBusters