









































- Comparison to collocated and nearby monitors (Multi-station and Group reports)
- Review of diagnostic data (Diagnostic Report)

### 4.3.1. Calibration report review

The Calibration Report contains results from automated and manually initiated Envistas Ultimate quality control check sequences. The Calibration Report should be reviewed on a weekly basis. An optimal time to review the Calibration Report is Monday morning as many quality control checks occur early on Monday mornings (before business hours). Doing so should provide operators with ample lead time to plan their schedules to ensure that any failed QC checks and instrument malfunctions can be investigated and addressed as soon as possible. Figure 2 below presents a monthly Calibration Report for a nephelometer. In the event of a quality control check failure such as those in red below, operators should investigate the failure, take any necessary corrective action, and alert Quality Assurance of any erroneous or suspect data. Any calibration check failures and any subsequent action taken should be documented in the electronic station log book. In the event of an instrument recalibration or other adjustment, a pre-adjustment “as-found” and post-adjustment “as-left” QC check must be completed and submitted to the Ecology AQP QAC.

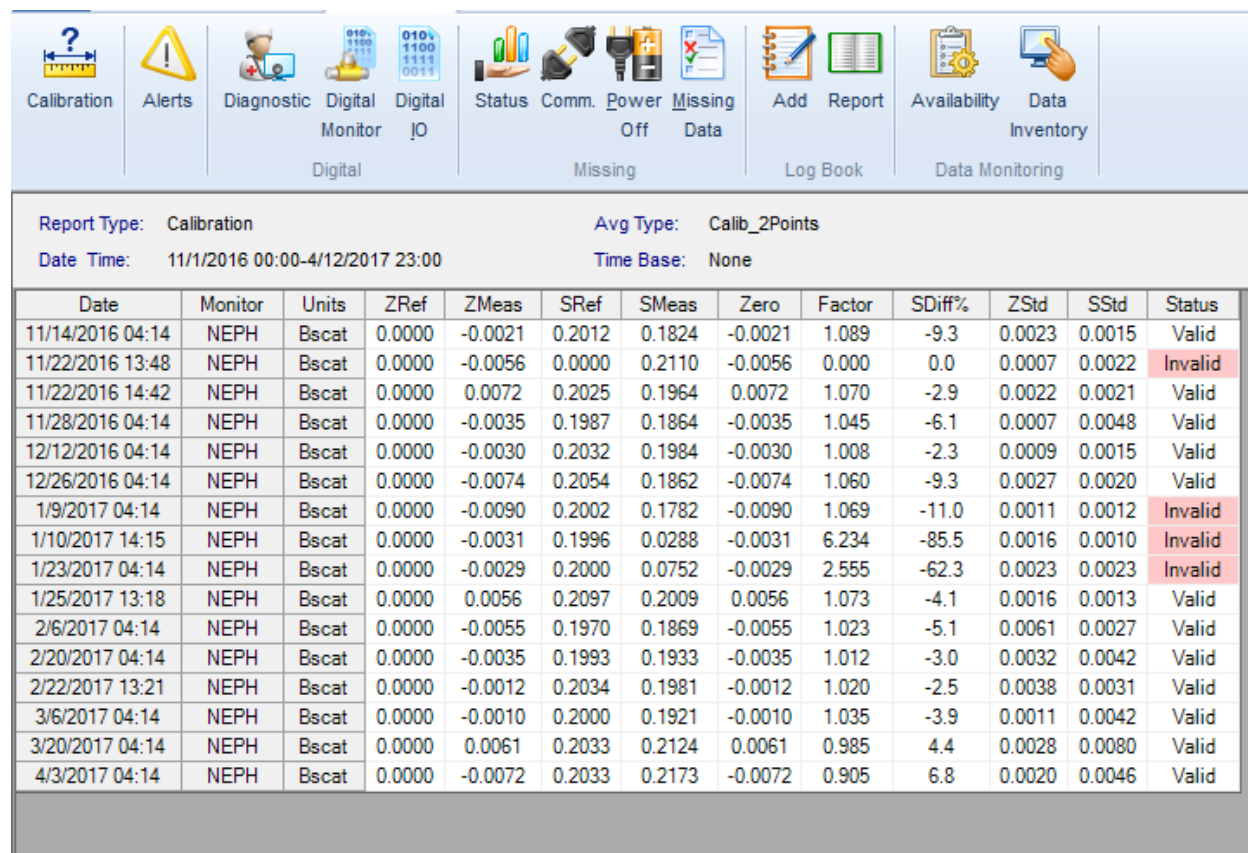


Figure 2: EnvistaARM Calibration Report

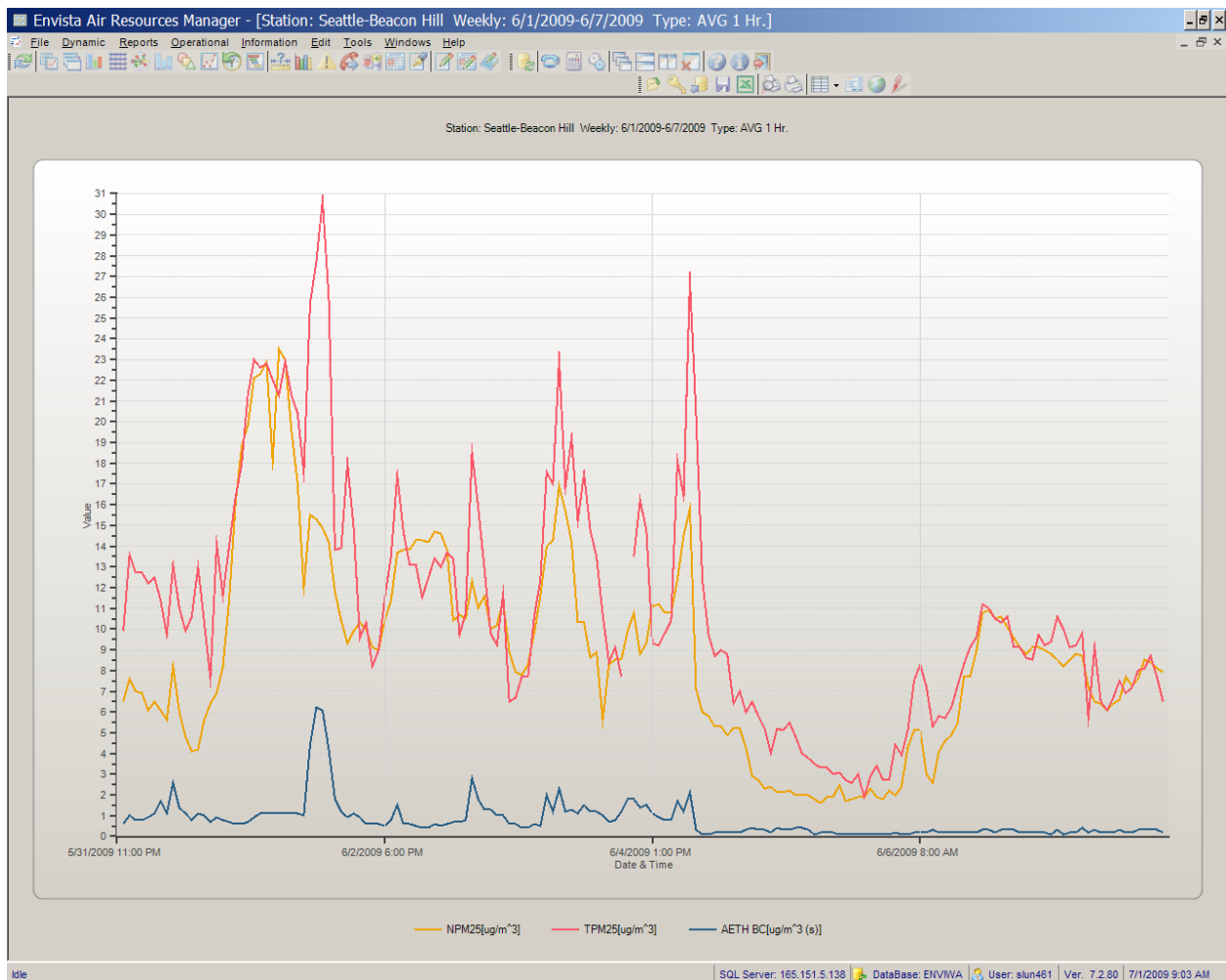
### **4.3.2. Graphical data review**

In many cases, viewing data graphically is superior to viewing data in tabular form as instrument malfunctions tend to be obvious when data is displayed graphically. Nevertheless, tabular data can prove useful in identifying minimum and maximum values (e.g., using the Station Report). Maximum and minimum values outside of normal instrument operation are indications of a problem and should be investigated and resolved.

At a minimum, operators should review the following graphical data on a weekly basis:

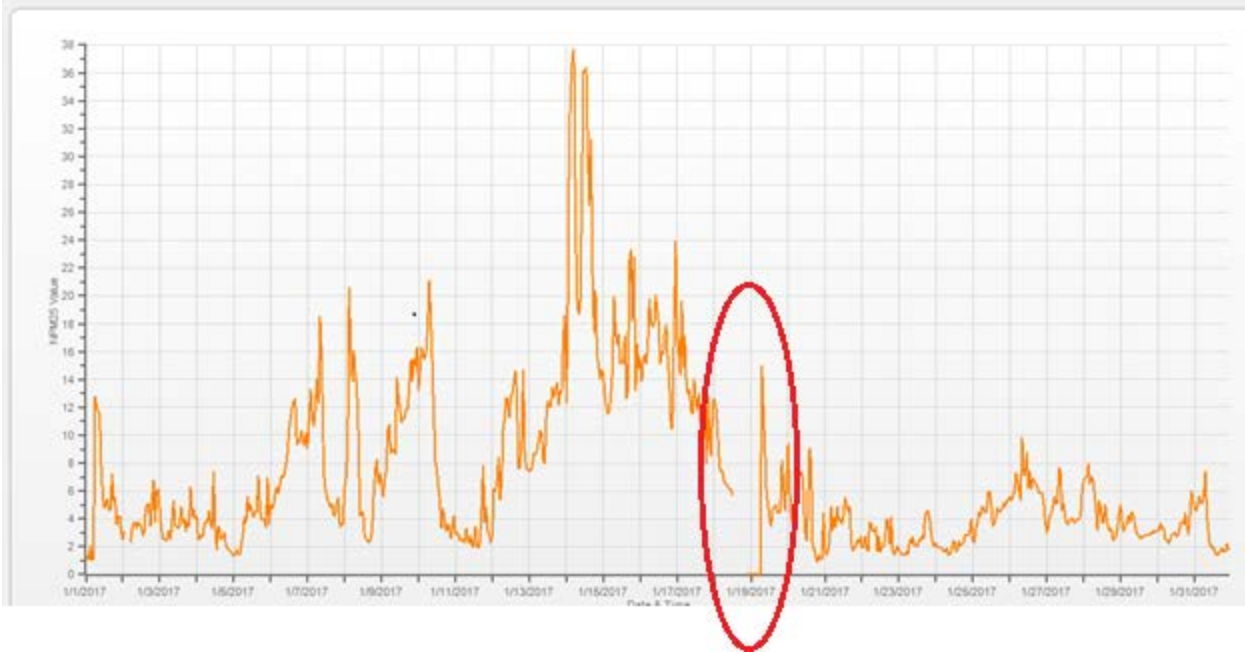
#### **4.3.2.1. Station report: 1-hour averages**

Operators should review similar parameters from the same site or from different sites in the same airshed using one or several of the following reports: Station Report, Group Report, Multi-Station Report. Figure 3 below presents a Station Report hourly average comparison of NPM25, TPM25, and the black carbon portion of PM2.5 collected by an Aethalometer (AETH BC) at the Seattle, Beacon Hill station. These parameters compare fairly well with the exception of the Aethalometer. It appears to stop tracking on the 4th of June, possibly an indication of an instrument problem that should be investigated further.



**Figure 3: Station Report - multiple Parameter 1-Hour Averages**

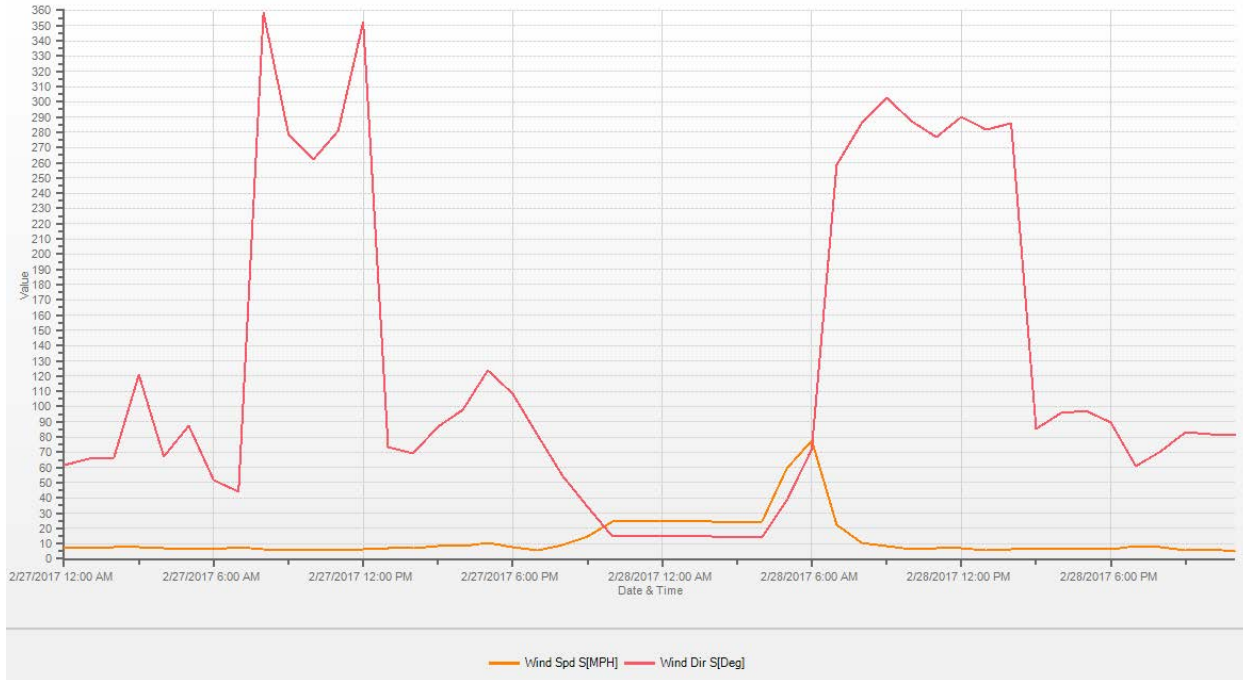
Below is another example of a one-hour average station report. Figure 4 shows nephelometer (NPM25) data that has at least one readily identifiable irregularity; a loss of data followed by a straight line at zero late in the day on 1/18/17 to early on 1/19/17. Operators must investigate the cause of such problems and take appropriate corrective action. In addition, operators should alert the QA team to all such problems so that any erroneous data can be invalidated.



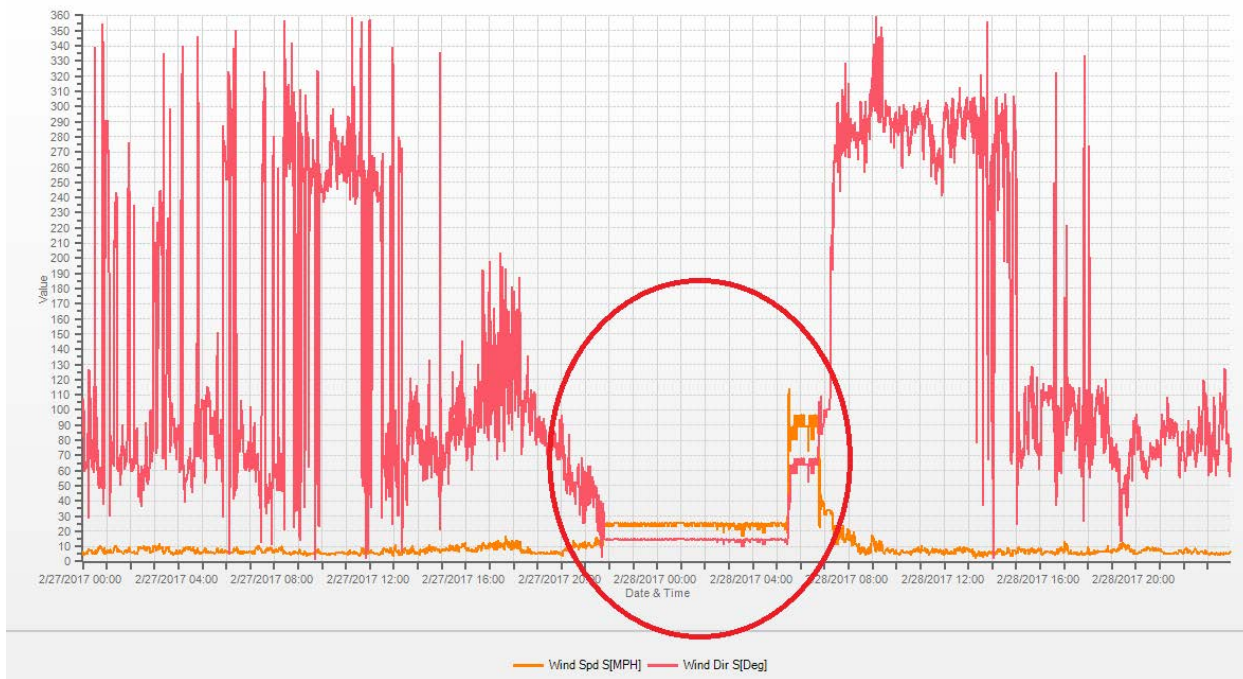
**Figure 4: Station Report - 1-Hour Averages**

**4.3.2.2. Station report: 1-minute averages**

Some problems may not be visible through viewing hourly averages. Therefore, operators should also review graphs of 1-minute data (1-minute averages). For example, the hourly wind data in Figure 5 might not look alarming except for the 80 mph wind during the early morning hours of 2/28. However, looking at the minute data in Figure 6 there is an obvious problem with the wind speed and wind direction from late evening on 2/27 to the afternoon of 2/28. In addition to more obvious errors like this one, other less obvious problems such as erratic instrument operation (i.e., spiking, noise, etc.) that may be smoothed out in 1-hour averages are readily identifiable in the 1-minute graph.



**Figure 5: Station Report - 1-Hour Averages**



**Figure 6: Station Report - 1-Minute Averages**

### 4.3.2.3. Multi-station report: hourly averages

Graphical displays of data collected by instruments measuring the same pollutant in the same airshed should reasonably be expected to generally track each other – in other words, the data should be comparable. Comparing the graphical traces from several stations for the same parameter is an excellent way to identify suspect data. To do such comparisons, operators should generate a Multi-Station Report for several monitors in the same geographic area. The Multi-Station report is only available through the EnvistaARM and Ecology’s website. Multi-Station reports cannot be generated at the logger level via the Reporter. Data that does not compare well to other area monitors should be examined more closely for instrument/sensor malfunction(s). Figure 7 presents an hourly Multi-Station Report for pressure data of nephelometer monitors in the Spokane area from 12/16/2014 – 1/5/2016. Pressure readings appear to compare well until sometime early in the day on December 29th when the Colville monitor drops and stops tracking with the other sites nearby. This is indicative of an instrument/equipment problem at the Colville site. Discrepancies warrant further investigation as soon as possible.

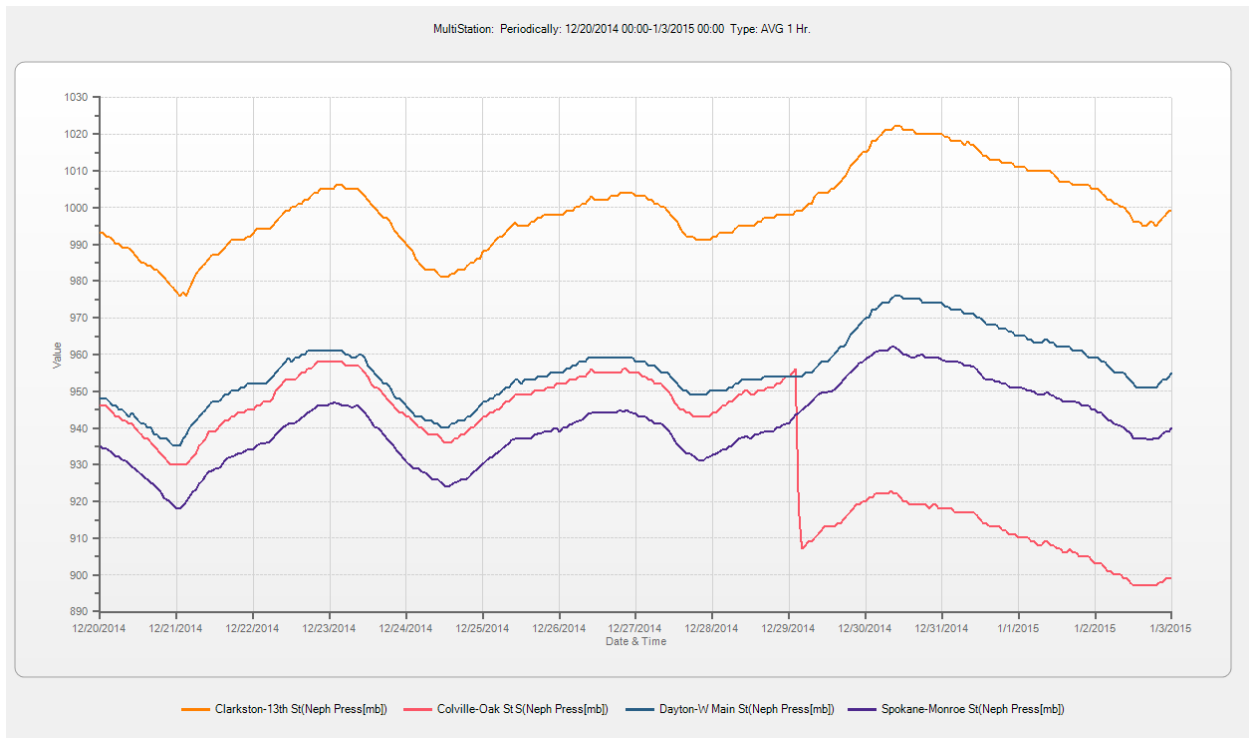


Figure 7: Multi-station report

### 4.3.3. Diagnostic report

Operators should review diagnostic data from their monitors via the Diagnostic Report. This report can be accessed through the data logger’s Reporter or EnvistaARM software. Diagnostic parameter results outside the range of normal instrument operation as defined in the parameter-



specific SOPs should be investigated and corrective action taken as soon as possible. Figure 8 below is an example of a Diagnostic Graph for a PM<sub>2.5</sub> FEM analyzer.

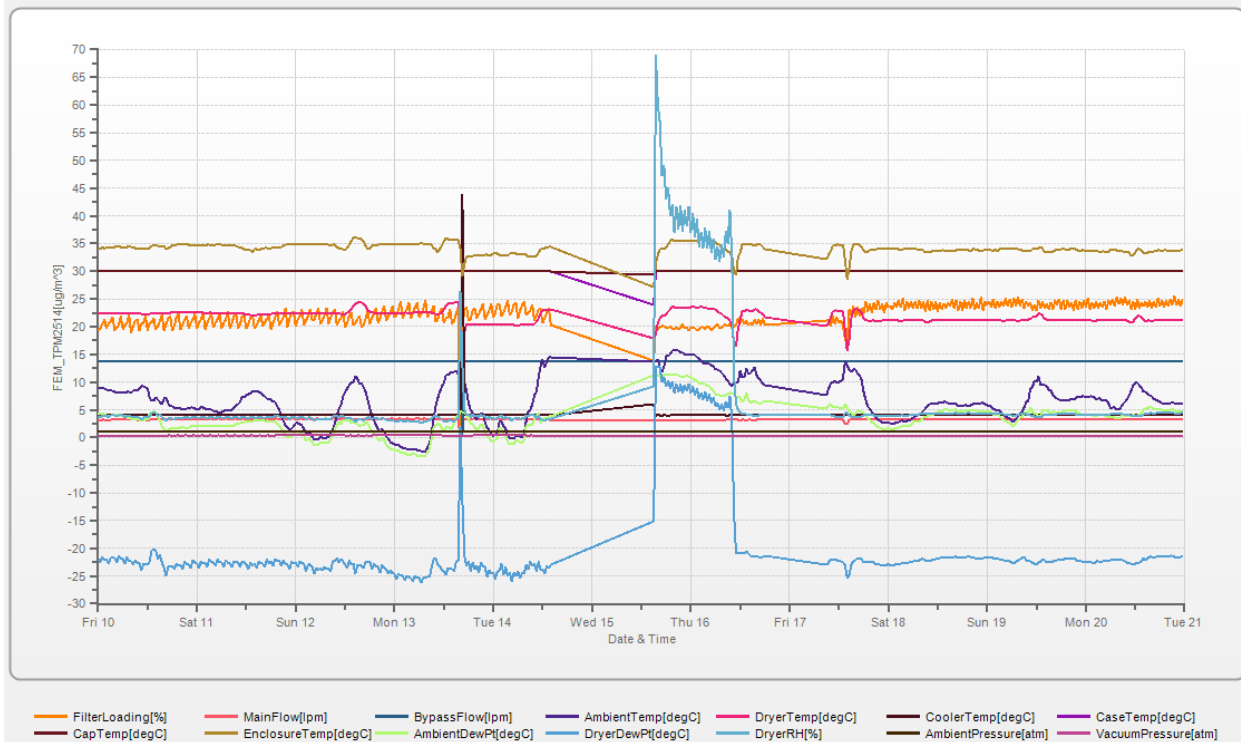


Figure 8: Diagnostic graph for a PM<sub>2.5</sub> FEM analyzer

#### 4.4. Final data validation

Final data validation is conducted by Quality Assurance personnel and is an independent, thorough review of the data. Quality Assurance personnel rely heavily on the EnvistaARM for review and validation of data. The EnvistaARM is similar to the Ultimate Reporter in many ways and features additional options, such as Multi-Station Report and Final Data Validation. However, edits made in the EnvistaARM will not appear on the site logger.

Quality Assurance personnel will conduct a thorough qualitative and quantitative review of the station log book entries, quality control check results, performance audit results, operator documentation, and collected data that will include, but is not limited to, the following activities:

- **Assessment of Data Completeness** – contact operator if data is missing or flagged for extended period without supplementary information provided in the QC form or electronic log book
- **Assessment and Review of Documentation** – ensure all station log books and required forms are properly and thoroughly documented

- **Quality control and quality assurance activities** – ensure all required precision checks and performance audits are within acceptance criteria via the EnvistaARM Calibration Report, operator documentation, and performance audit results
- **Proper operation and maintenance of instrument** – verify that all maintenance activities have been completed
- **Comparability** – using the EnvistaARM, review Station, Group, and Multi-Station Reports to ensure comparability of monitored data
- **Edit data** – invalidate erroneous data and data that does not meet data quality objectives or correct values or flags based on evidence they were captured incorrectly.
- **Lock data per Final Validation** – after thorough review of all data, set the Final Validation designation in the EnvistaARM, locking all validated data from further edits
- **Notify AQS Coordinator** – Conduct timely review and notify AQS Coordinator as soon as data have been validated and are ready for submittal to EPA. This will ensure that Ecology complies with the reporting requirements described in section 58.16 of the most recent version of 40 CFR Part 58

Below, in Figure 9 is an example of a spreadsheet that the Quality Assurance personnel use when validating FEM PM<sub>2.5</sub> data.

	A	C	D	E	F	G	H	I	J	K	L
1	Site Name	AQS ID	Group report	Station Report	Diagnostics	Logbook	QC	QA	Final Validation Set	PARS Nouveau	Notes
2	Seattle-Beacon Hill	530330080									
3	Bellingham-Yew St	530730015									
4	Wenatchee-Fifth St	530070011									
5	Ellensburg-Ruby St	530370002									
6	Anacortes-202 Ave	530570011									
7	Vancouver-NE 84th	530110024									
8	Tacoma-S 36th St	530530024									
9	Spokane-Augusta	530630021									
10	Toppenish-Yakama Tribe	530770015									
11	Omak-Colville Tribe	530470013									
12	Yakima-4th Ave S	530770009									
13	Bremerton-Spruce Ave	530350007									
14	Darrington-Fir St	530610020									
15	Kent-James	530332004									
16	Lynnwood-212	530610005									
17	Marysville-7th Ave	530611007									
18	Marysville-7th Ave (collocated)	530611007									
19	Seattle-10th and Weller	530330030									
20	Seattle-Duwamish	530330057									
21	Tacoma-L Street	530530029									
22											
23											
24											
25	Jill's TEOMs										
26	Jill's BAMs										
27	Sean's Sites										
28											

Figure 9: FEM PM<sub>2.5</sub> Data Validation Spreadsheet

## 5. References

- "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I – A Field Guide to Environmental Quality Assurance." EPA-600/R-94/038a. April, 1994.
- "Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II – Ambient Air Quality Monitoring Program." EPA-454/B-17-001. January, 2017.
- "Quality Assurance Handbook for air Pollution Measurement Systems, Volume IV – Meteorological Measurements." EPA-454/B-08-002. March, 2008
- Code of Federal Regulations, Title 40, Part 58 (40 CFR 58).
- "Envista ARM Air Resources Manager". Envitech Ltd. Envista ARM Ver. 7.7.14. September, 2014.
- U.S. Environmental Protection Agency. Office of Air Quality Planning and Standards. "Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD)." Research Triangle Park, 1987 (EPA-450/4-87-007).  
<https://www.epa.gov/sites/production/files/2015-07/documents/monguide.pdf>