Terms of Reference

Trials to understand factors influencing pad moisture and ammonia emissions in livestock faecal pads and the effect of interventions

Background

Management of livestock during export seeks to minimise the risks of abrasion injuries, high ammonia emissions and pugging / coat contamination, as well as providing a suitable lying substrate. However, these outcomes are influenced by a wide range of factors related to animals, the vessel and the journey, and the interventions, preparation and management undertaken by exporters and stockpersons / veterinarians / crews.

The Livestock Export Program (LEP) recently funded a literature review of bedding and environmental conditions (McCarthy, M and Banhazi, T (2016), Bedding management and air quality on livestock vessels – a literature review, W.LIV.0290). This report considered a wide scope of research conducted – particularly in relation to ammonia – by the LEP and others over the last two decades. A list of some of the key research projects are at Attachment 1.

W.LIV.0290 identified the complexity of these factors and recommended further work focused on establishing environmental monitoring and enhancing the understanding of pad moisture and the factors influencing it. It also identified research opportunities related to flooring, The International Convention for the Prevention of Pollution from Ships (MARPOL) regulations and a further literature review targeted at ammonia mitigation.

The industry is now looking at investing in detailed research to increase the rigor of scientific knowledge and understanding of pad moisture and condition, including the rates and nature of ammonia emissions, and the effect of interventions or management processes. There has been some substantive early research into ammonia and interventions, and an extensive anecdotal understanding of pad management exists (as captured within both W.LIV.0290 and an earlier project W.LIV.0254).

Given the complexity of factors that may influence the pad condition and the resulting ammonia emissions, the LEP considers that land based studies that can isolate variables and enable detailed measurements are required.

The purpose of these studies will be to develop and validate a clear understanding of the interactions of the different factors and how they affect cattle and sheep pads and influence outcomes, and how different interventions influence these factors and outcomes. A key output will be the ability to understand and predict pad moisture, ammonia issues and the likely effect of interventions during voyages using a consistent methodology, equations or other measure.

In relation to ammonia, LEP research and W.LIV.0290 provides a strong platform of information for the industry. W.LIV.0290 recommended research to identify the best technique for measuring and monitoring ammonia levels on livestock vessels and determine an industry time-weighted average. However, the LEP considers that – particularly in light of the W.LIV.0290 finding that ammonia emissions appear to be episodic – by conducting land-based studies a better understanding can be built around how significant an issue ammonia is and what degree of monitoring it necessitates.

In combination, the LEP is undertaking research into the piloting of animal welfare indicators with Murdoch University. Ammonia is an indicator which has been selected for
piloting and Murdoch will be responsible for considering whether and how it can be monitored and measured and what it represents in terms of animal welfare performance.

The Murdoch University project will also be able to commence collection of data of pad condition and abrasion mortality and morbidity. Linkages between this bedding/ammonia project and the Animal Welfare Indicators Pilot project will be critical in ensuring both research aligns and delivers the data and findings necessary to support industry.

Terms of Reference

The Livestock Export Program (LEP) is seeking expressions of interest from qualified consultants to deliver the below terms of reference. The LEP will select the best placed researcher to deliver all or part of the review terms of reference.

Phase 1: Development of pad moisture and ammonia emission equation and methodology

A consultant is required to conduct land based studies and trials to build the scientific knowledge and understanding of pad moisture and the rates and nature of ammonia emissions, and the factors influencing them, for cattle (*Bos Taurus* and *Bos Indicus*) and sheep faecal pads during livestock export.

A key objective will be the development of equations, with a predictive capacity, for pad moisture and ammonia emissions based on the knowledge gained through the trials.

The trials and equations should consider the factors outlined in W.LIV.0290 (such as ventilation, humidity, temperature, journey, deck type (open or closed), stocking densities, urinary output (relative to heat tolerance and likely conditions, faecal output, etc) for pads developed by the following primary classes of export livestock:

- *Bos Taurus* cattle – 450 kg black Angus steer, BCS of 3 on a scale of 1 - 5
- *Bos Indicus* cattle – 350 kg Brahman steer, BCS of 3 on a scale of 1 - 5
- Merino sheep – 40 kg wether (with less than 25 mm of wool), BCS of 3 on a scale of 1 - 5

Trials should consider the use of climate controlled facilities, non-climate controlled facilities, mock faecal pads and other innovative approaches in delivering the best methodologies and likelihood of quality and useful data / findings.

Phase 2: Measurement of interventions

Using the findings from Phase 1, the consultant should trial different interventions to determine what affect and relationship they have on pad moisture and ammonia emissions (i.e. as contributing variables to the factors assessed in phase 1). This should also be built into the predictive capacity and other outputs developed from phase 1 to identify the likely impact of different interventions and support risk mitigation planning / preparations.

As a precursor to land based trials, the consultant (s) should conduct a targeted literature and 'grey' materials (i.e. commercial avenues, government best practice guidance etc) review to identify possible interventions and existing information and R&D. With the support of the LEP, the consultant should also convene an industry consultative group to prioritise options.

The interventions trialled should include as a minimum:

- Simulated wash down
- Bedding/sawdust:
  - Trialing the addition of bedding prior to cattle and sheep going on the floor at different rates
  - Trialing the addition of bedding once the pad is developing (e.g. ‘extending the pad’)

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Trialing the above for different bedding options commercially available and assessing their absorptive capacity and other benefits.

- Ventilation:
  - Trialing different air speeds
- Additives – sprays and bedding additives
- Feed routines:
  - Provision of different rations (volume and content);
  - On shipboard ration prior to commencement of trial, transitioning during trial
- Removal of atmospheric moisture (low level air conditioning);
- Reduced stocking densities

**Phase 3: Practical trial of outputs (go / no go)**

The LEP expects that it will be necessary to test / prove the outcomes of phase 1 on-board representative voyages to confirm their relevance, accuracy and possible application in a practical setting. There may also be a need to conduct elements or all of phase 3 prior to a trial shipment to ensure that enough is known on interventions which are likely to be applied to a shipment (or required to under ASEL) so the data collected is of a suitable quality.

Any project proposals must be submitted utilising the MLA Preliminary Application Template. In particular, the proposal should:

1. Outline the approach that will be adopted to address the project/s and their respective objectives.
2. Outline and provide some detail in relation to the specific work activities proposed and timelines for their achievement.
3. Provide details of the information/data to be collected, collated and assessed and how these activities will be undertaken.
4. Include all resources and personnel required to undertake the project, including details of basis for charging (daily fees, number of days, expenses, etc.).
5. Propose a payment schedule, taking account of the following:
   - Progress payments may be negotiated against project milestones if the size and timescale of the project warrant this. The proposal should propose milestones and payments if required.
   - A minimum of 20% of the project budget must be retained for payment against the final milestone.
   - Payment of fees will be upon MLA acceptance of the attainment of the project milestones.

**Selection Criteria**

Applications will be reviewed by the Live Export Research & Development Advisory Committee, and selection the successful proposal(s) will be based on assessment against the following criteria, if shortlisted applicants will be then requested to submit a full detailed proposal:

- Soundness of the method proposed to achieve the project(s) objectives
- Demonstration of the applicant’s knowledge and understanding of the relevant issues;
- Track record of the applicant and proposed team members; and
• The project budget, delivery timeline and assessed value for money.

**Reporting Requirements**

The successful applicant will provide milestone reports (as required) and a final report giving full details of the results of the work. Milestone and final reports will be prepared in line with MLA report guidelines.

In addition to MLA standard reports, the following will also be provided to MLA at the time of delivery of the Final report:

1. a copy of all project data, including meta-data
2. a 800 word (maximum) magazine article
3. a Microsoft Power-point presentation summarizing key project outcomes

The consultant shall report directly to Sharon Dundon, Livestock Export R&D Manager, Meat and Livestock Australia.

**Confidentiality and IP**

The researcher will be required to enter into a standard contract for services with MLA.

**Payment of Fees**

The proposal should indicate the total cost of completing the project.

Payment of fees will be fully dependent upon MLA’s acceptance of milestone completion. The proposal should include reference to milestones and a schedule of payments as required.

**Further Information**

If you have questions regarding this project contact:

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*Preliminary Applications Close Friday 16 June 2017*
Attachment 1: Livestock Export Program Research and Development projects of relevance

McCarthy, M & Banhazi, T (2016), Bedding management and air quality on livestock vessels, a literature review, W.LIV.0290


McCarthy, M (2002?), Investigation into reducing odour emissions from partly loaded sheep vessels whilst in port, LIV.213A

Kitessa, S, White, C & Williams, A (2002), Investigating odour from partly loaded sheep vessels, LIV.213B

MAMIC (2001), Ventilation Efficacy on Livestock Vessels, SBMR.002

MAMIC (2002), Practical Ventilation Measures for Livestock Vessels, LIVE.211

Gaughan, J, Lott, S & Gordon, G (2003), Wetting Cattle to Alleviate Heat Stress on Ships, LIVE.219

Maunsell Australia (2004), Investigation of Ventilation Efficacy on Live Sheep Vessels, LIVE.212


Maunsell Australia (2004), Development of a heat stress risk management model, LIVE.116

Casey, R (2005), Potential Benefits of Jetting to the HS Model, LIVE.234

McCarthy, M (2005), Pilot monitoring of shipboard environmental conditions and animal performance, LIVE.223

Stacey, C (2006), Upgrade of biological assumptions and parameters used in the HS risk management model, LIVE.228


Eustace, C & Corry, S (2008), HotStuff version 3 – Revision of the heat stress risk assessment methodology to properly incorporate risk of heat stress while at port, LIV.249

Barnes, A, Beatty, D, Stockman, C, Maloney, S & Taplin, R (2008), Electrolyte supplementation of export cattle, and further investigations in the heat stress threshold of sheep and dairy cattle, LIVE.224


Buckley, B (2009), Detailed temperature and humidity climatology for Middle East Ports, W.LIV.0267

Stacey, C (2011), HotStuff 4, W.LIV.0277