RESEARCH ABSTRACT

ANIMAL SCIENCE

Title: Development of New Barn Commissioning and Building Component Integrity Protocols for Swine Housing Systems – **NPB #15-175**

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SCIENTIFIC ABSTRACT

For a swine housing system to function properly, the heating, cooling, and ventilation system components must work in harmony and individually as intended. A commissioning (Cx) process can be used to verify correct system function; however, swine facilities have yet to see the Cx process implemented due to the lack of instrumentation to measure the thermal environment (TE) and a technique to reduce the complexity of heat exchange and pig performance to a simple, common metric applicable across different facilities. Therefore, the goals of this project were to create a novel measurement system for quantifying the TE, develop a mechanistic model to understand the interaction between pigs and their TE, and lastly, establish the methodology to assess the TE with respect to pig performance. This project describes the design, validation, and implementation of an innovative TE sensor array (TESA) featuring dry-bulb and black globe temperature, airspeed, and relative humidity measurements. A low-cost omnidirectional thermal anemometer was engineered and calibrated for reliable airspeed measurements. These measured parameters were needed as inputs to estimate the convective, radiative, and evaporative modes of heat loss in the new model, which simulated the cascade of behavioral and physiological thermoregulatory responses of group-housed, grow-finish pigs as a function of the TE. Model results were used to generate the housed swine heat stress index (HS2I), which scaled TE impact from 0 (thermally comfortable) to 10 (severe heat stress), for assessing different combinations of the TE and predicting the subsequent impact on animal performance. HS2I was applied to spatially and temporally analyze data collected from a network of 44 TESAs deployed symmetrically in two rooms of a commercial swine facility. TESA adds a new level of measurement precision greatly needed in modern facilities and goes beyond solely measuring dry-bulb temperature. The mechanistic model provides reasonable agreement with previously published results and can be used to inexpensively explore different combinations of the TE on swine performance. Overall, this project provided new technology and methods to quantify the impact of TE on swine performance. This is a requisite need to enable the further development and execution of a Cx process. Further, both TESA and HS2I will be helpful for designing new ventilation systems and evaluating risk management .