

## Verification of emission-reducing procedures in naturally ventilated cow houses by using optimised measurement methods

### Revision of the VERA test protocol “Housing Systems”

#### Authors:

Iris Beckert<sup>1</sup> and VERA Commission<sup>1</sup>: Anders Peter S. Adamsen<sup>2</sup>, Peter Demeyer<sup>3</sup>, Eva Gallmann<sup>4</sup>, Ewald Grimm<sup>5</sup>, Peter Kai<sup>6</sup>, Eberhard Hartung<sup>7</sup>, Sabrina Hempel<sup>8</sup>, Julio Mosquera<sup>9</sup>, Nico Ojink<sup>9</sup>, Paul Robin<sup>10</sup>, Bjarne Schmidt Bjerg<sup>11</sup>

<sup>1</sup>International VERA Secretariat, Gross-Umstadt; <sup>2</sup>SEGES, Aarhus, Denmark, <sup>3</sup>ILVO, Mellebeke, Belgium, <sup>4</sup>University of Hohenheim, Agrartechnik, Stuttgart, Germany, <sup>5</sup>KTBL, Darmstadt, Germany, <sup>6</sup>Aarhus University, Denmark, <sup>7</sup>University of Kiel, Kiel, Germany, <sup>8</sup>ATB, Potsdam, Germany, <sup>9</sup>Wageningen Livestock Research, Wageningen, The Netherlands, <sup>10</sup>INRA, Rennes, France, <sup>11</sup>University of Copenhagen, IVH, Frederiksberg, Denmark



#### Objectives

Make environmental efficiency and operational stability of emission-reducing procedures transnationally comparable!

- By using uniform and scientific test procedures and develop a revised test and verification standard
- Meet special challenges of emission measurements in naturally ventilated animal houses

#### Material & Methods

Connect expert knowledge and results of scientific studies from Denmark, the Netherlands, Germany, Belgium, France and Switzerland – as it is common practice during the creation of international standards.

Plan an inter-laboratory test to improve the assessment of measurement uncertainties under on-farm conditions

#### Results

Revised version of the VERA test protocol for ‘Housing and Management Systems’ focussing on:

- NH<sub>3</sub>, odour, dust emissions
- Related parameters (e.g. ventilation rate, CO<sub>2</sub>, agronomic conditions)
- Operational stability of the system (e.g. uptime of system, consumption of electricity, water, chemicals).

## Key amendments of the revised protocol

#### General

Introduction of ‘Standard Reference Methods’ (ISO 14793) – for higher flexibility in measurement methods but still assuring high measurement quality:

- Ammonia: impinger system
- Odour: dynamic olfactometry (EN 13725)
- Dust: gravimetric measurement (relevant EN standards)
- Air volume: fan-wheel anemometer or emission values derived from tracer gas

#### Agronomic requirements

**Aim: allow best possible transferability of the test results to other countries/farms.**

- Comprehensive summary of agronomic requirements for an emission test
- Compliance with all national regulations on animal welfare, total environment, occupational health and safety and food safety
- Definition of standard dairy house = loose housing with cubicles
- Summary of national emission factors of VERA member countries

Criterion (Excerpt)	Example: Dairy cows
Animal occupation rate	90–100%
Herd composition	> 70% of house must be occupied by cows
Housing system in use before test	> 2 months
Production level	≥ 25 kg fat and protein corrected milk per cow and day
Feed composition	≥ 50% roughage, 160–180 g CP per kg dry matter



#### Inter-laboratory test

**Plan phase 1:**

Comparison of the measurement devices for NH<sub>3</sub>, CO<sub>2</sub> and accompanying parameters without sampling variability

- Standardised gas measuring chamber with a mixture of different gases representing typical farm conditions.
- Test one measurement point in a ‘real-life’ animal house

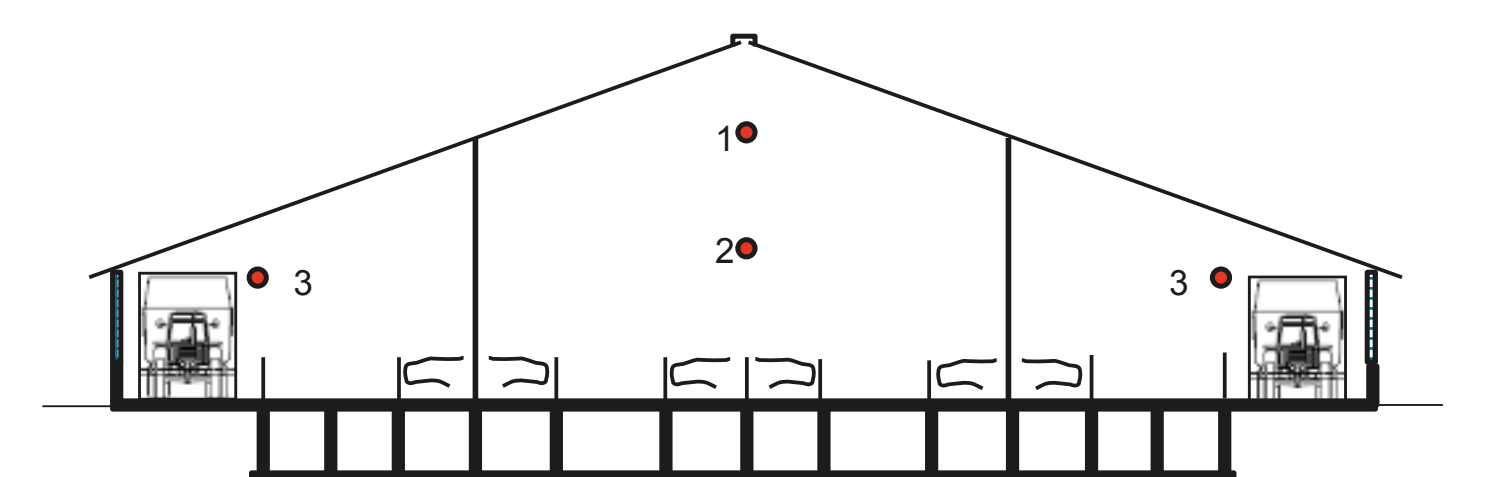
#### Naturally ventilated buildings

**Key alterations and major requirements:**

- **Test design**  
Case-control design = preferred option or multi-site approach (more expensive, min. 4 test locations)  
Deviation limits for a case-control approach  
Alternative test designs (‘fixed case-control’ or ‘on-off’) with specific requirements

- **Emission patterns**  
Depending on the animal weight and growth. ‘Growth’: stable (e.g. dairy cows), linear increase (e.g. fattening pigs) or exponential increase (e.g. broilers).  
Must be considered in test plan.

- **Sampling points (CO<sub>2</sub> balance method)**



Ingoing air: ≥ 1 sampling point outside the house at all open side walls (≥ 5 m distance).  
Other sources: to be considered/measured.

- **Sampling frequency**  
≥ 6 measurement periods of ≥ 24 hours distributed over one year.  
Number: depends on power of test design.  
Distribution: depends on the emission pattern.
- **Calibration, validation, on-site verification**  
Good laboratory practice emphasised (e.g. calibration procedures, estimates of measurement uncertainties according to the requirements of ISO 17025 to be documented and reported).
- **Calculation of the emission value**  
CO<sub>2</sub> balance method: CIGR calculation rules.  
→ open Excel calculation tool



#### Acknowledgements:

Danish Environmental Protection Agency  
Dutch Ministry of Infrastructure and Environment  
German Federal Ministry of Food and Agriculture (BMEL)