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**REVIEW OF ACOUSTIC CONSULTANCY WORK
UNDERTAKEN FOR ALCOA'S PINJARRA EFFICIENCY
UPGRADE PROJECT**

FOR

ALCOA AUSTRALIA

Client: Alcoa of Australia
Client Contact: Gordon Baird
SVT Contact: Jim McLoughlin
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1	Jim McLoughlin	Paul Kewick	4/11/03	Issued for use

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1 INTRODUCTION

SVT were requested by Alcoa World Alumina Australia to undertake an independent review of the work carried out by Alcoa's noise consultant (Herring Storer Acoustics) relating to the proposed Pinjarra Efficiency Upgrade Project.

Herring Storer Acoustics (HSA) has undertaken noise modelling and a program of noise monitoring in order to assess the acoustic impacts of the proposed upgrade. HSA has concluded that noise emissions associated with the proposed upgrade will comply with noise limits imposed under the Environmental Protection (Noise) Regulations 1997 provided that certain noise mitigation measures are incorporated into the upgrade design.

1.1 Background

Alcoa proposed to increase alumina production capacity at the Pinjarra refinery by about 600,000 tpa to 4.2 Mtpa. This equates to an 18% increase in annual production. The efficiency upgrade is to be primarily achieved by increasing yield from the Bayer Liquor circuit, utilising existing equipment as much as possible.

The upgrade will include the introduction of new equipment and modifications to existing plant. Two new co-generation units have already been approved for construction at the refinery.

Existing noise emissions from the Pinjarra refinery are in compliance with the noise limits imposed by the Regulations for noise sensitive residences to the south of the refinery, and the refinery has only received complaints relating to isolated incidents which do not represent normal refinery operation.

1.2 Scope of Work

The objectives of this review are as follows:

- To verify the methodology used for noise modelling of the refinery;
- To assess the validity of the noise predictions from the acoustic model;
- To review the noise monitoring work used to support the acoustic model;
- To review and comment on the noise mitigation recommendations provided by HSA.

In preparation of this review SVT has reviewed the following reports prepared for Alcoa by HSA:

- *Acoustical Assessment of Efficiency Upgrade at Alcoa Pinjarra Refinery* – August 2003(Ref. 2206-1-03029-6-6); and
- *Pinjarra Alumina Refinery Environmental Noise Monitoring* – June / July 2003 (Ref. 2200-2-03029-6-5).

HSA has also provided SVT with an overview of the proposed upgrade project which includes a summary of the main noise generating equipment components of the upgrade.

SVT has visited HSA's offices to discuss the work undertaken and to inspect the noise model on which HSA's assessment is based. SVT has also liaised with the DoE to discuss noise issues relating to the project.

SVT has also undertaken a site visit to obtain a first hand impression of current emissions from the Refinery.

2 REVIEW OF NOISE MODELLING

Acoustic modelling of the refinery has been undertaken by HSA. The acoustic model was first developed in 1997 and was updated in 2002.

2.1 Modeling Software

The current acoustic model has been developed using the “SoundPlan” software package. This software is widely accepted in the acoustics community and is suitable for predicting noise emissions from the Pinjarra refinery.

The prediction algorithms used by the model are essentially the same as those described by CONCAWE in their report entitled “*The prediction of noise from petroleum and petrochemical complexes to neighbouring communities*”. (However, SoundPlan adopts methods described in a Scandinavian model to account for screening by barriers.) Although the CONCAWE algorithms were developed for the petrochemical industry they are considered to be valid for other industry types. The prediction algorithms are valid for distances greater than 100m from the sound source.

2.2 Meteorological Inputs

Meteorological inputs to the modelling are intended to represent worst case conditions for sound propagation as determined by noise monitoring and analysis of historical wind data for the area. It is SVT’s opinion that the conditions used are representative of worst case conditions for sound propagation.

2.3 Topographical and Barrier Inputs and Ground Absorption

The acoustic model incorporates ground contours at 5m intervals. The model also includes the screening effects of the major buildings and structures at the refinery. SVT believes that this level of detail is appropriate for the acoustic model.

The acoustic model assumes different absorptive properties for the ground at the refinery, rural areas, natural bush, forested areas and pine plantations. SVT has reviewed the ground absorptions used in the noise model and are satisfied that they are appropriate.

2.4 Sound Power Inputs Used

HSA has provided SVT with a comprehensive list of the sound power levels used as input into the acoustic model, both for the existing refinery and for the equipment associated with the proposed upgrade. The sound power levels used appear to be consistent with SVT’s experience of similar equipment.

The total sound power level for the existing refinery is approximately 130dB(A). The estimated sound power level for the new equipment associated with the upgrade project is 117 dB(A). Sound power levels for the upgrade project have been based on measurements for existing equipment at the refinery and similar equipment at the Wagerup refinery. The sound power level assumed for the new co-generation plant is 119 dB(A). This is considered to be a conservative over-estimate and is greater than the actual noise specification prepared for the co-generation plant.

2.5 Calibration Of The Model

The noise monitoring results have been compared with noise predictions for the existing refinery under worst case sound propagation conditions and there appears to be good agreement between the measured and predicted results for locations to the south of the refinery. The predicted levels at low frequencies (below 125Hz) are somewhat lower than the measured values. This is unlikely to have a significant impact on the predicted overall levels which are influenced primarily by noise in the frequency range from 160Hz to 800Hz where there is good agreement between measured and predicted values. HSA has attributed this underprediction to the limitations of the acoustic modelling with respect to low frequency ground absorption and temperature inversion effects.

Detailed verification of the model has not been carried out for propagation towards residences to the north of the refinery since it is reported that previous noise monitoring results demonstrate noise levels at the northern residences are acceptable. (See attached fax from HSA.)

2.6 Modelling Results

The results from the acoustic modelling are presented as noise contours for worst case sound propagation conditions towards the residences to the south of the refinery. Noise predictions are also provided at the nearest southern residence for the existing refinery operations and the upgrade operating scenario.

SVT has checked the results of the modelling by undertaking a simplified assessment based on the overall existing and upgraded plant sound power levels provided by HSA. SVT's simplified assessment yields results of a similar magnitude to those presented by HSA and therefore SVT believe that the model of the refinery provides a good indication of sound attenuation during propagation to the south of refinery.

At SVT's request, HSA has also provided noise level predictions for residences to the north of the refinery which are closer to the refinery than the southern residences. These results show borderline compliance with environmental noise limits. However, HSA believe that the model over-predicts noise levels to the north of the refinery. (See attached fax.)

An independent review of the noise model was previously carried out by ERM in 1998. The model has since been updated.

3 REVIEW OF NOISE MONITORING

3.1 Overview of Monitoring

Continuous noise monitoring was conducted at a location to the south of the refinery for a period of six weeks during June / July 2003. This period was selected after analysis of historical wind data which showed that worst-case conditions for sound propagation are most likely to occur at this time of year. The continuous monitoring data was supported by operator attended measurements on seven occasions when Bureau of Meteorology forecasts indicated a high likelihood that worst-case propagation conditions would occur.

3.2 Noise Monitoring Equipment and Procedure

HSA has provided details of the measurement equipment used to collect noise data and have described the noise monitoring procedure. SVT are satisfied that both the equipment used and procedure adopted are appropriate.

3.3 Noise Monitoring Location

Noise monitoring has been undertaken at Napier Road to the south of the refinery. This location was chosen to minimise the impacts of extraneous noise from localised noise sources on the recorded noise levels. The choice of location is appropriate for assessing noise impacts to the south of the refinery.

3.4 Noise Monitoring Results

From the data presented it appears that HSA has been successful in collecting reliable measurements recorded under worst-case sound propagation conditions. The interpretation of the recordings seems plausible and the results indicate that existing noise levels comply with environmental noise limits to the south of the refinery. The measured noise data occasionally show evidence of tonality in the 40Hz 1/3 octave frequency band. HSA's interpretation of this occasional tonality is that it is most likely to be associated with noise emission from locomotives and not with continuous noise emission from the refinery. SVT believes that this is a plausible interpretation but has no supporting data.

3.5 Compliance Assessment

HSA's assessment of compliance is based on the monitored noise levels corrected for the additional sound attenuation between the noise monitoring location and the nearest noise sensitive residences. The correction has been derived from the acoustic model of the refinery. SVT has checked the correction factor applied and believe that it is accurate. The monitoring results demonstrate that the refinery currently complies with environmental noise limits to the south of the refinery. The refinery is, however, clearly audible under these conditions.

3.6 Site Visit by SVT

SVT has undertaken a site visit to gain a first hand impression of noise emissions from the refinery. The site visit was conducted on 31/10/03 – 1/11/03. SVT has confirmed with Alcoa that production rates were normal during this period.

During the site visit, the prevailing winds were light and favoured sound propagation to the north of the refinery. Hence at the monitoring location on Napier road to the south of the refinery, the refinery was inaudible. The refinery was audible to the north, and spot sound recordings taken at the end of North Spur Road (where it joins the approach road to the refinery) showed reasonable agreement with the results predicted by the refinery noise model. The conditions during SVT's observations were not ideal for characterising noise from the refinery. However, based on the observations made, SVT found no evidence to doubt the validity of the noise model.

4 DISCUSSION

The following equipment associated with the upgrade has been identified as significant in terms of noise emissions:

- New ball mill and associated pumps;
- New seed filtration facility including vacuum pumps, blowers and pulp stacks;
- Additional bay to cooling tower;
- New calciner blower; and
- Additional steam valves for building 42.

The upgrade project will also involve upgrading of some existing pumps and piping systems.

In order to limit the noise impacts of these items of equipment, HSA has recommended the following noise controls.

- Provision of an acoustic shroud over the new ball mill;
- Provision of high efficiency fans and best practice design for the new seed filtration building;
- Full enclosure for additional blower in calcination area;
- Intake and discharge silencers for other new blowers;
- Attenuation of steam valves and pipework noise for building 42.

It is SVT's opinion that these noise controls are appropriate.

In addition to noise controls for new noise sources, several existing noise sources will also be treated. This will include upgrades to pumps and piping systems to reduce cavitation noise and excessive throttling of pumps, attenuation of existing steam valves and pipework noise for building 42, and an upgrade of the oxalate kiln which should attenuate noise emitted from the stack.

The noise model for the upgrade assumes these noise controls have been implemented and HSA has recommended that acoustic specifications are developed for the major noise sources.

Provided that the upgrade is constructed in accordance with HSA's recommendations, the overall sound power level of the upgrade should be considerably lower than the overall sound power level of the existing facility. Therefore, any increase in overall emission levels should be marginal.

The noise monitoring results adequately demonstrate that compliance with environmental noise limits is currently being achieved under worst-case sound propagation conditions at noise sensitive residences to the south of the refinery. The acoustic model is effective in demonstrating that the upgrade project is also able to achieve compliance.

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**FACSIMILE TRANSMITTAL**

REF: 03029-6-6

TO: SVT FAX NO: 9381 3588

ATTENTION: Jim McLoughlin

FROM: Paul Drew

DATE: 21st October, 2003

SUBJECT: **EFFICIENCY UPGRADE: ACOUSTIC REVIEW INFORMATION**

NUMBER OF PAGES INCLUDING COVER PAGE: 5

Jim,

The following is in response to your email of this morning.

1. Model ground type: Soundplan ground types are based around a "co-efficient". We have represented the refinery proper as asphalt (0.1), the rural areas as (0.45) and the forested areas (0.5 natural bush, 0.65 pine plantations).
2. The predicted noise level for the refinery (as existing) under worst case conditions with receiver at Napier Road monitoring location is 34.9. Note that you can calculate this yourself by summing the individual A-weighted source contributions for this receiver (eg. exclude the upgrade and co-generation sources).
3. We have not carried out detailed verification of the model to the northern residences, as previous monitoring showed that noise levels were acceptable at the northern residence (north spur road). The model predicts the following levels under worst case conditions with wind from 35 degrees west of south.

Refinery only	34.7
Refinery + Cogen	35.2
Refinery + cogen + upgrade	35.5

When we look at the source contributors we find that the model predicts the powerhouse ID stacks (300 & 600 Hz tones) and the oxalate stack (160 Hz tone) as being the most significant contributors.

Past monitoring only showed the 160 Hz (which was also from the powerhouse forced draft fans, now attenuated) as a contributing frequency. The efficiency upgrade includes an RTO (Regenerative Thermal Oxidizer) which will be located after the existing oxalate ID fan and should significantly reduce the 160 Hz emissions from this source. Previous measurements by SVT (on behalf of the Pinjarra Powerhouse) have shown that the ID Fan stacks 300 Hz tone is not a significant contributor and the model probably over-estimates this stack emission (the model uses a 100mm barrier to a horizontal plane source instead of directivity) as inputting directivity into SoundPlan was very complex (for that version of SoundPlan) at the time this part of the model was developed). Exclusion of the Powerhouse ID stack and oxalate stack noise sources reduces the predicted level from 35.5 dB(A) to 34.6 dB(A).

Herring Storer Acoustics
Our ref: *-1-*

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4. The independent review of the model (then in ENM and relatively basic) was carried out by Daniel Lloyd (on behalf of ERM at the time).

As we currently are experiencing some problems with our email / computer system the source contribution as calculated by SoundPlan for the worst case conditions to the the northern residential area are attached.

Should you wish to contact me, the use of fax or phone (0408 930 532 out of hours) is likely to be the most reliable form of communication.

Regards,
For Herring Storer Acoustics



Paul Drew
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