SCOTT
SCOTT TECHNOLOGY LIMITED
Scott Technology Centennial 1913 - 2013

AMPC

mla donor COMPANY

final report

Project code: P.PIP.0327 & P.PSH.0701

Prepared by: Sean Starling

Scott Technology

Date submitted: June 2014

PUBLISHED BY
Meat & Livestock Australia Limited
Locked Bag 991
NORTH SYDNEY NSW 2059

JBS Fully Automated X-Ray Lamb Middle System

This is an MLA Donor Company funded project.

Meat & Livestock Australia and the MLA Donor Company acknowledge the matching funds provided by the Australian Government and contributions from the Australian Meat Processor Corporation to support the research and development detailed in this publication.

Abstract

Scott Technology have successfully installed a fully integrated lamb automation system comprising of an x-ray, primal and middle process. The x-ray middle formed part of this project and was supported by the simultaneous commercial purchase of a primal machine by JBS. The installation at Bordertown was not without its issues, with items such as non-uniform metal gambrels, slaughter floor processing and chilling peculiarities that resulted in non-uniform rib caged carcases (once in rigour), cutting blade material issues when combined with the cleaning chemicals used at JBS, and a wide range of JBS customer specifications resulted in the x-ray middle (developed under project P.PIP.0327) to be then re-worked under a subsequent project (P.PSH.0701) to ensure the benefits predicted by Scott, JBS, MLA, AMPC and Greenleaf were achieved.

Executive summary

Scott Technology, JBS, MLA and AMPC have successfully installed and refined a fully integrated lamb x-ray primal middle system at JBS Bordertown's processing facility that is exceeding all pre-install predicted benefits as ascertained by independent evaluation by Greenleaf enterprises.

Scott and JBS have installed an X-ray Middle lamb automation system under an MLA R&D project (with the addition of a lamb primal cutting machine simultaneously undertaken) at JBS Bordertown. After installation of the system, and initial dry and wet (i.e. with product) commissioning, Scott and JBS ascertained that various causes resulted in the cutting results not being ideal, shown by the primal machine and eventually also realised within the middle machine once commissioning commenced with large product runs.

These causes of variation and poor machine performance (compared to that at other facilities where Scott equipment is installed) were attributed to both Scott machine related and JBS processing operations related (i.e. slaughter floor and chilling regime) issues. As a result both JBS and Scott (with MLA being continually informed) continued to work on the installed system and JBS processing operations to ensure an optimum whole of system performance met the required JBS processing aspirations.

In addition to various accuracy issues, the JBS installation experienced considerable blade breakage issues. Scott worked with the supplier, and in parallel with a materials group (the Quest Integrity group – confidential report available), to develop a new metal recipe and heat treatment process for Bordertown. Again although the initial breakage issue is confined to the primal machine, the middle machine utilises the same blades and the problem manifest itself within the middle unit operation as well, as expected. The cause of the breakages are a result of pitting from the JBS cleaning chemicals, which in turn lead to stress fractures and eventually blade breakage.

This additional work came at a cost that was above and beyond the scope of the original project. Scott undertook a supplementary project with MLA to conclude the troubleshooting processing and draw the system to a commissioned stage and ultimate Customer handover.

The system is now installed as a fully automated and integrated lamb x-ray primal middle system that according to an independent cost benefit analysis by Greenleaf is exceeding the original pre-install benefit evaluation.

Contents

Page

1 BACKGROUND 5

2 PROJECT OBJECTIVES 6

2.1 P.PIP.0327 – FULLY AUTOMATED X-RAY LAMP MIDDLE SYSTEM 6
2.2 P.PSH.0701 – JBS X-RAY MIDDLE/PRIMAL INTEGRATED LEAP 6

3 METHODOLOGY 6

3.1 CUSTOMER SPECIFICATION, DESIGN, MANUFACTURE AND INSTALLATION 6
3.2 PRODUCT COMMISSIONING AND SYSTEM ACCEPTANCE 7

4 RESULTS AND DISCUSSION 7

5 MOVING FORWARD 12

6 APPENDICES 13

APPENDIX A – X-RAY (AND PRIMAL) SIGN OFF. 13
APPENDIX B – SYSTEM DESIGN/LAYOUTS ERROR! BOOKMARK NOT DEFINED.

1 Background

For the past ten years Scott Technology (within its joint venture company Robotic Technologies Ltd) and supported by MLA, AMPC and various Australian processors has been developing their vision of a fully automated bone-in lamb boning system that removes operators from bandsaw interaction, provides uniform boning room production speed and significantly increases yield. The vision is depicted in Figure 1.

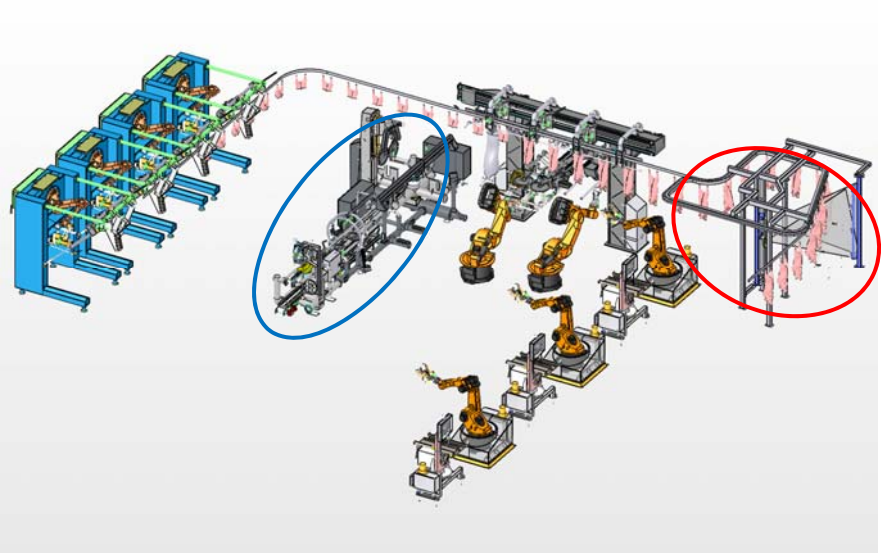


Figure 1: Boning Room Vision (fully automated room)

Under this project (along with a supporting commercial purchase) JBS further developed and install an x-ray middle system as an R&D project whilst simultaneously installing, under a commercial agreement with Scott Technology, a primal system to prepare the middles and ensure the required x-ray data for the middle system to operate has the required data integrity, via remaining in full control of the carcase and resulting middle system, for further processing by the middle system.

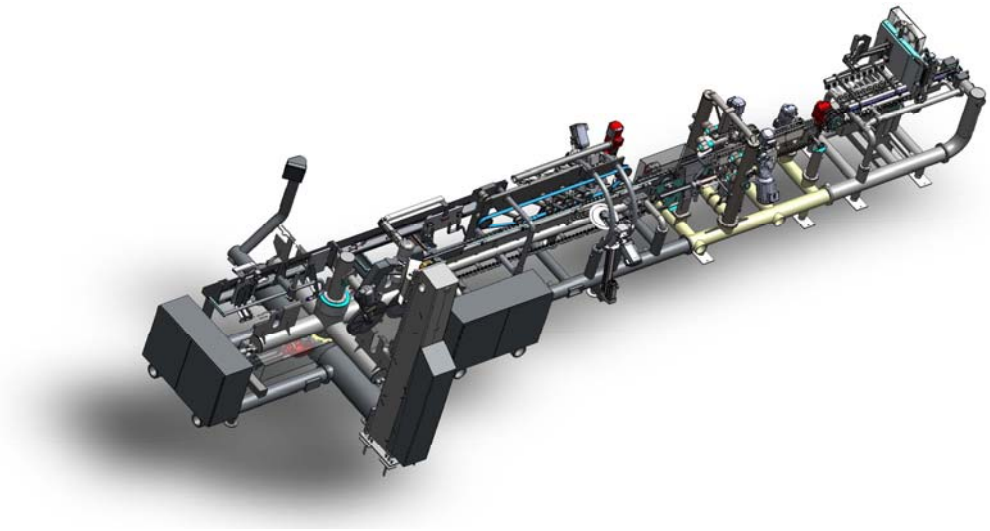


Figure 2: Middle System

As the project commenced product commissioning resulted in various items arising that significantly impacted on the maximum potential benefit that was possible from the installed system. These identified issues, which required both system redesign and upstream process understanding and changes were address in a subsequent support project.

2 Project objectives

2.1 P.PIP.0327 – Fully Automated X-Ray Lamp Middle System

The project objectives were to:

1. Successfully install and have operational a fully automated middle machine processing 10 carcases per minute,
2. Undertaken an industry open day, and
3. Develop a post installation cost benefit analysis and dissemination video and report.

2.2 P.PSH.0701 – JBS X-ray middle/primal integrated LEAP

The project objectives were to enable Scott to conclude the troubleshooting process and draw the integrated X-ray middle and primal system to a commissioned stage and ultimate customer handover. This was to be achieved by the following:

1. Ensure that the Scott x-ray middle (and associated primal) unit operations are presented with the best possible processed carcases that in turn will provide JBS the best possible return for their investment into the Scott developed knowhow.
2. To take the current installed Scott equipment and using its capability ensure that JBS get the best possible product outcome possible, even when this exceeds the current contracted specification.
3. Develop a new metal material specification for JBS stock that significantly reduces the current rate of blade failure.

3 Methodology

3.1 Customer Specification, Design, Manufacture and Installation

The customer specification process, design, build and installation components of the project were relatively uneventful considering the size of the investment.

To manage the risk of such a large development project it was decided to install the X-ray (and associated primal system) and the middle under two separate phases.

3.2 Product Commissioning and System Acceptance

The X-ray (and Primal) system were installed in July 2013 and underwent product commissioning in early August 2013. It was at this time that various issues arose (discussed in the results section). It was not until May 2014 that the system (both Scott machine and JBS process) was refined and that the entire system was deemed acceptable by all parties (refer Appendix A)

The middle machine installation commence late November 2013 and it also had similar improvement issues that were identified. It was not until late June 2014 that the entire system was deemed acceptable to all.

4 Results and Discussion

The system is now operational and acceptable to all parties with recent Greenleaf CBA determining that better than predicted benefits have been realised. The remainder of this report section contains a summary of the types of issues that were encountered between installation and final sign off.

The two main issues have been the cutting accuracy of the forequarter and hindquarter resulting cuts, and blade breakage on the primal tower, both of which are expected to transfer to issues in the middle machine. There were minimal to no issues pertaining to machine mechanical reliability.

The Scott x-ray system works on the premises (as proven acceptable at all previous installations), that the left and right side of the rib cage hang uniformly on a lamb carcase when in in rigour. Hence Scott rotate the carcase slightly when being processed in the x-ray unit operation to obtain a larger picture/image of one side of the rib cage only (the right side) and hence a better/larger image for image analysis purposes, and then refer the right side (the measured side) onto the left side of the carcase for machine cutting purposes.

Of interest, even if the left and right side of the carcase were both simultaneously x-rayed, to keep machine purchase prices to the lowest possible, the Scott primal cutter and middle machine cannot process a carcase that has a lopsided rib cage. For this to be achievable additional components would need to be installed which would in turn increase the cost to Australian processing Clients. An example of a carcase not hanging correctly and hence the 4th rib location on the left and the right side not parallel to each other AND both perpendicular to the horizontal plane is depicted in the following image. Note the bubble on the spirit level is not positioned in the middle of the two

level lines. This image is one of the images taken by Scott staff during the various evaluation steps that have occurred.

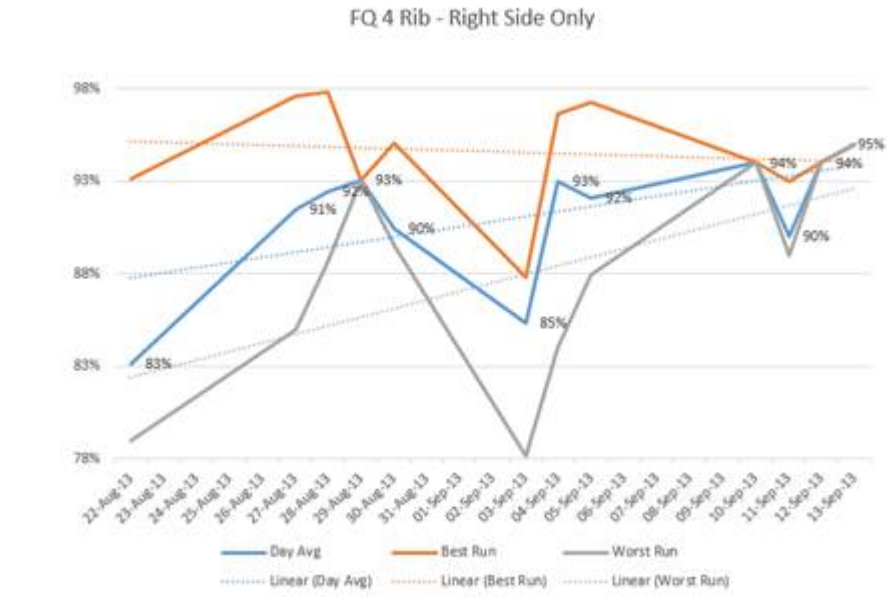
Originally the JBS Bordertown facility utilised metal skids/gambrels and this caused animals to set into rigour in a lopsided manner and hence resulted in a cut forequarter having unequal ribs on the left and the right side of the carcase. A previous variation covered the costs of mechanical changes to the Scott system to enable the system to handle the wider plastic skids, however did not cover the costs associated with labour (and related travel costs) in working on the system leading up to this discovery and the post ongoing involvement of Scott staff, working with JBS staff, to minimise additional upstream causes such as an aggressive hide puller or how the chillers are stacked.

Hence, once the JBS system was converted to plastic skids, then is was also ascertained that it was not just the metal skids that were causing the problem (although they were some of the cause) and that additional work was required on both the Scott system and JBS processing operations within the slaughter floor and chilling operations to reduce the ribcage horizontal misalignment issue.

There was a continual debate (although professional) between Scott and JBS as to the cause of the rib cutting inaccuracy. In essence after Scott invested considerable time continually ensuring that the mechanical system was in alignment, all mutually agreed that there were upstream processing causes that needed to be addressed in addition (Led by JBS and supported by Scott).

The first improvement step change occurred after the 23rd August when the commitment was made to convert the Scott equipment to plastic hooks. Since then a combination of mechanical alignments of all mechanical aspects and x-ray algorithm software improvements have been made, the later almost on a daily basis, throughout September. The following depicts the stepwise improvement changes at Bordertown during this period.

			4 Rib FQ - Measured Side			4 Rib FQ - Whole Carcase		
	Runs		Day Avg	Best Run	Worst Run	Day Avg	Best Run	Worst Run
22-Aug-13	3		83%	93%	79%	73%	87%	62%
27-Aug-13	7		91%	98%	85%	84%	95%	74%
28-Aug-13	6		92%	98%	89%	89%	90%	84%
29-Aug-13	1		93%	93%	93%	87%	87%	87%
30-Aug-13	3		90%	95%	90%	83%	85%	77%
03-Sep-13	3		85%	88%	78%	81%	85%	74%
04-Sep-13	7		93%	97%	84%	92%	97%	83%
05-Sep-13	5		92%	97%	88%	92%	97%	87%
10-Sep-13	1		94%	94%	94%	87%	87%	87%
11-Sep-13	2		90%	93%	89%	79%	88%	77%
12-Sep-13	4		94%	94%	94%	85%	86%	84%
13-Sep-13	2		95%	95%	95%	83%	88%	77%



Reality check with ALC system

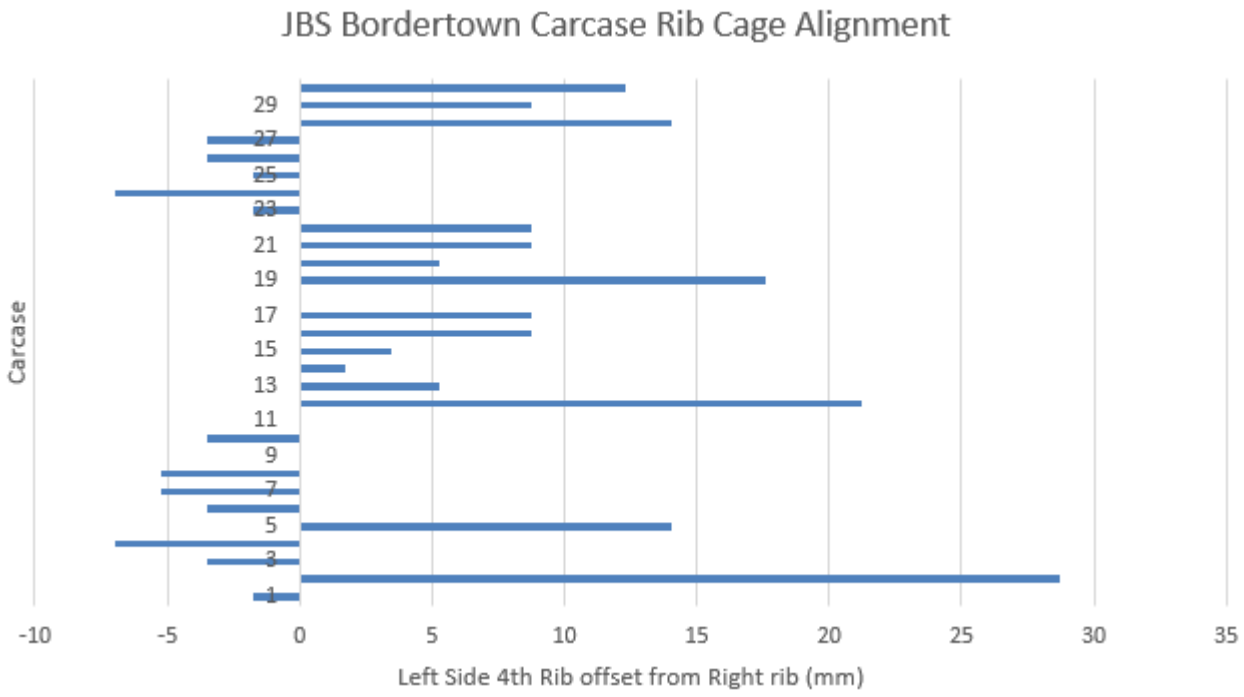
On the 16th September, Scott undertook evaluation work at ALC to ascertain if there were any changes in accuracy at ALC since installation. This resulted in a 94.9% accuracy looking at both sides of the rib cage and 95.5% on the Scott measured side. These results are within the Scott contract deliverable for JBS however where not being achieved at JBS. This again confirmed that other causes of inaccuracy were evident at Bordertown and encouraged Scott and JBS to look for non-machine causes of inaccuracy at Bordertown.

Understanding non-machine related inaccuracy issues

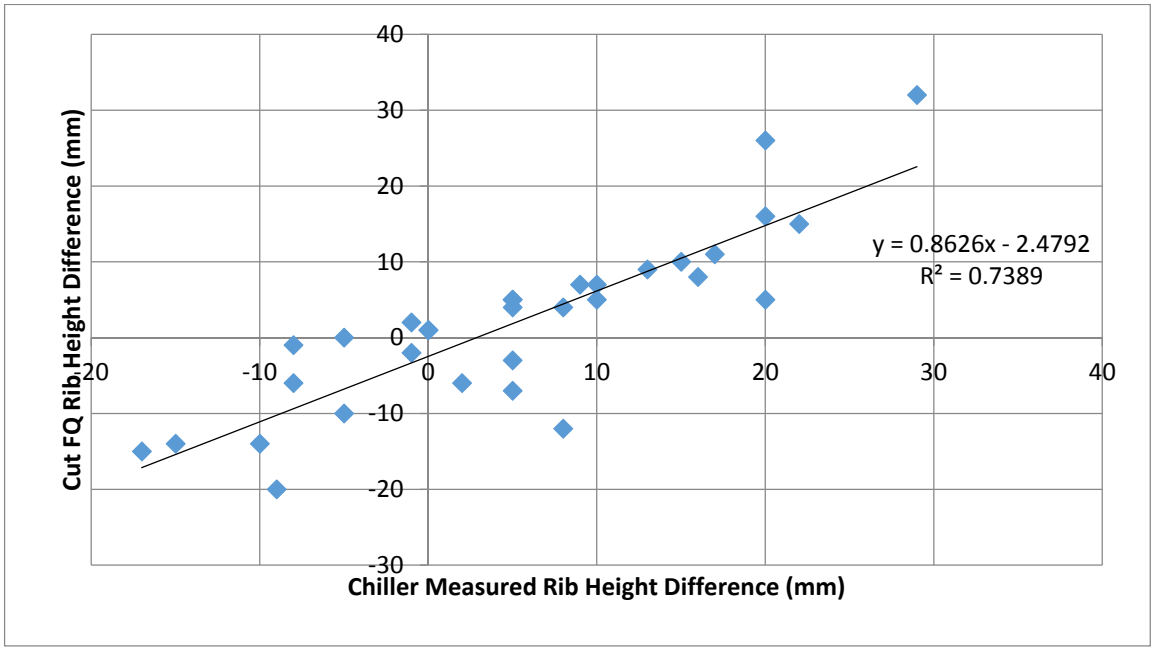
On the 23rd September 2013, a team of JBS/Scott personnel undertook a preliminary analysis in the chiller of 30 random carcases to ascertain the frequency (and magnitude) of any alignment issues of the fourth rib on the left and the right of the carcase with respect to being horizontal.

The chart below sets the right rib at a zero datum point. The chart then depicts if the left rib was lower (+ve result) or higher (-ve result) from the right rib. Note with intercostal spacing approximately 10mm on average, and taking a centre point intercostal cutting point of 5 mm, any left rib that is >5mm in either direction will reduce the 'left side cutting accuracy' noticeably being a concern, a 10mm misalignment would arguably be a definite bad cut.

- 57% of measured carcases had a +/- 5mm misalignment
- 20% of measured carcases had a +/- 10mm misalignment



During early October, Scott undertook a larger sampling regime at Bordertown and ascertained the following results. This time the carcases where measured in the chiller and then the resultant forequarter (once cut by the primal system) compared with the measured chiller carcase results to confirm that that prediction of a bad cut from a chiller measurement truly resulted into a real life poor accuracy cut.



All of this work assisted Scott and JBS to then commence looking for other pre-chiller production causes and hence result in a lower than ideal cutting accuracy for JBS.

A similar approach and methodology also occurred on the hindquarter cutting accuracy.

Middle Machine Product Output

During the commissioning of the middle machine it became apparent that there was misalignment within JBS as to what is an acceptable cutting specification for the racks and now also a revisit (as a result of the installed middle machine) the real specification for the maximum angle of a forequarter cut in the primal system. Scott eagerly worked in co-operation with the customer on defining the best specification for JBS moving forward. This process consumed valuable commissioning time and resources and hence exceeded the wet commissioning budget originally allowed for.

As such, Scott obtained a variation to continue to work with JBS Bordertown and ensure that the best possible product outcome from the installed system is obtained by JBS, whether this exceeds the current contract specification or not.

Blade Breakage

At least ten (10) blades, at a RRP of $5,000(each) failed. The preliminary report from the Quest Integrity Group, report with filename: 105389 01 Report Issued February 2014.pdf (Supplied as a confidential document to MLA) ascertained that the cause of the breakages were a result of pitting

from the JBS cleaning chemicals, which in turn lead to stress fractures and eventually blade breakage.

Figure 1a 1st blade breakage – showing crack locations.

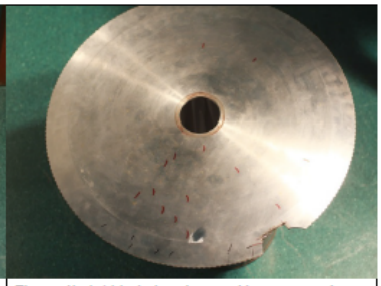


Figure 1b 1st blade breakage – Hammer marks (red).

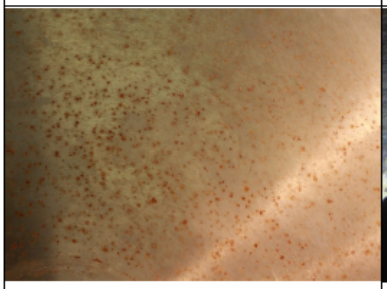


Figure 1c 1st blade breakage - Corrosion pitting.

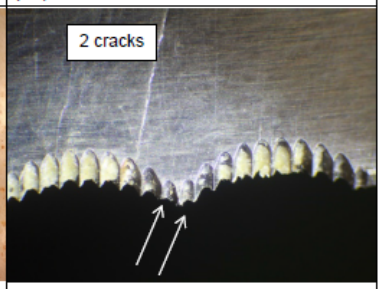


Figure 1d 1st blade breakage - Wear of top tips (arrowed) and cracking.

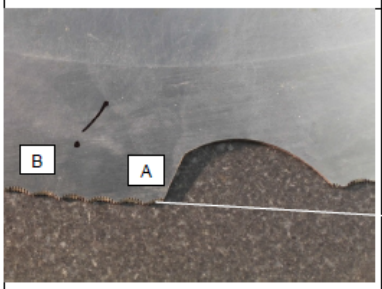


Figure 1e 1st blade breakage - Fracture A first failure and B adjacent crack.

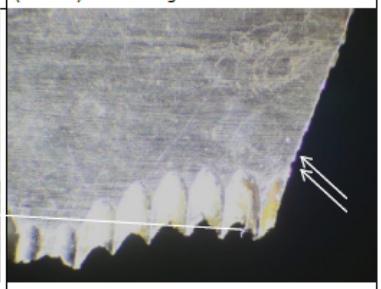


Figure 1f 1st blade breakage - Origin region of fracture A – Rounded pits were present at the edge of the crack (arrowed).

5 Moving forward

Utilising the Greenleaf CBA, and JBS (and ALC) as reference sites, Scott will continue to market the x-ray primal middle suite of offerings to the Australian processing sector.

6 Appendices

Appendix A – X-ray (and Primal) sign off.

SCOTT

PROJECT DETAILS

Scott Project No. 237
Scott Project Name JBS Integrated X-Ray / Primal
Customer JBS Australia
Contract Name Quotation JBS 120512, dated 20th July 2012

"Try Before You Buy" Start

This document certifies the machine referred to above has reached the stage of "try before you buy" start, as of ~~Monday~~, May 7th, 2014. It has been agreed that the TBYB period will be 12 months from this date.

Notes

1. **Try before you buy – Final payment**
   - Final payment for the machine will be May 7th, 2015.

Signature:

	8/5/14
On Behalf of JBS	**Date**

Scott Technology Ltd | 630 Kaikorai Valley Road | Private Bag 1960 | Dunedin 9054 | New Zealand | Ph +64 3 478 8110 | Fax +64 3 488 0657 | www.scott.co.nz