FALL 2024

PICARRO ETO CONFERENCE

Streamlining Emissions Compliance in the Sterilization Industry

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Workshop B: Measuring and Calculating Destruction / Removal Efficiency (DRE)

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Some Terms, as a Refresher

DRE: Destruction / Removal Efficiency. Computed as **DRE (%) = (1 – (outlet/inlet)) * 100**
CEMS: Continuous Emissions Monitoring System (general term, and Picarro-specific.
WMS: Workplace Monitoring System (Picarro specific)
SWEL: Site-wide Emissions Limit **1**: By EtO Usage 2: By Emissions Stream

Emissions Stream Components:
SCV: Sterilizer chamber vent, which pulls the high concentration out of the chamber after a sterilization cycle is complete (*nom. concentration 10s-100%)*
CEV: Chamber Exhaust Vent, a.k.a. a “back vent”, an interlocked vent that opens up when the chamber door is opened after sterilization to prevent release of residual EtO from the chamber (*nom. concentration, 1000s of ppm*)
ARV: Aeration vents, ducting that captures air from aeration (*nom. concentration: 10s-100s ppm*)
Group 1: Fugitive emissions around components that carry EtO directly, e.g. sterilizer chambers, pumps, EtO drums (*nom concentration: 10s-100s ppm*)
Group 2: Fugitive emissions associated with sterilized goods after removal from aeration (*nom. 10s of ppb to 10s of ppm, depending on circulation and materials*)

Important Caveats about DRE

EPA has promised to circulate **a guidance document** in the coming months to clarify certain areas they didn't adequately describe in the EtO NESHAP. These points include, e.g.:

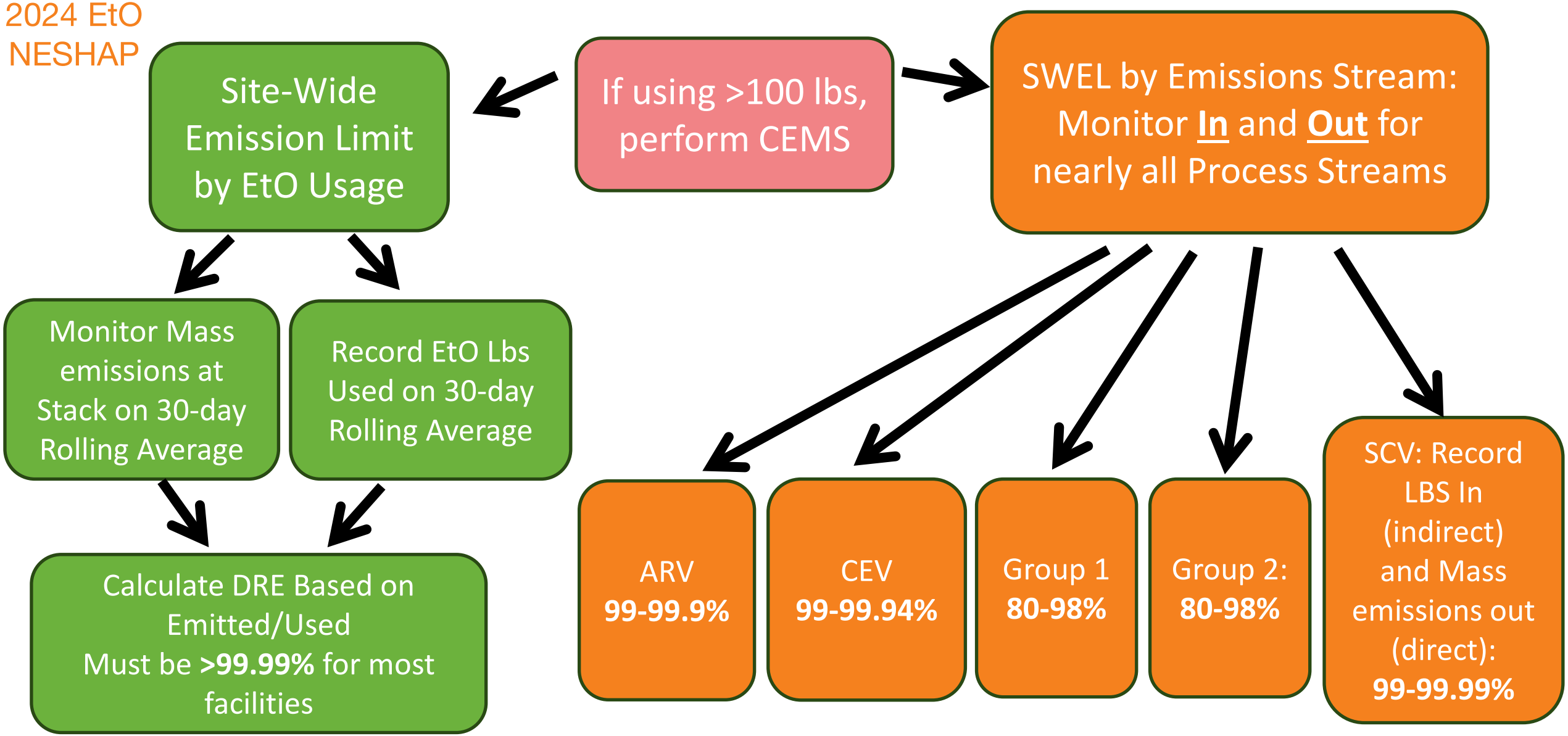
- Guidance on Group 1 and 2 emissions when dry beds recirculate some amount of the plant air
- Specifics of how inlet/outlet measurements should be done, esp. regarding whether inlet sample lines will require the same calibration and QA considerations as outlets (likely).
- Much of the initial worry about the NESHAP reporting DRE came from understandable misreading of the rule.

FIFRA ID has **not been released**, and is now anticipated to be delayed through at least January.

- It is not clear whether FIFRA will be prescriptive about abatement technology and facility design, or just about exposure levels.
- It is not clear whether there will be any requirements about DRE at this point—likely not.

2024 EtO NESHAP

NESHAP Emissions Stream Compliance



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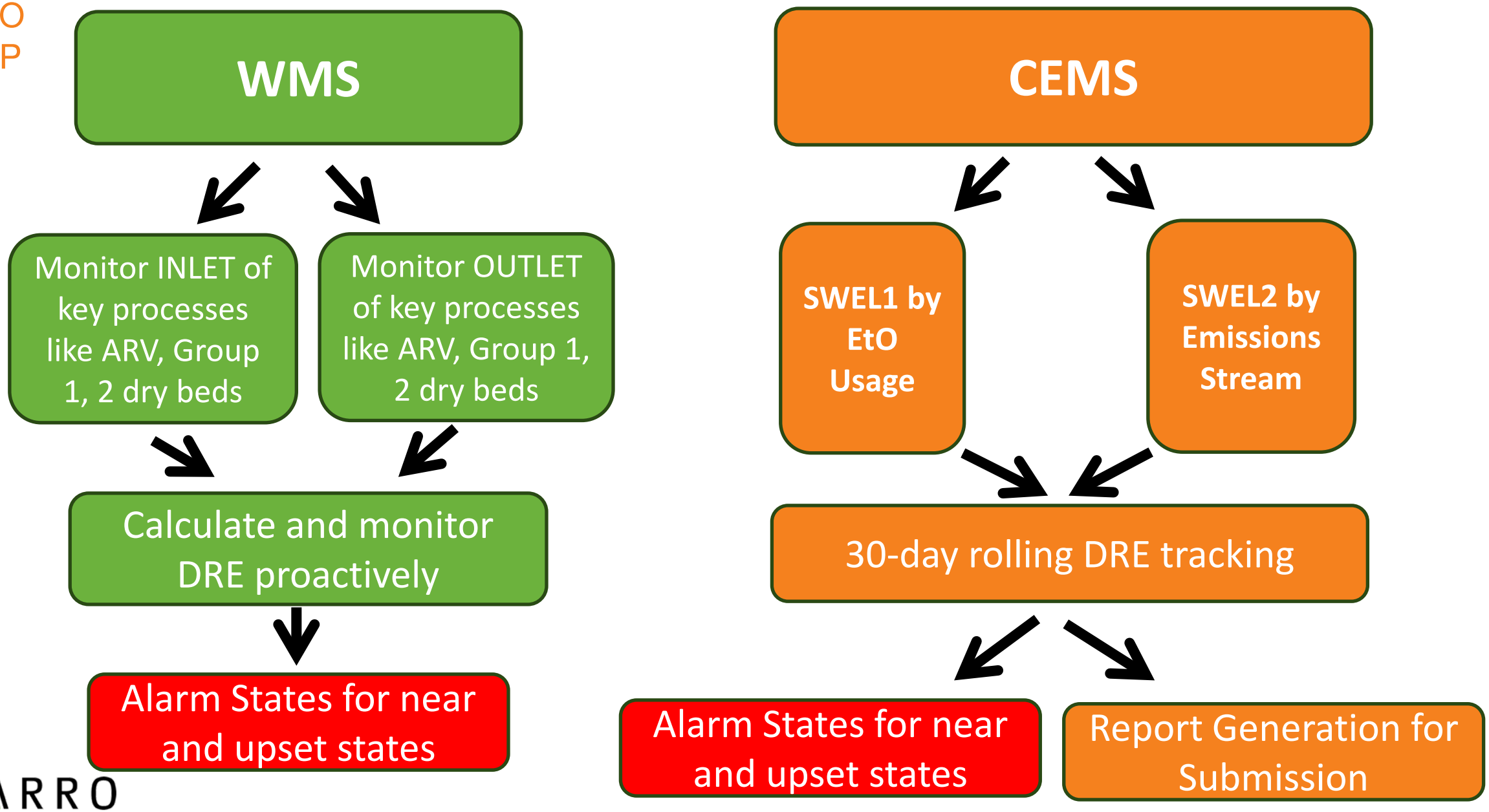
How CEMS and WMS Track DRE

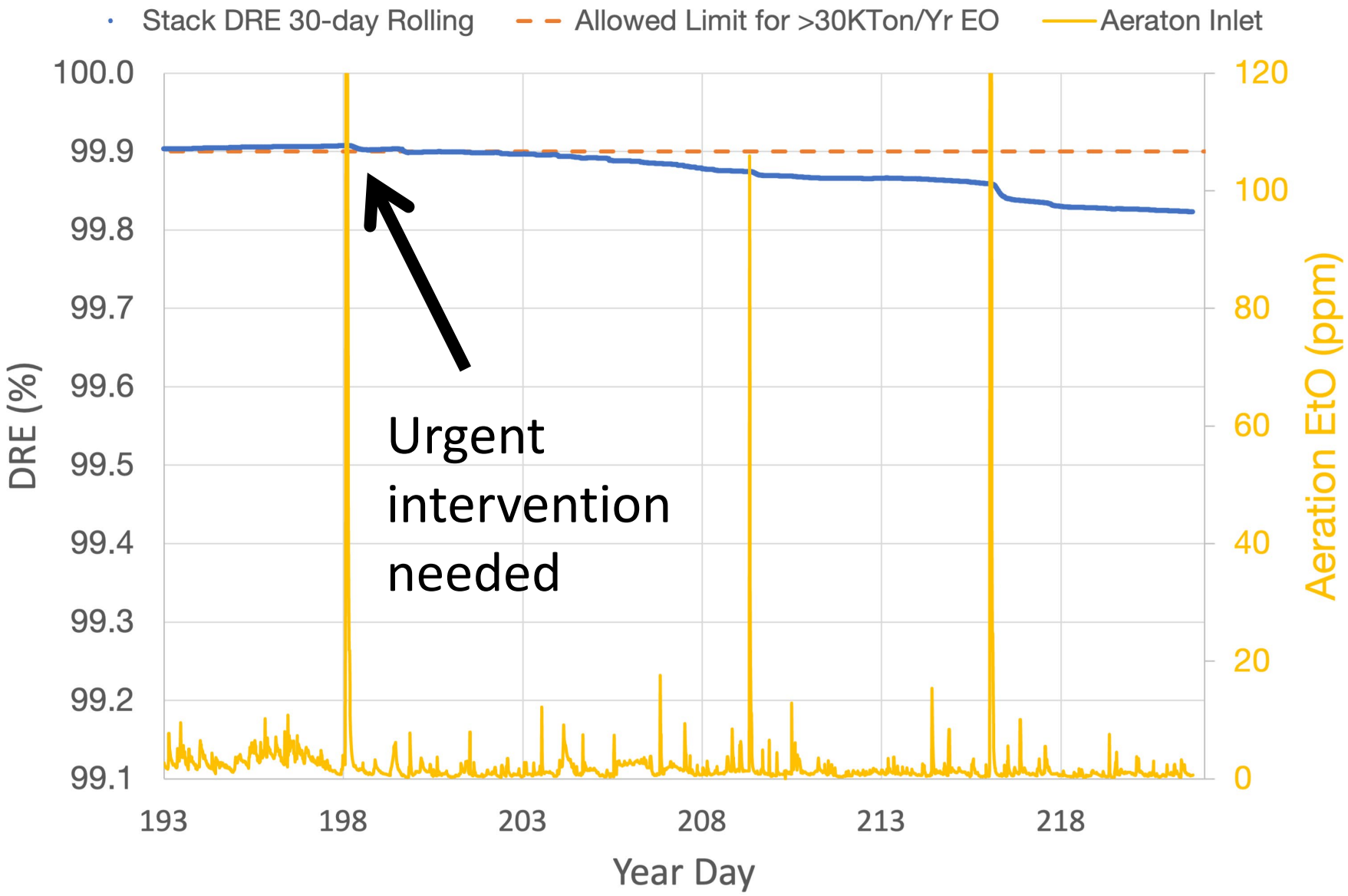


“We’re not able to track our dry bed Destruction Removal Efficiency in real time to be sure we’re not going to drop below an acceptable limit for the NESHAP. Can you help with this?” §

§Customer concerns paraphrased

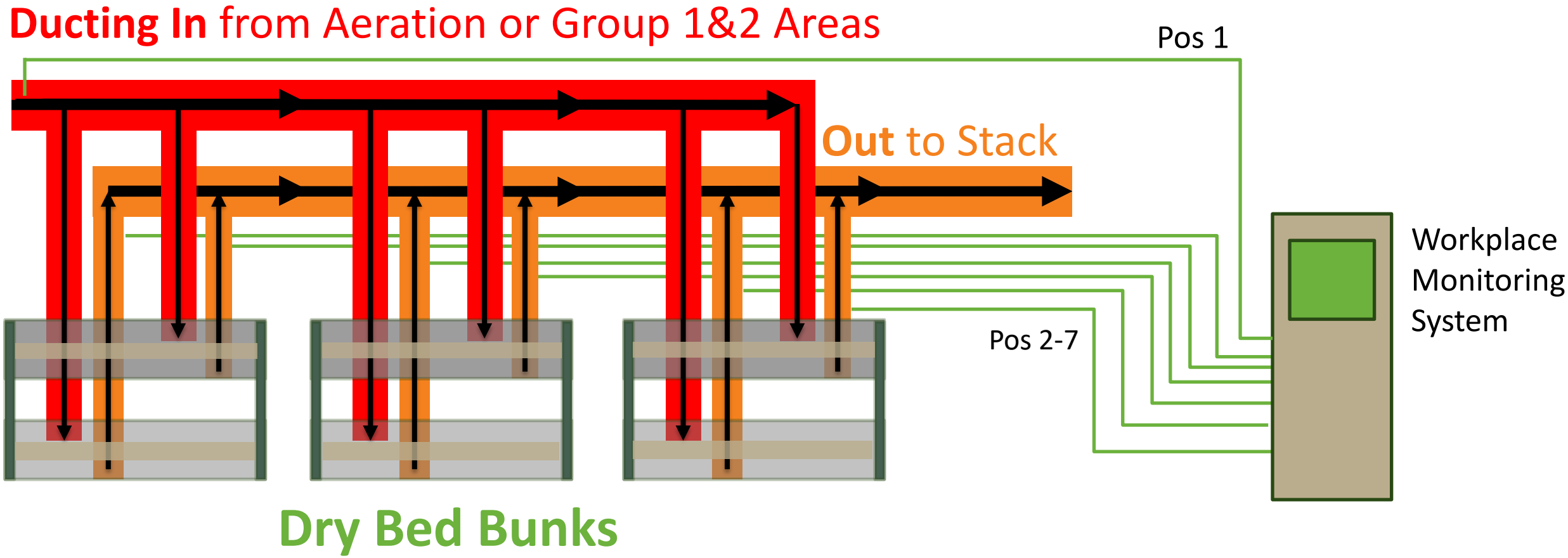
Gradual Loss of DRE for Aeration Emissions Steam

Facility's aeration emissions stream was dropping below 99.9% applicable NESHAP DRE, but it was unclear which dry bed was causing the drop, or if all were getting expended at the same time.



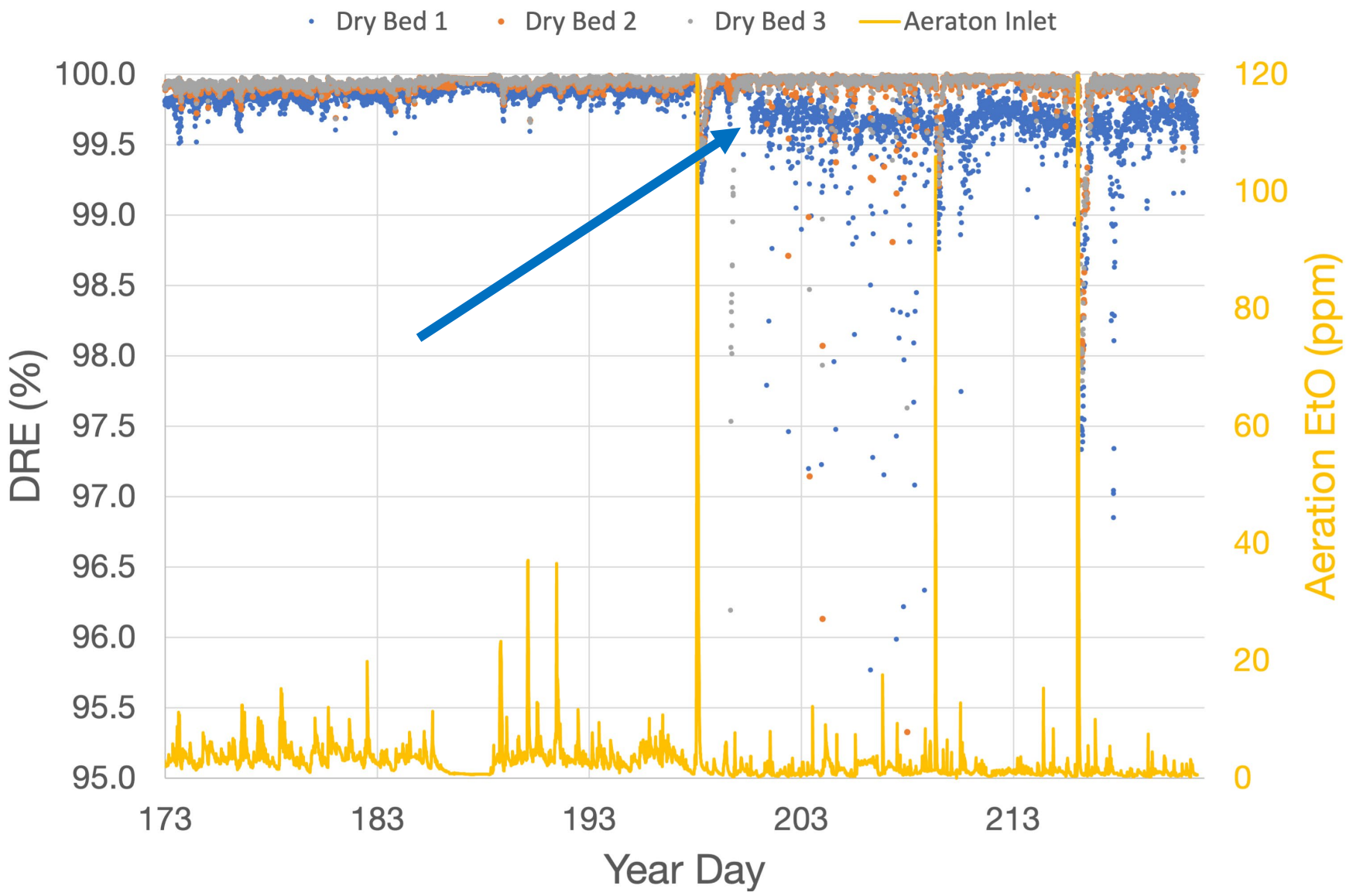
Proactive Strategies: Individual Dry Bed DRE Monitoring

Picarro installed monitoring lines at the inlet to dry beds (outlet from Aeration) and the outlets from dry beds to track destruction efficiency in real time across the dry beds.

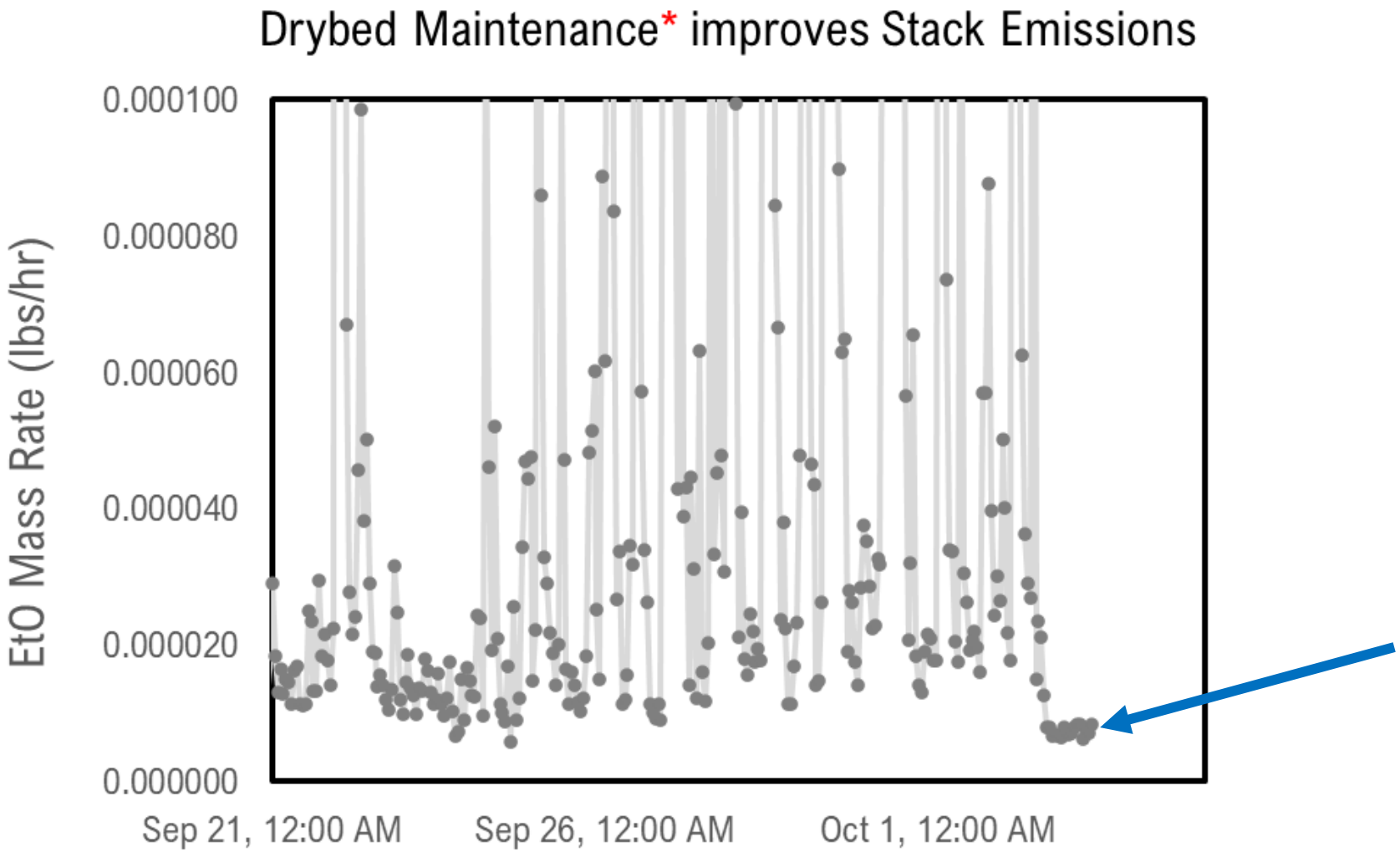


Proactive Strategies: Individual Dry Bed DRE Monitoring

*Picarro Workplace DRE Process Monitor showed which specific dry bed negatively impact overall DRE due to breakthrough—here **Dry Bed 1**, an older design than the others—starting around Year Day 200. This DRE monitoring ability now allows the facility to take action **before** it significantly impacts 30-day rolling SWEL, or DRE in the future.*

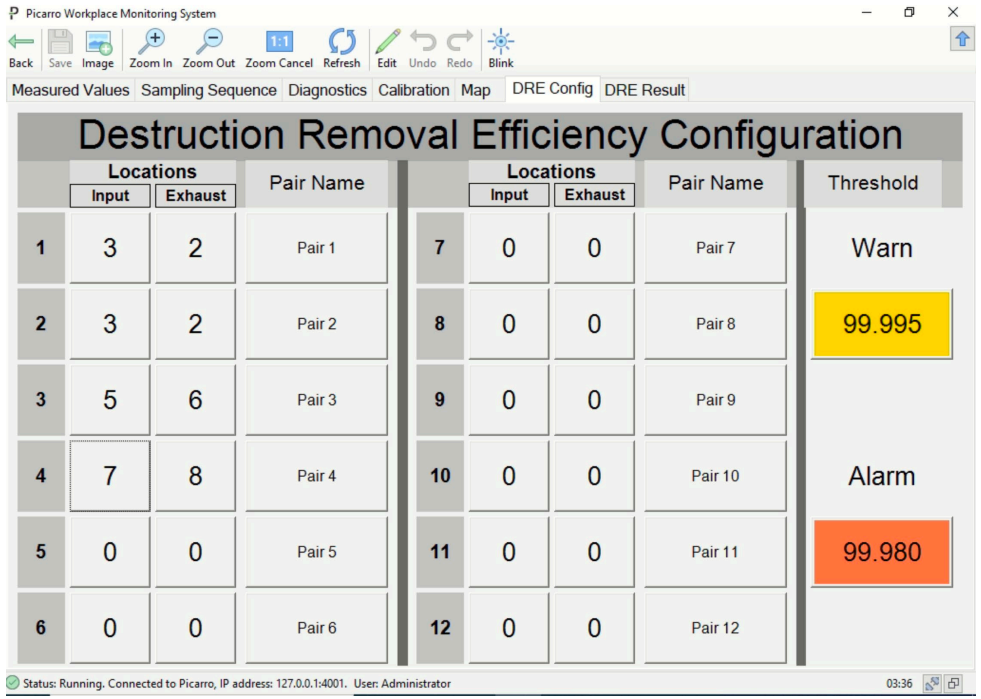


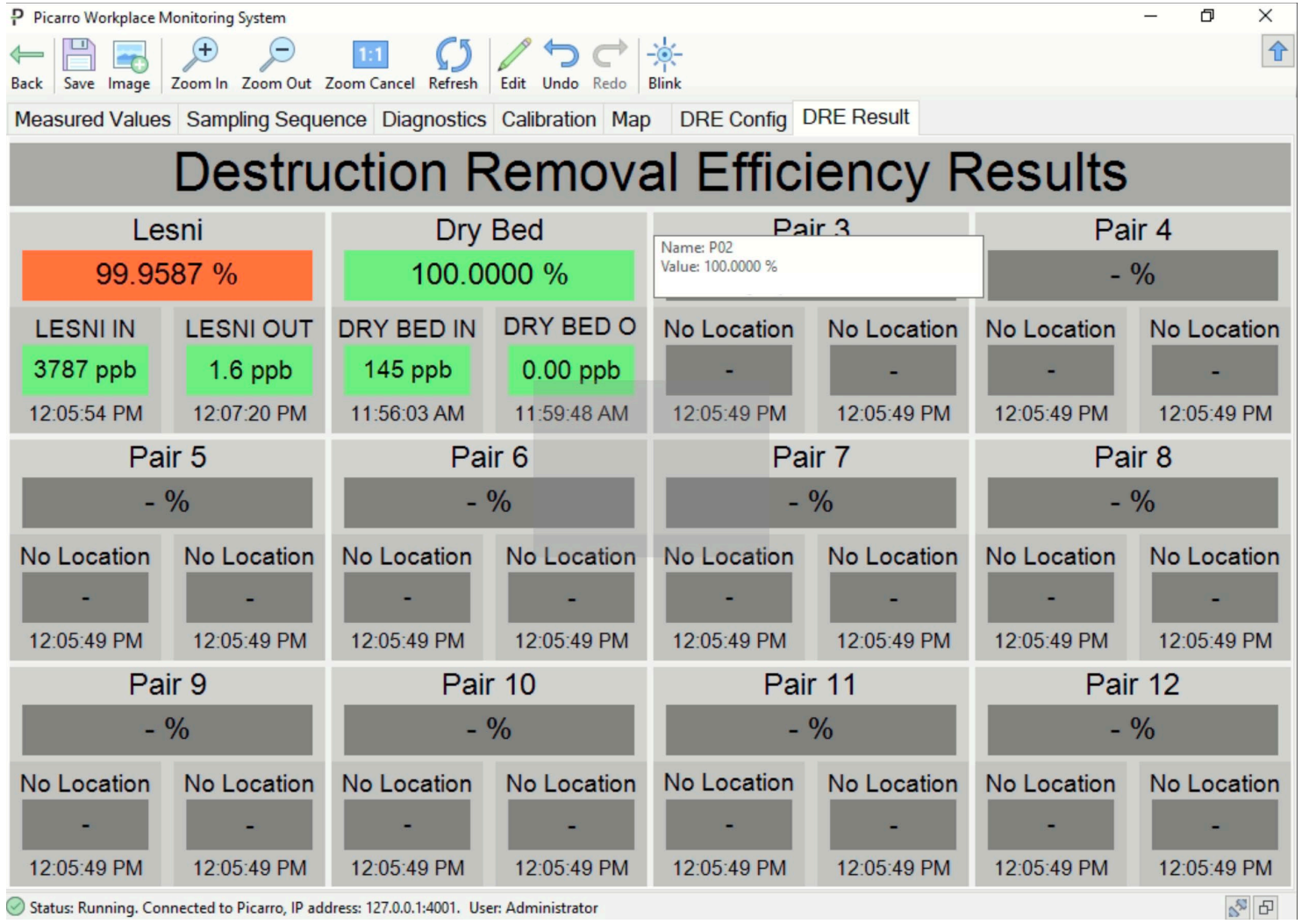
Dry Bed Maintenance Improves Stack Emissions



Proactive Strategies: Individual Dry Bed DRE Monitoring

Picarro DRE utility allows customers to track DRE across dry beds and other components to monitor efficiency in real time and produce alarm states if efficiency nears or drops below allowable DRE.





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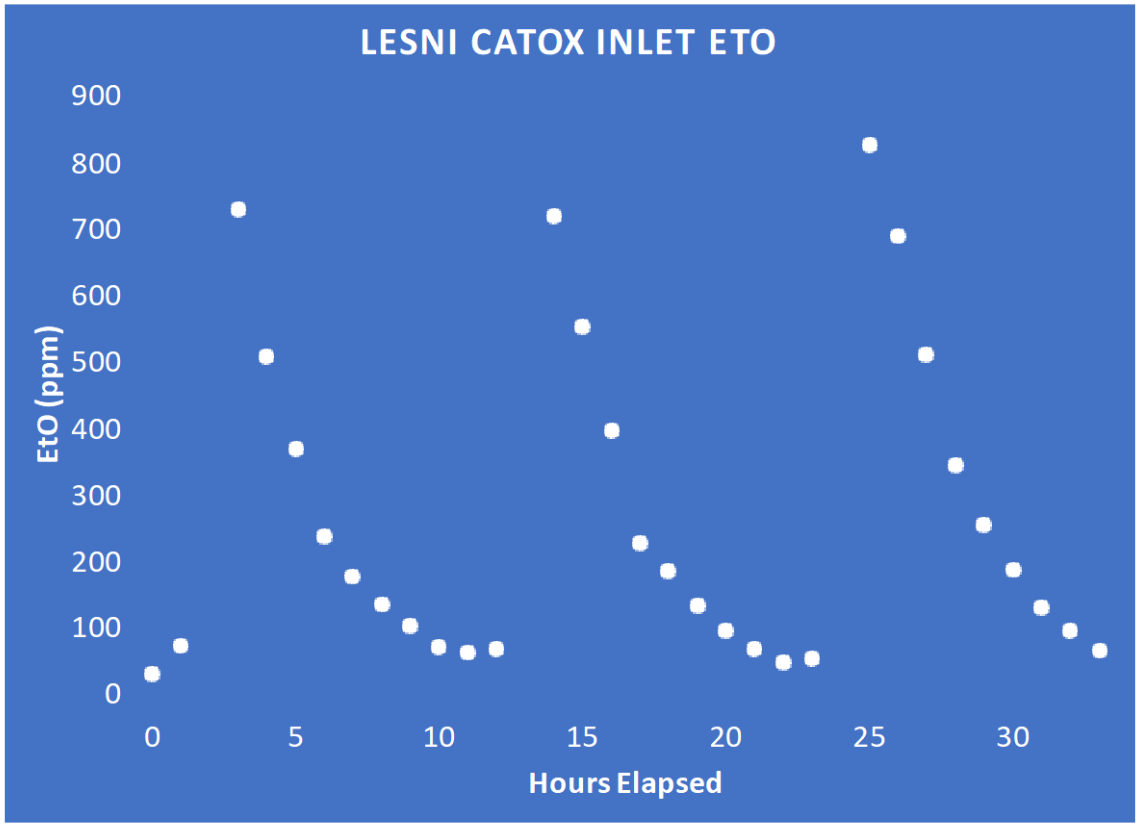
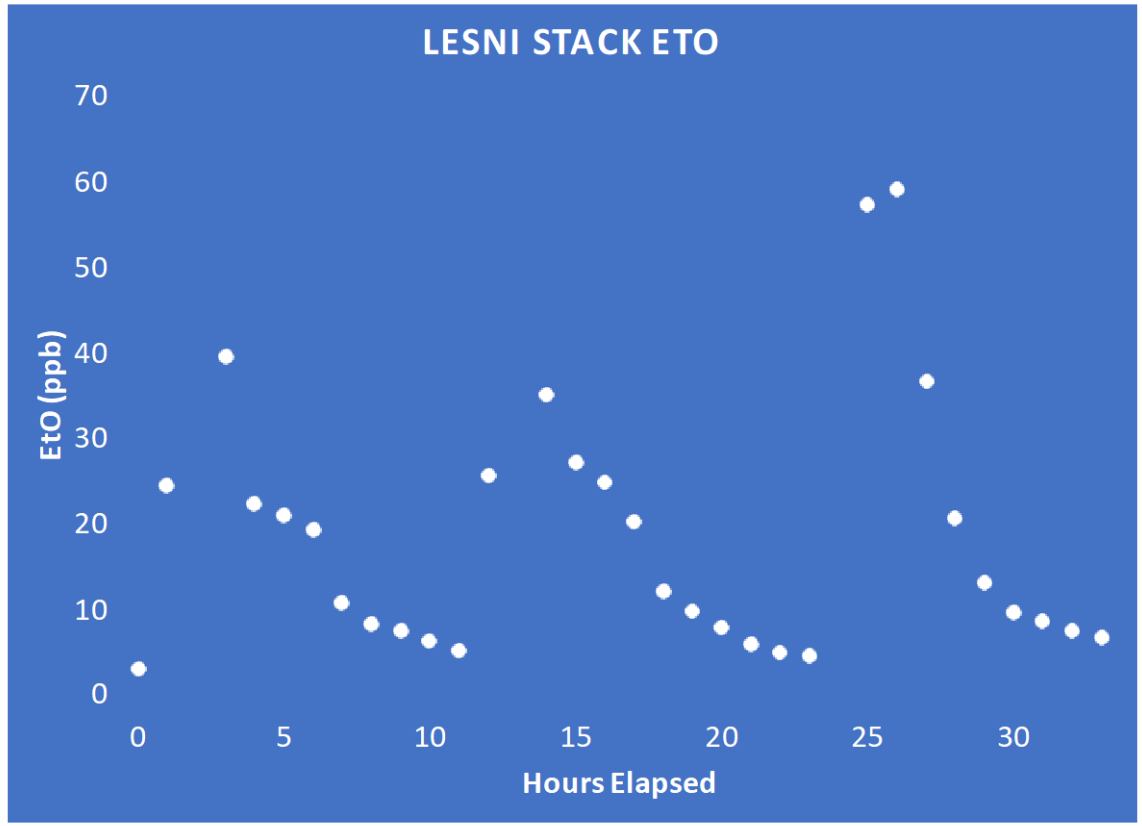
“The stack testing we’ve had done in the past had much higher detection limits than what’s expected in PS-19. We have no idea if our system is well tuned and will meet requirements coming online with the new NESHAP.” §

§Customer concerns paraphrased

Inlet-Outlet CEMS Monitoring (SWEL by Emissions Stream)

- *Picarro CEMS deployed to look at inlet and outlet values into a LESNI CatOx*
- *Inlet to CatOx shows values up to 830 ppm on an hourly average basis.*
- *Outlet shows 10s of ppb, with an average of 11.9 ppb.*

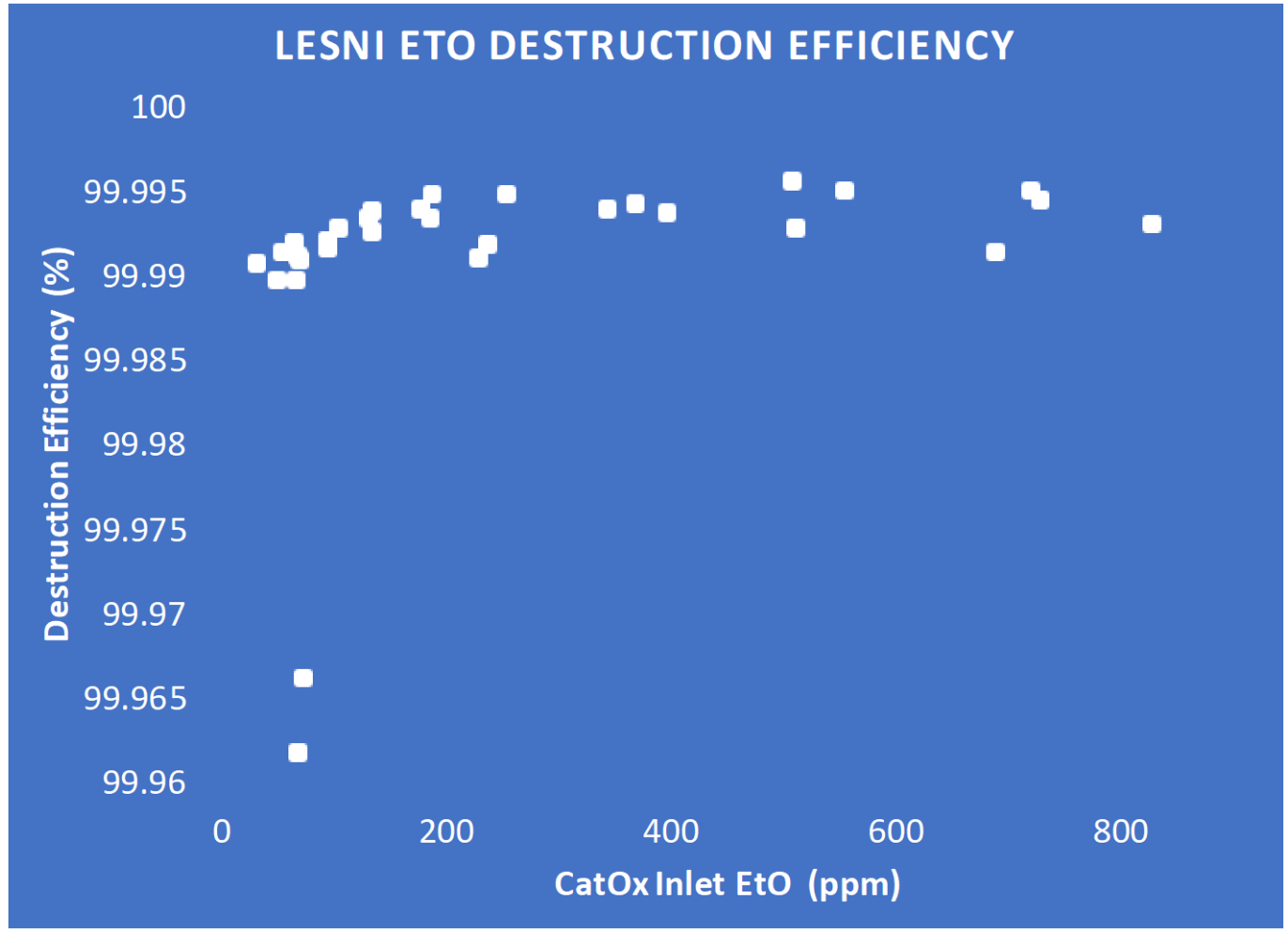




Field Observations: LESNI CatOx Destruction Efficiency

Average DE > 99.991% on the CatOx, meeting all standards in the 2024 EtO NESHAP.

BUT the facility had damaged a component of the CatOx, which suggested this might be sub-optimal conditions for actual emissions



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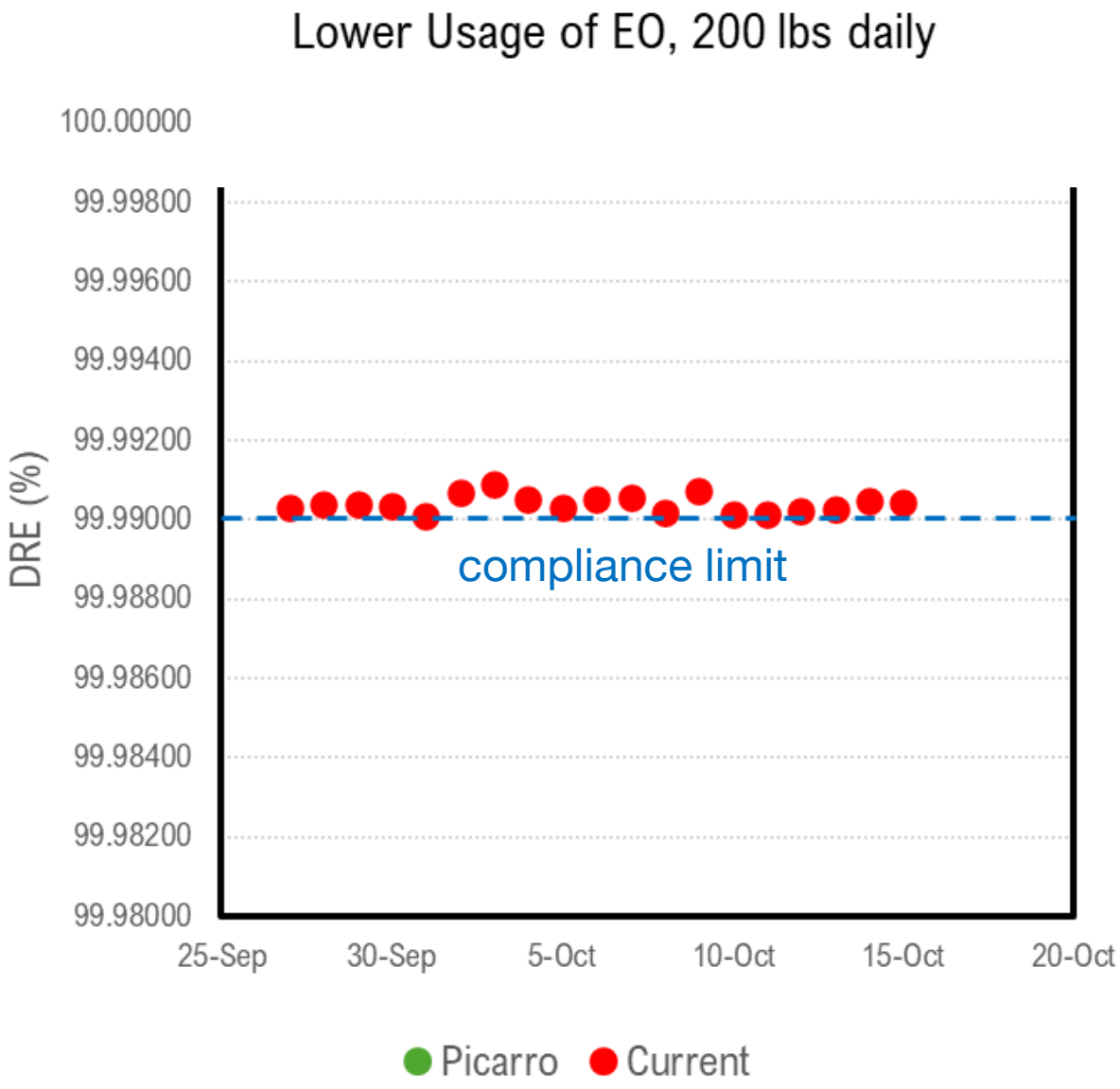
But wait; that is only just good enough… Is that typical? NO!

Another site with a well-tuned LESNI with 6-year-old catalyst and using the SWEL1 option (EO lbs used to calculate DRE)

Legacy stack CEMS with a higher detection limit around 20+ ppb indicated DRE barely at the compliance limit

Picarro CEMS showed consistent values <2 ppb, and DREs well above 99.999%



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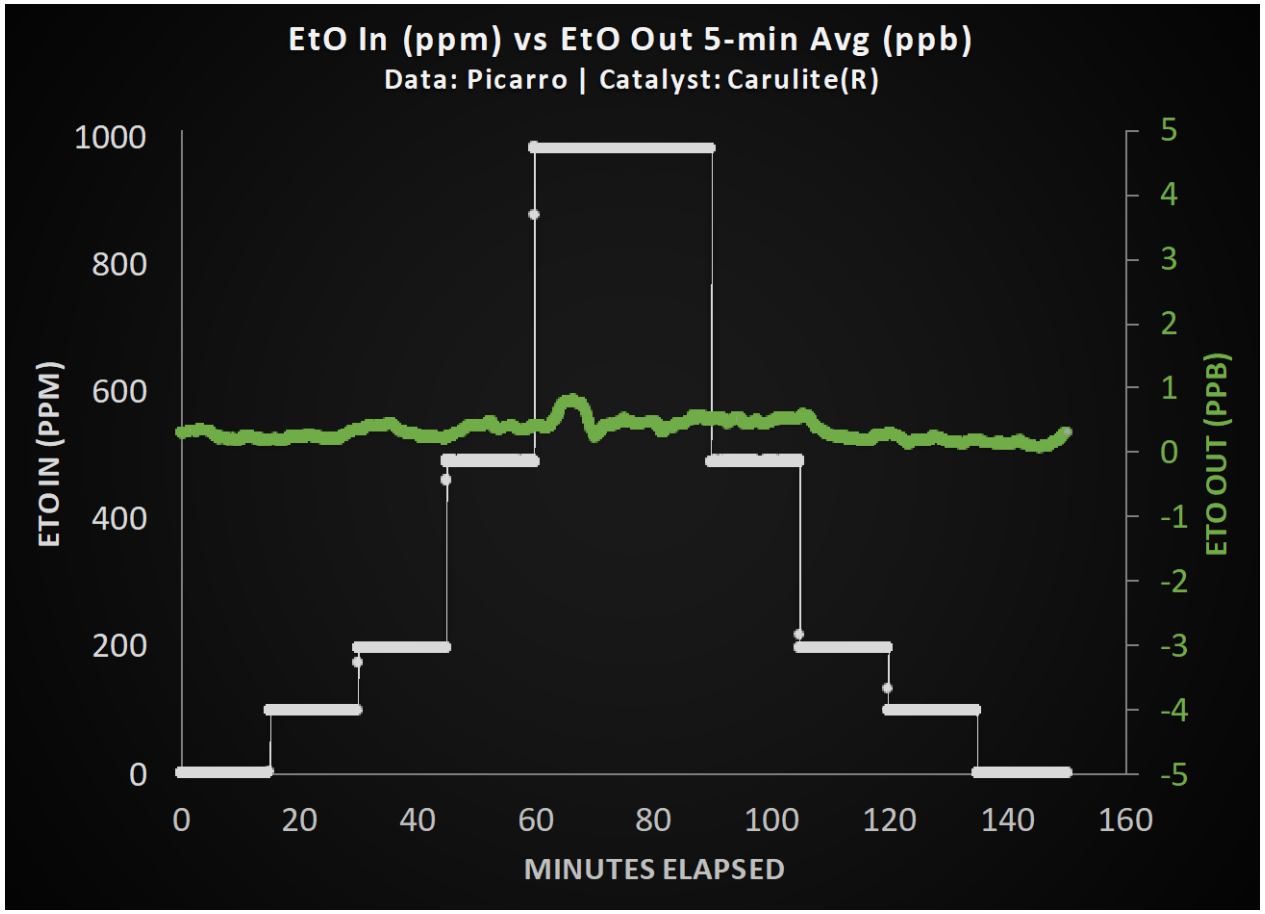
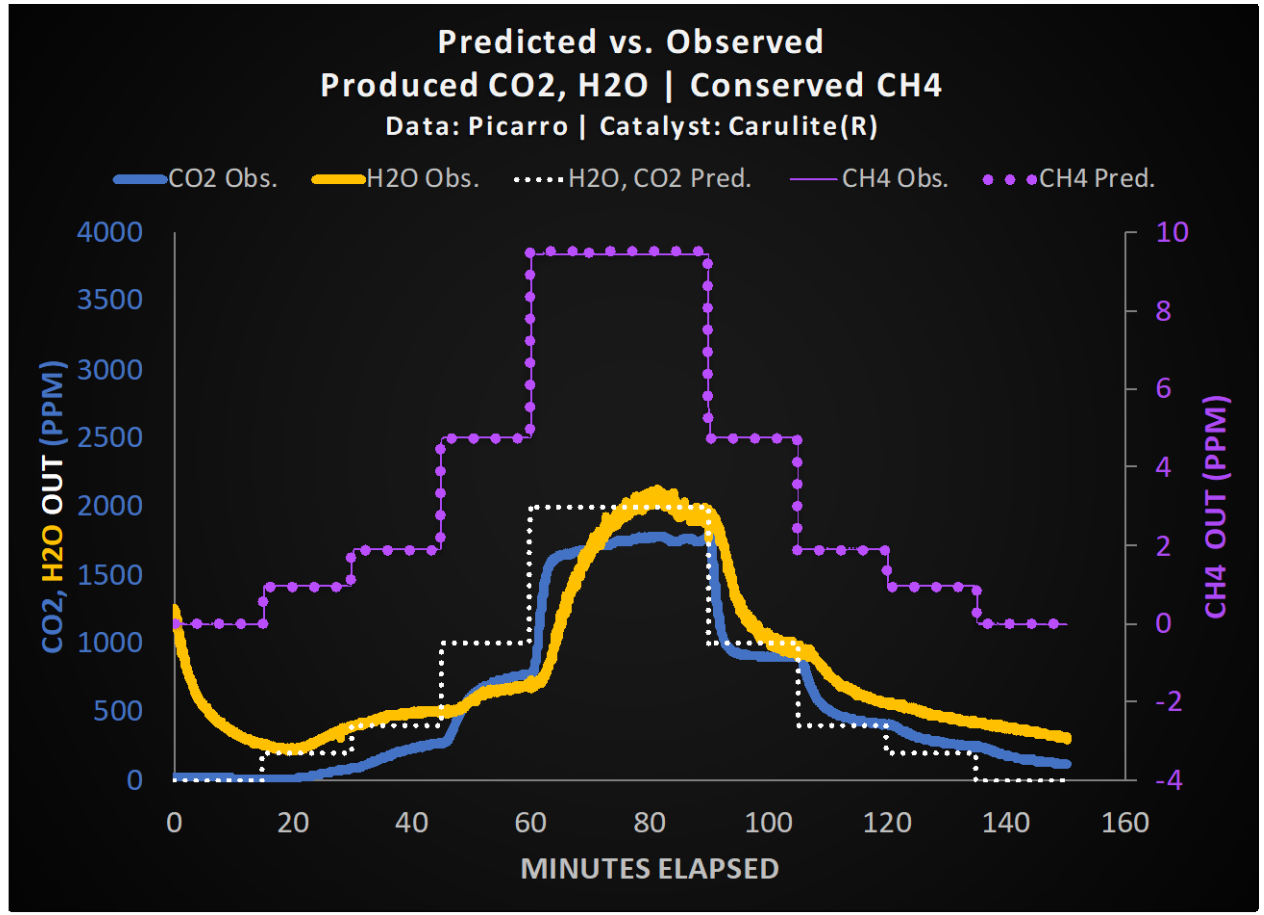
How do we prove that?
Validating DRE through Tracer Gas, Chemistry

CARUS®





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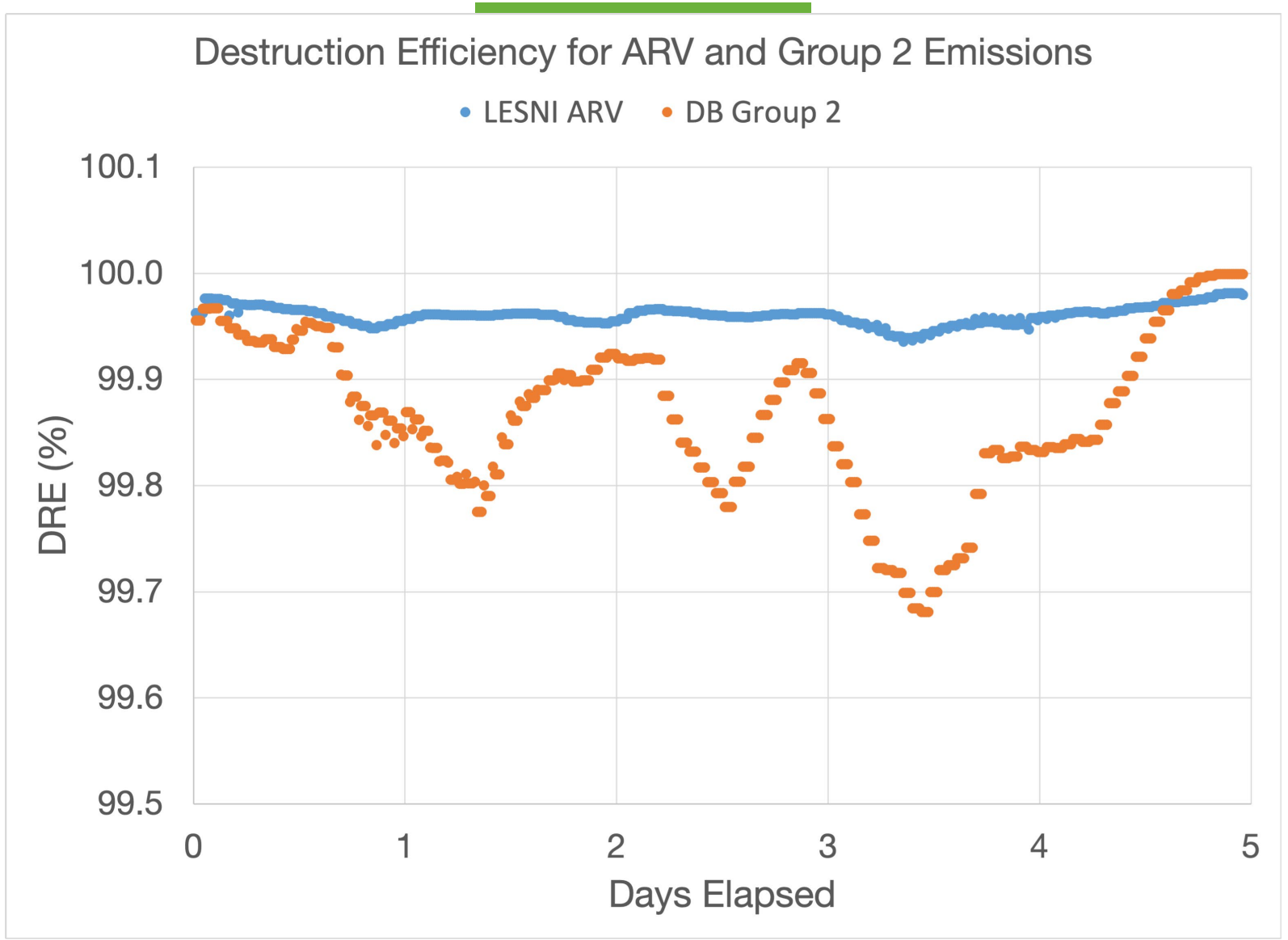
Aeration and Group 2 Emissions DREs



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Technical Questions

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