Navigating Challenges and Solutions: South Coast AQMD Experience with Met One BAM 1020 3rd Generation Monitors

2024 NAAMC

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Juan Garcia

Monitoring Operations Manager

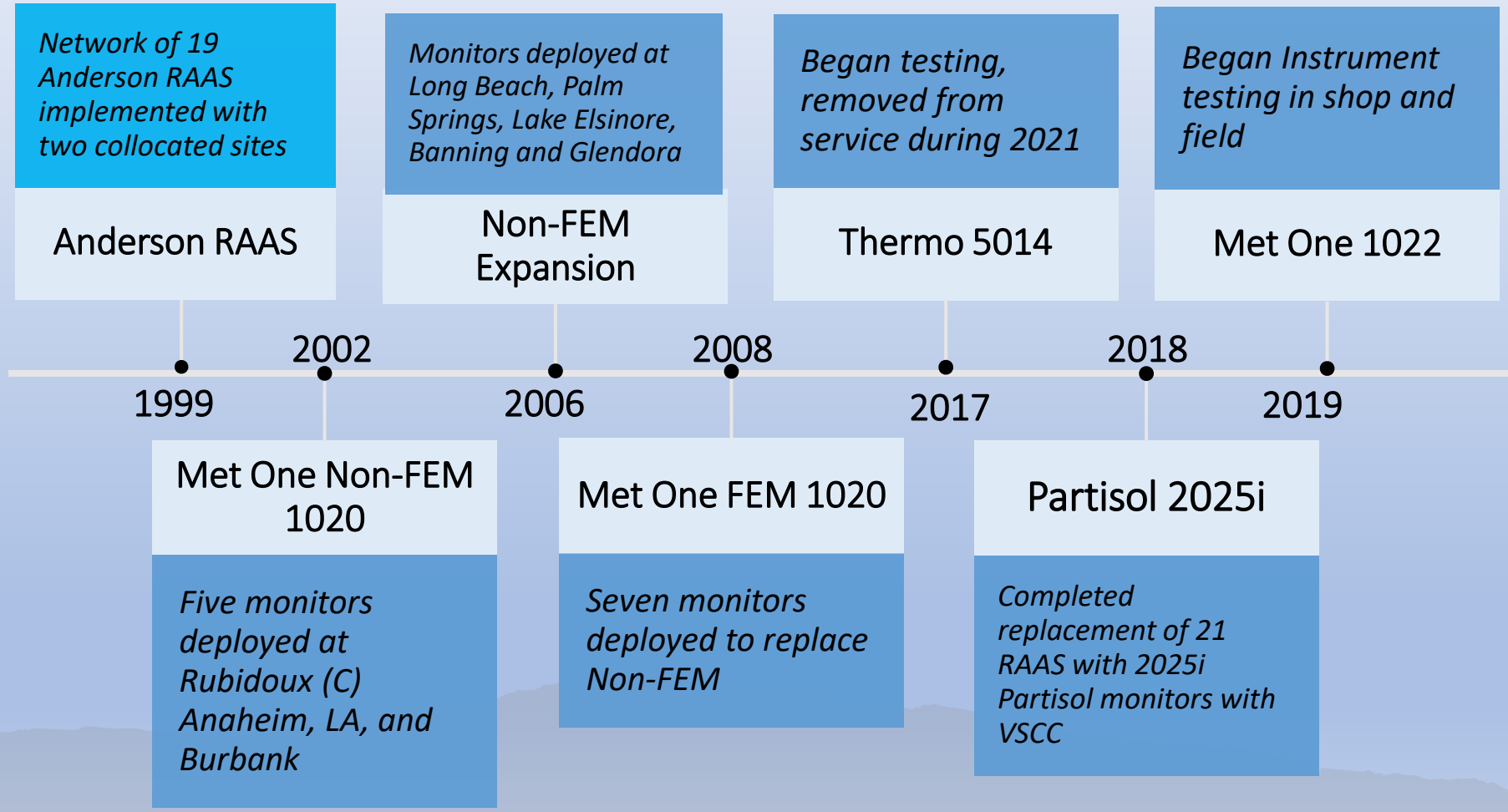
South Coast AQMD

JGarcia@aqmd.gov

Gen-3 BAM 1020 Overview

- Background
  - BAM History
  - PM2.5 Network Considerations
- Assessment
  - New Instrumentation
  - Initial Acceptance Testing
- Testing
  - Initial Field Results
  - Zero Test Issues
- Corrective Action
  - Formal Acceptance Testing
  - Time Sync Findings
- Summary
  - Customer Support
  - Formal Acceptance Testing
- Keys to Success

Monitoring Network Background PM2.5 Implementation

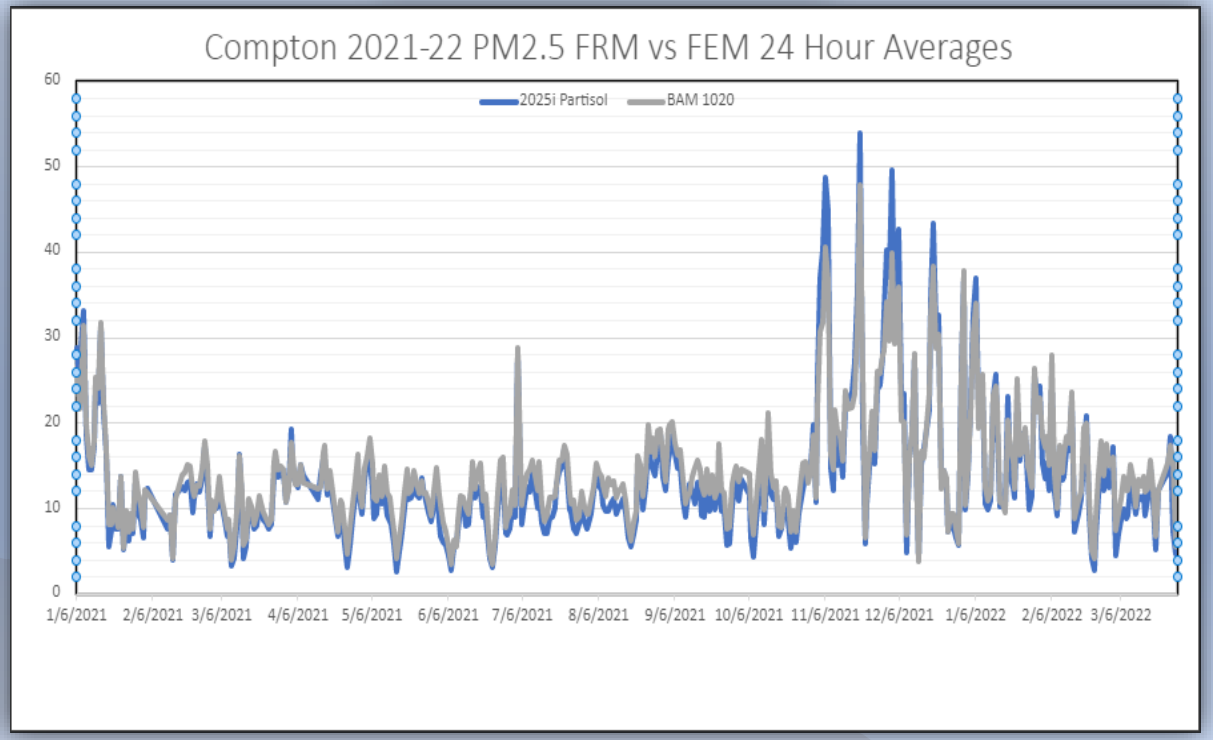


2024, we currently have:

- 23 PM2.5 monitoring sites
- 16 FRM sites
- 8 FRM/FEM sites
- 7 Non-FEM sites

Current Real Time PM2.5 Network Considerations

- Advantage:
  - Real time hourly PM 2.5 updates
  - Less labor intensive than sample collection
  - Gen-2 appeared to be more stable and less noisy than other continuous monitors
- Disadvantage:
  - Unable to remotely troubleshoot problems (Gen-2)
  - FEM and FRM correlate well, but FEM tends to read higher
  - History of failing US EPA's FRM vs FEM comparison
- Opportunity to upgrade network
  - Purchased Gen-3 to replace Gen-2
  - Plug and play right…What can go wrong??



Gen-3 BAM Initial Acceptance Testing

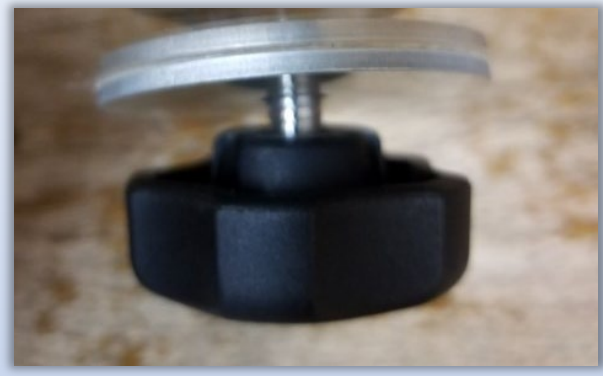
- Basic testing
  - Ensure all components are in box
  - Connect the pump, sensor, heater, grounding cable and testing down tube
  - Dark count
  - In-house calibration and zero test
  - Deploy to field
  - Field calibration and zero test
  - Begin sampling

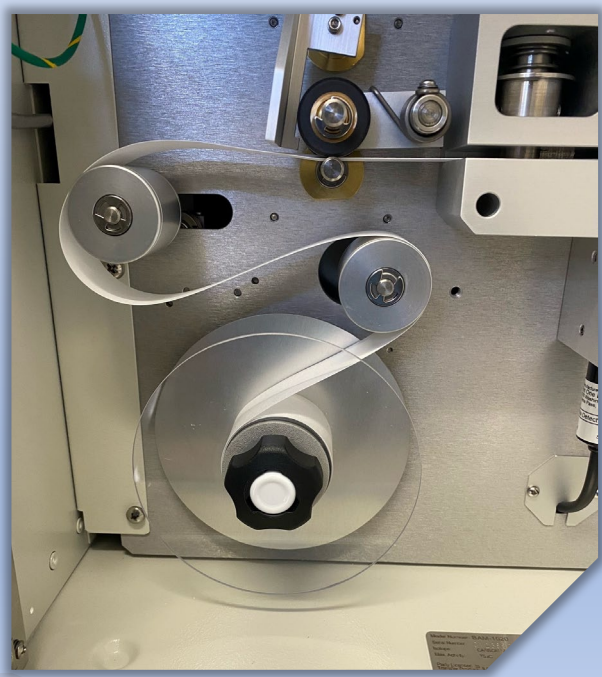
- Gen 3 monitors were first deployed by South Coast AQMD in March 2022

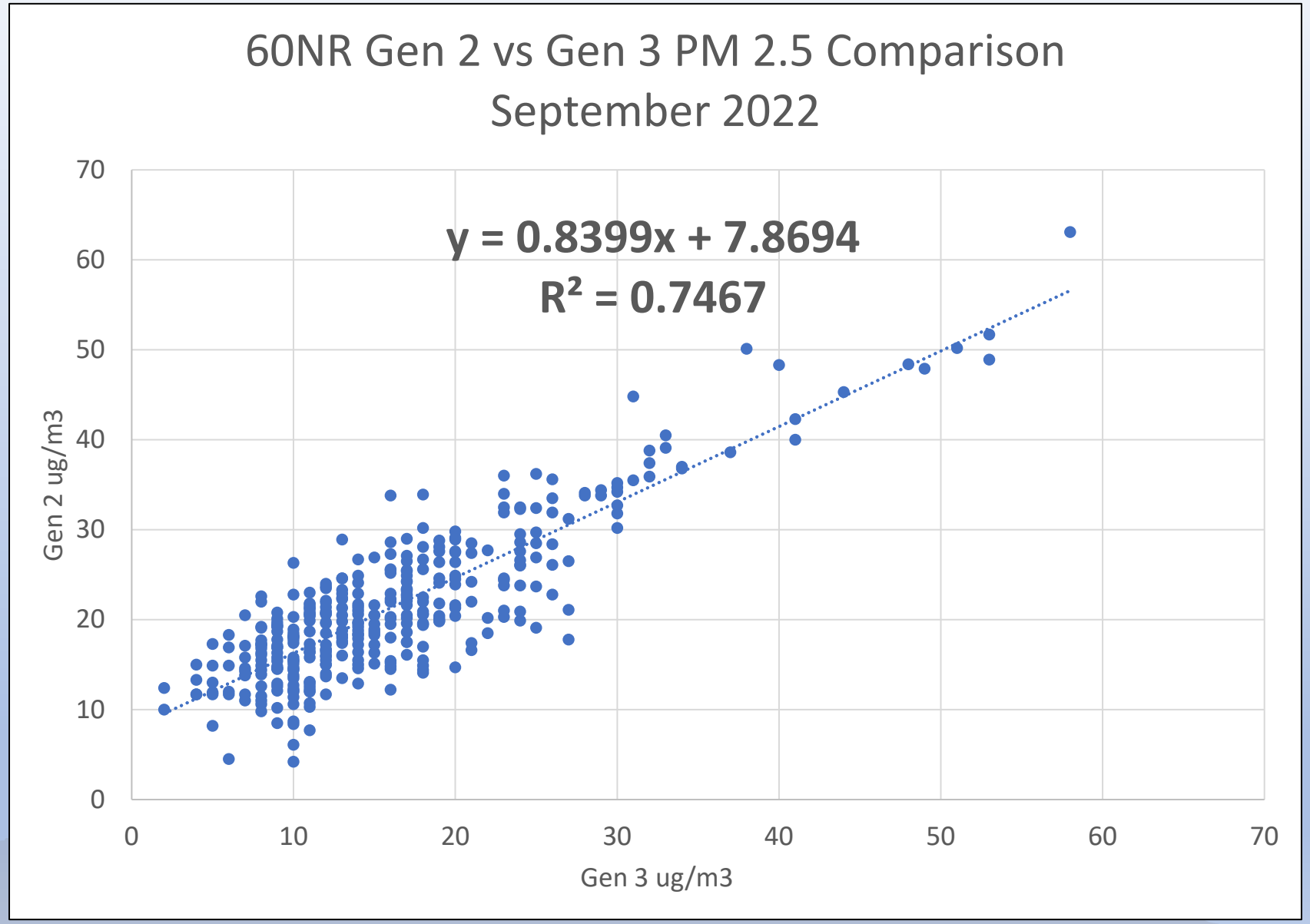
- Mixed Field Results
  - Zero test passed at HQ, mixed results in the field at near road sites (60NR/W710)
  - Gen 3 units experienced some data loss which delayed their deployment

BAM 1020 GEN-3 Initial Field Results

- Build Quality
  - Improperly assembled take-up reel, resulting in tape misalignment
  - New pinch rollers accumulate tape debris quickly and need frequent cleaning
- Hardware
  - Power supply
  - Grounding issues
    - Paint on internal ground connection
- Firmware
  - Ethernet dropouts caused the BAM to fail in responding to further requests.
- Zero Test
  - Zero test impacted by a high background and standard deviation values during field deployment





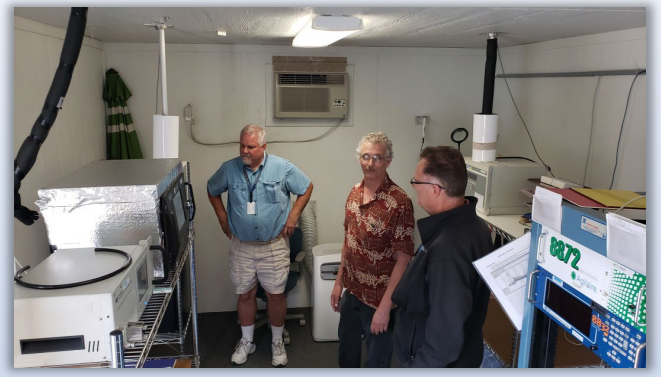

60NR Gen 2 vs Gen 3 PM 2.5 Comparison
September 2022
y = 0.8399x + 7.8694
R² = 0.7467
Gen 2 ug/m3
Gen 3 ug/m3
0
10
20
30
40
50
60
70

BAM 1020 Gen-3 Corrective Actions

- Communicated directly with Met One engineers regarding issues
- All South Coast AQMD 1020 Gen 3 units were returned to Met One for upgrades and inspections
- Upgrades done at Met One:
  - Removed paint at chassis ground points
  - Replaced ball slide bearings
  - Firmware updates
- Field upgrade recommended by Met One:
  - Relocate ground wire from the pump to earth ground on wall outlet
  - Minimize temperature swings during zero test

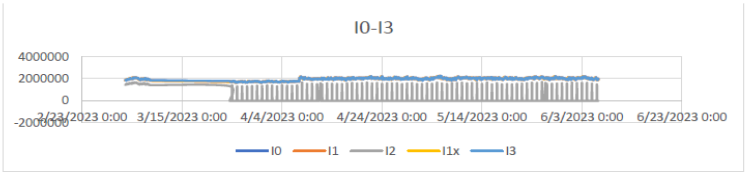
BAM 1020 Gen-3 Corrective Actions [Cont.]

- Met One Engineers conducted site visits to investigate ongoing issues, showcasing strong teamwork and collaboration
- Discovered production problems leading to grounding and power supply concerns
- Identified that the ball slide assembly contributed to problems
- Engineers found no issues during inspection at our HQ lab and two other sites, commending our comprehensive documentation
- Met One final report suggested improved grounding and temperature control

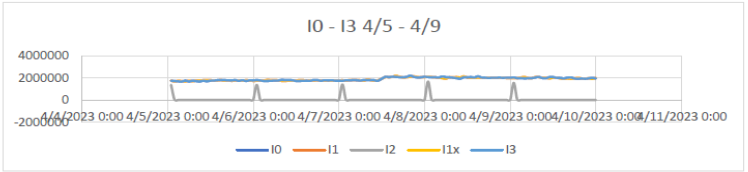


Gen 3 BAM 1020 SN DN11588 Located at "60 NR site". Set to PM2.5.

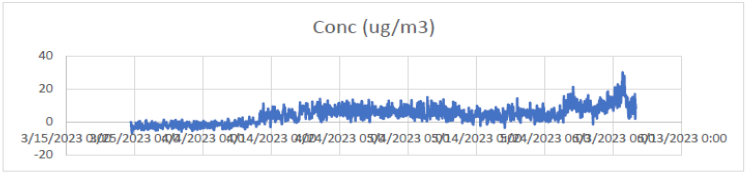
For a quick glance, I've graphed I0-I3, AT-FT, RH-FRH, and BP-FP



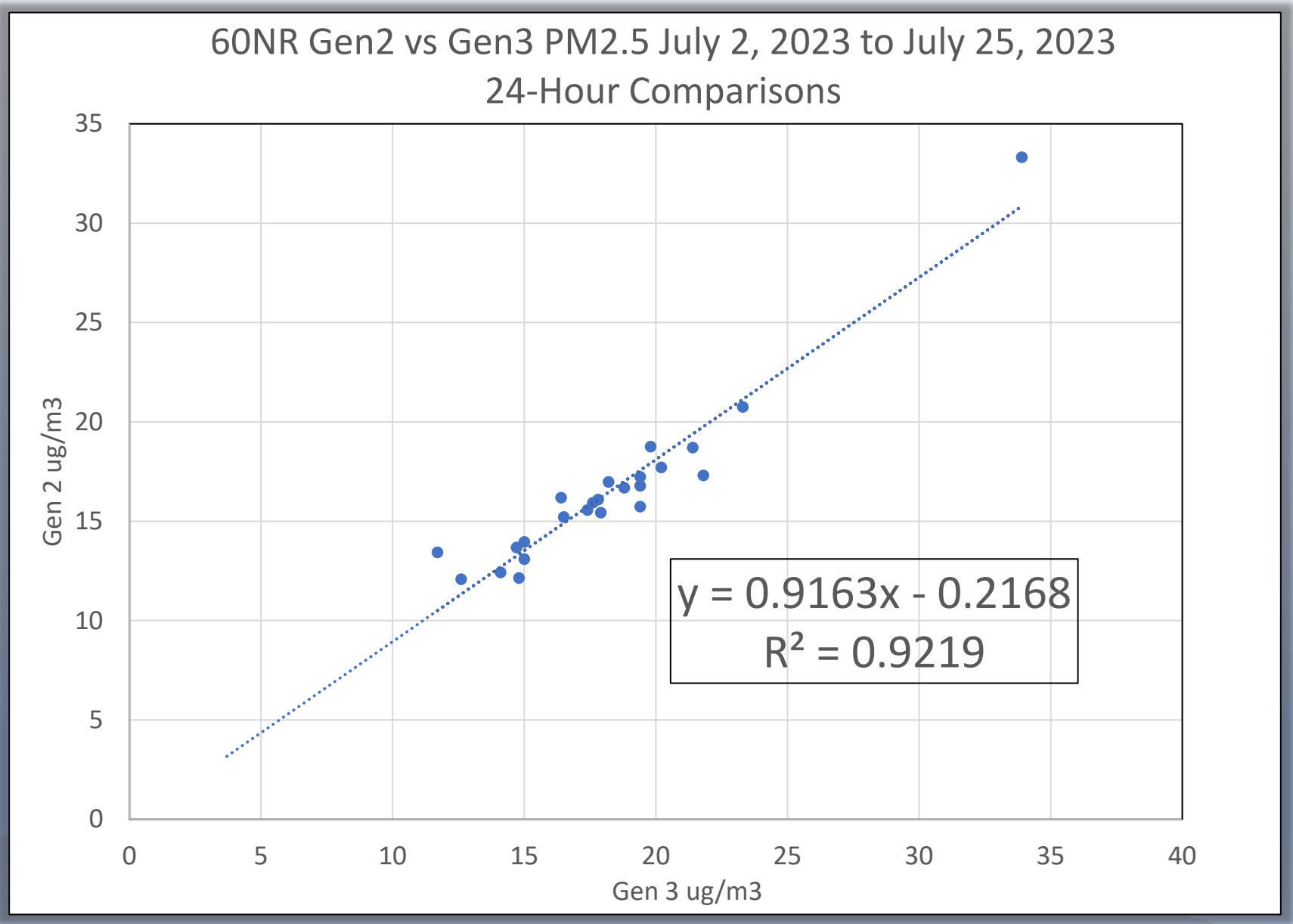
From 3/3/23 the counts start at 1,860,000 and slowly drift down to 1,740,000 on 3/23/23. This could possibly be test data from BAM Test because the span check is turned off but could also be a zero test. On 3/24/23 the rise and fall of the counts becomes more active and the span check is set to 24Hr until 4/7/23 when they jump up to 2,000,000+ on 4/8/23 and stay biased high until the end of the record.



If we look more closely at the counts jumping up on 4/7 the jump is not as dramatic as it looks in the historical data. The counts leading up to the jump and following the jump seem stable. This is most likely data from before and after a zero test.

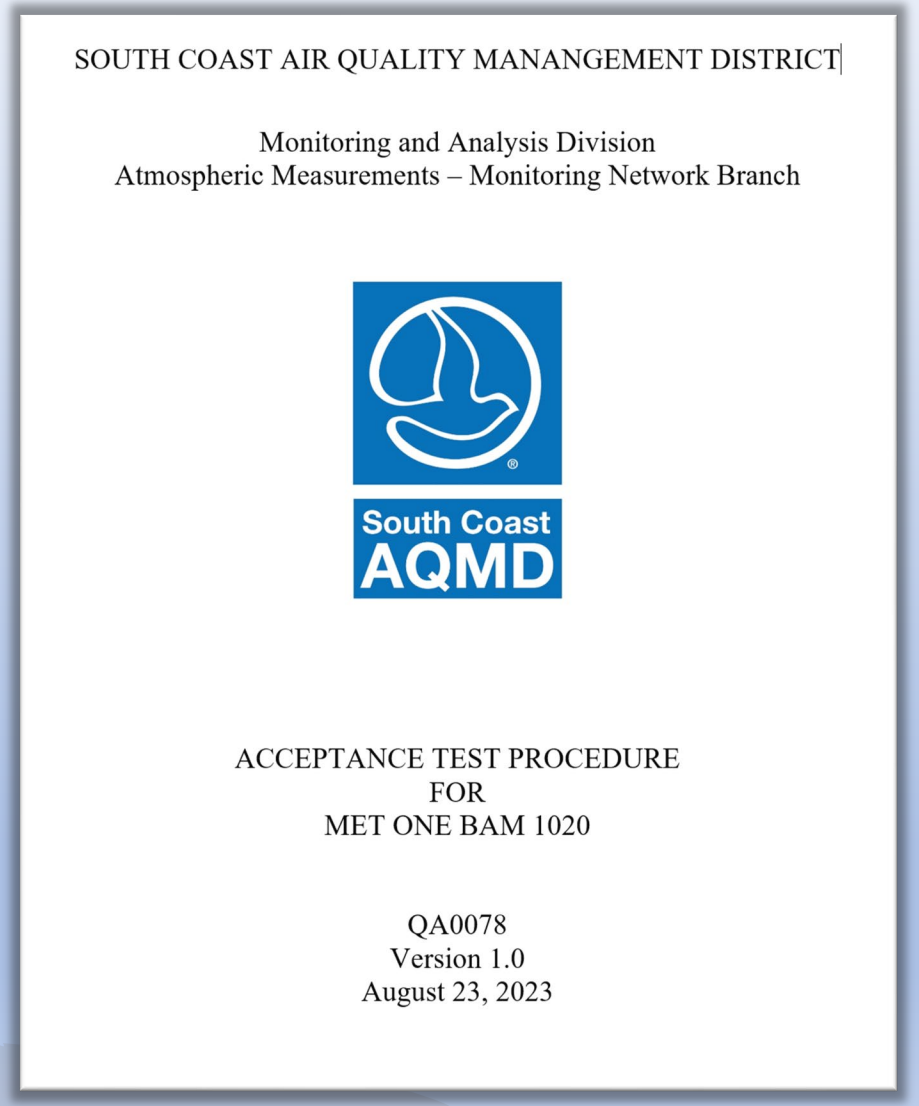


Looking at the data either the PM levels were very low or a zero test is being performed.


60NR Gen2 vs Gen3 PM2.5 July 2, 2023 to July 25, 2023
24-Hour Comparisons
Gen 2 ug/m3
Gen 3 ug/m3
0
5
10
15
20
25
30
35
40
y = 0.9163x - 0.2168
R² = 0.9219

BAM 1020 Gen-3: Formal Acceptance Testing

- Strengthened Acceptance Testing for the new Gen 3 BAM 1020
- In house testing at South Coast AQMD
  - Physical Inspection / Certified Paperwork
  - Dark Count, Beta Count
  - Calibrate and zero test for 72+ hours
- Field Testing
  - Collocation testing at specific stations
  - Background testing new instruments
  - Minimum five days of data to compare with existing GEN-2 BAM
  - Use scatter chart with the best fit line
    - $R^2 \geq 0.9$
    - Slope 1.0 ± 0.1
    - Intercept 0.0 ± 2.0
- Final deployment to air monitoring station



SOUTH COAST AIR QUALITY MANANGEMENT DISTRICT

Monitoring and Analysis Division
Atmospheric Measurements – Monitoring Network Branch

South Coast AQMD

ACCEPTANCE TEST PROCEDURE
FOR
MET ONE BAM 1020

QA0078
Version 1.0
August 23, 2023

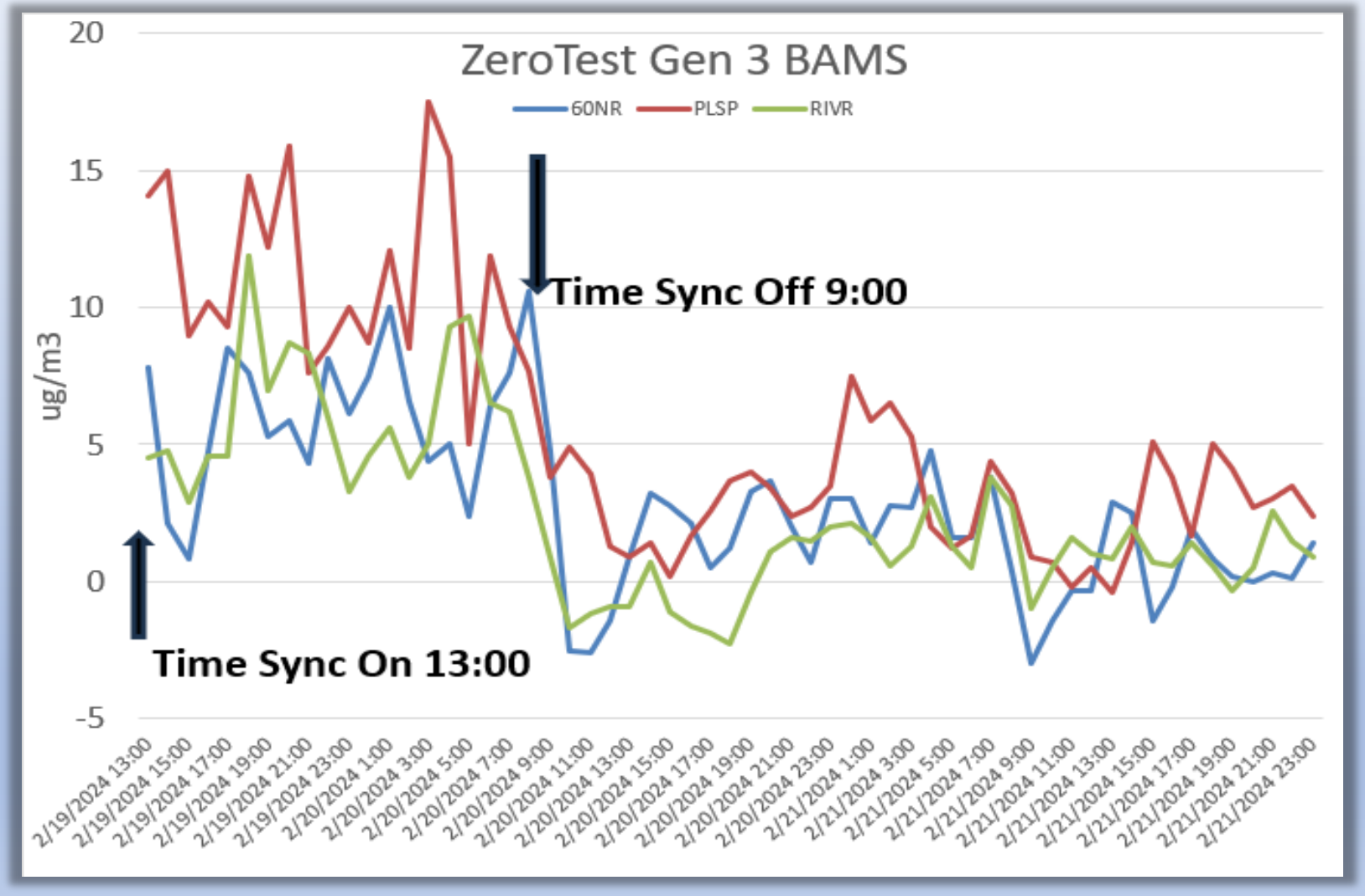
Acceptance Testing Findings

Time Sync Issues

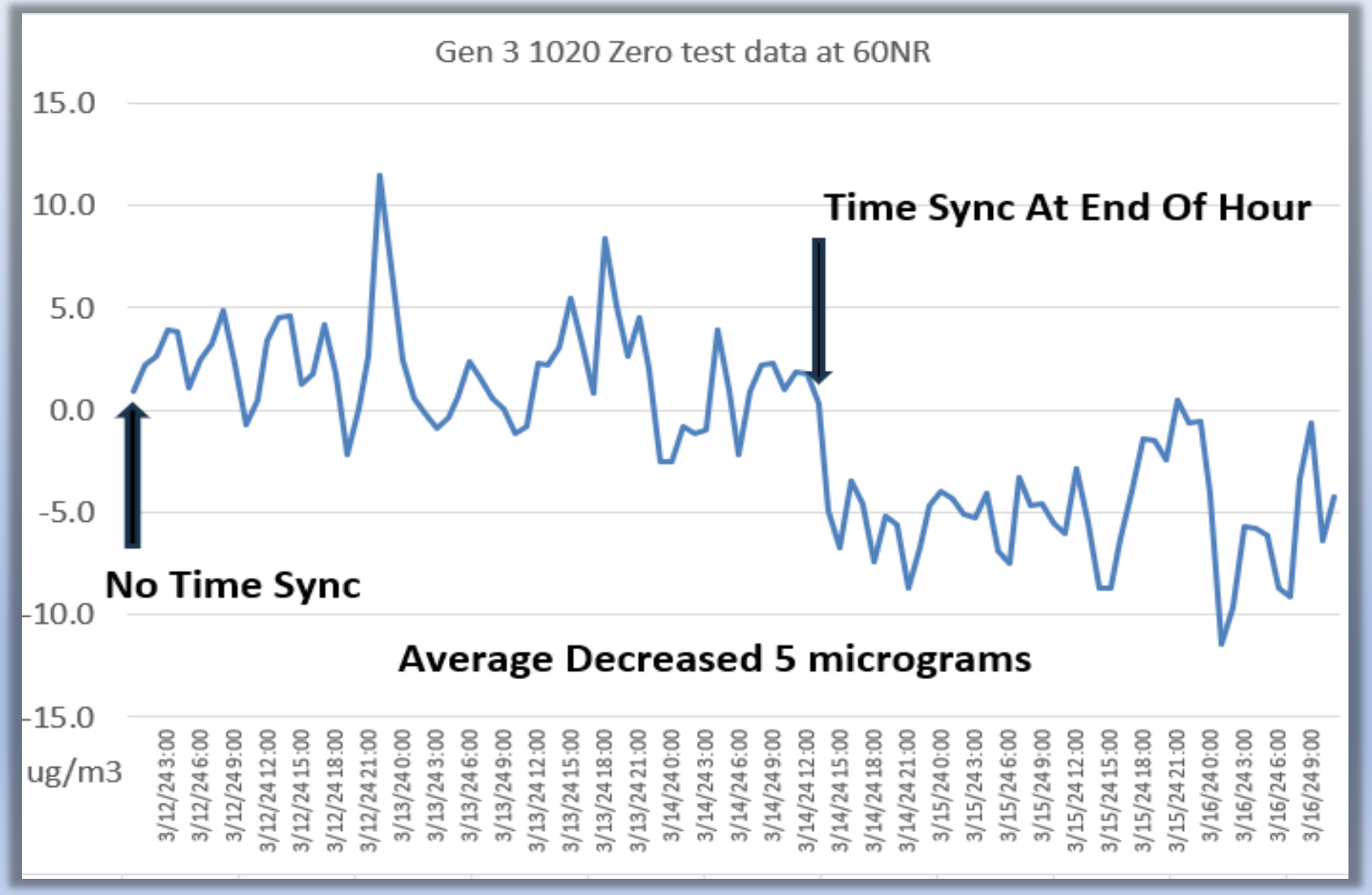
- The primary cause of increased background noise was due to time sync issues
- These issues could cause the background levels to increase by 4-8 ug/m3

Solution

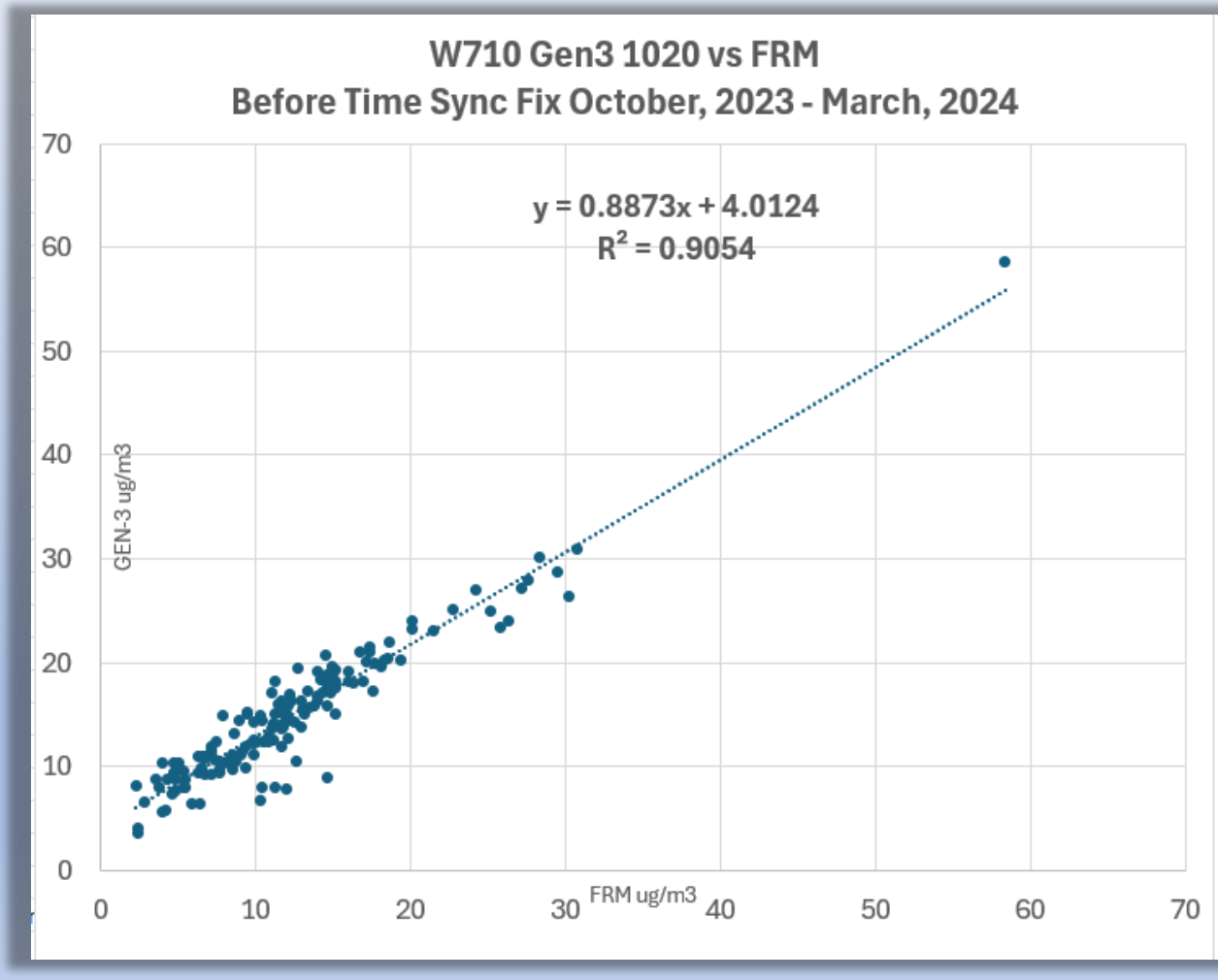
- Adjust the time sync to occur in the middle of the hour

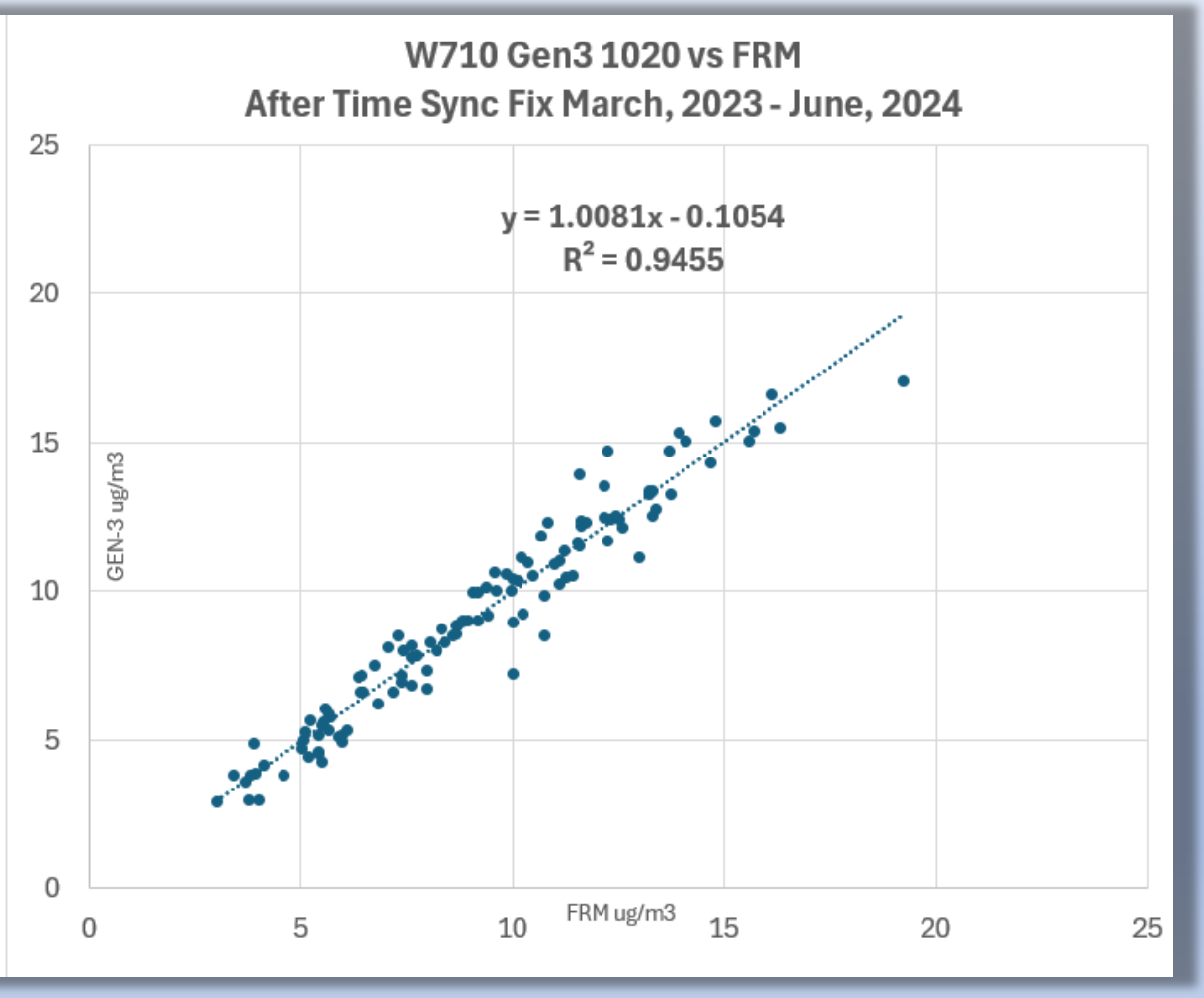


Acceptance Testing Findings [Cont.]



W710 GEN 3 FEM/FRM Comparison





BAM 1020 Gen-3: Summary

- Grounding issues were ruled out as a cause
- Maintaining temperature control is crucial
- Time sync was identified as the primary cause of elevated background readings
- Collaboration between Met One and South Coast AQMD has been highly productive, enhancing instrument performance and validation

Keys to Success

- Strengthened Acceptance Testing for the new Gen 3 BAM 1020
  - Perform acceptance testing of all new instrumentation
  - Collocated field testing
- Update SOPs for maintenance and calibrations
  - Zero testing is critical
  - Preventive maintenance
- Work directly with the manufacturer to solve issues
- Training, Training, Training!!!

Questions?

Juan Garcia
South Coast AQMD
JGarcia@aqmd.gov