Nitrogen Foam in Pennsylvania Poultry Operations

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Agricultural Emergency Services Inc.

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Presentation Overview

- Overview of current technologies available
- Features and drawbacks of Nitrogen Foam for poultry
- Considerations for use
- What the equipment looks like
- Validation Trials 2025
- Planned improvements
- Future work

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Overview of current technologies

- VSD+
  - New guidelines pending
  - Layer facilities
  - Facility design dependent
- CO_2
  - Limited availability
  - House limitations
- Medium expansion, air-based foam
  - Limited to floor birds
    - Solid floors
    - Limited foam height

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Overview of current technologies

- Liquid Nitrogen Whole House Gassing
  - Still in development
  - Promising for a variety of house types
- Manual (Cervical Dislocation/MAC/containerized CO_2)
  - Limited to smaller flocks (usually)
  - High level of exposure for workers

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Nitrogen Foam

- High Expansion Nitrogen Foam
  - Welfare/humane considerations
  - Less water
  - More complex equipment
  - Wide variety of house types ?
  - Livestock
  - Less live animal handling

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Considerations for Use- HENF

- Time
  - 24 hours?
    - May need other options for first house
    - Retrieval of NF generators
- Resources
  - Less water needed
  - Pumper truck
    - Low pressure high flow vaporizer?
- Personnel
  - Less exposure to virus

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Considerations for Use-HENF

- House design
  - Can penetrate cages and climb at least 30 feet
  - Manure pits/slatted floors
  - Barn layout and equipment (brooder boxes, cages, etc.)
- Time to respond
  - Farm density
  - First house option?
- Equipment
  - Pumper truck
  - Water
  - Reduced disinfection needs

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NFDS Equipment

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Validation Studies

- Funded thorough NADPRP
  - PA01.22- A Study of Logistic Requirements and Best Management Practices for Utilizing Nitrogen Foam Euthanasia in Pennsylvania Swine and Poultry Operations
- Trial 1 - May 2024, PDA/PSU
  - Initial application and testing of NFDS on slatted floors and mock elevated systems
- Trial 2- June 2025, PDA/ Industry
  - Broiler Breeder Replicate Trial
  - First NFDS replicate trial in US for poultry operations
- Trial 3- Sept. 2025, PDA/ Industry
  - Elevated deep pit layer pullet facility

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Field Trial #1, Broiler Breeder

Commercial
50' x 400'x 12'

Figure 1: Facility Overview

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Field Trial #1, Broiler Breeder

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Field Trial #1, Broiler Breeder

Slatted Floor 2' deep when empty

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Field Trial #1, Broiler Breeder

Minimal Sealing

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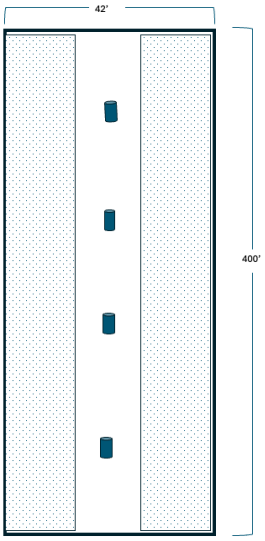
Field Trial #1, House Layout



House Volume: 184,800 Cubic Feet

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Field Trial #1, 8X Speed

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Field Trial #1, Consumables

- Replicate 1
  - Fill Time: 34 minutes
  - Water : ~ 3066gallons
  - Gas: 240,000 CF
  - Foam used at 1% concentration
- Replicate 2
  - Fill Time: 32 minutes
  - Water : ~ 3040 gallons
  - Gas: 238,000 CF
  - Foam used at 1% concentration

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Field Trial #1- Lessons Learned

- Nitrogen Foam wants to stack more than flow laterally
- Water consumption less than to air generator foam for whole house depopulation of similar size
- Penning to scratch area only (15x400) for medium expansion nozzle foam requires more bird interaction and equates to similar water usage.
- Removal of foam
  - Building ventilation
  - Can take hours
  - Good idea?

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Clearing The Barn

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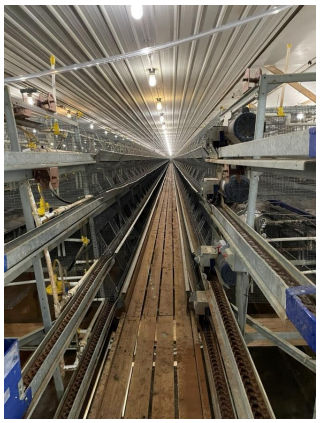
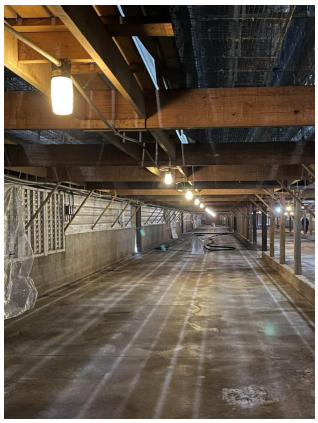
Field Trial #2, Elevated Caged Layer





House Size : 50'x420'x19'

House Volume: 399,000 Cu Ft.

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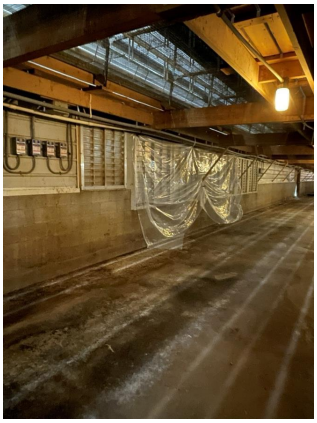
Field Trial #2,Elevated Caged Layer



Fans sealed with plastic and house wrap

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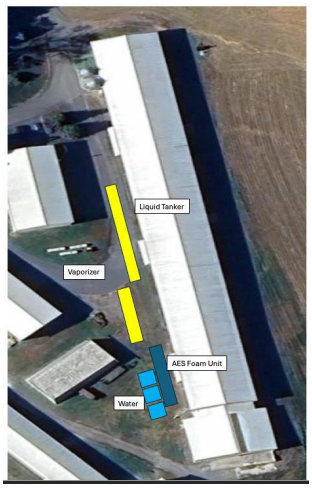
Field Trial #2, Space Requirements



Entry point for all hoses

4- 3000 gallon drop tanks used

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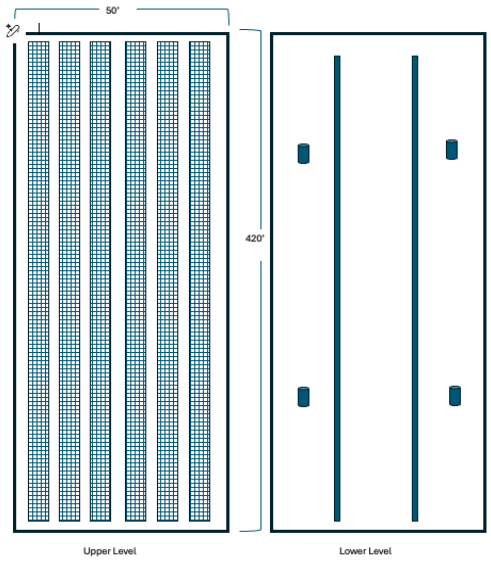
Field Trial #2, Equipment Layout



House Volume:399,000 cu feet

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Field Trial #2,

250’ Hose Feeding the furthest generator

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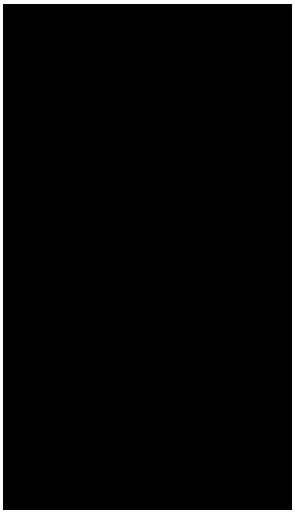
Field Trial #2, Foam Application



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Field Trial #2,

- Bubble Quality

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Field Trial #2, Foam Application

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Field Trail 2, Data Collected

Oxygen Level

- Recorded every 10 Minutes
- Foam/ Gas Start @11:02am
- 11:16am- 18.4% O2
- 12:54 pm- 6.8% O2

Top of Cage system–rear of house

Nitrogen Level

- Maximum Level Recorded
  - 12:56 pm - 92.21%

Top of Cage system –front of house

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Field Trial #2, Data and Consumables

- Replicate 1
  - Fill Time: 110 minutes
  - Water : ~ 10,000 gallons
  - Gas: 738,000 CF
  - Foam used at 1% concentration
  - Maximum Gas pressure in system 97 psi
  - Min/ Max Nitrogen temperature @ manifold 82-97 F

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Field Trial #2- Lessons Learned

- Complete fan sealing on lower levels
- Sealing from outside, if possible, for all fans.
- Placing equipment of both levels of the structure
  - 4 foam generating units may not be enough to distribute appropriately
- Not all cages need to be covered in a moderately sealed building for adequate oxygen depletion
- Risk of evacuation of virus materials during ventilation for equipment recovery

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Field Trial #2, Lessons Learned

Foam Leakage-

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Field Trial #2, Lessons Learned

Lack of sealing for efficient post ventilation led to loss of foam in the structure

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Field Trial #1- Lessons Learned

Clearing the barn-

- For rapid succession multi-house facilities, multiple sets of generators and inhouse hoses are needed for equipment transitions

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Costs of Supplies for Trials 1&2

Trial 1 (per replicate, broiler breeder)

Commodity	Cost
Liquid Nitrogen	$2145
Water	$400
Foam	$1155

- Total gas delivery ~$24,000 (2 days)

Trial 2 (layer pullet)

Commodity	Cost
Liquid Nitrogen	$5850
Water	$900
Foam	$3500

- Total gas delivery ~$20,000

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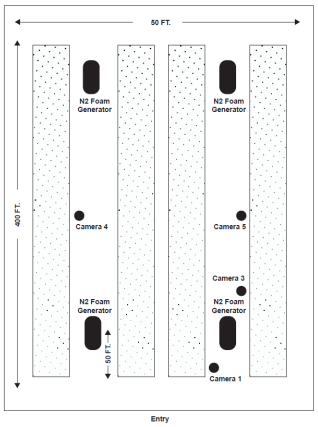
CA-Field Pilot #1

- Commercial cage free egg layer
- 400 ft x 50 ft x 7 ft
- Two-story barn
- Four rows of equipment on each level, scratch area between rows of equipment
- Two-tiered system with nest area on bottom and platform on the top with feed and water



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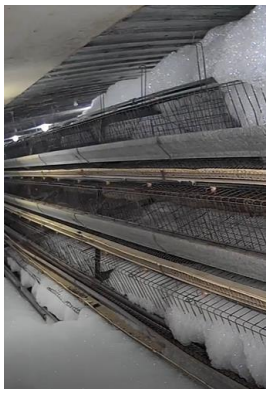
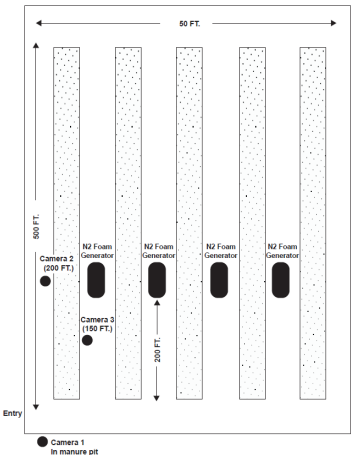
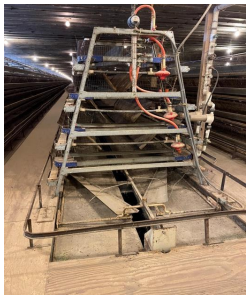
CA-Field Pilot #2





- 500 ft x 50 ft x 8.25 ft
- 5 Cage Rows
- Nine-inch gap under each row of cages for manure and airflow down to the pit
- May 2025



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Possible Improvements- Conclusions

- Onboard low pressure high flow vaporizer
- Replicates of in-house equipment for set-up staging efficiency
- Configurations of foam generators to maximize even distribution- 6 vs 4(current design), same overall flowrate
  - 30,000 gallons foam / minute

- Nitrogen Foam has been tested in 4 poultry structures in 2 states
  - only one trial replicated twice (PA Trial #1)

Future Projects

- Continuation of deep pit layer for replication, remaining funds in 2022 PA NADPRP, expires May 2026
- Second round of NADPRP funds for NFDS trials on breeding and shallow pit duck rearing facilities, 3 replicates to qualitatively and quantitatively assess the impact of the use of nitrogen foam technology on pekin ducks. Funded NADPRP 2025

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Questions

Thank you!

- Contact Info:

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Acknowledgements:

- USDA APHIS National Animal Disease Preparedness and Response Program (NADPRP)
- Industry partners

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