Feed Outage at Lewis Site (R2)

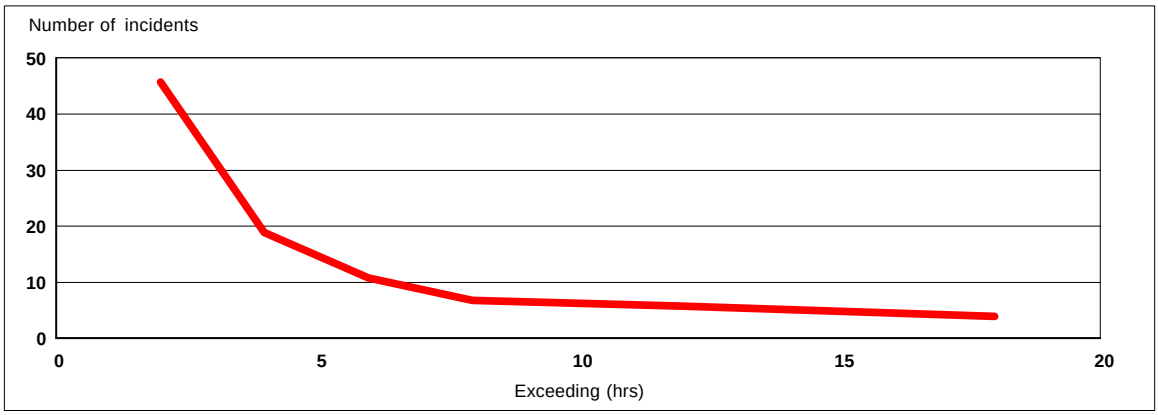
I was asked to look at particularly low readings for feed and water in this room over the period 31st Aug to 3rd Sep 2001.
First, I checked the raw data for data outage - low readings in counted factors could be due to data loss, or resets in the monitoring equipment. Readings checked out correctly - from about 1:30 pm on Friday 31st Aug to about 10 am on the 3rd Sept (Labor Day), neither auger in this room was operated. Water intake was measured at severely below preceding and subsequent levels.

As far as I can determine, the data is an accurate representation of what actually occurred. Unless it be that the feed was delivered by hand the pigs had no feed for around 3 days. This view is substantially reinforced by the considerably reduced water intake during this period. The only valid alternative explanation would be that the pigs were all removed from the building during this time. This is somewhat implausible, as it appears there were significant numbers of pigs in the building until at least 10pm on 31st August, as shown by water intake.

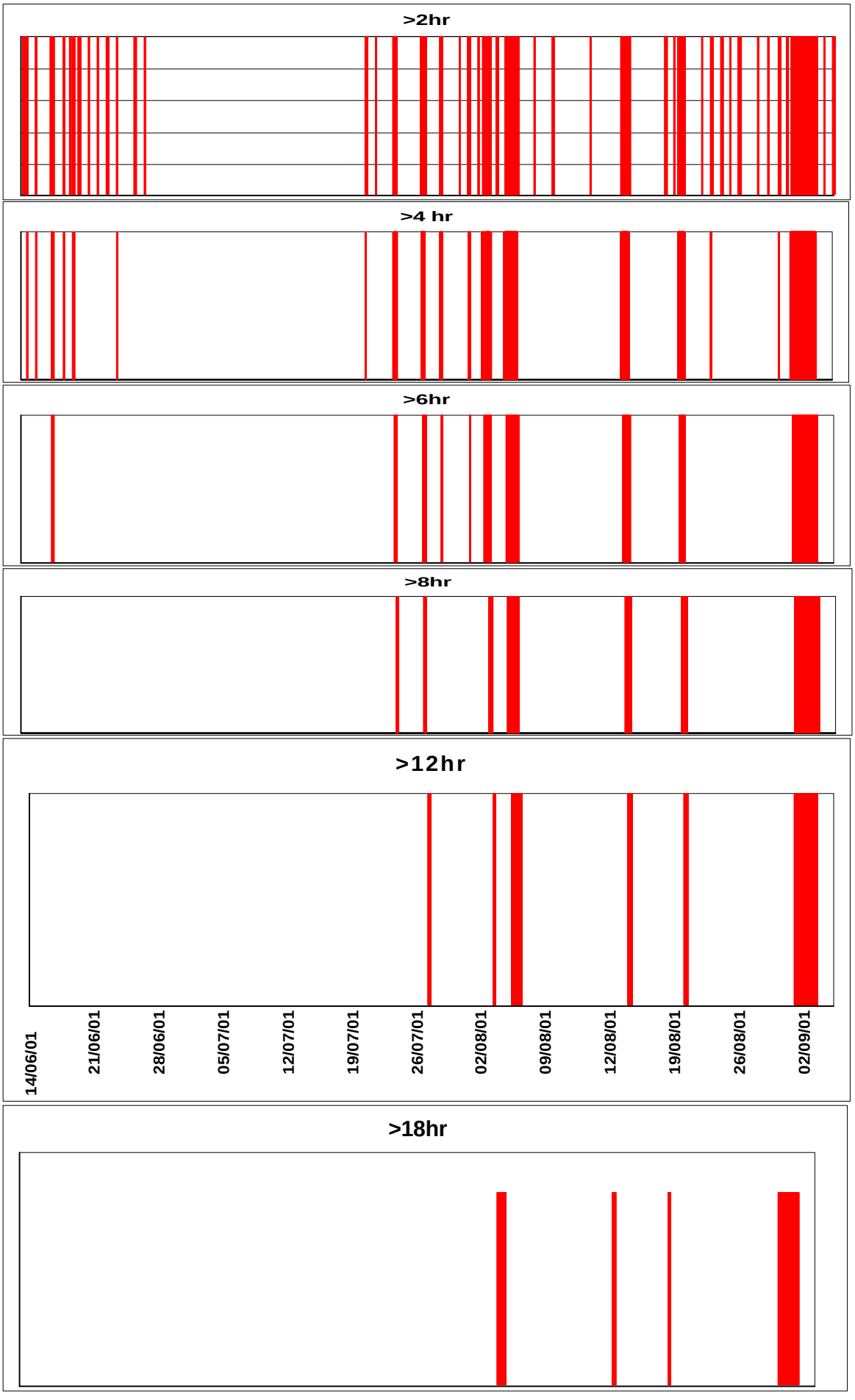
Reviewing preceding data, it is clear that this is by no means an isolated incident. Noticeable gaps are to be seen in the feed trace on several previous occasions. On each occasion, there was a noticeable drop in water intake.

Feed Outage Analysis

My first step was to carry out a feed off run length analysis. By which I mean looking for periods when neither auger for a certain length of time.
Firstly, when neither auger ran for 2 hours or more, then four hours and so on.



The analysis is shown on the following page.
(The width of the vertical line in each case represents the amount of time in excess of the chosen period.)
Above - As the chosen period increases, so the number of instances decreases.
As can be seen, it is not uncommon for neither auger to run in any particular period of 2 hours, or even up to 4 hours, typically during the night.
However, it is unusual for neither feed auger to have run after around 6 hours, and exceptional if it is more than 8 hours.



I feel it is a reasonable proposition that a problem is indicated by neither auger running for a period of 6 hours.

On this bases, the data points to a fairly regular occurrence of feed outage.

An interesting point to note is that the end of the outage conditions - whether or short or long - is typically either around 7 or 8 am or 4 to 5 pm. This suggests manual intervention - i.e. that the condition has been corrected/reset when looking at the animals.

However, the protracted periods of outage typically appear at weekends. It may or not be significant that the longest period of outage occurred on Labor Day weekend.

The total amount of running time measured for Auger 1 and Auger 2 is very similar (about 5% different over the 82 days), but Auger 2 runs many more times.
In the 7992 sample periods, an Auger 1 runs in 1402 of them, while Auger 2 runs in 5194.
That is, Auger 1 runs in about 17% of sample intervals, while Auger 2 runs in 62%.
Ignoring, for the moment, the effect of multiple runs within a single sample interval (15 minutes), the average running time (within one interval) for Auger 1 is 1 minute 46 seconds, while for Auger 2 it is only 27 seconds.

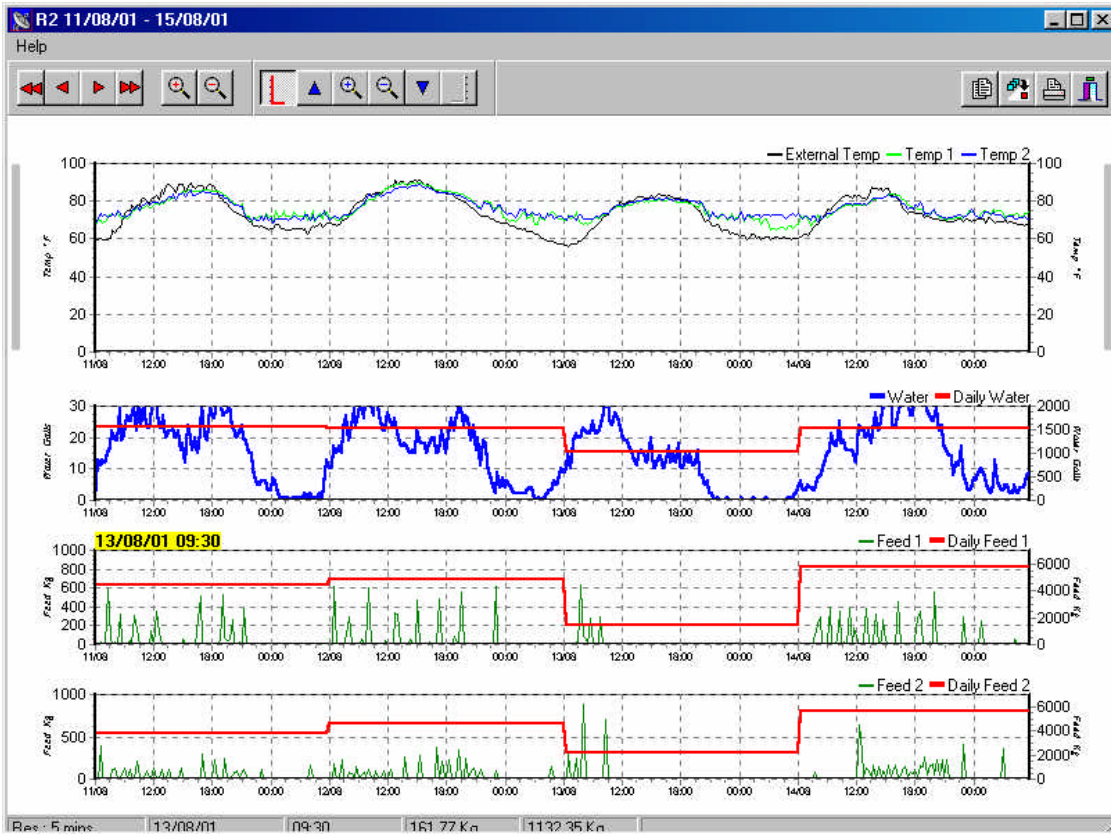
What causes the feed delivery loss?

Note that only times when both augers have not run are counted - that is, when there must be a common cause to neither augers running.
There may well be other times when either auger is actually not functioning, but this is difficult to distinguish (in a generalised way) from not needing to run.
Common causes would be either the (presumed) single bin bridging, or an electrical problem affecting both such as a circuit breaker trip out (if supplied from a single one).
Since such conditions are only restored in morning and evening, it's assumed the condition is corrected manually (e.g. by banging bin to settle bridged feed, resetting auger overrun timers).

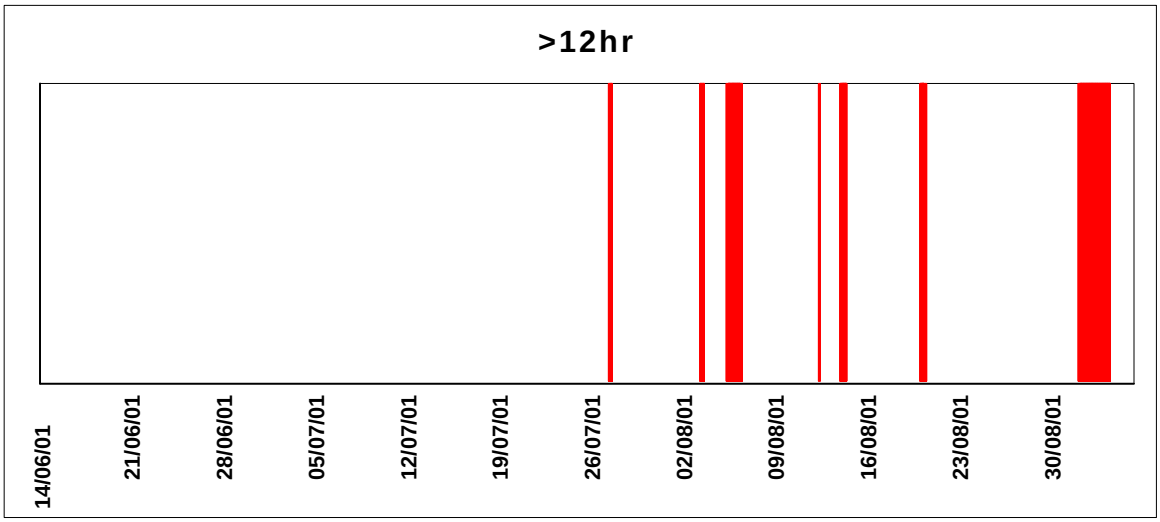
It should also be noted that - if feed delivery loss is due to bridging and consequent overrun timer trip - the running up to the moment of trip will be counted in (since mains is still on the auger) and the actual feed delivery may be less than indicated.

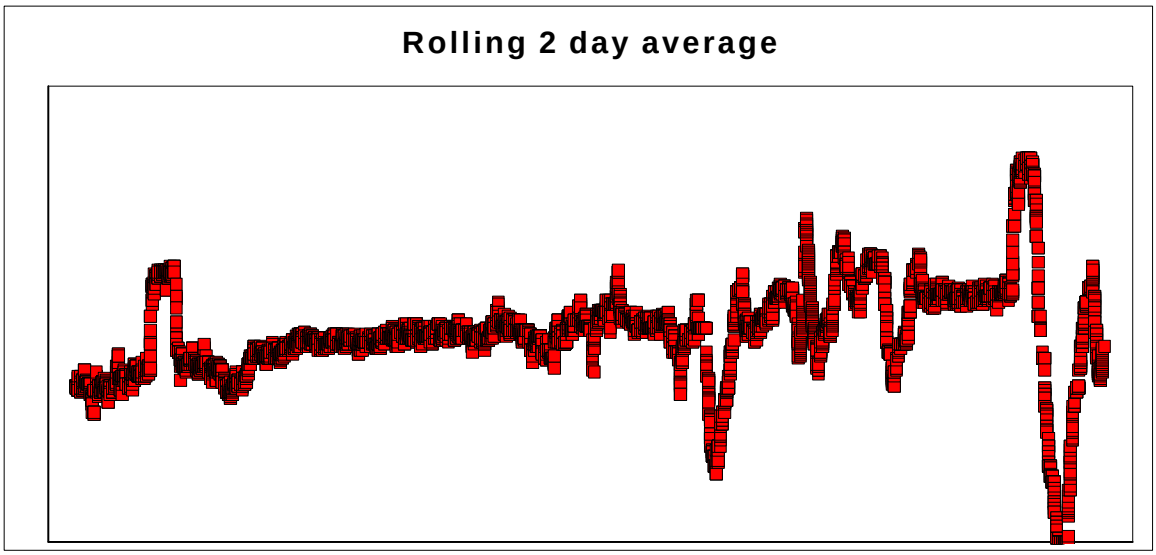
At what point does feed delivery loss lead to loss of growth?

Feed delivery loss leads to loss of growth on account of lost feed intake.
Of course, this depends on when the feed delivery failure occurs. If it is sometime during the night and restored first thing in the morning, it appears that feed intake loss if relatively marginal. However, when feed delivery loss occurs in the morning - or is not corrected in the morning - it is clear that there is a dramatic and irretrievable loss of feed intake.



This screen dump shows the incident commenced around 10 am on 13th Aug. Due to high temperatures, pigs were in a pattern of a water (and feed) intake dip during the middle of the day. It can be clearly seen that water intake (feed not being present) does NOT recover in the afternoon. Furthermore, night time water intake (used mainly for digestion and waste elimination) is totally absent. It is clear that the pigs have suffered seriously reduced feed intake on that day.
Feed intake on that day is reduced by 64% on that day. Whilst higher the next day, the increase is only 21%, nothing like enough to make up for the loss on the 13th.



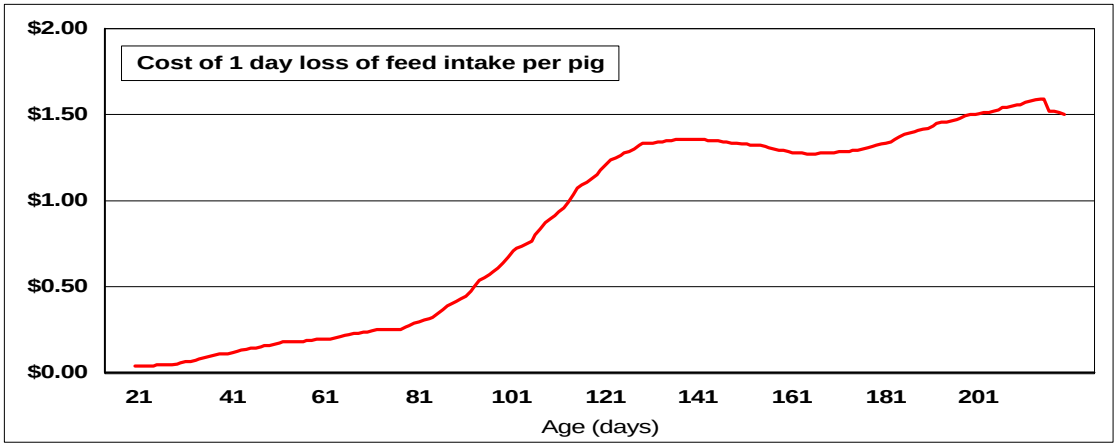


Comparing periods of prolonged outage with the rolling average over 48 hours, it can be noted that there may be a peak following the dip, but the increased consumption is nowhere as big as the loss. That is, the loss of intake is a genuine loss, and is not made up subsequently.

Costs of loss of feed

The following chart shows my estimate of the costs of loss of one day's loss of feed intake per pig. It is based on estimates of the "normal" feed intake and the maintenance requirement of pigs at certain ages.
For example, if "normal" pig intake is 2 times maintenance and one day is lost, then a loss of one day's intake will take a day to make up (somewhat crude I admit).

On this basis, the cost of the 31st Aug to Sep 3rd incident is around $3,900 (1000 animals for 3 days @ $1.30). Taking other such incidents over the period studied into account, an overall estimate of $6,000 is probably more realistic.



Summary & Conclusions

The incident 31st August to Sep 3rd as shown in Barn Report is a genuine one. That is, the data appears to represent what actually happened in terms of feed and water intake. Whilst a glaring incident, it is not an isolated case in this building.

The data suggests a loss of potential profit of (conservatively) $3 to $6 per pig over the 2 1/2 months studied.

Whilst it appears that human error - in failing to spot the feed outage at an earlier stage - has contributed enormously to the scale of the problem, it should not be forgotten that the primary cause of the problem is the feeding system itself. This appears to be quite unsatisfactory in providing a consistent and reliable delivery of feed without significant human attention.

In the 31st Aug incident, the outage should have been detected on the evening round on that day, or at least the morning round on the next. However, even if it had been detected on the evening round of 31st, a significant loss of intake would still have occurred. (From this and other data, it appears that pigs simply will not make up the difference in the short time remaining before bedtime).

Whether the unreliability of the feeding system is due to poor design, low quality components, lack of maintenance, the nature of the feed, or whatever, should be urgently investigated.

Serious consideration should be given to enhancing the feed auger control and detection system in order to reduce the risks of such incidents recurring. Barn Report has a role in terms of indicating the scale of the problem. However, the analysis of the data suggests that far more timely action is required than can be provided by this route - within 2 or 3 hours, not within a day or so.

Improved alarm functionality could be provided via an upgraded monitor system. (Which would incur some software costs.) However, there are significant limitations using this route. Chiefly, that a monitor system has to accept the longest interval which might be "normally" encountered. It has to accept the data as is, with extremely wide tolerance. (We are only too aware that an alarm system that alerts a problem often - or dares disturb anyone's sleep - whether justifiably or not - is seen as the problem.) The tolerance bands liable to be set in such a circumstance - such as 12 hours or more of no auger operation - would have avoided the most gross of the incidents, but would leave substantial remaining potential financial loss.

To be effective, I consider that the tolerance should be only 2 or 3 hours at most, should operate primarily during the day, and specifically should detect and alarm in the event of overruns. This is not very easy to arrange with a purely monitor function. The specification of our embedded feed control algorithm is, I think, much closer to the required specification.