Environmental Impact Assessment for the proposed Aluminium Pechiney smelter within the Coega Industrial Zone, Port Elizabeth, South Africa

SPECIALIST STUDY:

NOISE

September 2002

Prepared by

VIBRACOUST

Klaus Weber
VibrAcoust International CC
Consulting Engineers
Acoustics
Noise Control
Vibration Technologies
P. O. Box 6046
Westgate 1734 South Africa
Tel.: +2711768-2730
Fax: +2711768-2740
Email: vibracoust@global.co.za

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Aluminium Pechiney is considering the establishment of an aluminium smelter within the IDZ Coega near Port Elizabeth. The smelter would utilise new generation AP50 technology and produce approximately 485 000 tonnes of aluminium per year. If a decision is made to proceed at the Coega site, construction is planned to commence in 2003, lasting for approximately 26 months, with first production starting in 2005.

This sound impact investigation was commissioned as part of the Environmental Impact Assessment (EIA) for the proposed smelter. A key objective of this investigation is to assess whether noise levels from the smelter are within national and international guidelines. Of particular relevance are the World Bank guidelines, which stipulate a maximum allowable noise level of 70 dB(A) for industrial areas during the daytime and nighttime. This measurement is for receptors located outside the project property boundary.

Taking into consideration the World Bank guidelines, the significance rating for noise impacts is assigned based on the following criteria:

<table>
<thead>
<tr>
<th>Noise level at boundary of site</th>
<th>Significance rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constantly or regularly &gt; 70 dB(A)</td>
<td>High</td>
</tr>
<tr>
<td>Occasionally/for short periods of time &gt; 70 dB(A)</td>
<td>Medium</td>
</tr>
<tr>
<td>Continuously &lt; 70 dB(A)</td>
<td>Low</td>
</tr>
</tbody>
</table>

**Noise impacts during the construction phase**

During the construction phase, the greatest noise emissions are from earth moving equipment, impacting equipment (eg. pile drivers, jack hammers and drilling) and blasting activities. Blasting represents the greatest noise source, but would be limited to very short time periods. Pile driving is the second greatest noise source, with the guideline of 70 dB(A) only reached over a distance of approximately 360 to 530 meters, depending whether the sound is transmitted over a hard (eg. paved) surface or a soft (eg. vegetated) surface. It is therefore anticipated that impacts from pile driving are likely to extend beyond the boundary of the smelter site. However, this impact is moderated by pile driving activities only occurring over a short time period at the beginning of the construction phase. Mitigation measures are recommended to reduce noise impacts from the construction phase. For example, these include design measures such as providing a vegetated buffer on the inner perimeter of the property of at least 100m for most, if not all directions; and operations measures such as ensuring that the users of impacting equipment are well educated and trained in ways of minimising noise generation. With mitigation, all noise impacts during construction are expected to be of either low or medium significance.

**Noise impacts during the operations phase**

Several potential sources of noise were identified for the smelter site during operations (eg. Gas Treatment Centres, Fume Treatment Centres, rodding shop and vibrating screens). However, good design principles, which are standard practice in a modern smelter, will successfully reduce these impacts to being of low significance. Noise emission levels at the boundary of the smelter site are predicted to be within the 70 dB(A) guidelines set by the World Bank and recommended in the “Ambient noise guidelines” (Jongens Keet Associates, 1999) as the most appropriate noise guidelines to be used for industrial areas in the IDZ.
The noise emitted by trucks transporting ingots downhill to the port was identified as the most significant noise source during operations. Approximately 56 truckloads per day will be required to transport the ingots to the port, using a road constructed specifically for use by vehicles within the IDZ. The low frequency rumbling from motorbrakes increases the noise emission from trucks. This effect is to be tested by monitoring in regular intervals. A likely mitigation measure, if required, is disabling the motorbrakes on the trucks transporting ingots, and use of disc/pad brakes only. This mitigation measure has been applied successfully at the Mozal smelter near Maputo, though it results in a slight increase in vehicle operating costs due to the need to service the disc/pad brakes more regularly. This modification does not affect operational safety.

The noise impact caused by other PAS2005 trucking operations (from Port Elizabeth Harbour and Port of Ngqura) were superimposed onto the existing road traffic situations, and found to only add a negligible increase in noise levels. The noise impact from these trucks is therefore predicted to be of low significance.

### Summary of predicted noise impacts from the Aluminium Pechiney smelter project

<table>
<thead>
<tr>
<th>Nature of Impact</th>
<th>Status</th>
<th>Extent</th>
<th>Duration</th>
<th>Intensity</th>
<th>Probability of occurrence</th>
<th>Confidence</th>
<th>Significance (with mitigation)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise from impacting equipment (pile drivers, jack hammers, rock drills)</td>
<td>Negative</td>
<td>Site</td>
<td>Short</td>
<td>Medium</td>
<td>Probable</td>
<td>Moderate</td>
<td>Medium</td>
</tr>
<tr>
<td>Noise from blasting activities</td>
<td>Negative</td>
<td>Site</td>
<td>Short</td>
<td>Medium</td>
<td>Probable</td>
<td>Moderate</td>
<td>Medium</td>
</tr>
<tr>
<td>Noise from general construction activities (earthmoving, materials handling, stationery equipment)</td>
<td>Negative</td>
<td>Site</td>
<td>Medium</td>
<td>Low-medium</td>
<td>Probable</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Operations phase</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise from the 24 hour operation of the smelter</td>
<td>Negative</td>
<td>Site</td>
<td>Long</td>
<td>Medium</td>
<td>Definite</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Noise from unloading of raw materials at the Port of Ngqura</td>
<td>Negative</td>
<td>Port</td>
<td>Short¹</td>
<td>Medium</td>
<td>Definite</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>Noise from trucking of ingots from the smelter to the Port of Ngqura</td>
<td>Negative</td>
<td>Local</td>
<td>Short¹</td>
<td>Medium</td>
<td>Definite</td>
<td>High</td>
<td>Medium</td>
</tr>
</tbody>
</table>

*Note 1: Noise impacts from unloading and trucking during operations are *short term* in that they are not continuous emissions, but only occur when ships unload or when trucks travel to the harbour. However, they will occur over the full plant life of 40 years.*
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        Elizabeth, South Africa. Specialist Studies Report. CSIR Report No. ENV-S-C 2002-
        092B, Stellenbosch, South Africa.
### Glossary of Terms and Abbreviations Used

The symbol ? refers to other terms defined in this section.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>A-weighting</strong></td>
<td>See ? weighting.</td>
</tr>
<tr>
<td><strong>Alternatives</strong></td>
<td>A possible course of action, in place of another, that would meet the same purpose and need (of proposal). Alternatives can refer to any of the following but are not limited here to: alternative sites for development, alternative site layouts, alternative designs, alternative processes and materials. In Integrated Environmental Management the so-called “no go” alternative refers to the option of not allowing the development and may also require investigation in certain circumstances.</td>
</tr>
<tr>
<td><strong>Alumina</strong></td>
<td>Alumina is the name given to the raw material, aluminium oxide (Al₂O₃), which is used in the melting process to produce aluminium. It is a white powdery oxide produced through refining of bauxite.</td>
</tr>
<tr>
<td><strong>Aluminium</strong></td>
<td>Aluminium (in metallic form) is a relatively lightweight metal, which is highly corrosion resistant, an excellent thermal conductor, non-magnetic, non-toxic and highly workable. End uses of aluminium include building and construction materials, electrical products, packaging and containers, cooking utensils, the aeronautical, automotive industries and leisure goods industries. Aluminium is produced by a smelting process, which separates the aluminium from alumina (aluminium oxide) through electrolytic reduction.</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
<td>The process of collecting, organising, analysing, interpreting and communicating data that is relevant to some decision.</td>
</tr>
<tr>
<td><strong>Casthouse</strong></td>
<td>Liquid aluminium, which is extracted from the potline, is transported to the casthouse where it is cast into aluminium ingots.</td>
</tr>
<tr>
<td><strong>Cryolite</strong></td>
<td>A mineral (sodium aluminium fluoride) which is the main component of bath in the aluminium smelting process.</td>
</tr>
<tr>
<td><strong>Decibel [dB]</strong></td>
<td>A unit of ? level which denotes the logarithmic ratio between two quantities: the number of decibels corresponding to this ratio is 10 times the logarithm (to the base 10) of this ratio. The typical linear numeric range is unwieldy (? Sound Power 10⁻¹⁰ to 10⁻¹ W, ? Sound Pressure 10⁻⁵ to 10¹ Pa: 1 and the human ear responds logarithmically, i.e. the difference between 10 and 100 linear sound pressure units is perceived equal to the difference between 100 and 1000 linear sound pressure units. The logarithmic scale is therefore used preferentially to a linear scale (? SWL 20 to 200 dB, ? SPL 0 to 120 dB). Decibels are defined as: ( n \text{ decibel} = n \text{ dB} = 10 \log( x / x_{\text{ref}}) ), e.g. for ( x = x_{\text{ref}} ) (. x / x_{\text{ref}} = 1 : \log(1) = 0 : 10 \log(1) = 0 ) for ( x = 2 : x_{\text{ref}} ) (. x / x_{\text{ref}} = 2 : \log(2) = 0,3 : 10 \log(2) = 3 ) which is literally generally valid, e.g. with reference ( x_{\text{ref}} = 1 ) apple, 3 apples can be expressed as 4.77 dB apples, as ( 10 \log(3/1) = 4.77 ).</td>
</tr>
<tr>
<td><strong>Directivity</strong></td>
<td>Most sound sources exhibit definite directional characteristics, that is, they radiate greater sound in some directions than in others. This is described by the ? directivity factor.</td>
</tr>
<tr>
<td><strong>Directivity Factor</strong></td>
<td>Ratio of ? sound intensity in a specific angle to the to the ? sound intensity at the same distance from the source averaged over all angles.</td>
</tr>
<tr>
<td><strong>Environment</strong></td>
<td>The biophysical, social, economic, cultural, political and historical context within which people live and within which development takes place.</td>
</tr>
</tbody>
</table>
### Environmental impact
A change resulting from the effect of an activity on the environment, whether desirable or undesirable. Impacts may be the direct consequence of an organisation’s activities or may be indirectly caused by them.

### Environmental impact assessment
An Environmental Impact Assessment (EIA) refers to the process of identifying, predicting and assessing the potential positive and negative social, economic and biophysical impacts of any proposed project, plan, programme or policy which requires authorisation of permission by law and which may significantly affect the environment. The EIA includes an evaluation of alternatives, as well as recommendations for appropriate mitigation measures for minimising or avoiding negative impacts, measures for enhancing the positive aspects of the proposal, and environmental management and monitoring measures.

### Environmental issue
A concern felt by one or more parties about some existing, potential or perceived environmental impact.

| Equivalent Continuous Sound Pressure Level | The value of the constant continuous sound pressure level, in decibels, that is representative of the instantaneous sound pressure levels measured over a specified time interval. If the equivalent continuous sound pressure level is applied with A-weighting, it is abbreviated $L_{Aeq}$. |
| Frequency [Hz] | The number of times a sound wave repeats itself in one second. For example, a bass voice has a low frequency while a soprano voice has a high one. Audible frequencies range from 30 Hz to 20000 Hz. Frequencies are often quoted in frequency bands, mainly as octave or as 1/3 octave bands. |

<p>| Fume treatment centre | The fume treatment centre (FTC) extracts and recycles fluoride, poly-aromatic hydrocarbon containing tar and dust from emissions created by the anode baking process. |
| Gas treatment centre | The gas treatment centres have the primary role of recycling the fluoride and dust captured from the pots. |
| Industrial Development Zone | An Industrial Development Zone is an area identified for industrial development. The aim is to attract domestic and foreign investment into industrial and commercial parks by providing serviced industrial sites with purpose-built infrastructure. |
| Ingot | Bars of aluminium metal which are produced as the final product of the primary aluminium smelting process. |
| Integrated environmental management | IEM provides an integrated approach for environmental assessment, management, and decision-making and to promote sustainable development and the equitable use of resources. Principles underlying IEM provide for a democratic, participatory, holistic, sustainable, equitable and accountable approach. |
| Interested and affected parties | Individuals or groups concerned with or affected by an activity and its consequences. These include the authorities, local communities, investors, workforce, consumers, environmental interest groups and the general public. |
| Key issue | An issue raised during the Scoping process that has not received an adequate response and which requires further investigation before it can be resolved. |
| Level | Denotes the measure of an entity like sound pressure or sound power on a logarithmic dB scale. The sound power level is abbreviated SWL, the sound pressure level SPL. |
| Liquid pitch | Pitch is a heavy, sticky, tar-like by-product derived from the coking of coal. It is used as a binding agent for the petroleum coke in the anode blocks, prior to baking. |
| Listed activities | Development actions that are likely to result in significant environmental impacts as identified by the Minister of Environmental Affairs and Tourism in terms of Section 21 of the Environment Conservation Act. |</p>
<table>
<thead>
<tr>
<th><strong>Negative impact</strong></th>
<th>A change that reduces the quality of the environment (for example, by reducing species diversity and the reproductive capacity of the ecosystem, by damaging health, or by causing nuisance).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noise</strong></td>
<td>Unwanted sound, either subjectively or by authoritative definition.</td>
</tr>
<tr>
<td><strong>Pitch fume treatment centre</strong></td>
<td>The pitch fume treatment centre (PFTC) treats PAH containing tar and dust emissions from the paste plant.</td>
</tr>
<tr>
<td><strong>Positive impact</strong></td>
<td>A change, which improves the quality of life of, affected people or the quality of the environment.</td>
</tr>
<tr>
<td><strong>Potline</strong></td>
<td>Pots are electrically connected and arranged in long buildings called potrooms. Two potrooms constitute a potline.</td>
</tr>
<tr>
<td><strong>Rating Level</strong></td>
<td>The equivalent continuous A-weighted sound pressure level ( L_{Aeq} ) during a specified time interval plus specified adjustments for tonal character and impulsiveness of the sound.</td>
</tr>
<tr>
<td><strong>Relevant authority</strong></td>
<td>The environmental authority on national, provincial or local level entrusted in terms of the Constitution and in terms of the designation of powers in Notice No. R. 1184 of 5 September 1997 with the responsibility for granting approval to a proposal or allocating resources.</td>
</tr>
<tr>
<td><strong>Rodding shop</strong></td>
<td>Newly manufactured anodes are attached to an electrical conducting stem in the rodding shop before being transported to the potline.</td>
</tr>
<tr>
<td><strong>Scoping</strong></td>
<td>This refers to the process of determining the spatial and temporal boundaries (the extent) for the EIA and key issues to be addressed in an environmental assessment.</td>
</tr>
<tr>
<td><strong>Smelting</strong></td>
<td>Aluminium smelting refers to the separation of aluminium from aluminium oxide.</td>
</tr>
<tr>
<td><strong>Sound</strong></td>
<td>Evoking the sensation of hearing through oscillation of pressure in an elastic medium exciting the hearing organs.</td>
</tr>
<tr>
<td><strong>Sound Intensity</strong></td>
<td>The sound energy flow through an area unit in W/m(^2).</td>
</tr>
<tr>
<td><strong>Sound Intensity Level</strong></td>
<td>The sound intensity expressed in dB.</td>
</tr>
<tr>
<td><strong>Sound Level</strong></td>
<td>See sound pressure level.</td>
</tr>
<tr>
<td><strong>Sound Power</strong></td>
<td>The total sound energy radiated by a source in a certain time interval, divided by the duration of that interval. Sound power is an objective physical property of a sound source, independent of distance, obstructions etc.</td>
</tr>
<tr>
<td><strong>Sound Power Level</strong></td>
<td>Sound power referred to as a 'level' is measured on a logarithmic scale and is abbreviated ( SWL ). Reference sound power is 10(^{-12}) W (also see dB).</td>
</tr>
<tr>
<td><strong>Sound Pressure</strong></td>
<td>The change in fluid pressure (usually air), which causes the sensation in the ear to hear a sound.</td>
</tr>
<tr>
<td><strong>Sound Pressure Level</strong></td>
<td>Sound pressure referred to as a 'level' is measured on a logarithmic scale and is abbreviated ( SPL ). 'Sound level' (the word 'pressure' omitted) is to be understood as sound pressure level. ( SPL ) is used to describe noise impact. Reference sound pressure is 2(\times)10(^{-5}) Pa (also see dB).</td>
</tr>
<tr>
<td><strong>Weighting</strong></td>
<td>The human ear perceives sound levels differently at different frequencies. To accommodate this phenomenon, weightings are applied to the sound levels in the individual frequency bands. Most widely used is the A-weighting. The human ear is most sensitive at 2000 to 4000 Hz and drops off towards lower and higher frequencies and the electronic A-weighting network incorporated in a sound level meter simulates this characteristic. A-weighted levels are indicated as dB(A).</td>
</tr>
</tbody>
</table>
### ABBREVIATIONS

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$A_2O_3$</td>
<td>Alumina (Aluminium Oxide)</td>
</tr>
<tr>
<td>AP</td>
<td>Aluminium Pechiney</td>
</tr>
<tr>
<td>$CO_2$</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>CDC</td>
<td>Coega Development Corporation</td>
</tr>
<tr>
<td>CONCAWE</td>
<td>Conservation of clean air and water - Europe</td>
</tr>
<tr>
<td>CSIR</td>
<td>Council for Scientific and Industrial Research</td>
</tr>
<tr>
<td>dB</td>
<td>decibel</td>
</tr>
<tr>
<td>DEAT</td>
<td>Department of Environmental Affairs and Tourism (National)</td>
</tr>
<tr>
<td>DEAE&amp;T</td>
<td>Department of Economic Affairs Environment &amp; Tourism (Eastern Cape)</td>
</tr>
<tr>
<td>FSR</td>
<td>Final Scoping Report</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EIR</td>
<td>Environmental Impact Report</td>
</tr>
<tr>
<td>FTC</td>
<td>Fume Treatment Centre</td>
</tr>
<tr>
<td>GTC</td>
<td>Gas Treatment Centre</td>
</tr>
<tr>
<td>I&amp;AP</td>
<td>Interested and Affected Party</td>
</tr>
<tr>
<td>IEM</td>
<td>Integrated Environmental Management</td>
</tr>
<tr>
<td>IDZ</td>
<td>Industrial Development Zone</td>
</tr>
<tr>
<td>$kV$</td>
<td>Kilovolt</td>
</tr>
<tr>
<td>$L_{Acp}$, $L_{Aeq(1\text{hour})}$</td>
<td>See ‘equivalent continuous sound pressure level $L_{eq}$ in section Definitions / Glossary. Where this refers to a measurement period of 60min or 1hr, it is depicted as $L_{Aeq(1\text{hour})}$</td>
</tr>
<tr>
<td>MW</td>
<td>Megawatt</td>
</tr>
<tr>
<td>NMM</td>
<td>Nelson Mandela Metropolitan Municipality</td>
</tr>
<tr>
<td>PAH</td>
<td>Poly-aromatic hydrocarbon</td>
</tr>
<tr>
<td>PAS2005</td>
<td>Pechiney Aluminium Smelter 2005 project</td>
</tr>
<tr>
<td>PE</td>
<td>Port Elizabeth</td>
</tr>
<tr>
<td>PFTC</td>
<td>Pitch Fume Treatment Centre</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Participation Programme</td>
</tr>
<tr>
<td>POP</td>
<td>Persistent Organic Pollutants</td>
</tr>
<tr>
<td>RMS</td>
<td>Root Mean Squared – a type of time average: $rms = \sqrt{\langle f(x)^2 \rangle}$</td>
</tr>
<tr>
<td>ROD</td>
<td>Record of Decision</td>
</tr>
<tr>
<td>SABS</td>
<td>South African Bureau of Standards</td>
</tr>
<tr>
<td>SEA</td>
<td>Strategic Environmental Assessment</td>
</tr>
<tr>
<td>SMME</td>
<td>Small, Medium and Micro Enterprises</td>
</tr>
<tr>
<td>$SO_2$</td>
<td>Sulphur dioxide</td>
</tr>
<tr>
<td>SPL</td>
<td>Spent potlining / Sound Pressure Level (noise &amp; acoustics)</td>
</tr>
<tr>
<td>SWL</td>
<td>Sound Power Level</td>
</tr>
</tbody>
</table>
1. **INTRODUCTION**

1.1 **Purpose of this study**

The motivation for the PAS2005 lies in the increasing worldwide demand for aluminium, projected to be 2.5% per annum for the next 8 years. PAS2005 will produce approximately 485,000 tonnes of primary aluminium per annum.

The purpose of this study is to contribute to the decision making process by establishing quantitatively and qualitatively the noise impact which will be caused by the construction and operation of PAS2005.

1.2 **Background to the proposed project**

Aluminium Pechiney (AP), a French company globally active in production of aluminium, is investigating the installation of an Aluminium Smelter at the Coega Industrial Development Zone (IDZ), 25 km north of Port Elizabeth, Eastern Cape Province, South Africa. These engineering, planning and environmental studies are conducted in parallel to similar ones in Australia, these being the last two candidate locations for the smelter out of an original list of eleven.

The wider area around Port Elizabeth, which includes the previous municipalities of Port Elizabeth, Uitenhage and Despatch, is known as the Nelson Mandela Metropolitan Municipality (NMMM). The **Aluminium Pechiney Smelter** project to be commissioned in **2005** is hereafter referred to as **‘PAS2005’**. The area to be occupied by PAS2005 is 80 ha.

Three primary locations (the **smelter**, the **Port of Ngqura** and the **Port Elizabeth harbour**) and a number of secondary locations (local suppliers and customers and townships housing staff and labourers) play a role during construction and operation.

The function of the **Port of Ngqura** terminal is to receive raw material (aluminium, coke and liquid pitch) for the Pechiney Smelter and to export aluminium ingots produced by the smelter to the international market. The Port of Ngqura will be functional by 2005, coinciding with production start-up of the smelter. The Port of Ngqura facilities (previously called Coega Harbour) are hereafter referred to as **‘Port of Ngqura’**.

The **Port Elizabeth harbour** will serve as main arrival point of internationally and nationally sourced equipment and material during the construction phase where this is more cost effective than by road or rail transport. During operational phase, aluminium fluoride and heavy fuel oil will be shipped in relatively small quantities, i.e. where it is more cost effective to berth and unload in P. E. harbour rather than docking especially in the Port of Ngqura. The Port Elizabeth Harbour facilities are hereafter referred to as **‘P.E. Harbour’**.
The average employment for the duration of the construction phase is approximately 4500 personnel, peaking at approximately 6000. During the operation phase, approximately 750 permanent staff will be employed, with a further approximately 250 direct subcontractors.

Figure 1 shows the aluminium smelter layout, which is similar to that of other Southern African aluminium smelters (i.e. at Richards Bay and in Maputo) and an oblique visualisation of the smelter in the Coega IDZ. Figure 2 shows the location of the smelter and IDZ in the Port Elizabeth area.

Figure 1: Schematic of smelter PAS 2005, showing a plan view and oblique visualisation
Figure 2: Location of the PAS2005 project in relationship to Coega, Port Elizabeth and Algoa Bay.
1.3 Terms of reference

The Specialist Study on Acoustics (i.e. noise impacts) addresses and includes:

- The impact of the proposed PAS 2005 project on noise levels at the proposed site in the Coega IDZ, at the proposed Port of Ngqura, at the PE harbour (during construction only) and for the proposed transport routes from the Port of Ngqura to the smelter.
- Predicted noise levels from PAS2005 within the context of current and potential future ambient noise levels on noise levels at the IDZ site.
- Comparisons of predicted noise levels to relevant national and international standards and to the World Bank Guidelines.
- Proposals for remedial measures to reduce the potential noise impacts.
- Integration and co-operation with the study for transportation.

1.4 SCOPE OF THE STUDY

The scope of the study encompasses all noise related phenomena and their evaluation with regards to the severity and impact on affected areas as listed below.

During the periods of construction, commissioning and operation:

- Pechiney Aluminium Smelter site
- Conveyor Corridor between smelter site and Port of Ngqura
- Activities at the Port of Ngqura (import of raw materials and export of product)
- Activities at the Port Elizabeth Harbour (arrival of construction equipment/ goods and import of raw materials)

In addition, during the operation period:

- Road transport of small quantities of raw products between the PE Harbour and the smelter site
- Road transport of finished product (aluminium ingots) between the smelter site and Port of Ngqura

In addition, during the construction period:

- Handling in PE Harbour and road transport of material, goods and equipment between PE harbour and the smelter site
- Increased density of personnel transport.
2. OVERVIEW OF TYPES OF NOISE EFFECTS, RELEVANT NOISE REGULATIONS, STANDARDS AND GUIDELINES

2.1 Types of noise effects

It is important to have an understanding of noise as a pollutant in order to value the assessments and the mitigation measures recommended in this report. Some of the most prominent effects of noise are described below.

(i) **Sleep disturbance**

Although development of residential dwellings is explicitly ruled out within the IDZ, sleep disturbance is a result of noise exposure and there may well be the occasional watchman who stays for a number of shifts on the property. Sleep disturbance starts at noise levels of 30 dB(A) for steady state continuous noise at the sleeper's ear. In special situations even lower levels may disturb sleep. The most important noise exposure parameter for sleep disturbance however is the maximum peak level of the exposure, which points to the importance of avoiding noise from lorries and aircraft in residential areas at night. From study findings the general conclusion can be drawn that to ensure undisturbed sleep the maximum sound pressure level should not exceed 45 dB(A). Field studies indicate deterioration in mood or symptoms such as tiredness, headache and nervous stomach where heavy traffic occurs at night and the recommended values are exceeded.

(ii) **Extra-auditory effects**

A great number of these mainly psycho-physiological effects of noise have been reported in the subject literature. The most important of them manifest themselves in physiological stress responses and, particularly at higher levels, in cardio-vascular reactions. But also mental health effects and influences on performance and productivity have been observed and documented. Intensive research on these subjects is still ongoing. It can be generally concluded from the present state of knowledge that exposure to environmental noise acts as a stressor to health as it may lead to measurable changes in e.g. blood pressure, heart rate, vasoconstriction, endocrine excretion levels and admission rates to mental hospitals.

(iii) **Interference with Communication**

Noise levels frequently attained in streets, gardens and on balconies interfere with speech. Noise levels inside buildings usually cause occupants to close windows if they wish to hold a conversation once the external continuous noise level reaches 70 dB(A). It is generally accepted that noise levels in homes should not exceed 40-45 dB(A), levels that are often exceeded by traffic noise even with the windows closed.
(iv) **General Annoyance**
A less specific, but nevertheless serious effect of environmental noise is that it simply disturbs and annoys people. The feeling of annoyance results not only from sleep disturbance and interference with communication, but also from less well defined feelings of being disturbed and affected during all kinds of activities as well as during periods of rest. Because of the subjective nature of annoyance, evaluation must be carried out using survey techniques such as questionnaires. Studies to date show the importance of traffic noise as an annoyance factor in the general population.

Physiological issues about the ear and related matters are to be found in Appendix 3.

2.2 **Noise related regulations**

(i) **Environmental regulations**
Applicable noise regulations are contained in Municipal by-laws, which are essentially closely related to the ‘National Noise Regulation’ (act 73 of 1989) [NNREG], which, although gazetted, was never promulgated, but only served as a guideline for Municipal noise regulations.

Since 1994 the authority regarding noise issues has been transferred to the provincial governments. Three of these have since legislated and promulgated their provincial noise regulations, namely Freestate, Gauteng and Western Cape. These three exercises resulted in severe discrepancies between each other. The other six provinces (including the Eastern Cape) have therefore not yet followed suit. Regulations originating from other authorities like the Civil Aviation Authority differ from the Noise Regulation and there is a general lack of uniformity. A working group of acoustical experts is presently in the process of drawing up recommendations to solve this issue.

The present state of affairs is that regulations are in place in the form of ‘municipal by-laws’, which are based on the above National Noise Regulation; the local authority applied marginal modifications at the time of promulgation. Generally, these regulations are based on the “7 dB rule”, which is presently being seriously scrutinised and criticised (7 dB rule: to allow a 7 dB increase over the existing ambient level, which then becomes the ambient level and then to allow another 7 dB increase over that by the next developer etc., thereby permitting a creeping increase of level). It is in the interest of any developer to maintain an open mind regarding the possible acoustical principles.

(ii) **Occupational safety and health regulations**
Noise management in terms of occupational health and safety regulations is beyond the scope of this specialist study and therefore only brief mention is made of this matter. Nonetheless, it is an important internal matter and if the mitigation is handled correctly and with foresight, it will contribute to the environmental effects as it reduces environmental mitigation efforts.
The core of these regulations is formulated as follows (extracted from Environmental Regulations for Workplaces, 1987, paragraph 7. Noise and hearing conservation):

“3. The employer shall reduce the equivalent noise level to below 85 dB(A) or, where this is not reasonably practicable, he shall reduce the level to as low as is reasonably practicable and take all reasonable steps to isolate the source of the noise acoustically.

4. Where the equivalent noise level in any workplace cannot be reduced to below 85 dB(A), as contemplated in subregulation (3), the employer shall -

a. demarcate the boundaries of all noise zones in such workplace by posting up notices to that effect in conspicuous places along such boundaries and at all entrances to and exits from any room where the whole of such room constitutes a noise zone; and

b. prohibit any person from entering a noise zone unless such person wears hearing protectors.”

2.3 Noise related standards, codes of practice and guidelines

This section provides an overview of the following relevant noise guidelines or Codes of Practice (The SABS codes of practice are guidelines and not binding unless they are called upon by laws or regulations):

- South African Bureau of Standards Code of Practice 0103:1994 ‘The measurement and rating of environmental noise with respect to annoyance and to speech communication’ [SABS0103]
- World Bank [WB] and European Union guidelines [EU]
- Ambient noise guidelines for the Coega Industrial Development Zone [JKA]

Sound Pressure Level is expressed in decibels and is often used as the measurement unit for noise guidelines. Figure 3 below provides examples of Sound Pressure Levels.
2.3.1 SABS Code of Practice 0103

Titled ‘The measurement and rating of environmental noise with respect to annoyance and to speech communication’, this standard covers a method of measurement and rating of noise to determine the suitability of an environment with respect to possible annoyance (i.e. whether complaints could be expected) or to predict speech communication efficiency. It also recommends acceptable limits. Table 1 is relevant in this investigation as provided below:

<table>
<thead>
<tr>
<th>Type of district</th>
<th>Rating level $L_r$ for ambient noise $\text{DB}(A)$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Outdoors</strong></td>
</tr>
<tr>
<td></td>
<td>Day-time</td>
</tr>
<tr>
<td>a) Rural districts</td>
<td>45</td>
</tr>
<tr>
<td>b) Suburban districts with little road traffic</td>
<td>50</td>
</tr>
<tr>
<td>c) Urban districts</td>
<td>55</td>
</tr>
<tr>
<td>d) Urban districts with some workshops, with business premises, and with main roads</td>
<td>60</td>
</tr>
<tr>
<td>e) Central business districts</td>
<td>65</td>
</tr>
<tr>
<td>f) Industrial districts</td>
<td>70</td>
</tr>
</tbody>
</table>
2.3.2 SABS Code of Practice 0210

Titled ‘Calculating and predicting road traffic noise’, this standard covers comprehensively road traffic noise related matters.

This standard covers a procedure for calculating and predicting road traffic noise under typical South African traffic and sound propagation conditions, in terms of a one-hour-equivalent continuous A-weighted sound pressure level \( L_{Aeq} \) for any chosen time interval (in multiples of one hour). The procedure relates both to traffic operating on uninterrupted flow road facilities and to stop-start conditions on interrupted flow road facilities.

The procedure of traffic noise prediction is to be followed in three consecutive parts: (details in the paragraph on ‘Scientific principles’):

- Calculation of the basic noise level for a set of standard conditions at a reference distance of 10 m from the source line.
- Calculation of the primary corrections, i.e. the corrections for
  - speed and percentage of heavy vehicles,
  - gradient and
  - road surface texture.
- Where necessary, calculation of the secondary corrections for
  - propagation and screening,
  - site layout (e.g. reflections) and
  - angle of view.

A more detailed version of the SABS 0210:1996 is provided in Appendix 1, pages 14 to 16.

2.3.3 SABS Code of Practice 0328

South African Bureau of Standards Code of Practice 0328 edition 1 2000 ‘Methods for environmental noise impact assessments’. This code of practice provides methods of environmental noise impact investigations which

- identify all the issues that could have an effect on the environment;
- assess the impact of the identified issues on the environment; and
- identify probable alternatives and assess their impact on the environment.

2.3.4 SABS Code of Practice 0357

In 1981 an international study group for CONCAWE (CONservation of Clean Air and Water – Europe), which was commissioned by a number of oil companies, presented the results of its investigation into ‘The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities’. It was recognised that the empirical CONCAWE method of noise prediction is more accurate than other methods used before (e.g. VDI 2714), that it is reasonably easy to apply and that it is also valid for many other types of noise sources like PAS 2005. It can be applied to the smelter and to the port facilities.
The CONCAWE method was adopted by SABS as recommended practice ARP 014-1990 and later as code of practice 0357 edition 1 2000 ‘The calculation of sound propagation by the Concawe method’.

The approach taken by CONCAWE is to calculate from a known sound power octave band spectrum of a noise source the sound pressure levels in octave bands.

The procedure is as follows:

The following two variables result in the Pasquill Stability Criterion (A - G)

- Wind speed (scalar)
- Solar radiation and cloud cover during daytime and cloud cover during night time

Although generally used for calculation of dispersion of airborne material, this measure is well suited to describe the state of the lower atmosphere and allows a sufficiently accurate estimate to be made of the atmospheric temperature gradient, which affects the propagation of sound.

- Wind speed (vector), obtained from 10 years’ S A Weather Bureau data for Port Elizabeth and shown in graphic form (graphs 1 to 5) in Appendix 1 lead to the meteorological category (1 to 6).

The sound pressure level is computed as function of the above meteorological category and the following nine variables

- Distance (m)
- Source height (m)
- Receiver height (m)
- Distance over soft ground (m)
- Temperature (°C)
- Relative humidity (%)  
- Barometric pressure (kPa)
- Barrier height (m)
- Barrier distance from source (m)

The procedures are applied in the example Appendix 1, page 13.

2.3.5 World Bank and EU guidelines

The World Bank parameters for the evaluation of noise emission and immission are defined in the World Bank document ‘Pollution Prevention and Abatement Handbook’ in the chapters ‘General Health and Safety Guidelines’ and ‘Part III - Aluminum Manufacturing’. The relative passages from the World Bank ‘Pollution Prevention and Abatement Handbook’ are reproduced on page 21 of Appendix 1. These guidelines stipulate that the maximum allowable Sound Pressure Level (L_{Aeq(1hour)}) is 70 dB(A) for industrial areas during the daytime and nighttime.
The European Commission Green Paper Brussels 04/11/1996 ‘Commission for the European Community Future Noise Policy’ follows the World Bank regulations regarding non-industrial districts but is not applicable for industrial districts. As it is CDC’s explicit aim not to allow residential development to take place in the IDZ, the EU green paper is not applicable.

2.3.6 Ambient noise guidelines for the Coega Development Zone

A document entitled “Coega development zone: ambient noise guidelines” has been prepared by Jongens Keet and Associates (February 1999). This document was produced for the purpose of screening proposed projects and activities for noise pollution by the Coega local authority, the Environmental Manager of the Coega IDZ and prospective tenants (section 1 Introduction). It was, however, not intended to substitute the process of an environmental noise impact assessment. The rejection of permissible sound level increase of 3 dB (applying the World Bank guideline) or 7 dB (applying the South African guideline) to avoid “creeping” noise levels to develop, is supported (it was implemented through the current Gauteng noise regulation), although this method is also not without problems.

2.3.7 Codes of Practice and Guidelines applied in this study

Whereby SABS 0103:1994 differentiates daytime, evening and night time outdoors rating levels for industrial districts (70, 65, 60 dB(A)), the World Bank guideline applies 70 dB(A) throughout. As a code of practice is not legally binding, but constitutes a recommendation, we express the opinion that within an industrial district, which operates around the clock, the emitted noise is virtually constant and therefore the World Bank rule is more acceptable. This is also partially the viewpoint expressed in the document ‘Coega Development Zone – ambient noise guidelines’ ref. [JKA].

Based on the discussion in this chapter, the following items are selected as being suitable to serve as fundamentals:

- The World Bank guideline for industrial areas which allows 70 dB(A) as the noise level maximum limit is used. A target level of 67 dB(A) caused by PAS2005 at the boundary of the smelter site, allows a future neighbour also to generate noise to a maximum of 67 dB(A) which combine to 70 dB(A). If, for any reason, the establishment of a neighbouring noise generator can be excluded (e.g. boundary against a river or a highway) this can be taken into consideration and the boundary level is allowed to reach 70 dB(A). This principle also applies to composite noise sources inside the property and is taken care of by standard engineering design procedures.

- SABS code of practice 0357 edition 1 2000, the SABS implementation of the Concawe method of prediction of sound propagation is used. This is acknowledged as the most advanced prediction method of sound propagation since the PAS2005 projects meets the model description, this is the obvious choice.
- SABS code of practice 0210:1996 is a well-established and proven method for predicting road traffic noise to a very detailed degree. It further has the advantage to allow for additions and omissions of procedural steps, which make it well suitable for this purpose where other developments have not yet taken place and a number of variables are not known.

- SABS code of practice 0103:1994 Table 2 for evaluation of characteristic rating levels of residential districts.


3. **APPROACH TO THE STUDY**

3.1 **Scientific methodology of the study**

The scientific, physical and engineering principles employed in the development of this acoustics assessment are listed and explained in this section. This is done by explaining the sequence of calculations undertaken in Tables 1 to 13 in Appendix 1.

3.1.1 **Calculation of noise emission levels and noise impacts for the construction and operations phase for the smelter and port activities (Tables 1 to 6)**

For the construction phase (Tables 1 to 3) and operation phase (Table 4 to 6), the establishment of Impact Significances is developed in the following manner. All Tables list the noise sources in the first column titled ‘Item & Description’. Tables 1 and 4 list sound pressure and power levels; Tables 2 and 5 list the effects for different target sound levels; and Tables 3 and 6 show the different assessment categories and the significances with and without mitigation.

*Tables 1 and 4*

- Types of machines are identified through observation, experienced data, data obtained from other parties like AP and literature.
- A typical set of noise emission data is determined for each type of noise source. In this case the most convenient common denominator is the A-weighted free field sound pressure in 15 m distance and characteristic relative frequency spectra. Data originate from literature and conducted measurements.
- By applying the Concawe method in reverse with meteorological category 4, the sound power levels (SWLs) are established.
Tables 2 and 5

- By applying the Concawe method directly with the above established SWLs and meteorological category 6, the distances for the three different critical resulting sound levels of 70, 55 and 45 dB(A) are established.
  - This method was chosen as it provides more detailed quantitative information about the noise propagation than a simple “yes/no” statement referring to noise levels exceeding limits at specific locations.
  - The meteorological category 6 follows the selection procedure of the Concawe method together with wind data obtained from the S A Weather Service (Tables 16 to 20, Appendix 1).

- Two different scenarios affecting the important factors of ground absorption are investigated: from the noise source 200 m hard ground and the balance soft ground, reflecting the present situation without developments outside PAS2005 and hard ground over the full distance with developments having been established throughout the IDZ. No buffer zones and no reflections and barrier effects of other developments have been allowed for, as no data are available.

Tables 3 and 6

- Observations of other similar applications and common reasoning are used to establish extent, duration, intensity and probability of each item. Significances are defined from the definitions:

  **Low**
  - Sound levels always lower than established limit levels

  **Medium**
  - Sound levels sometimes lower and sometimes higher than established limit levels

  **High**
  - Sound levels always higher than established limit levels

3.1.2 Calculation of motor vehicle generated noise for the construction and operations phases of the smelter for key transport routes (Tables 7 to 12)

The road traffic noise situation is investigated from the angle of increase of traffic volume. According to SABS 0210:1996 a volume increase follows the formula $\Delta SPL = 10 \cdot \log(V_2/V_1)$ (the logarithmic principle of noise level summation) and the heavy vehicle (> 1525 kg) content $p$ in %, combined with the speed of traffic $v$ in km/h which follows the formula

$$L_{p,v} = 33 \cdot \log(v + 40 + 500/v) + 10 \cdot \log(1 + 5 \cdot p/v) - 68.8.$$

The procedure of this investigation is tabulated in the tables. Secondary corrections as provided by SABS 0210:1996 are not applicable as the other characteristics of the road traffic do not change.
3.1.3 Calculation of the noise propagation from the PAS 2005 to Motherwell during the operations phase and under worst case conditions, using the Concawe method (Table 13, Appendix 1)

With the variables set to values as listed in Table 13 page 13, Appendix 1, the result is that the effective sound level in Motherwell caused by the operation of the smelter is 23 dB(A). The sound power levels are derived from a process equal to the one described above under 3.1.1: ‘By applying the Concawe method in reverse with meteorological category 4, the sound power levels (SWLs) are established.’ This case study also serves as detailed example for the Concawe method and serves to demonstrate that the noise generated during construction and operation has low significance affecting Motherwell as the nearest residential district and consequently all residential districts.

3.2 Assumptions

This study is based on the following assumptions:

(i) It is assumed that machinery and vehicle noise emission levels are similar to those experienced at smelters using comparable technology and design. Unusual equipment or unusual equipment combinations are found mainly in the unloaders, rodding shop and cast house.

(ii) Road traffic noise evaluations are taken on the road reserve as having the horizontal distance from the source line to the receiver of 7.5 metres (which is the distance ‘d’ in accordance with SABS 0210:1996, paragraph 6.2 Note 1: In cases where the measurement method is not practicable, or for planned roads, the correction can be approximated by assuming the distance d to be equal to 7.5 m.).

(iii) The boundary of the smelter site at which noise levels are calculated is taken as the edge of the 80 ha site area. This results in a distance of at least 200m from the plant to the boundary. For many parts of the site, this distance to the boundary will be in the order of 400m. However, in the calculations in the assessment section, it is assumed the plant is 200m from the boundary.

(iv) The boundary of the conveyor route at which noise levels are calculated is taken as the edge of a 200m corridor from the conveyor centre line to the corridor boundary. The boundary for the unloading activities at the Port of Ngqura is also taken as 200m from the edge of the operational area used by the unloaders.

(v) In the Concawe method calculations for the noise impacts during operation of the smelter, a worst case meteorological conditions is assumed that meteorological condition 6 exists, which is equally representative for day time and night time. The Conditions for reverse application to determine SWLs in octave bands is meteorological category 4, 15 m over hard ground, source & receiver height 1.4 m, no barriers, which is assumed to be the basis for the tabulated sound levels. The
meteorological category follows from the Pasquill stability criterion A or B which follows from wind speed of < 1.5 m/s and non-overcast sky.

The meteorological information is obtained from the South African Weather Service and is graphically illustrated in graphs 1 to 5 in Appendix 1. The wind speeds shown are mean speeds, which vary between 3 and 8 m/s depending on the wind direction. Being average speeds, it is assumed that there are lengthy periods of time when the actual wind speed reaches double the mean value. This brings the wind speed rating to = 6 m/s in any direction.

(vi) Of particular importance during the construction period is the combination of several individual noise sources, which may nominally exceed acceptable noise levels. Because there is a sizeable distance between the individual noise sources, the individual levels have usually decayed enough so that the resulting level is below the limit.

The same principle applies to the operation phase where, however, constructive mitigation measures are engineered and applied. This is a design process which must commence with procurement and follow through to monitoring during operation.

(vii) In the assessment section, impact significance is assigned based on the following criteria (70 dB(A) without neighbouring development, 67 dB(A) with). There is no legally binding regulation for 67 dB(A), but this is rather to be regarded as “good engineering practice”.

<table>
<thead>
<tr>
<th>Noise level at boundary of site</th>
<th>Significance rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constantly or regularly &gt; 70 / 67 dB(A)</td>
<td>High</td>
</tr>
<tr>
<td>Occasionally/for short periods of time &gt; 70 / 67 dB(A)</td>
<td>Medium</td>
</tr>
<tr>
<td>Continuously &lt; 70 / 67 dB(A)</td>
<td>Low</td>
</tr>
</tbody>
</table>

(viii) An existing salt factory in a distance of 1000 m to 1500 m from the smelter is assumed to increase the apparent existing ‘rural district’ by 5 dB to rating levels of ‘urban districts with little road traffic’ (due to the distance, soft ground cover and the topography, this is a reasonable assumption, although the describing words do not meet with the situation), outdoors daytime 45 dB(A), outdoors evenings and weekends 40 dB(A) and outdoors night-time 35 dB(A).

(ix) Combinations of noise levels occur frequently, during construction and operation phases. Most construction machines do not operate continuously but rather erratically, thus reducing the mean level due to diversity over time.

Furthermore, taking only geometric propagation into account, a reduction of 3 dB will be reached at double the distance from the reference distance in case of a line source and 1.4 x the distance from the reference distance in case of a point source, which is the normal situation during the construction phase. This means that, from
the observation point of a listener two equal point noise sources, which are situated so that they enclose a right angle with the observer, will be measured at the same noise level as a single source in straight line with the observer. The below figure illustrates this, i.e. the sound sources A and B emit the same noise level, then the composite sound level from the two sources A is the same as that from the sound source B alone, experienced by the observer C.

This model proves that, if noise sources are not closely grouped together, but spread apart, the emission is measurably reduced. Furthermore, machines with a noise emission of = 10 dB lower than another one situated nearby does not have an effect on the noise level at the receiver position. These three effects (diversity in space, diversity in time and level difference) are estimated and assumed to compensate for the compound effect.

3.3 Methodology for impact assessment and mitigation

(i) Methodology for the assessment of potential impacts

- The significance of potential impact is described as follows:
  
  **Low:** Where the impact will not have an influence on the decision or require significant accommodation in the project design
  
  **Medium:** Where it could have an influence on the environment, which will require modification of the project design or alternative mitigation;
  
  **High:** Where it could have a ‘no-go’ implication for the project regardless of any possible mitigation.

- The assessment of impact significance is based on the following convention:

  *Nature of impact* - this reviews the type of effect that a proposed activity will have on the environment and includes “what will be affected and how?”
**Extent** - this indicates whether the impact will be local and limited to the immediate area of development (the site or the servitude corridor); limited to within 5km of the development; or whether the impact may be realised regionally, nationally or even internationally.

**Duration** - this reviews the lifetime of the impact, as being short term (0 - 5 years), medium (5 - 15 years), long term (>15 years but where the impacts will cease after the operation of the site), or permanent.

**Intensity** - here it is established whether the impact is destructive or innocuous and is described as either low (where no environmental functions and processes are affected), medium (where the environment continues to function but in a modified manner) or high (where environmental functions and processes are altered such that they temporarily or permanently cease).

**Probability** - this considers the likelihood of the impact occurring and is described as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of prevention measures).

- The status of the impacts and degree of confidence with respect to the assessment of the significance, is stated as follows:

  **Status of the impact:** A description as to whether the impact will be positive (a benefit), negative (a cost), or neutral.

  **Degree of confidence in predictions:** The degree of confidence in the predictions, based on the availability of information and specialist knowledge.

- Impacts are described both before and after the proposed mitigation and management measures have been implemented.

- All impacts are evaluated for the full-lifecycle of the proposed development, including construction, operation and decommissioning.

- The impact evaluation takes into consideration the cumulative effects associated with this and other facilities, which are either developed, or in the process of being developed in the region.

- The specialist study attempts to quantify the magnitude of potential impacts (direct and cumulative effects) and outline the rationale used. Where appropriate, national standards are used as a measure of the level of impact.

(ii) **Methodology for the Mitigation and Monitoring**

- Where negative impacts are identified, mitigation objectives are set (i.e. ways of reducing negative impacts), and attainable mitigation actions are recommended.
Where no mitigation is feasible, this should be stated and the reasons given. Where positive impacts are identified, actions to enhance the benefit must also be recommended.

- Quantifiable standards for measuring the effectiveness of mitigation and enhancement will be set. In addition, monitoring procedures and review programmes to assess the effectiveness of mitigation will be recommended.

4. KEY NOISE SOURCES

The main noise sources considered in this study result from the smelter site itself, related activities at the Port of Ngqura and Port Elizabeth Harbour, and the conveyor between the Port of Ngqura and the smelter site. In addition, noise from the transport of materials or products between the Port and the smelter site during operations is also investigated.

Material flow occurs between the PE Harbour and the smelter during construction phase and between mainly Port of Ngqura and to a lesser degree PE Harbour and the smelter during operation phase. This activity is prone to becoming a noise issue regarding road transport. Belt conveyor noise for transporting alumina and coke is another potential noise source.

4.1 Construction phase noise sources:

- Ship unloading activities of construction equipment and material in Port Elizabeth harbour.
- Truck loading activities of construction equipment and material.
- Road transport between harbour and building site (both directions).
- Road transport between other locations and building site (both directions) (supply of material from other sources than Port Elizabeth harbour).
- Truck unloading activities of construction equipment and material at the building site.
- Transport of personnel to and from building site.
- Use of construction machinery and equipment on building site:
  - Earth moving equipment
    - Bull dozers, Front loaders, Tractors, Scrapers, Graders, Pavers, Trucks
  - Materials handling
    - Concrete mixers, Concrete pumps, Cranes, Derricks, Trucks
  - Stationary equipment
    - Pumps, Generators, Compressors
  - Impacting equipment
    - Pile drivers, Jack hammers, Rock drills, Pneumatic tools
  - Other
    - Saws, Vibrators, Blasting activities
4.2 Commissioning phase noise sources:

- Use of construction machinery and equipment on building site:
  - Cranes, Derricks, Trucks, Generators, Compressors, Jack hammers, Pneumatic tools, Saws
- All items listed under ‘Operating phase noise sources’

4.3 Operating phase noise sources:

- Alumina and coke unloaders in the Port of Ngqura.
- Compressed air plants vacuuming spillage from conveyor system.
- Conveyor belt systems, drives and idlers.
- Conveyor belt terminals at smelter silos.
- Compressor installations.
- Blower installations.
- Gas treatment centres.
- Fume treatment centres.
- Rodding shop.
- Vibrating screens.
- Ball mills.
- Cast house.
- Cooling towers.
- Trucking of finished products from smelter to Port of Ngqura and empty trucks return.
- Trucking of aluminium fluoride and heavy fuel from Port Elizabeth harbour to smelter.
- Transport of personnel to and from work places.

The nature of the activities led to the necessity of an investigation taking the form of an investigation procedure in accordance with SABS 0328 consisting of a scoping report followed by an environmental impact report (in SABS ARP 020 referred to as sound impact investigation ‘class 2’ and ‘class 1’).

Experience from noise monitoring at comparable smelters, from other measurements and from available literature, enabled the identification of appropriate sound levels for equipment and machinery. These are listed in Tables 1 and 2, Appendix 1 for building and construction related noise sources; and in Tables 4 and 5, Appendix 1 for operation related noise sources. Appendix 1 Tables 3 and 5 are assessments of noise impacts for the construction and operation phase respectively. Reference will be made to these tables in the section dealing with impact assessment and mitigation.

5. EXISTING SOUND ENVIRONMENT AND AFFECTED AREAS

SABS 0103:1994 Table 2 provides district noise levels in the form of ‘Rating Levels’, which are sufficiently precise as to allow an accurate prediction.

The land on which the smelter, the conveyor track and the hauling route are intended to be established are characterised as ‘rural districts’. With an existing salt factory in a distance of
1000 m to 1500 m the rating levels are assumed to be equivalent to ‘urban districts with little road traffic’ (due to the distance, soft ground cover and the topography, this is a reasonable assumption, although the describing words do not meet with the situation) outdoors daytime 45 dB(A), outdoors evenings and weekends 40 dB(A) and outdoors night-time 35 dB(A).

Motherwell, the nearest residential area to the PAS2005 smelter, is best described as ‘c) Urban districts’, i.e. outdoors daytime 55 dB(A), outdoors evenings and weekends 50 dB(A) and outdoors night-time 45 dB(A).

With regards to the Coega IDZ the PAS2005 project being established in a declared (zoned) industrial district, the noise criteria is determined to be 70 dB(A) during day and night time.

Both above items correspond with the World Bank guidelines and the Coega Development Zone – Ambient Noise Guidelines.

6. IMPACT ASSESSMENT, MITIGATION AND MANAGEMENT ACTION

This chapter contains an assessment of the predicted sound impacts resulting from the PAS 2005 smelter, the Port of Ngqura operations and the Trucking Routes related to PAS 2005. Both construction and operation phases are considered. The commissioning phase activities are either part of the construction or the operating phase and are therefore not separately assessed.

As a building programme is not available at this stage, no composite $L_{Aeq}$ values for the combined noise level for the number of construction items can be calculated at the property boundary.

The environmental noise criteria are evaluated as the sound levels occurring on the property boundary of the 80 hectare AP smelter, the Port of Ngqura and the boundary of the defined conveyor corridor between AP smelter and Port of Ngqura. The road reserve assumption as allowed for in SABS 0210:1996 is used as measurement basis for road traffic noise.

The assessment of the predicted noise impacts associated with the PAS2005 project are summarized in Appendix 1 Tables 3 (construction phase) and 6 (operation phase). The glossary contains explanations of the abbreviations and terminology and methods used in these tables.

The documented target noise levels in the regulations are to be understood as binding not only after PAS2005 is completed and goes into production, but also has to allow for composite effects, i.e. the design level is to be set to 67 dB(A) where the regulation requires 70 dB(A) in order to allow the neighbouring development also to emit 67 dB(A) and thus not to exceed 70 dB(A) at the boundary of the smelter site. The frequency characteristic of the emitted noises has no bearing on the physics of composite sources.
Regarding the construction phase, the following is to be considered:

The heading 'Duration' refers to the construction period, reference to the life cycle would be trivial as all durations would be ‘short’.

Regarding operation phase, the following is to be considered:

Under SHIP UNLOADERS and CONVEYOR BELT SYSTEM and the other components forming part of the port operation, the heading 'Duration' is to be understood as relative to the life cycle of the AP plant or the Port of Ngqura unloading facilities if that is shorter (i.e. if there is a future change in procedures in that alumina and coke unloading is no longer conducted in the same way or at all in the Port of Ngqura).

Under TRUCKS, the gradings under the heading 'Duration' are to be understood as relative to the length of the day time or night time period respectively. Only the haulage of aluminium ingots is anticipated to be a 24 hour operation. Duration relative to plant or equipment life span is ‘long’ in all instances.

Under SMELTER EQUIPMENT the terms can be taken literally.

6.1 Construction phase

The assessment of impacts during construction is provided in Appendix 1 (Table 3). Refer to Appendix 1, Tables 1 and 2 for detailed information. The $L_{A\text{max}}$ @ 15 m distance are extracted from Harris Handbook of noise control. The noise impacts of activities during the 26 months of construction from 2002 to 2005 are dealt with as different parcels, depending on activities foreseen during different periods. The main impacts are summarised below:

- Preparation for construction phase: building construction roads, erecting security demarcations like fences etc. and building stores, site workshops, site offices and other temporary structures. Accommodation for workforce is explicitly not provided within the IDZ, but a construction village is planned at Wells Estate south of PAS2005 smelter.

  Impact significance with and without mitigation: Low
  Key sources of noise generation: manual labour, some trucking.

- Earthworks involving bull dozers, blasting, pile driving, scraping, other specialised digging and earth moving equipment and machinery and trucking.

  Impact significance without mitigation: High, with mitigation: Medium
  Key sources of noise generation: manual and machine labour, high impulsive impacts by blasting and pile driving.

- Building and other structure construction incorporating laying foundations, casting slabs, building walls and roofing.
Impact significance with and without mitigation: Medium
Key sources of noise generation: manual and machine labour, most severe incidences expected to be caused by jobbing activities like woodwork with circular saws etc. Some shielding of noisy activities is possible through completed structures.

- Installation and erection of production equipment and machinery and services like water and electricity.

Impact significance with and without mitigation: Low to medium
Key sources of noise generation: manual and machine labour, most severe incidences foreseen to be caused by jobbing activities, like sawing, drilling, hoisting etc. A good amount of shielding of noisy activities is possible through completed structures.

- Production plant and machinery commissioning and start-up.

Impact significance without mitigation: Medium, with mitigation: Low
Key sources of noise generation: manual and machine labour, most severe incidences foreseen to be caused by snagging (corrective activities) and commissioning activities.

- Unloader and conveyor system construction and installation, parallel to the above smelter construction phase activities.

Noise severities similar to the ones above, except that little shielding by completed structures can be expected.

- Trucking / hauling of material and equipment and road transportation of personnel forms a significant part of the noise emission. The “run of the mill” motor vehicles will be trucks with total mass of between 5 and 30 tonnes, however numerous extra heavy vehicles can be expected delivering bulky equipment.

6.2 Commissioning phase

Refer in full to the following section 6.2 ‘Operation phase’

6.3 Operation phase

Application of engineering mitigation measures throughout the smelter, conveyor system and unloaders to obtain boundary sound levels that meet the required guidelines is an established and proven engineering process. For example, this procedure for noise management has been applied successfully at the Mozal and Hillside smelters. The procedure is implemented from conceptual design through detail design, procurement, construction, mechanical and electrical installations, commissioning and operational monitoring.
For that reason, the smelter, conveyor systems and unloaders, and not the individual components contained in these sections, are regarded as established systems to which mitigation is to be applied if necessary. There is no need for engineering mitigation, provided that best practice is applied.

The assessment of impacts during operations is provided in Appendix 1 (Table 6), with supporting calculations in Tables 4 and 5.

For the purposes of this noise assessment, the following key components of the project are identified:

(i) Smelter, with individually recognised high noise level activities indicated in Figure 4.

As a single compounded noise source, the smelter is designed and built to generate noise levels conforming with the world bank regulations, i.e. 67 dB(A) where neighbouring developments are possible and 70 dB(A) where these can be positively ruled out.

*Impact significance with and without mitigation: Low*

(ii) Port activities include primarily unloading of alumina and coke with two suction unloaders (as illustrated in Figure 5). The boundary distance for noise emission is, consistent with smelter and conveyor corridor, 200 m.
The suction unloaders generate individually a noise level of 67 dB(A) in 50 m distance. As there are two unloaders, they would together generate 70 dB(A) if they were located close together. Experience in Richards Bay shows, that if they are operating simultaneously, they are at > 100 m distance from each other, which results the combined level to be in the region of 68 dB(A) (observed by VibrAcoust). With the 200 m boundary distance this is not affecting the impact significance. Of great importance as mitigation is management action in form of strict application of maintenance routines.

**Impact significance with mitigation: Low, without mitigation: Medium to High**

(iii) The unloading process is accompanied by some dust generation. This is controlled by a process of vacuuming the conveyor station near the unloaders. Further away from the unloaders the alumina and coke have settled well enough on the conveyor belt that no significant amount of dust occurs and vacuuming is no longer required. An air compressor station is situated in the port facility for this purpose of vacuuming.

The compressors are housed in protective buildings which, due to their construction as protective enclosures, reduce noise levels generated by these machines to < 67 dB(A).

**Impact significance with and without mitigation: Low**

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**Figure 5: Alumina and Coke Unloader**
(iv) The conveyor system itself transports alumina and coke from the port of Ngqura to the smelter over a distance of some 3.8 km. The conveyor is placed in a secure corridor and is driven by electric motors.

Conveyor systems are potentially noisy with regards to squeeeking and faulty bearings. Mitigation in the form of predictive maintenance (e.g. vibration monitoring) and scheduled lubrication is essential.

(v) The finished product in form of aluminium ingots is transported from the smelter to the port via 24 ton (payload) trucks.

The noise generated by these trucks consists of engine, driving and brake noise. The main cause is found in the use of motor brakes which generate a very high level low frequency noise. Although not quite as annoying as “thumping” disco music with high bass levels, it behaves similarly and can under unfavourable meteorological conditions carry very far. Very unfavourable meteorological conditions may cause sound waves to be reflected by upper layers of air and, particularly in the lower frequencies like motor brakes, increase the noise propagation distance. This situation is to be monitored. If monitoring results in mitigation measures to be implemented, one of the first options is disabling the motor brakes. The use of disk brakes alone is safe for driving. Also, maintenance must be conducted regularly, with particular attention given to the silencing components of the vehicles like exhaust silencers, absorbing lining of engine hoods etc.

It is further advised to schedule trucking to curb nighttime hauling as far as possible. This is feasible with 15 hour operations.

Impact significance with mitigation: Low to medium,
without mitigation: Medium to High

6.4 Road traffic

Traffic facts and numbers used in this section were taken from the Specialist Study on Traffic and Transportation (dated June 2002) undertaken for this EIA. These were computed to arrive at related noise levels and the calculations are shown in Appendix 1, Tables 7, 8, 9, and 10.

Eight transportation scenarios were investigated, representing the main road traffic arteries affected by PAS2005:

- N2 south and north of the MR 450
- Ranger south and north of the MR 450
- MR435 south and north of the MR 450
- MR460 south and north of the MR 450
Each scenario was further studied in absolute terms and relative to the composite effect caused by PAS 2005. This enabled the calculation of traffic noise levels for the following situations:

- the Pre-PAS2005 situation alone (i.e current situation),
- the situation with construction caused traffic added; and
- the situation with production caused traffic added (i.e. operations phase).

The conclusion is that the road traffic changes brought about by PAS 2005 result in an increase of road traffic noise of between 0 (zero) and 1.5 dB. The measurement time period is 1 hour, allowing a representative traffic flow to pass the measuring point. The latter increase is not noticeable by the human ear and is also difficult to follow by measurements with a sound level meter because this variation is within measurement tolerances. This conclusion is, however, true only if the 24 T aluminium ingot trucks descend to the port without using a motor brake. Measurements by this firm prove that motor brakes emit high levels of low frequency noise which is very annoying and decays least over distance, so that this specific noise would become a problem. Disabling the motor brakes in no way reduces the operating safety of the trucks but increases the operating cost by increase of brake pad wear and truck maintenance (according to Truckafrica, one of the biggest road hauling companies in South Africa).

This is reversible if, through monitoring, the compounded road traffic noise level (caused by PAS2005 and other road users) increases to such an extend that the PAS2005 hauling operation would not cause any significant change in compounded noise level with or without motor brakes. This change is quantified as $= 0.5$ dB(A). This situation may arise from increase of traffic or other road users not adhering to the ‘disciplined driving’ rules.

The distance from the Aluminium Pechiney quay area to Jahleel Island, the nearest island, which is a sea bird breeding ground, is almost 2 km. The PAS2005 related port activities will not be noticeable at that distance, but truck motor brakes can well be heard on the island.

### 6.5 Generally applicable mitigation measures

During the construction phase, high activity levels in all respects will make the smelter construction site the epicentre of created noise. With implementation of correct engineering noise mitigation measures and management actions, the smelter will, once construction ceases, become one of the less problematic items.

Mitigation measures are, at this stage, broadly referred to and the degree of effectiveness is stated with a high degree of confidence. Detailed solutions are, however, to be implemented during design or even construction phase.

SABS ARP 020 provides in paragraph 7.6 a list of practical mitigation measures by answering, inter alia, the following questions:

a) Can the number of noise sources be reduced?
b) Can the noise sources be replaced by more silent types?
c) Can the duration of the noise be reduced or limited?
d) Can the direction of maximum noise emission be changed?
e) Can structures be insulated?
f) Can silencers be fitted?
g) Can the distances between sources and target area be increased?
h) Can acoustical screening be used?
i) Can the target area be moved?
j) Can the traffic route be changed?
k) Can the target area be re-zoned?

More proven noise abatement methods are illustrated in Appendix 3.

6.6 Specific mitigation measures and management actions with reference to foot notes Tables 3 and 6 Appendix 1

6.6.1 Construction phase

Table 3 provides possible engineering mitigations and management actions for the construction phase.

The notes in Table 3 are to be interpreted as follows:

Note¹:
- Keep all equipment in good working order.
- Operate equipment within it's specification and capacity. Don't overload machines.
- Apply regular maintenance particularly with regards to lubrication.
- Operate equipment with appropriate noise abatement accessories like sound hoods and ensure that these accessories are correctly maintained.
- Operate equipment in as diversified a manner as possible, i.e. if possible, spread operation of equipment throughout working periods rather than operating several items simultaneously.
- Turn equipment off when not in use.

Note²:
- Position equipment in sheltered locations.
- Utilize partly finished buildings to accommodate equipment.

Note³:
- Carefully select times when the environment is least sensitive to noise impact, preferably during daytime hours and during normal working days.

6.6.2 Operation phase

Table 6 of Appendix 1 provides notes on the types of mitigation actions that should be applied for the equipment use and activities listed in that table. The notes are to be interpreted as follows:
Note 1:
- Keep all equipment in good working order.
- Operate equipment within its specification and capacity. Don’t overload machines.
- Apply regular maintenance particularly with regards to lubrication.
- Operate equipment with appropriate noise abatement accessories like sound hoods.
- Operate equipment in as diversified a manner as possible, i.e. if possible, spread operation of equipment throughout working periods rather than operating several items simultaneously.
- Turn equipment off when not in use.

Note 2:
- Operate equipment only with doors of the enclosure being closed where such an enclosure is present.
- Position equipment in sheltered locations.
- Install signboards demanding that doors be kept closed.
- Install signboards dictating hearing protectors in plant rooms.

Note 3:
- Carefully select times of operation when the environment is least sensitive to noise impact, preferably during daytime hours during working days.
- Observe during maintenance particularly that noise abatement devices are in good order, e.g. motor brakes, exhaust mufflers, engine hoods etc.
- Permanently disable all exhaust brakes on trucks. The operational functions and safety of the vehicles will not be affected by this, however, wear of brake shoes and brake drums will increase.
- Curb trucking operation during night time as much as possible.
- Vehicle maintenance is to ensure that noise abatement devices like exhaust mufflers, engine hoods etc. are in good condition and order.
- Educate truck drivers about the characteristics of Diesel engines, i.e. that the flat torque characteristic allows ascending an incline in a higher gear, which is a less noisy operation.

Further, soft ground cover reduces significance by increasing the decay of sound propagation. AP is to keep or develop as much green plant growth as possible and provide a vegetated buffer on the inner perimeter of the property of at least 100m width for most, if not all, directions. Other developments within the CDC should be encouraged to follow the same route.

These mitigation measures must be incorporated into the planning and design and the Environmental Management Plan of the PAS2005 for the construction and operation phases.

Appendix 2 provides engineering and management mitigation methods, both for construction and operation phases.
6.7 Proposed monitoring programme

6.7.1 General

An overlap exists between noise related matters which ought to be monitored, and monitoring processes in other areas.

In particular, OSH (occupational safety and health) related mandatory monitoring requirements are often sufficient to be used for environmental purposes. This refers mainly to noise exposure monitoring at the working place, which is essentially a data collection process which may be using the same units as environmental noise monitoring requires, covering nearly the full range of machinery and equipment inside the smelter and the harbour facilities. Also, for example, in the field of machine condition monitoring, a fair amount of information can be shared, specifically from activities like vibration monitoring.

6.7.2 Monitoring summary

The proposed monitoring programme is provided below. The merits of integrating the noise monitoring for the smelter with monitoring for the wider IDZ and Port of Ngqura also need to be considered.

<table>
<thead>
<tr>
<th>What</th>
<th>When</th>
<th>Where</th>
<th>Standard</th>
<th>Monitoring Equipment</th>
<th>Time Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boundary locations</td>
<td>2 / annum</td>
<td>Near noise intensive sources</td>
<td>World Bank</td>
<td>Sound level meter</td>
<td>Full plant life span (to be adjusted as the IDZ develops)</td>
</tr>
<tr>
<td></td>
<td>1 / annum</td>
<td>Throughout in 400 m intervals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nearest residential district</td>
<td>1 / annum during worst conditions</td>
<td>Nearest point to plant</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Port activities</td>
<td>2 / annum</td>
<td>Near noise sources</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conveyor system</td>
<td>1 / annum</td>
<td>Along buffer zone both sides in 1000m intervals</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aluminium hauling trucks</td>
<td>2 / annum</td>
<td>Aluminium ingot hauling routes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

7. PERMIT REQUIREMENTS

7.1 Permits

No permits are required, however, the TAP requires an evaluation of potential noise emissions.
7.2 CDC Tenant Applications Procedure Questionnaire

The CDC requires, as part of its Tenant Questionnaire information leading to a decision if certain actions are to be taken, information as per the applicable pages of the ‘Tenants Questionnaire’ (transcript on pages 14 and 15 Appendix 1). The completion of this Tenants Questionnaire constitutes a Class 3 investigation per SABS ARP 020. The purpose of a Class 3 sound impact investigation is to determine whether the proposed development may have acoustical implications. [SABS020]

According to this ‘Tenant Questionnaire’, PAS2005 activities are in List 1. A Class 2 sound impact investigation of the entire activity followed by a Class 1 investigation, where relevant, is required to be undertaken in accordance with SABS ARP 020 sound impact assessments for integrated environmental management. The purpose of a Class 2 sound impact investigation is to determine whether the acoustical implications could be significant. [SABS020]. The purpose of a Class 1 sound impact investigation is to determine and quantify the acoustical impact of, or on, the development [SABS020].

This specialist study meets the requirements of a Class 2 and Class 1 investigation.

8. CONCLUSIONS AND RECOMMENDATIONS

The main noise sources are identified as high impact activities, which are:

<table>
<thead>
<tr>
<th></th>
<th><strong>Significance</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>without mitigation</strong></td>
<td><strong>with mitigation</strong></td>
</tr>
<tr>
<td>During construction:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pavers</td>
<td>High</td>
<td>medium</td>
</tr>
<tr>
<td>Scrapers</td>
<td>High</td>
<td>medium</td>
</tr>
<tr>
<td>Pile drivers</td>
<td>High</td>
<td>medium</td>
</tr>
<tr>
<td>Jack hammers</td>
<td>High</td>
<td>medium</td>
</tr>
<tr>
<td>Blasting</td>
<td>High</td>
<td>medium</td>
</tr>
<tr>
<td>During operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trucks to Port of Ngqura</td>
<td>High</td>
<td>medium</td>
</tr>
<tr>
<td>Gas treatment centre</td>
<td>High</td>
<td>low</td>
</tr>
<tr>
<td>Fume treatment centre</td>
<td>High</td>
<td>low</td>
</tr>
<tr>
<td>Anode rodding shop</td>
<td>High</td>
<td>low</td>
</tr>
<tr>
<td>Vibrating screens</td>
<td>High</td>
<td>low</td>
</tr>
</tbody>
</table>

Key mitigation measures and management actions during construction:

Study and apply Appendix 2 of this document.
- Limit occurrence of main noise sources to daytime and weekdays / avoid nighttime, weekends and holidays.
- Use machines and equipment that operate at state of the art noise levels.
- Avoid where possible concentrated operation of noisy machines and equipment, i.e. spread such operations over the building site.
Keep machines and equipment well serviced, maintained and lubricated.
Switch machines and equipment off when not in use.
Apply provided mitigation devices where applicable, e.g. keep mobile compressor hoods closed and sealed during operation.
Locate noisy equipment behind noise barriers like constructed walls where possible.

Key mitigation measures and management actions during commissioning and operation:

- Study and apply Appendix 2 of this document.
- Keep staff which is in contact with machines and equipment, like operators and maintenance technicians, up with developments through training and education sessions.
- Commissioning of machines at higher than operating noise levels must be kept to a minimum and must be conducted during working days and working hours.
- Plan and design for maximum soft ground cover within and where possible outside the boundary.
- Purchase machines and equipment that operate at state of the art noise levels.
- Trucks, which are used for hauling aluminium ingots between smelter and port, must have their motor brakes disabled.
- Monitor noise emission of machines and equipment and implement pro-active mitigation measures as and when appropriate to the best benefit of all stakeholders.
- Co-ordinate efforts between departments responsible for environmental, occupational safety and health and predictive machine monitoring to share relevant information and implement changes to the best benefit of all stakeholders.
- High quality and state of the art service and maintenance of machinery and equipment must be sustained at all times.

The main recommendations in the context of the PAS2005 project are seen as:

a) Strict implementation of mitigation measures in all aspects during the construction phase.

b) Upholding truck mitigation measures, primarily regarding disciplined driving habits and disabling the motor brakes at the expense of increased cost of brake pad replacements.

c) Generally keeping equipment in good working order by conducting regular adequate maintenance operations and keeping structures in good order.

d) Application of mitigation measures provided, in particular, positioning noisy plant and machinery inside sufficiently sealed enclosures or buildings.

The composite effect of multiple noise sources resulting in sound levels exceeding that of one source often quite considerably, needs to be borne in mind during procurement and design of plant.
Of great importance is the control of performance consistency by means of monitoring after satisfactory baselines are established. The design condition of a machine is, amongst other, characterised by its lowest possible noise emission. Deviations from these optimal setpoints result in increase of sound levels. Such performance “creeping” is avoidable by monitoring actions.

9. REFERENCES

[SABS0103] SABS Code of practice 0103:1994 titled ‘The measurement and rating of environmental noise with respect to annoyance and to speech communication’.


[Harris] Harris – Handbook of Noise Control 2nd edition 1979


