AUSTRALIAN MEAT PROCESSOR CORPORATION

Beef Spinal Cord Removal Stage 2 Process Risk and Benefits

Project code:	2013/5043
Prepared by:	Scott Technology
Date Published:	February 2016
Published by:	Australian Meat Processor Corporation

The Australian Meat Processor Corporation acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

This publication has been prepared and typeset by Scott Technology. No content in this report has been amended by AMPC and it does not reflect the opinion or position of AMPC.

Table of Contents

1. Executive Summary

MAR recently completed project "A.TEC.0088 Beef Spinal Cord Removal – Development Trials". In this project research and development along with manual and robotic tests and trials where completed to determine suitable tooling for an automated Beef Spinal Cord Removal process. The tooling developed and deemed best suited for this process incorporated the use of High Pressure Water and Vacuum "HPWV". Trials with the HPWV tool provided confidence in the concept as a potential solution for automated spinal cord removal. However it also highlighted the need for further work, prior to any full scale development, to ensure the process is viable. A summary of the areas that need this further work are listed below:

- Assessment of the process risk of HP water being forced into the meat through the nerve canals
- Review of potential Cost and Process Benefits and Risks
- Confirmation of vision and sensing ability to accurately detect spinal cord.
- Carcass presentation and stabilisation
- Tooling development to minimise water use (optimise pressure, flow nozzle designs)
- Tooling development to minimise SRM spread over carcass during the process

The aim of this project was to address the first two of these prior to further development stages to provide further confidence the HPWV process provides adequate benefits whilst ensuring the process does not introduce new and unmanageable risks. Specifically the project was to:

- Investigate potential process risk associated with HP water being forced into the meat through the nerve canals
- Review of potential Cost and Process Benefits and Risks associated with the HPWV process.

Trials were conducted at Manildra Meats, in the presence of representatives from AMPC and AMIC, using the same high pressure water and vacuum unit that had been used previously for robotic trials.

Following the trial a debrief was held with AMIC and AMPC. The feedback, was positive (see attached report from AMIC Veterinary Counsel in Appendix 1) suggesting that the process achieved a similar result to the manual process and that no additional water was retained by the carcass as a result of the high pressure water. It was recommended however that a visit to a processor that processes carcasses for US/McDonalds/Burger King supply be incorporated into any follow on projects to compare the results achieved using the HP/Vacuum with the result currently achieved manually.

From a cost and process benefits point of view the benefits provided by the Robotic Beef HPWV Spinal Cord Removal System include:

- Addressing the shortage of skilled labor
- Eliminating the OH&S risks associated with the manual task
- Improving the consistency of the process
- Improvement in hygiene
- Reduction in contamination
- Improvement in downstream processing

And it has a calculated payback time of 2.9 years

As a result of the positive outcome of this project MAR recommends that the next stage in the development of a fully automated spinal cord removal system, Stage 3 - Beef Spinal Cord Removal Technical Risks and further development be investigated.

2. Project Objectives

Prior work completed by MAR has established that the use of a High Pressure Water and Vacuum 'HPWV' tool was best suited as a potential solution for automated spinal cord removal. However the work carried out also highlighted the need for further work, prior to any full scale development, to ensure the process is viable. A summary of the areas that need further attention are listed below:

- Assessment of the process risk of HP water being forced into the meat through the nerve canals
- Review of potential Cost and Process Benefits and Risks
- Confirmation of vision and sensing ability to accurately detect spinal cord.
- Carcass presentation and stabilisation
- Tooling development to minimise water use (optimise pressure, flow nozzle designs)
- Tooling development to minimise SRM spread over carcass during the process

The aim of this project was to address the first two of these prior to further development stages to provide further confidence the HPWV process provides adequate benefits whilst ensuring the process does not introduce new and unmanageable risks. Specifically the project was to:

- Investigate potential process risk associated with HP water being forced into the meat through the nerve canals
- Review of potential Cost and Process Benefits and Risks associated with the HPWV process.

3. Methodology

This project aimed to assess whether there was any potential process risk associated with using HP water and vacuum to remove the spinal cord from beef carcasses and then review potential cost and process benefits and risks associated with this process.
The assessment of the risk was conducted in two stages. Step 1 was to identify, through consultation with industry, what the concerns and perceived risks were and then identify suitable test procedures that should be carried out to mitigate these concerns. Step 2 was to conduct trials onsite with the HPWV system conducting the tests that had been identified in Step 1.
The system cost and process benefits and risks were then reviewed by taking into account the system capital cost and anticipated benefits provided by the system.

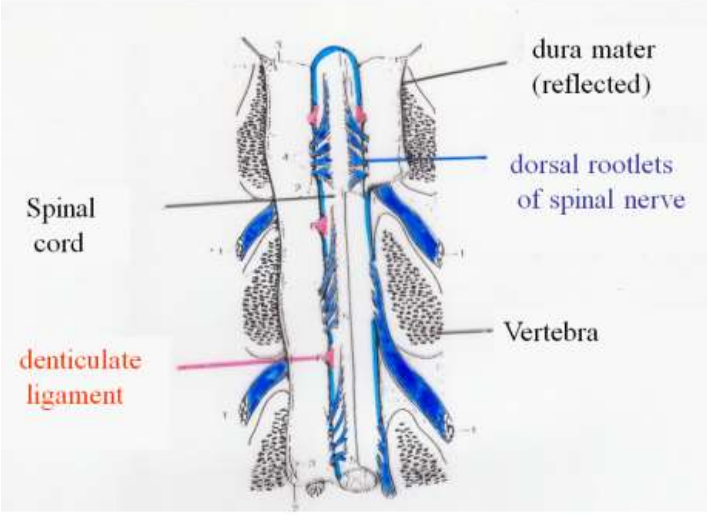
3.1 Identify Perceived risks and tests

Discussions were held with both AMPC and MLA as well as internally at MAR with regards to who the most appropriate industry members would be to consult with to determine

a) potential risks associated with high pressure water being forced into the meat through nerve canals
b) possible testing procedure to be performed on carcass pieces to confirm whether these risks are really an issue

It was felt that rather than consulting with processors, input from a food safety point of view would be more appropriate. With this in mind the Veterinary Counsel (VC) with the Australian Meat Industry Council, was contacted and the Veterinary Counsel provided the attached FSIS BSE Exclusion Requirements document (Appendix 3) and the images below.

Dorsal view of spinal cord
with dura partially reflected



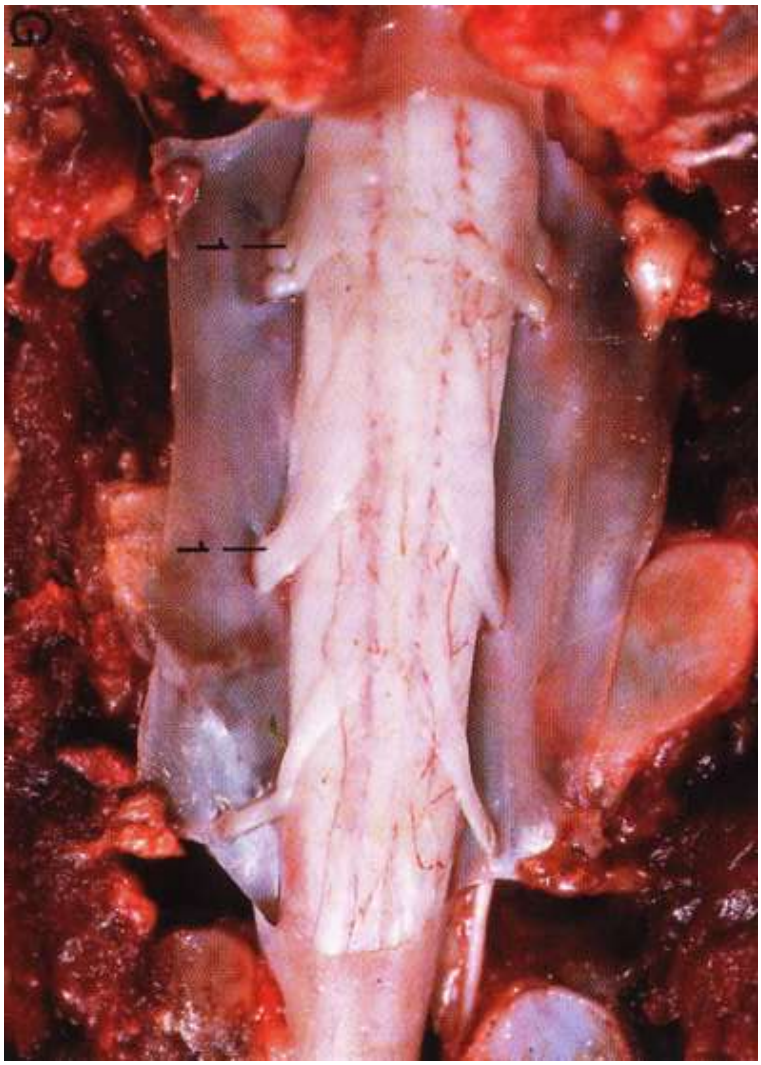


Fig. 1 The above images were supplied by the Veterinary Counsel for AMIC and show diagrammatically and an actual photo of a beef carcass spinal cord with the dura reflected.

Section Three on page three of the attached document highlights that the Spinal Cord and the Dorsal Root Ganglia are the items that are considered Specific Risk Materials (SRM's) and must be removed from the spinal column.
The current process of removing this material commonly involves using a circular cutting tool that gets in behind the spinal cord and dura mater and cuts the Dorsal Root Ganglia free before sucking all the removed material away.

Fig. 2 The image shows one of the tools that is currently used manually to remove the spinal cord from beef sides. It consists of a circular rotating cutting blade that gets in behind the spinal cord and cuts the Dorsal Root Ganglia before vacuuming away the removed material.

Feedback from the VC was that that provided the water jet from the proposed HPWV process was operating at an angle that is acute to the surface of the spinal column then it would severe the Dorsal Root Ganglia with the duramata and remove these along with the spinal cord as is achieved using the hand held tool shown above. With this being the case and the fact that the material is not being broken up as it is removed it is felt that the potential for any SRM material to be forced back into the nerve canals is small.

3.2 Testing and Trials

High pressure water and vacuum trials were conducted on site at Manildra Meats on the 18th November 2014 in the presence of representatives from AMIC and AMPC. The setup used was the same as been used previously for robotic trials, with the high pressure water unit and vacuum system shown below.

Fig. 3 High pressure water unit and vacuum unit ready to conduct trials and testing at Manildra meats in Cootamundra NSW.

The tool used was also is the same as was used for the robotic trials the image below shows the roll face adaptor. The high pressure water enters from the top and the water and SRM material is sucked away by the vacuum from below when the tool is held in a vertical position as shown.

Fig.4 This image shows the Robotic spinal cord removal tool developed during past trials. The high pressure water enters from the top and the spinal cord and water are removed by vacuum at the bottom of the tool.

Two carcasses were processed during this trial and the attached video shows the first of these. The image below shows the starting point and the video shows how the tool was moved down the length of the spine. The carcass was supported from behind to prevent carcass movement.

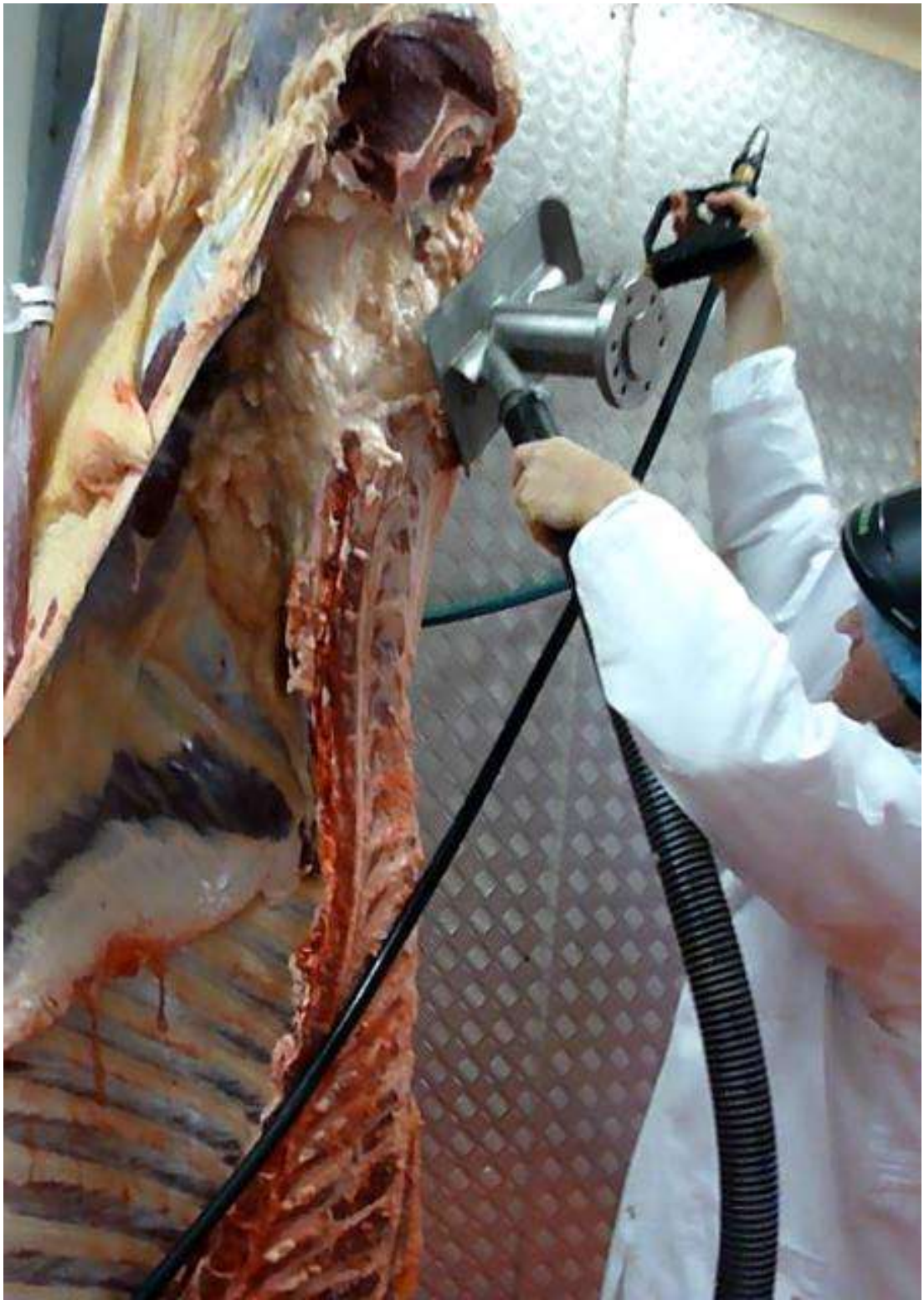


Fig. 5 This image shows the starting point for the trial and the attached video shows the trial being conducted on one of the carcasses.

4. Project Outcomes

4.1 Testing and Trials

The image below shows the spinal cord in the spinal canal before the trial

Fig. 6 Spinal Cord in canal before trial

The image below shows the spinal canal following the trial

Fig. 7 Cleaned spinal canal following trial with Spinal Cord and the Dorsal Root Ganglia removed

It can be seen from the video that not all of the desired material was cleaned out in the first pass of the tool. It is acknowledged however that the awkward setup using the robotic tool manually

was the major contributing factor to this. In reality with the tool on a robot and the carcass suitably stabilized a much better result would be achieved.

As can be seen from the image, the Spinal Cord and the Dorsal Root Ganglia, which are shown in Fig.1 on pages 6 and 7 of this report and are the items that are considered Specific Risk Materials (SRM's), have been removed from the spinal column. The image below shows the majority of the spinal cord removed in one piece.

Fig. 8 Image showing Spinal Cord following trial removed in one piece

With reference to the report from AMIC Veterinary Counsel (attached as Appendix 1 to this report) the process achieved a similar result to the manual process, severing the spinal nerves in around the same place. In addition the process did not appear to cause there to be any additional water to be retained by the carcass.

4.2 System Cost and Process Benefits and Risks

The estimated commercial capital cost of a Robotic Beef HPWV Spinal Cord Removal System after development is $250,000. Based on the following:

- Single shift per day
- Seven shifts per week
- One unit of labor saving
- Line speed of 100/hour

The estimated minimal OH&S and processing efficiency saving is $16,000/year. The table below details the payback period and rate of return.

Value Proposition

Gross Benefit Per Head	**Year 1**	**$0.30**
Net Benefit Per Head	**Over 10 Years**	**$0.13**
Net Present Value	**NPV**	**$436,972**
Profitability Index	**PI**	**2.75**
Payback time in years		**2.9**
Internal Rate of Return	**ROPC or IRR**	**37.92%**

The benefits provided the Robotic Beef HPWV Spinal Cord Removal System include:

- Addressing the shortage of skilled labor
- Eliminating the OH&S risks associated with the manual task
- Improving the consistency of the process
- Improvement in hygiene
- Reduction in contamination
- Improvement in downstream processing

The introduced risks of an automated system are mainly from an OH&S perspective and include:

- the introduction of high pressure water to the process
- the introduction of and automated robotic cell.

With the correct safety processes and equipment that is required for an automated system to be installed it is felt that the introduced risk is minimal.

5. Conclusions and Recommendations

Following the trial, a debrief was held with AMPC and AMIC. The feedback, as is detailed in the attached report from AMIC Veterinary Counsel, was positive, suggesting that the process achieved a similar result to the manual process and that no additional water was retained by the carcass as a result of the high pressure water. It was recommended however that a visit to a processor that processes carcasses for US/McDonalds/Burger King supply be incorporated into any follow on projects to compare the results achieved using the HP/Vacuum with the result currently achieved manually.

This positive result proves to the industry that the HPWV process is a viable method for removing the spinal cord and alleviates the concerns in regards to HP water and risk material being forced into the meat through the nerve canals.

This project was conducted as part of a six stage development process for Automating Spinal Cord removal. The six stages are detailed below:

Stage 1 – Beef Spinal Cord Removal Development Trials - *"A.TEC.0088"*

Stage 2 – Beef Spinal Cord Removal Process Risks & Benefits "This Project"

Stage 3 – Beef Spinal Cord Removal Technical Risks further development (industry assisted)

Stage 4 – Investigate possible dual process solution incorporating Beef Splitting (industry assisted)

Stage 5 – Pilot Prototype Installation of an Automated Beef Spinal Cord Removal System (industry assisted)

Stage 6 – Commercial Availability of Automated Beef Spinal Cord Removal 2015 - TBA

As a result of the positive outcome of this project MAR recommends that the next stage in the development of a fully automated spinal cord removal system, Stage 3 - Beef Spinal Cord Removal Technical Risks and further development (industry assisted) be investigated.

6. Appendices

Attached Report:
Beef spinal cord MS 2 Report
Visit to Manildra (Cootamundra) – 18 November 2014
John Langbridge B.V.Sc.

Attached Video:
20135043 Spinal Cord Trials at Manildra Meats 20141118

Attached Document:
FSIS BSE Exclusion Requirements