Quantum Laser for NOx Measurements
A Case Study

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September 15, 2026

What We Did

- Customer wanted to install the Emerson CT-4400 Quantum Laser for NOx measurement
- CiSCO agreed only if we could install it in parallel with the Chemiluminescent NOx analyzer already in place (951C)
- We installed the Quantum Laser analyzer in the Spring of 2026, but the plant did not operate until July 2026
- The CT-4400 unit is treated just like the Chemiluminescent analyzer
- This is an extractive CEMS – probe, heated sample line, sample dryer, etc.
- Data collection, daily calibration checks, CGA/Linearities for both analyzers for side-by-side comparison

What We Found

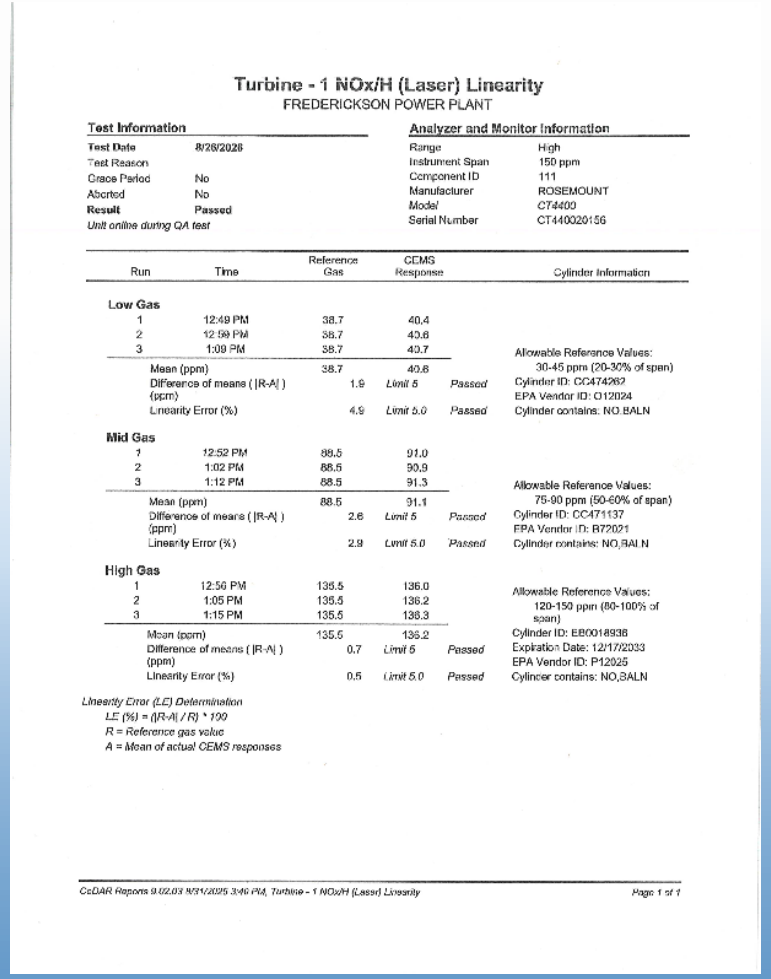
- Data from both analyzers is consistent and closely follows each other
  - Average Laser reading – 3.52 ppm (Minimum – 3.1 ppm; Maximum – 4.4 ppm)
  - Average 951C reading – 3.75 ppm (Minimum – 3.4 ppm; Maximum – 4.1 ppm)
  - Only one hour in 3 weeks of continuous run was the CT-4400 reading higher than 951C (of note – the highest NOx reading for both analyzers was during that hour)

What We Found

- Daily calibrations passed consistently and with only one fail – that fail was on NOx Low range Span gas and both analyzers failed by the same amount (it was a manual calibration). The plant appears to have been doing maintenance at that time.
- Low range – 10 ppm cal gas reference gas 9.3 ppm
- High range – 150 ppm cal gas reference gas 135.5 ppm
  - CT-4400 Average Absolute difference for Low Span – 0.08 ppm
  - 951C Average Absolute difference for Low Span – 0.19 ppm
  - CT-4400 Average Absolute difference for Low Zero – 0.05 ppm
  - 951C Average Absolute difference for Low Zero – 0.19 ppm
  - CT-4400 Average Absolute difference for High Span – 0.97 ppm
  - 951C Average Absolute difference for High Span – 0.80 ppm
  - CT-4400 Average Absolute difference for High Zero – 0.13 ppm
  - 951C Average Absolute difference for High Zero – 1.76 ppm

What We Found

- CGA/Linearity Checks passed for both analyzers



Turbine - 1 NOx/H (Laser) Linearity
FREDERICKSON POWER PLANT

Test Information

Test Date	**8/26/2026**
Test Reason	
Grace Period	No
Aborted	No
Result	**Passed**

Unit online during QA test

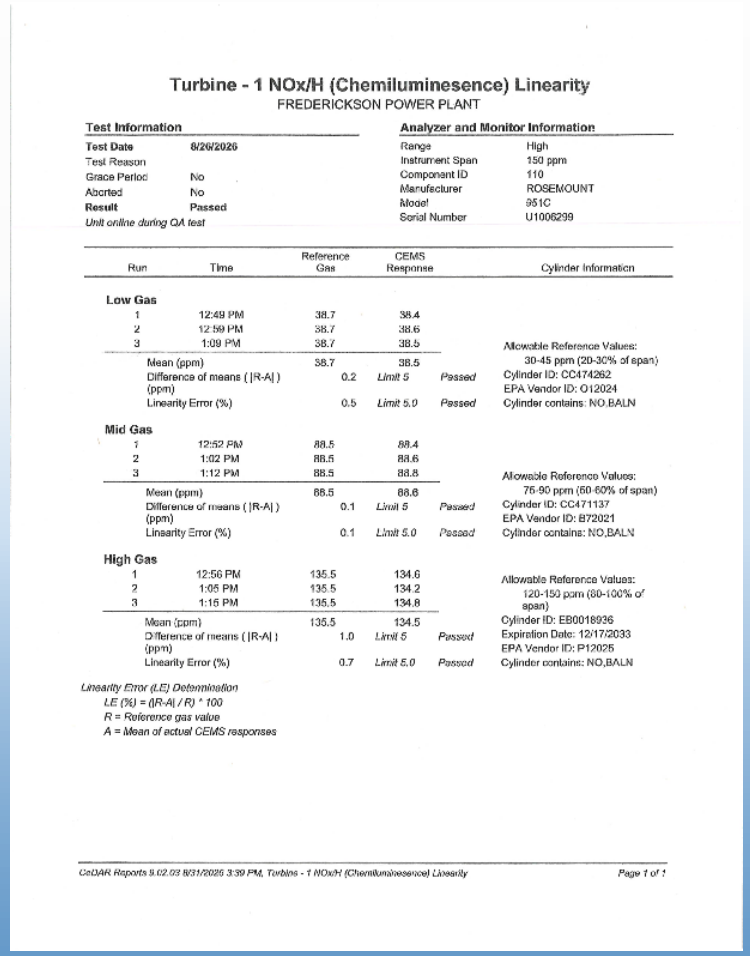
Analyzer and Monitor Information

Range	High
Instrument Span	150 ppm
Component ID	111
Manufacturer	ROSEMOUNT
Model	CT4400
Serial Number	CT440020156

Run	Time	Reference Gas	CEMS Response			Cylinder Information
Low Gas						
1	12:49 PM	38.7	40.4			
2	12:59 PM	38.7	40.6			
3	1:09 PM	38.7	40.7			Allowable Reference Values: 30-45 ppm (20-30% of span)
Mean (ppm)		38.7	40.6			Cylinder ID: CC474262
Difference of means (|R-A|) (ppm)		1.9	*Limit 5*		*Passed*	EPA Vendor ID: G12024
Linearity Error (%)		4.9	*Limit 5.0*		*Passed*	Cylinder contains: NO,BALN
Mid Gas						
1	12:52 PM	88.5	91.0			
2	1:02 PM	88.5	90.9			
3	1:12 PM	88.5	91.3			Allowable Reference Values: 75-90 ppm (50-60% of span)
Mean (ppm)		88.5	91.1			Cylinder ID: CC471137
Difference of means (|R-A|) (ppm)		2.6	*Limit 5*		*Passed*	EPA Vendor ID: B72021
Linearity Error (%)		2.9	*Limit 5.0*		*Passed*	Cylinder contains: NO,BALN
High Gas						
1	12:56 PM	135.5	136.0			
2	1:05 PM	135.5	136.2			
3	1:15 PM	135.5	136.3			Allowable Reference Values: 120-150 ppm (80-100% of span)
Mean (ppm)		135.5	136.2			Cylinder ID: EB0018936
Difference of means (|R-A|) (ppm)		0.7	*Limit 5*		*Passed*	Expiration Date: 12/17/2033
Linearity Error (%)		0.5	*Limit 5.0*		*Passed*	EPA Vendor ID: P12025
						Cylinder contains: NO,BALN

Linearity Error (LE) Determination
*LE (%) = (|R-A| / R) * 100*
R = Reference gas value
A = Mean of actual CEMS responses

CeDAR Reports 9.02.03 8/31/2026 3:40 PM, Turbine - 1 NOx/H (Laser) Linearity *Page 1 of 1*



Turbine - 1 NOx/H (Chemiluminesence) Linearity
FREDERICKSON POWER PLANT

Test Information

Test Date	**8/26/2026**
Test Reason	
Grace Period	No
Aborted	No
Result	**Passed**

Unit online during QA test

Analyzer and Monitor Information

Range	High
Instrument Span	150 ppm
Component ID	110
Manufacturer	ROSEMOUNT
Model	951C
Serial Number	U1006299

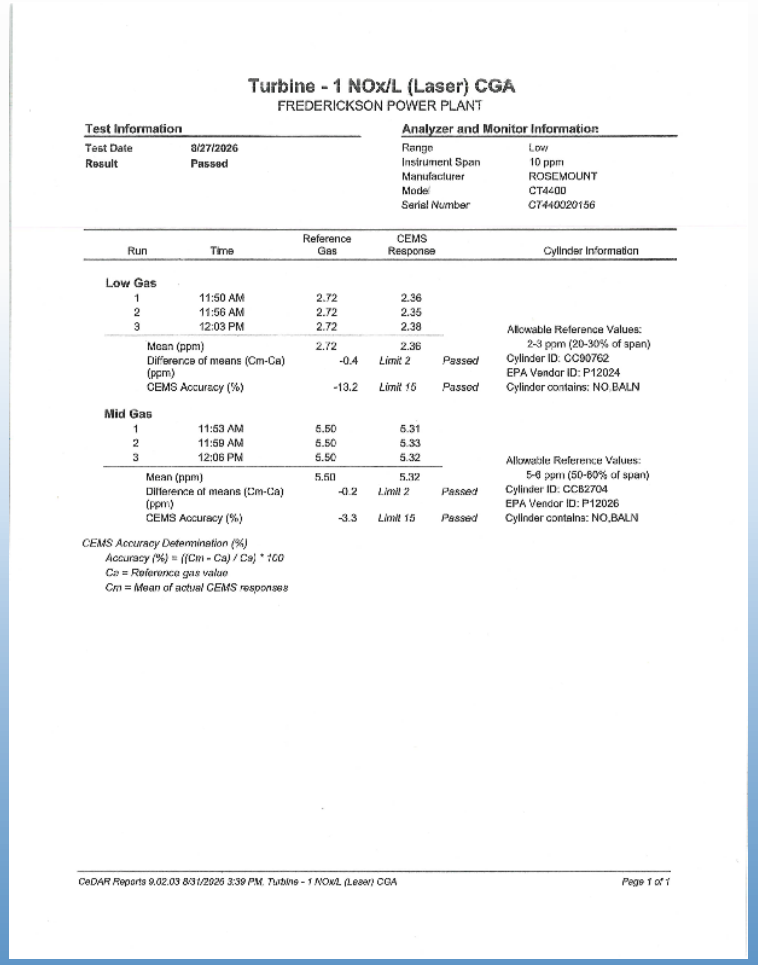
Run	Time	Reference Gas	CEMS Response			Cylinder Information
Low Gas						
1	12:49 PM	38.7	38.4			
2	12:59 PM	38.7	38.6			
3	1:09 PM	38.7	38.5			Allowable Reference Values: 30-45 ppm (20-30% of span)
Mean (ppm)		38.7	38.5			Cylinder ID: CC474262
Difference of means (|R-A|) (ppm)		0.2	*Limit 5*		*Passed*	EPA Vendor ID: G12024
Linearity Error (%)		0.5	*Limit 5.0*		*Passed*	Cylinder contains: NO,BALN
Mid Gas						
1	12:52 PM	88.5	88.4			
2	1:02 PM	88.5	88.6			
3	1:12 PM	88.5	88.8			Allowable Reference Values: 75-90 ppm (50-60% of span)
Mean (ppm)		88.5	88.6			Cylinder ID: CC471137
Difference of means (|R-A|) (ppm)		0.1	*Limit 5*		*Passed*	EPA Vendor ID: B72021
Linearity Error (%)		0.1	*Limit 5.0*		*Passed*	Cylinder contains: NO,BALN
High Gas						
1	12:56 PM	135.5	134.6			
2	1:05 PM	135.5	134.2			
3	1:15 PM	135.5	134.8			Allowable Reference Values: 120-150 ppm (80-100% of span)
Mean (ppm)		135.5	134.5			Cylinder ID: EB0018936
Difference of means (|R-A|) (ppm)		1.0	*Limit 5*		*Passed*	Expiration Date: 12/17/2033
Linearity Error (%)		0.7	*Limit 5.0*		*Passed*	EPA Vendor ID: P12025
						Cylinder contains: NO,BALN

Linearity Error (LE) Determination
*LE (%) = (|R-A| / R) * 100*
R = Reference gas value
A = Mean of actual CEMS responses

CeDAR Reports 9.02.03 8/31/2026 3:39 PM, Turbine - 1 NOx/H (Chemiluminesence) Linearity *Page 1 of 1*

What We Found

- CGA/Linearity Checks passed for both analyzers



Turbine - 1 NOx/L (Laser) CGA
FREDERICKSON POWER PLANT

Test Information

Test Date	8/27/2026
Result	Passed

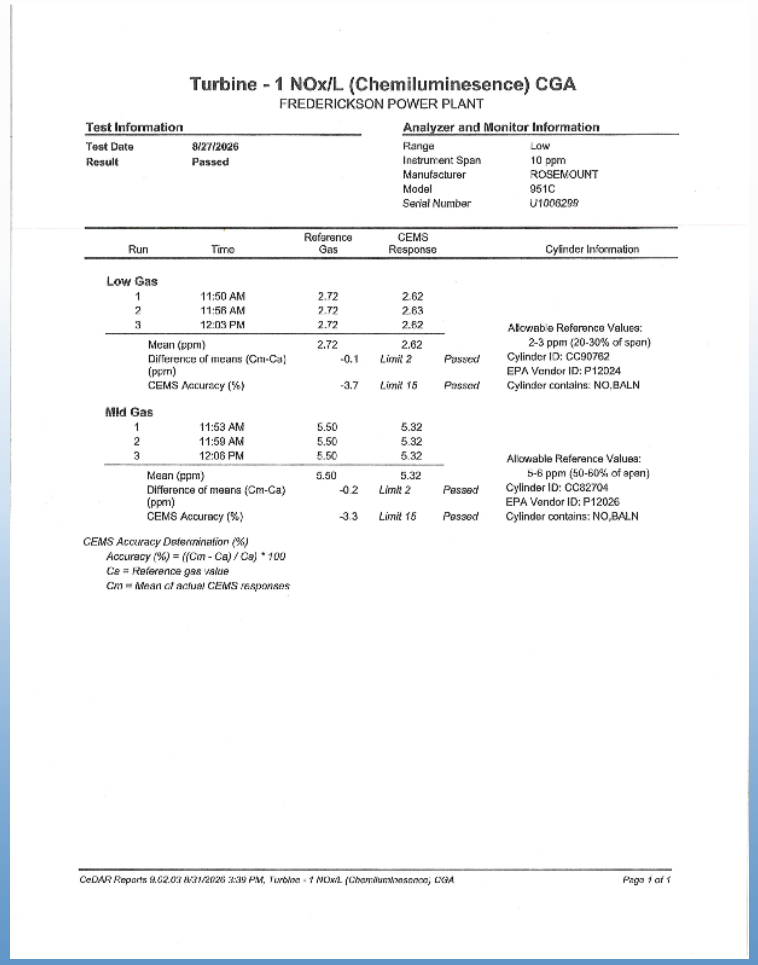
Analyzer and Monitor Information

Range	Low
Instrument Span	10 ppm
Manufacturer	ROSEMOUNT
Model	CT4400
Serial Number	CT440020156

Run	Time	Reference Gas	CEMS Response			Cylinder Information
Low Gas						
1	11:50 AM	2.72	2.36			
2	11:56 AM	2.72	2.35			
3	12:03 PM	2.72	2.38			Allowable Reference Values: 2-3 ppm (20-30% of span)
	Mean (ppm)	2.72	2.36			Cylinder ID: CC90762
	Difference of means (Cm-Ca) (ppm)	-0.4	*Limit 2*	*Passed*		EPA Vendor ID: P12024
	CEMS Accuracy (%)	-13.2	*Limit 15*	*Passed*		Cylinder contains: NO,BALN
Mid Gas						
1	11:53 AM	5.50	5.31			
2	11:59 AM	5.50	5.33			
3	12:06 PM	5.50	5.32			Allowable Reference Values: 5-6 ppm (50-60% of span)
	Mean (ppm)	5.50	5.32			Cylinder ID: CC82704
	Difference of means (Cm-Ca) (ppm)	-0.2	*Limit 2*	*Passed*		EPA Vendor ID: P12026
	CEMS Accuracy (%)	-3.3	*Limit 15*	*Passed*		Cylinder contains: NO,BALN

CEMS Accuracy Determination (%)
*Accuracy (%) = ((Cm - Ca) / Ca) * 100*
Ca = Reference gas value
Cm = Mean of actual CEMS responses

CeDAR Reports 9.02.03 8/31/2026 3:39 PM, Turbine - 1 NOx/L (Laser) CGA *Page 1 of 1*



Turbine - 1 NOx/L (Chemiluminesence) CGA
FREDERICKSON POWER PLANT

Test Information

Test Date	8/27/2026
Result	Passed

Analyzer and Monitor Information

Range	Low
Instrument Span	10 ppm
Manufacturer	ROSEMOUNT
Model	951C
Serial Number	U1006299

Run	Time	Reference Gas	CEMS Response			Cylinder Information
Low Gas						
1	11:50 AM	2.72	2.62			
2	11:56 AM	2.72	2.63			
3	12:03 PM	2.72	2.62			Allowable Reference Values: 2-3 ppm (20-30% of span)
	Mean (ppm)	2.72	2.62			Cylinder ID: CC90762
	Difference of means (Cm-Ca) (ppm)	-0.1	*Limit 2*	*Passed*		EPA Vendor ID: P12024
	CEMS Accuracy (%)	-3.7	*Limit 15*	*Passed*		Cylinder contains: NO,BALN
Mid Gas						
1	11:53 AM	5.50	5.32			
2	11:59 AM	5.50	5.32			
3	12:06 PM	5.50	5.32			Allowable Reference Values: 5-6 ppm (50-60% of span)
	Mean (ppm)	5.50	5.32			Cylinder ID: CC82704
	Difference of means (Cm-Ca) (ppm)	-0.2	*Limit 2*	*Passed*		EPA Vendor ID: P12026
	CEMS Accuracy (%)	-3.3	*Limit 15*	*Passed*		Cylinder contains: NO,BALN

CEMS Accuracy Determination (%)
*Accuracy (%) = ((Cm - Ca) / Ca) * 100*
Ca = Reference gas value
Cm = Mean of actual CEMS responses

CeDAR Reports 9.02.03 8/31/2026 3:39 PM, Turbine - 1 NOx/L (Chemiluminesence) CGA *Page 1 of 1*

What's Next

- Passed RATA on 9/1/2026 using CT-4400 analyzer
- Keep collecting data and verifying compliance and functionality
- Determine maintenance needs as analyzer continues to run

What to Consider

- Does this analyzer save on anything (time, money, …)
- This type of laser analyzer still needs a sample handling system
- Other than occasional filter change, no reason to climb stack

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