Introduction

Disease eradication strategies must be preceded by economic analysis of predicted results. This requires an evaluation of present and future functional biosecurity training and efforts, transport constraints, geographic and epidemiological considerations, and a working field/scientific knowledge of the challenging agent. Out of the analysis of predicted outcomes a realistic expectation of both initial and the duration of any successes must be established.

Over the last 30 years much has been accomplished in the US swine industry from a disease eradication perspective. The industrial changes in pig production along with the leadership of modern breeding stock companies has lessened the importance of many pathogens through elimination or reduced disease expression. All-in, all-out practices along with multisite production has reduced the risk or naturally controlled lice, mange, ascarids and other intestinal parasites, TGE virus, *Actinobacillus pleuropneumoniae*, erysipelas, *Salmonella choleraesuis*, *Mycoplasma hyosynoviae* and *hyorhinis*, tuberculosis, effects of toxic plants, most nutritional imbalances, tetanus, and a long list of many other agents.

Pseudorabies and porcine stress syndrome are two other notable diseases which were systematically eliminated by government and or producer mandate. Immediately preceding PRV, Classical Swine Fever was eradicated by veterinarians most of which only recently retired from active duty. We have also become quite good at eliminating specific agents from individual farms. These eradication programs have included whole and partial depopulations and various types of immunologically based “roll-overs”.

PRRS virus has become the modern plague to the swine industry. Within Premium Standard Farms we have made PRRS our eradication focus but Mycoplasma and a few other old nemeses have been attractive elimination pathogens as well. We have had some success, some failures that should have been expected and some that had unique opportunity to succeed but did not. Many of these are very generally described in the following historical descriptions.

Case Histories

Our first regional efforts at PRRS elimination began February of 2002 with our boar studs. MLV vaccine was discontinued followed by introduction of naïve boars. A monitoring program ensued with weekly PCR testing of sentinels and semen. By April of
that year it was apparent that all were remaining negative and semen was safe to use in elimination projects. Dr. Randy Jones and Dr. Lisa Becton drove this project with my assistance in Texas.

The Missouri stud is very large and positive when we began planning regional eradication strategies. We eventually supplied semen for all the Missouri elimination projects even though this stud is located approximately 1000 feet from a continuous flow PRRS active nursery. It has remained negative for more than 2 years with continuous activity in the nursery and adjoining breeding herd. Air conditioning may provide additional biosecurity defense against biting insects?

During May of 2002 we began our first PRRS elimination effort in a single multiplier in North Carolina. To take economic advantage of the gains we had made with the studs we knew negative gilt supply was an essential next step before any system control of PRRS could be obtained. The genetic replacement source had been stocked PRRS and Mycoplasma free, was in a very low pig density area for North Carolina, monitoring indicated negative weaned pigs, and farm history indicated stability for more than a year. Our first attempt was a low cost rollover without a gilt breeding project. Gilts were withheld for 60 days and entered as sentinels. Michael Griffin and his production team bought into the plan and committed great effort making the project a success. These gilts remained negative as did the nursery flow. After several months of convincing negative flow the continuous flow gilt finisher was depopulated. This phase of the project was managed by Dr. Wrenn Matthias. These sites have remained negative for both PRRS and interestingly also Mycoplasma hyopneumoniae for more than one and a half years. Shortly after the first NC multiplier appeared successful we began the second rollover. This farm had been following a MLV vaccination program for several years, had a history of no clinical signs, good isolation, and had a PRRS and Mycoplasma negative nucleus replacement source. The project was more difficult than the first because of internal GP production in an on site continuous flow nursery/finisher gilt developer. Producing negative replacements internally from serologically positive sows has greater risk of failure than the typical “rollover” developed by PIC. This required finding and then providing biosecurity protection to an offsite nursery and a functional monitoring program allowing us to confidently return negative gilt replacements back into the breeding herd. Dr. Randy Jones managed this project successfully. The breeding herd sentinels as well as nursery pig flow has remained negative for nearly 12 months. The continuous flow gilt finisher site will be depopulated by Leman Conference time. Our intention is to attempt a PRRS “rollover” in all farms supplied by this multiplier next year.

To complete the task of all negative semen and gilt replacements in NC we attempted a third multiplier “rollover” elimination attempt. This failed and the farm was eventually depopulated. A second continuous flow multiplier was replaced with a new start-up. Both of these continue to produce negative replacement gilts.

All of our gilt multiplication in NC is presently PRRS negative. Once we had a supply of PRRS negative gilt replacements we started taking advantage of elimination
opportunity. Stabilizing a system requires consistently negative gilts, semen and transport control. We have accomplished the first two in NC but have much yet to do with the latter.

With growing confidence among the production group we came up with a grand plan to roll large areas of sows negative in 20 week segments. This was our first attempt at what I call parity segregation – reverse the gilt introduction elimination. Since NC was our first pod to have consistently negative semen and gilt replacements we attempted this strategy in a 15,000 sow company owned segment of our production. This project began in the spring of 2003. We had a good history of farm stability and no onsite nurseries which is rare for us in NC. The farms were separately constructed and two of the farms were larger than the others fitting parity segregation and the opportunity to make a future switch. Dr. Matthis managed the elimination component of the project with immediate success based on negative sow farm pig flow. Just before the planned parity switch the gilt farm suffered a lateral virus introduction. Through good monitoring and communication the rest of the system was saved but only temporarily. Within three months of the parity switch a second virus managed to enter this farm and flowed down the pyramid with the weaned P-1’s to all but one of the sow parity farms. The gilt multiplier has remained negative and along with sequencing established a lateral source for both breaks. We have made no additional attempts in NC with parity segregation.

Our latest NC project is a very large, biosecure gilt breeding project where we can breed and gestate negative gilts for later introduction into stable well isolated farms. This provides a continuous rollover effort in geographic areas where our contract producers have some degree of isolation. During this period of active elimination projects we have made continuous attempts to improve our biosecurity through education, training, truck wash construction and management, and development of true health pyramids. Transport has been and continues to be the weakest link in our NC biosecurity effort.

To date the Missouri pods are where our most successful area eradication efforts have occurred. Although PSF has more than 100,000 sows and offspring in the northern Missouri area, one 25,000 sow system has reasonable geographic isolation. Our own internal multiplication was and remains PRRS positive requiring assistance from a negative breeding stock company (Genetiporc). This project began as a rolling depopulation of sow farms with later segregation of negative slaughter pigs into our multiple finishing sites. Isolated gilt development/isolation sites were chosen from outlying contact finishers. Missouri had long established breeding projects for our sow production to meet environmental stocking density constraints. This experience with gilt breeding projects gave added confidence that these projects could be accomplished without any significant loss of numbers entering our packing plant. The project began late winter 2003 with establishing our gilt isolation sites and focusing all positive bred gilts into the farms which were down the depopulation timeline. Dr. Becton along with the Missouri production team began extensive biosecurity training with all stakeholders, and support personnel. A new monitoring system was established and added sampling was added in the large Missouri stud. As the last of the negative pigs began arriving in our breeding project sites routine testing detected PRRS virus introduction into the largest isolation site. The decision was made to continue with a modified “rollover”. All gilts for this 5000 sow initial project were
purposely exposed and the project was closed to additional introductions. After 200 days the onsite nurseries were depopulated. One immediately and consistently produced negative pigs thereafter but the second farm required a second nursery depopulation at 250 days before consistently producing negative pigs. Both farms were stocked mycoplasma free and remain so. Sentinels have now been in the farm for many months remaining negative.

The remaining six farms were successfully depopulated and repopulated and also remain negative. This area eradication of PRRS and *Mycoplasma hyopneumoniae* continues to produce negative pigs. Production performance has been outstanding compared to our previous performance levels and compared to all of our other production centers. We have had some failures in this flow loosing three 8 barn finishing sites to a virus that matched the original sequence in the breeding project. We are eliminating virus at these sites through slaughter and should be complete by the time of this meeting.

Our second large project in Missouri started with the establishment of three health pyramids in the remaining 75,000 sows. In the first project we had the opportunity to segregate our pig transport and feed delivery into a separate PRRS negative fleet. This was difficult at first but as we gained ground in the first project, this was increasingly simplified as all pig flows became PRRS negative.

With the second project we began by parity segregating each of the three health pyramids, monitoring to determine stability. Pig flows were additionally segregated into gilt and sow offspring. One insurmountable biosecurity issue was transport management. We were aware that the likelihood of constant PRRS movement via trucks was significant. Prior to this time winter always brought PRRS and TGE outbreaks in many of our sow farms, nurseries and finishers. During February 2003 we retrofitted a prototype “Trailer Baker” at the Princeton Missouri truck wash. We have been continuously heat treating tractors and trailers for the past 20 months averaging >30 per day. Scott will discuss some of our validation studies during the seminar. This is a heat treatment process - not just drying. The PSF team did this in conjunction with many other biosecurity improvements essentially changing the health and biosecurity culture of the Missouri operations. Bill Homan and his production team deserve great credit for this effort. It is my opinion that nothing of this magnitude has been previously attempted let alone accomplished in the swine industry.

These parity switch projects are scheduled to be completed over the next 12 to 18 months hopefully developing the first 100,000 sow negative system. Our first 25,000 parity switch attempt is underway with over half of the sow farms producing negative pigs immediately after the switch. Several of the farms have required additional nursery depopulations. Sow farms that have attached nurseries create special problems and add both risk and cost to any elimination project. When designing production systems no site should be larger than what can later be depopulated without disrupting pig flow to the packing plant or cash flow – which ever is most essential to an operation.

Texas operations could be a book of their own. To date all attempts to eliminate PRRS have essentially failed with the lone exception the boar stud. Texas operations are
completely isolated from the rest of the US swine industry many miles from any significant sized operation. It is divided into two pods separated by approximately 20 air miles. The larger a 20 K site with nursery and finishing nested in the center of 14,000 acres. The smaller is 13,000 sows with separate nursery, finishing and wean to finish operations more than 4 miles from the two breeding herd sites.

Our first attempt to control PRRS was with parity segregation. All areas of production had suffered with repeated outbreaks and significant growing pig mortality since 1999. Although I have often considered it a waste of money, we have studied these viruses extensively with sequencing from all areas of the operation. No lateral virus introductions have occurred since 2001. This last outside virus arrived with gilt introductions but has never resurfaced. Virus activity in TX internal gilt production remained highly variable from nursery to selection ages and eventually destabilized the parity segregation process. The virus also appears to undergo rapid single point mutation rates, often appearing to exist in two separate host populations. Virus activity in the gilt farrowing farms during early summer 2003 created fear that we would cause a major outbreak in the larger sow parity pod thus all sow movement was suspended.

The decision was made to implement the highest standards of biosecurity and do a rolling depopulation of the southern pod (13,000 sows). All sites were fenced in with 24/7 guards patrolling the perimeters. Danish boot exchange sheds were added at each site at the fence line. Employees were shuttled into the facility by internalized vehicles. Internal feed trucks were utilized to offload mill feed preventing direct contact. All supplies and semen were moved into the farms though fumigation sheds. Bump chutes were built at the perimeter and shuttle buses delivered pigs to the chute. All potential direct contact with the growing pigs was eliminated. Strict and excessive downtime rules were implemented and enforced. Drivers were escorted during critical movements and negative and positive haul trailers were established and separated by more than 20 miles. The site took on the appearance and people movement control of a prison. The first site depopulated was the 3,300 multiplier. It was in final stages of repopulation when virus entered July 2003. This was attributed to transport at the time since these gilts had been 100% negative by PCR test just prior to moving. In retrospect the virus was a lateral introduction from the northern production pod. This site was depopulated a second time with temporary success. The finishing system in the southern pod had been depopulated and became a breeding project for the 10,000 sow side. This was successful and all of the southern sows were depopulated – repopulated and negative by October 2003. The 100,000 head wean to finish complex was the last challenge in this project. During December of that same year within three weeks of the last segregated positive pigs going to slaughter the virus did some remarkable feats. 14 of the negative barns appeared to have been infected during the same week if not the same day. Because of Christmas holiday and laboratory delays the larger southern sow site was exposed through weaned pig transport (no direct contact) for nearly 4 weeks. By the time our monitoring picked up the sero-conversion in wean to finish clinical signs were beginning in the sow farms. every attempt to contain the virus failed. Within 5 weeks all sites were viremic. As mentioned the boar stud was the only survivor. Plans for additional eradication projects in the northern sites were suspended. The virus had jumped 4.5 miles initially and then shorter distances to all other barns.
We are currently attempting a control/elimination with vaccine in all TX operations. The farms are stable but virus continues to circulate.

Conclusions

Functional biosecurity is a critical component of any regional eradication plan. My definition of functional is it must be practical, prioritize risk, rely on training more than rules, must address long term genetic introductions, semen, and most of all transport. It is my opinion that once semen and replacements are reliably negative, transportation of animals constitutes more than 95% of the remaining controllable risk.

Texas appears to have additional risk factors not present in North Carolina and Missouri. Seasonal influences do not exist. Twice I have observed multiple barns becoming infected on nearly the same day with an identical sequence pattern but matching nothing from previous recent isolations and geographically near-by locations. The virus appears to evolve at rates not reported by other investigators. It is still a mystery disease in TX.

Regional PRRS elimination is possible. There are many proven methods of elimination that have been successful but pig density and system structure along with management style and micro-system detail must be carefully considered before jumping to expensive and perhaps career ending plans. There is still a need for additional technological advances. The Trailer Baker concept appears functional but at a significant added cost to production. We have the tools to begin this process but must expect to travel like walking up hill on a Kentucky gravel road - sliding one step back for every three steps forward.

Acknowledgements

I would like to thank all of the PSF production personnel that made the dream of PRRS eradication their own dream. I owe a special word of thanks to Doctors Lisa Becton, Wrenn Matthys, Christina Venner, Randy Jones, Tim Loula, Matt Anderson, Danny Burns, Bill Christianson, and Jose Piva for their support. Dr. David James deserves special individual recognition and thanks for having faith when it all appeared costly and insane.