

ANIMAL WELFARE

Title: Validation and Demonstration of Utilizing High Expansion Nitrogen Foam for Large Scale Depopulation of Swine, **NPB Project #21-069.**

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Scientific Abstract:

The American Veterinary Medical Association (AVMA) defines depopulation as “the rapid destruction of a population of animals in response to urgent circumstances with as much consideration given to the welfare of the animals as practicable”.¹ There are a multitude of causes that necessitate the depopulation of swine including an animal health emergency, natural disaster, animal welfare emergency, and industry disruption. The AVMA categorizes methods of depopulation as approved, permitted in constrained circumstances, and not recommended. For swine, inhalant gases are an approved method which lead to death by hypoxia. The utilization of CO₂ gas has recently been studied and utilized in the United States. However, the use of CO₂ requires a modified airtight container that allows for the displacement of oxygen with the introduction of CO₂ over a 5-minute period.⁴ Nitrogen gas (N₂) has not been traditionally used for euthanasia or depopulation. It has been reported that nitrogen-based anoxia was the most promising method of euthanasia when oxygen concentrations were reduced to less than 2%.⁵ Further, it has been shown that “N₂-filled foam was effective at quickly purging the air of a containment box to create and maintain stable anoxic conditions.”⁶ The objectives of this study were to validate the use of high expansion nitrogen foam for the large-scale depopulation of swine and demonstration of Livetec Systems Nitrogen Foam Delivery System (NFDS) across multiple classes of swine. A standard roll off dumpster and portable cattle corral gating system were used for animal containment, with matched dimensions. Nitrogen foam was filled to a height of 7 feet to evaluate fill time of a standard volume container. A 20-minute dwell time was observed prior to using air lances to remove the foam and evaluate the animals. A total of 6 replicates were performed, with 3 replicates using feeder pigs (n=156), 1 replicate each of market animals (n=45), adult animals (n=25), and wean pigs (n=325). There was continuous monitoring and video recording through each replicate of depopulation. Prior to the trial, three (3) animals per replicate were anesthetized and had monitoring devices surgically implanted over the xiphoid, subcutaneously (excluding wean pigs). These monitored temperature, heart rate, and activity. Ten (10) animals per replicate had accelerometers placed on a hind limb to monitor activity. Animals were also observed for escape attempts, grunts, squeals, and time to cessation of movement (COM). Insensibility was confirmed by a veterinarian. Ten pigs per replicate were necropsied to evaluate presence of and if full occlusion of the trachea occurred from the foam. The time to fill the roll off container had a range of 80 to 140 seconds. Wean pigs in the corral

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containment took 141 seconds to fill. Evaluating the implanted sensors, the average time to cessation of movement, from the start of foam filling, for the three replicates of nursery pigs were 100.33, 89.00, and 151.33 seconds. For the market weight group the average time to COM was 63.33 seconds. The adults took an average of 169.25 seconds. For evaluation of the presence of foam in the trachea thirteen of twenty-eight nursery pigs, seven of ten market animals, six of twelve adults, and six of ten wean pigs all had presence of foam in the trachea. Of these 60 animals evaluated, none showed signs of occlusion of the trachea. In summary, a total of 6 replicates utilizing a total of 551 pigs from wean age to adult were successfully depopulated, with none displaying occlusion of the trachea, utilizing high expansion foam with the Livetec Nitrogen Foam Depopulation System.