

Site Audits

Air Quality Measurement Seminar

Monday 9th July 2007

David Butterfield, NPL

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Why perform an audit?

Audit results

- Gaseous measurements
- Particulate measurements
- Sample system collection efficiency

Why Perform An Audit?

Regular audits are required by legislation if data is to be reported to the EC (to be explained further in Paul Quincey's talk)

They provide evidence needed to:

- ratify individual datasets (to be covered in the next 2 talks)
- ensure comparability of data between sites in the Network
- ensure comparability of data year on year
- allow proper comparison with data from elsewhere, eg by assessing the measurement uncertainty
- discover malfunctions, problems and human errors that would otherwise be missed, eg cylinder drifts, leaks, sample line losses ...

Site Audits

NPL is UKAS Accredited to ISO17025 for Site Audits

Tasks performed:

Uncertainty, 95% k=2

- Analyser Calibration $\pm 4\%$
- Determination of on site standard concentration $\pm 4\%$
- NO₂ molybdenum converter efficiency test $\pm 1.5\%$
- Analyser span noise test 2 ppb
- Analyser zero noise test 1 ppb
- Particulate analyser calibration $\pm 1.5\%$
- Particulate analyser flow rate test $\pm 2\%$

- Sample system collection efficiency test $\pm 5\%$

Site Audits

Equipment needed:

- Gas Standards - recently certified, eg NO, NO₂, SO₂ and CO
- Ozone photometer – recently certified against NIST Standard Reference Photometer
- Flow Standard – recently certified
- Gas dilution system with gas phase titration facility
- TEOM filters of known mass



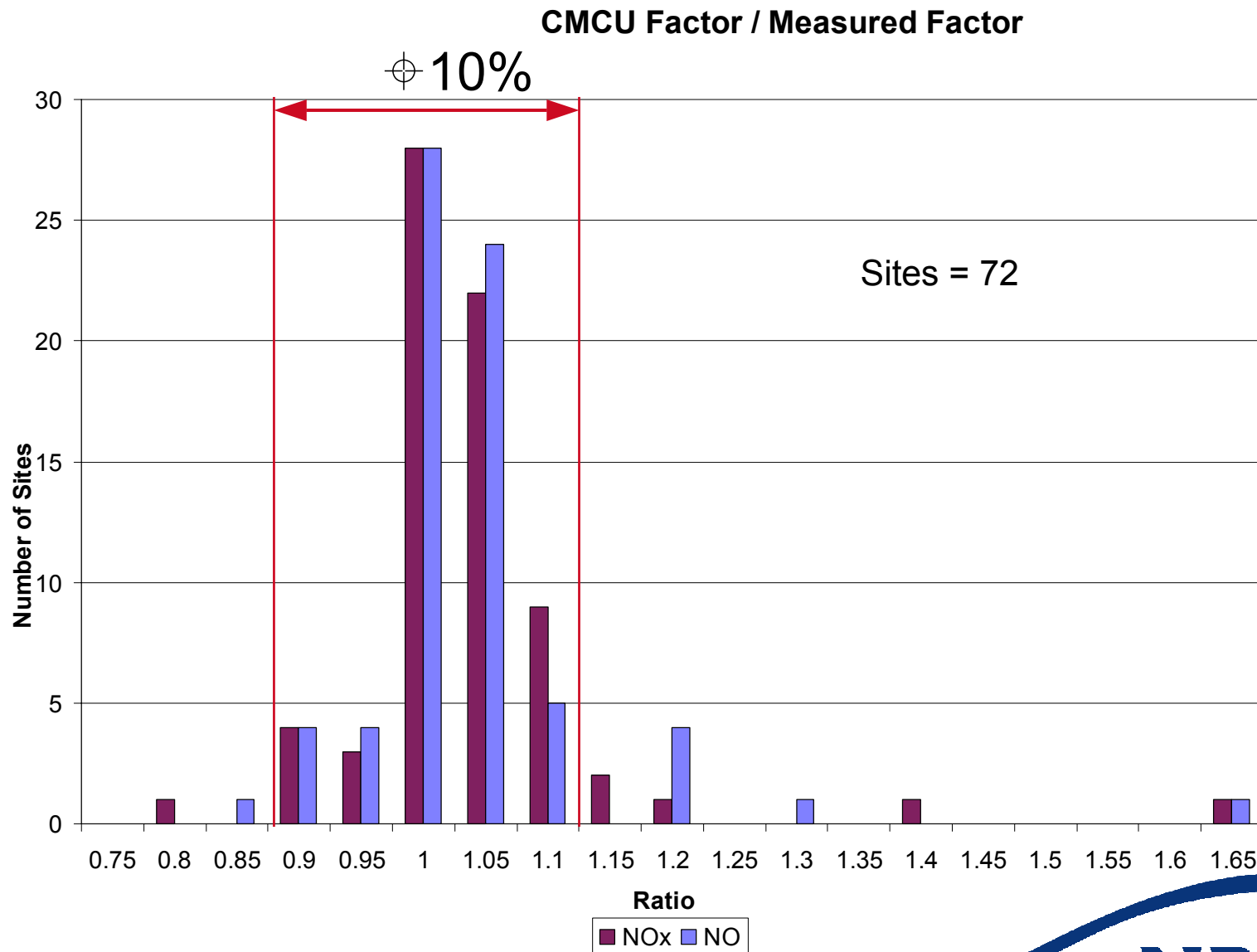
Audit Results

Obvious Faults Found

Fault	Number
Leaking analyser	10
PM head excessively soiled	10
Leaking switching valve in NO _x analyser	4
Analyser non-linearity > 10%	3
Inaccessible TEOM head	3
High noise levels on either span or zero	2
Logger Problem	1
TEOM flow fault	1
Manifold fault	1

Most leaks fixed by NPL before progressing with audit

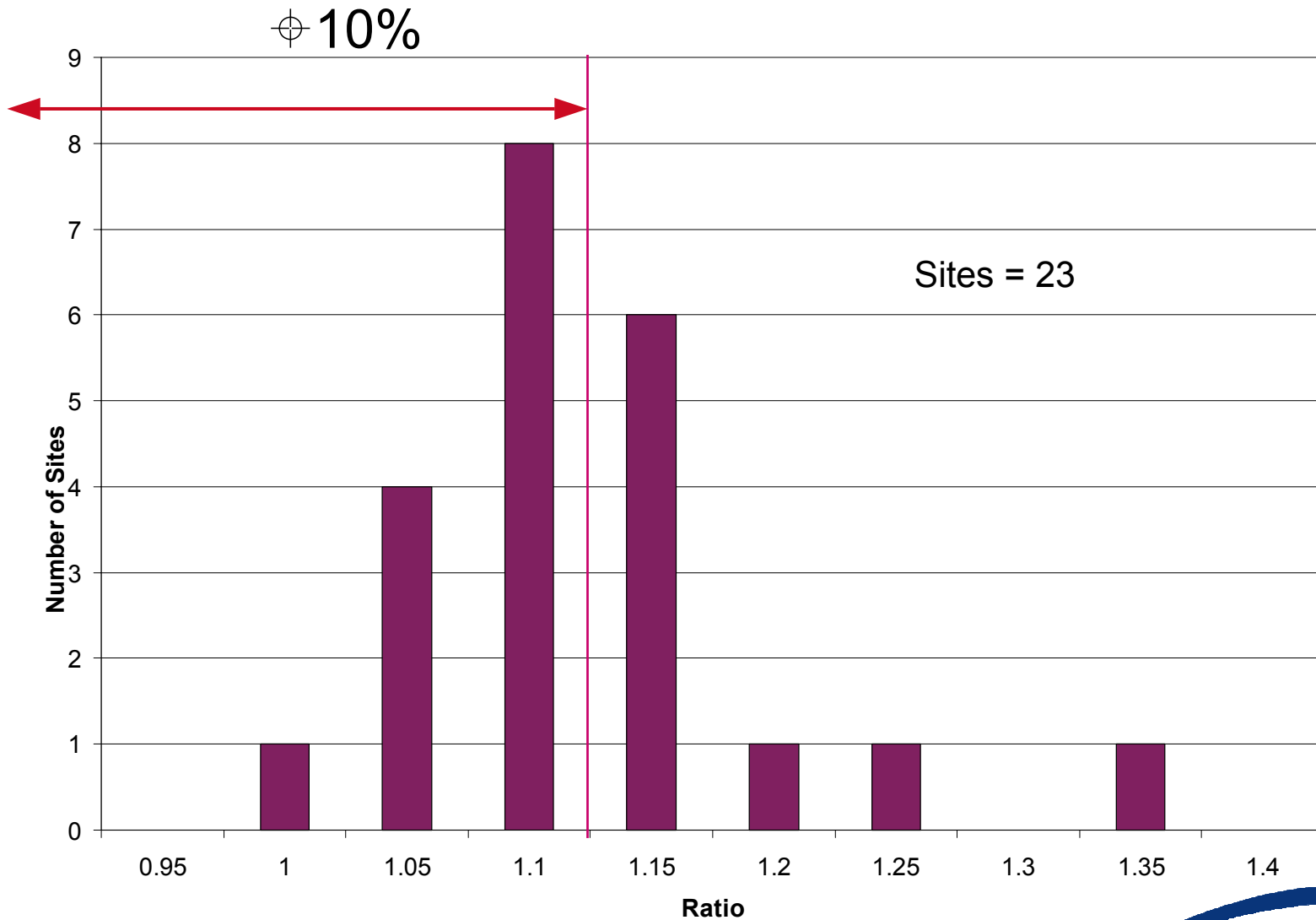
NO_x Analysers



Ratio > 1 Over Reporting Levels in Real Time

SO₂ Analysers

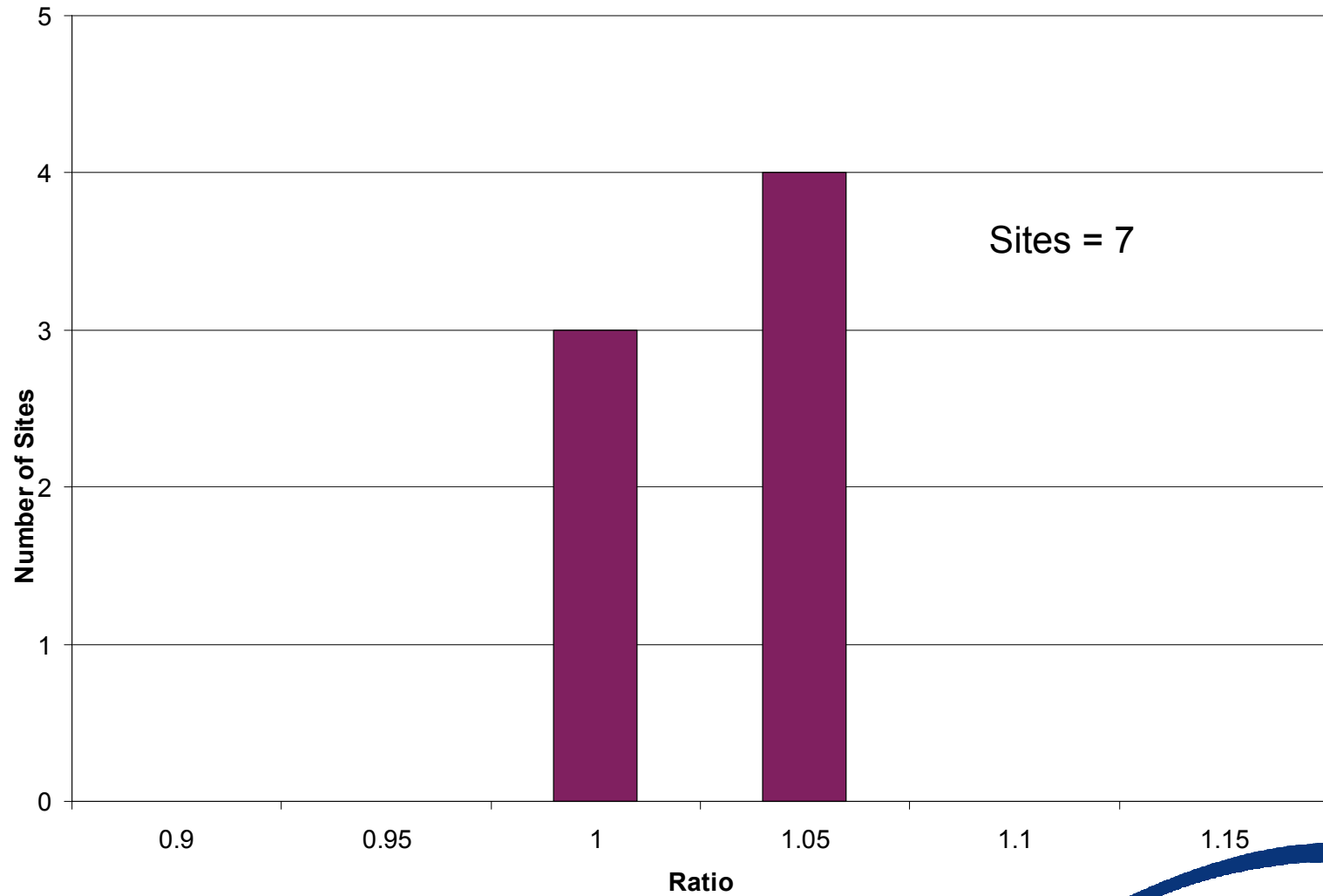
CMCU Factor / Measured Factor



Ratio > 1 Over Reporting Levels in Real Time

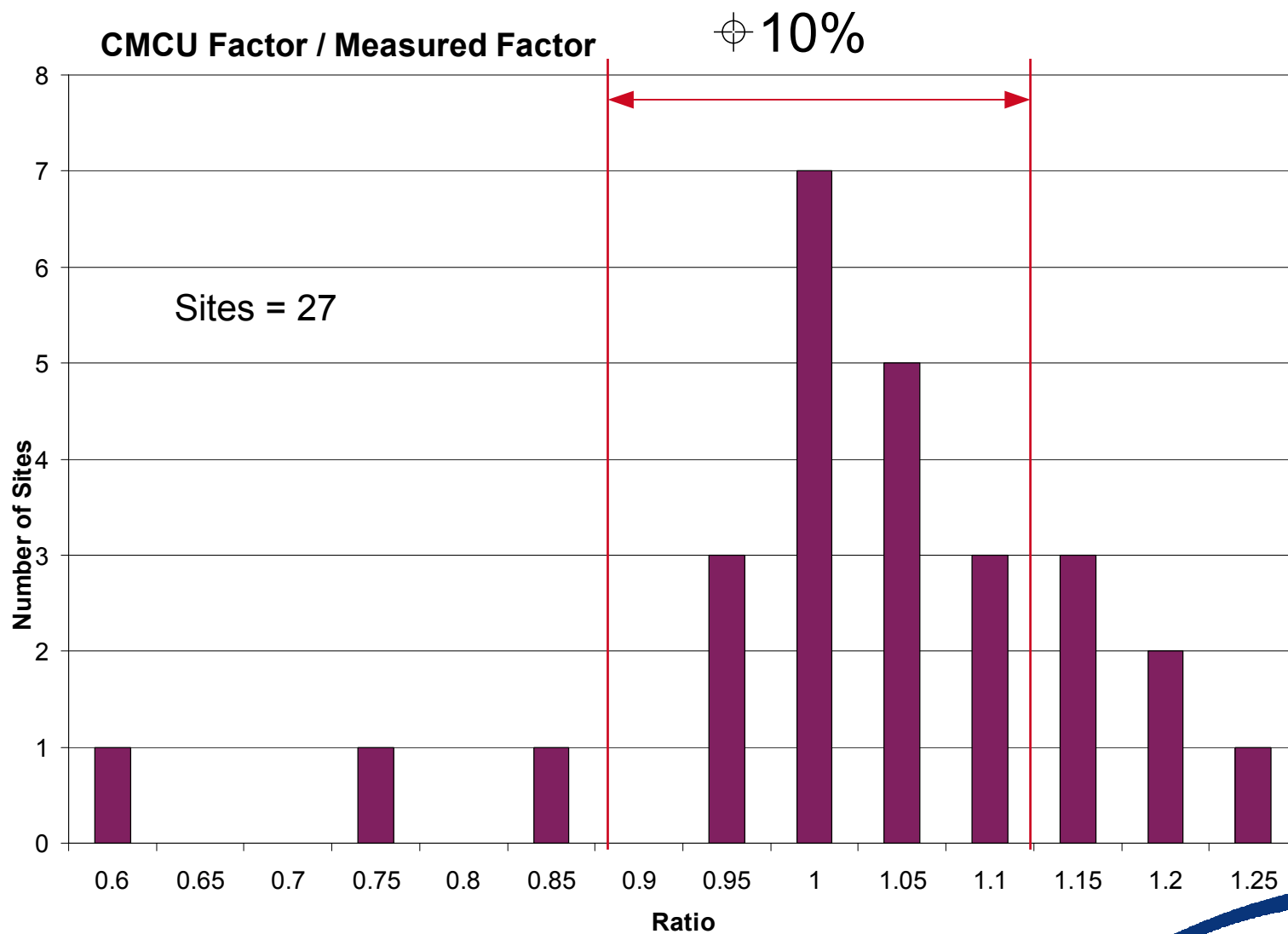
CO Analysers

CMCU Factor / Measured Factor



Ratio >1 Over Reporting Levels in Real Time

O₃ Analysers



Ratio >1 Over Reporting Levels in Real Time

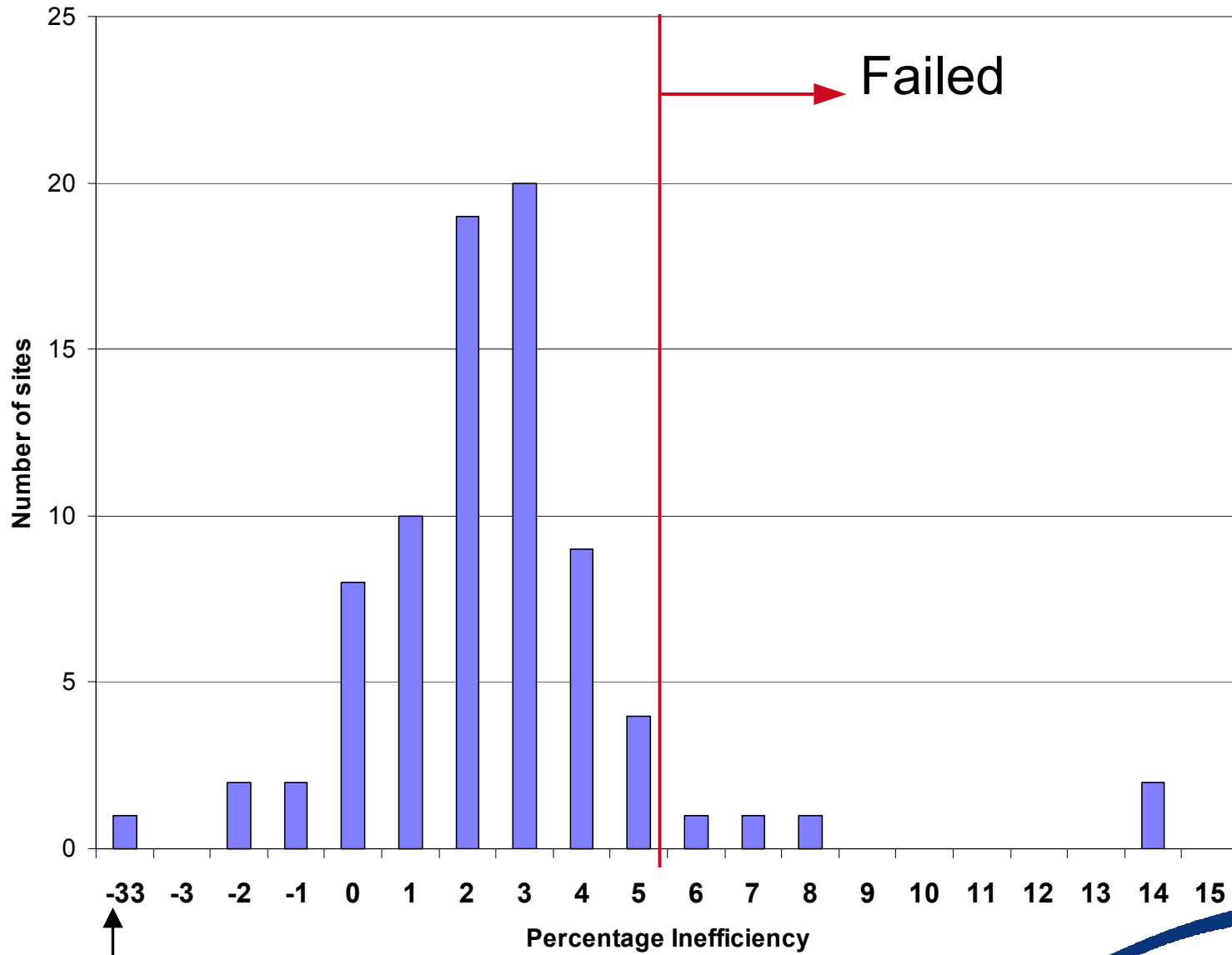
NO Cylinder Degradation

Site	% NO ₂ of NO _x	Site	% NO ₂ of NO _x
East Herts 3	17	Redbridge 4	11
Greenwich 7	3	Tower Hamlets 4	11
Islington 2	6	Hackney 6	6
Hackney 6	6	Hillingdon 2	4
Greenwich 12	4	Richmond Mobile	4
East Herts 2	4	Redbridge 3	3
Greenwich 9	4	Hillingdon 1	3
Redbridge 1	3		

NO → NO₂ in the cylinder

Possibility of NO₂ being reported low due to incorrect NO factor

NO₂ molybdenum converter inefficiency test

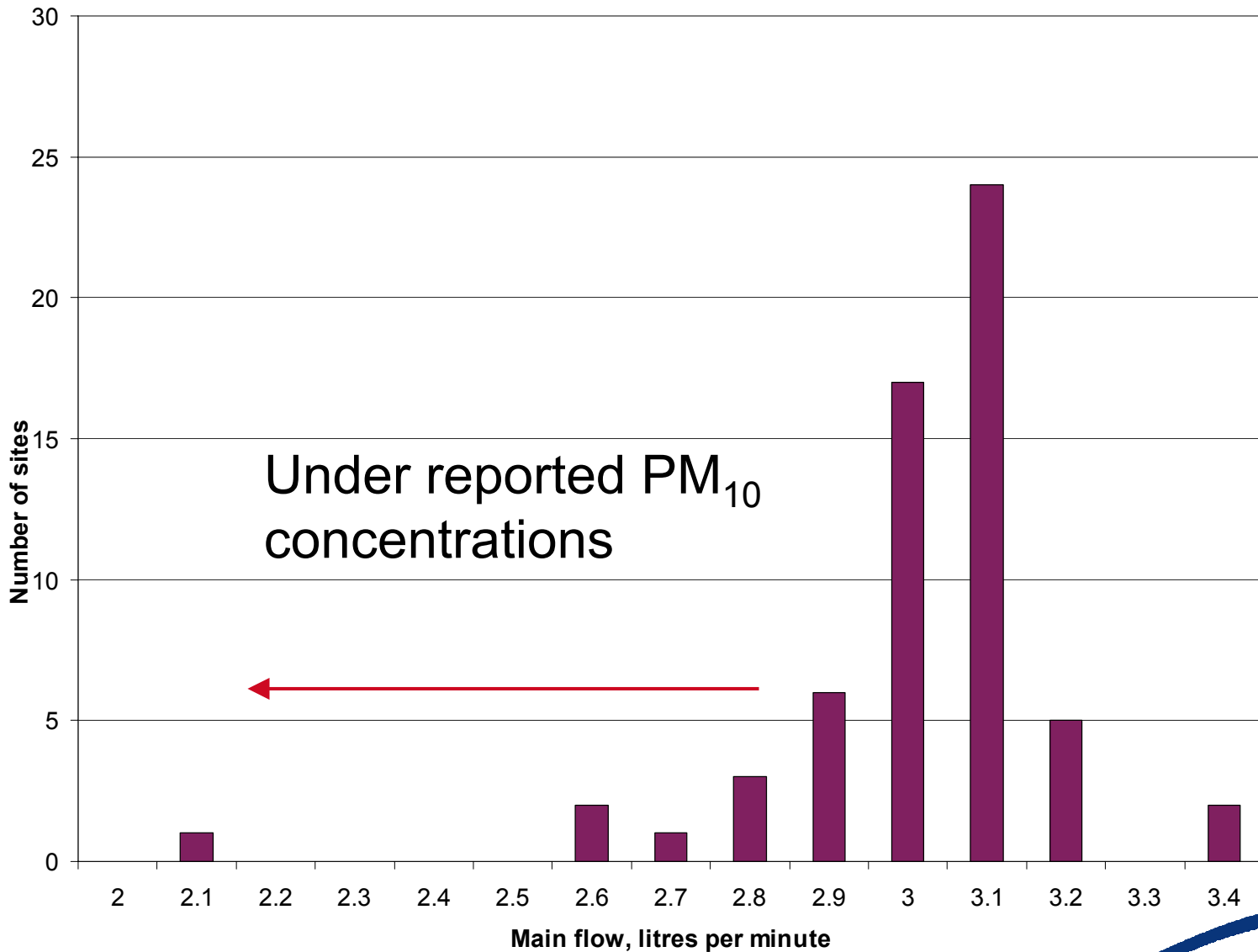


Failure caused by unstable analyser

Particulate analyser calibration

Site	Mass equivalent of noise on F_0 μg	Site	Mass equivalent of noise on F_0 μg
Croydon 3	19	Hounslow 4	31
Lewisham 2	12	Thames Rd South PM2.5	12

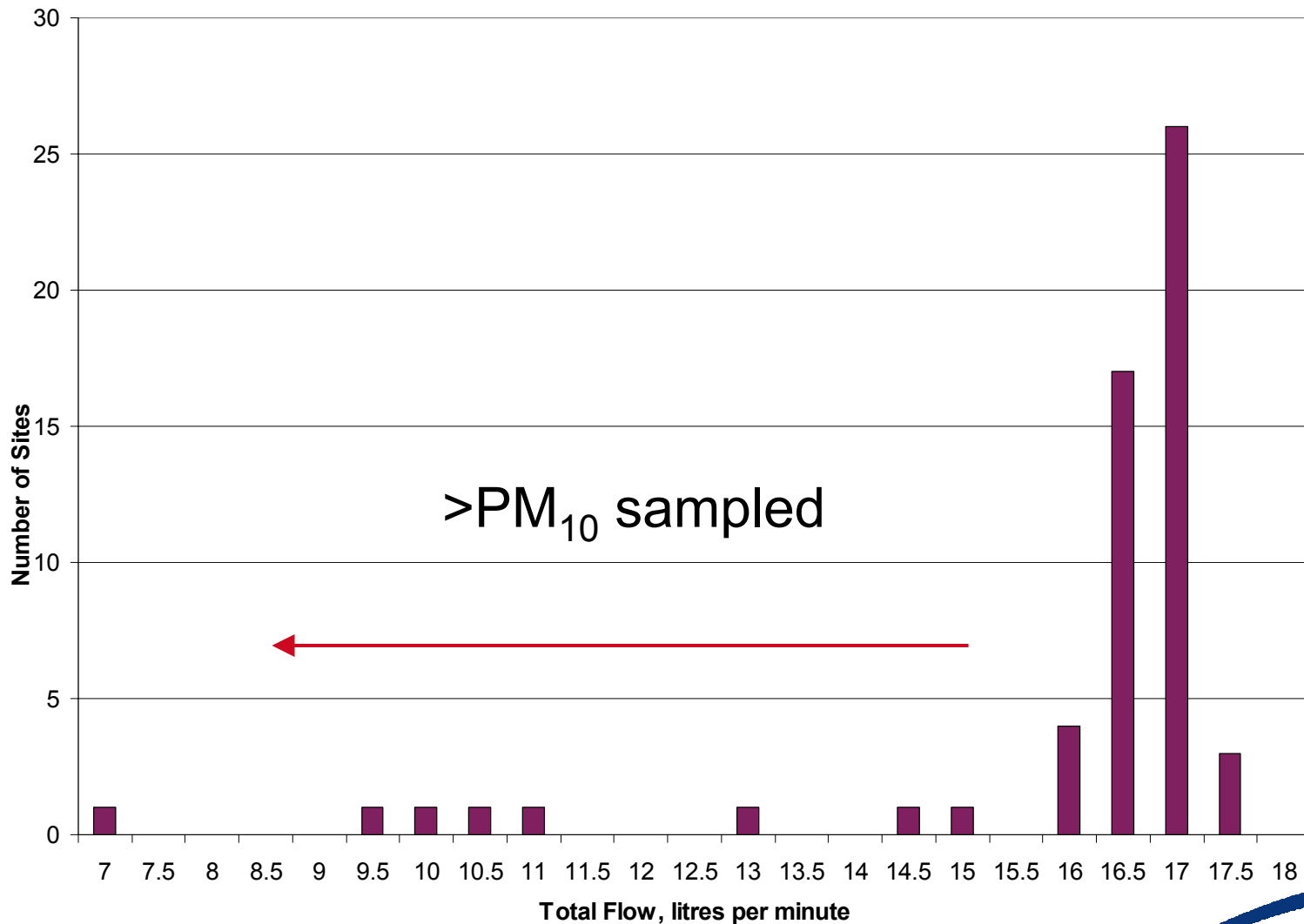
Particulate analyser flow rate - Sensor Flow



Target
3.0

Sites = 61

Particulate analyser flow rate - Total Flow

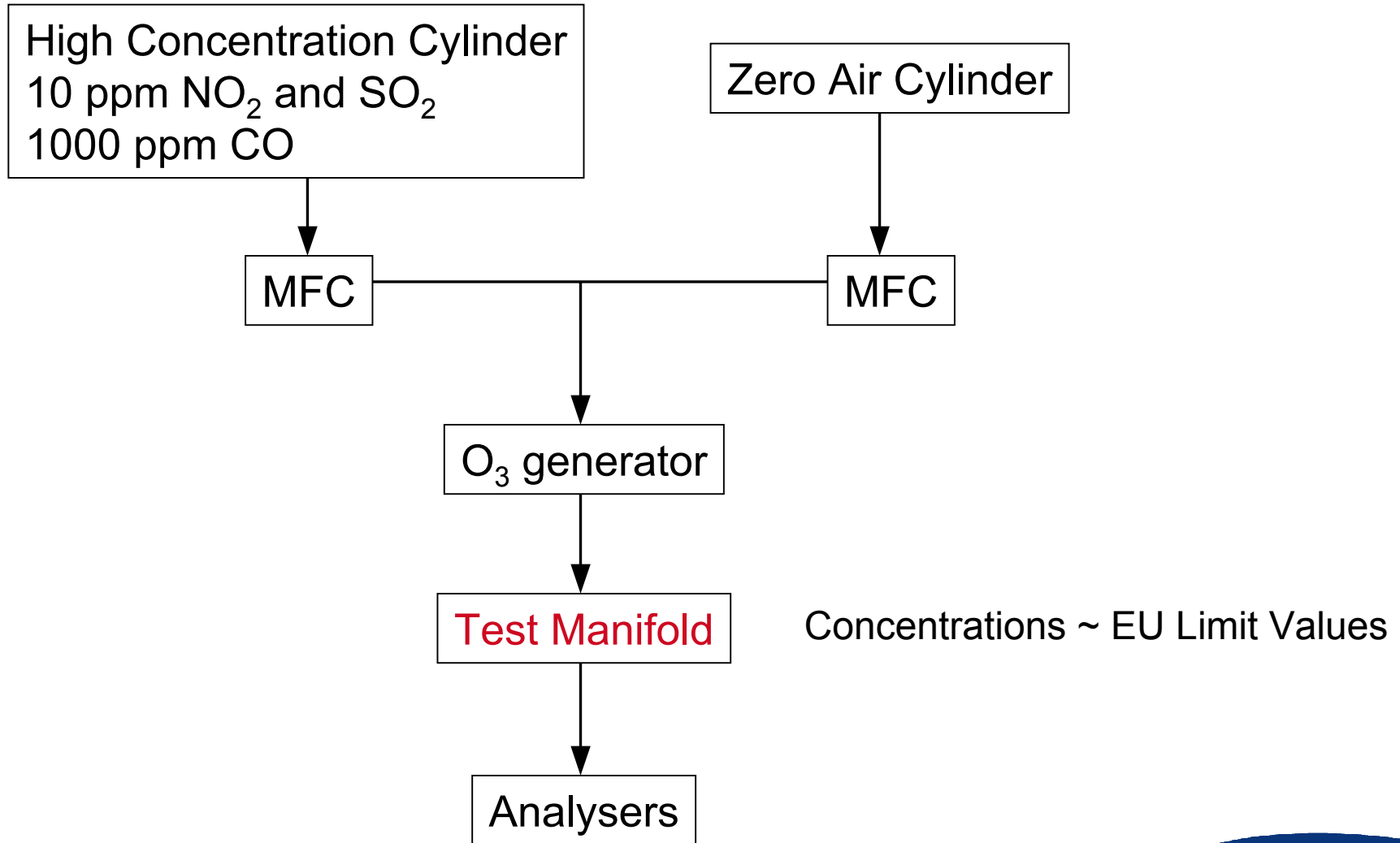


Target
16.67

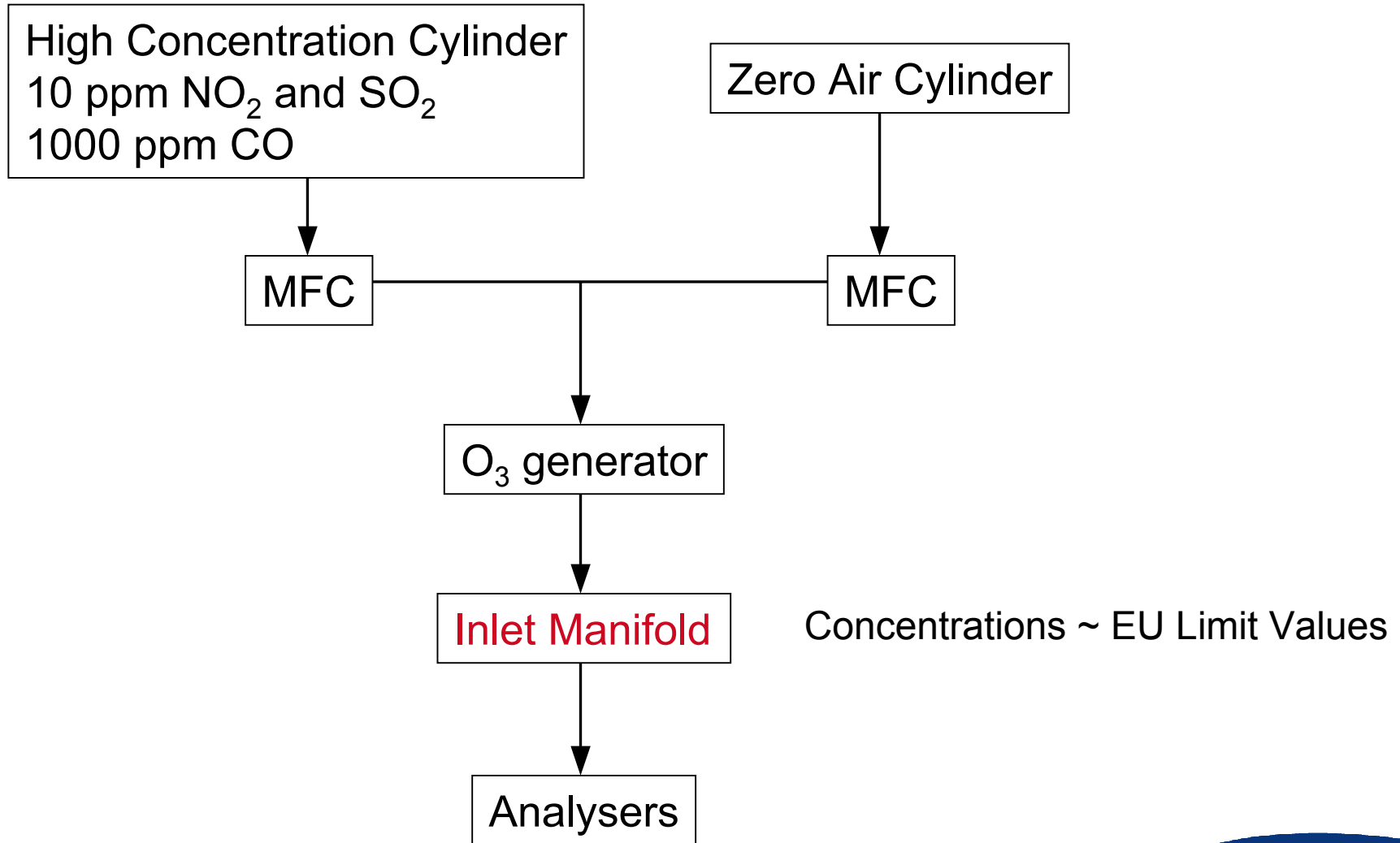
Sites = 58

Sample System Collection Efficiency Test

Overview – Phase 1

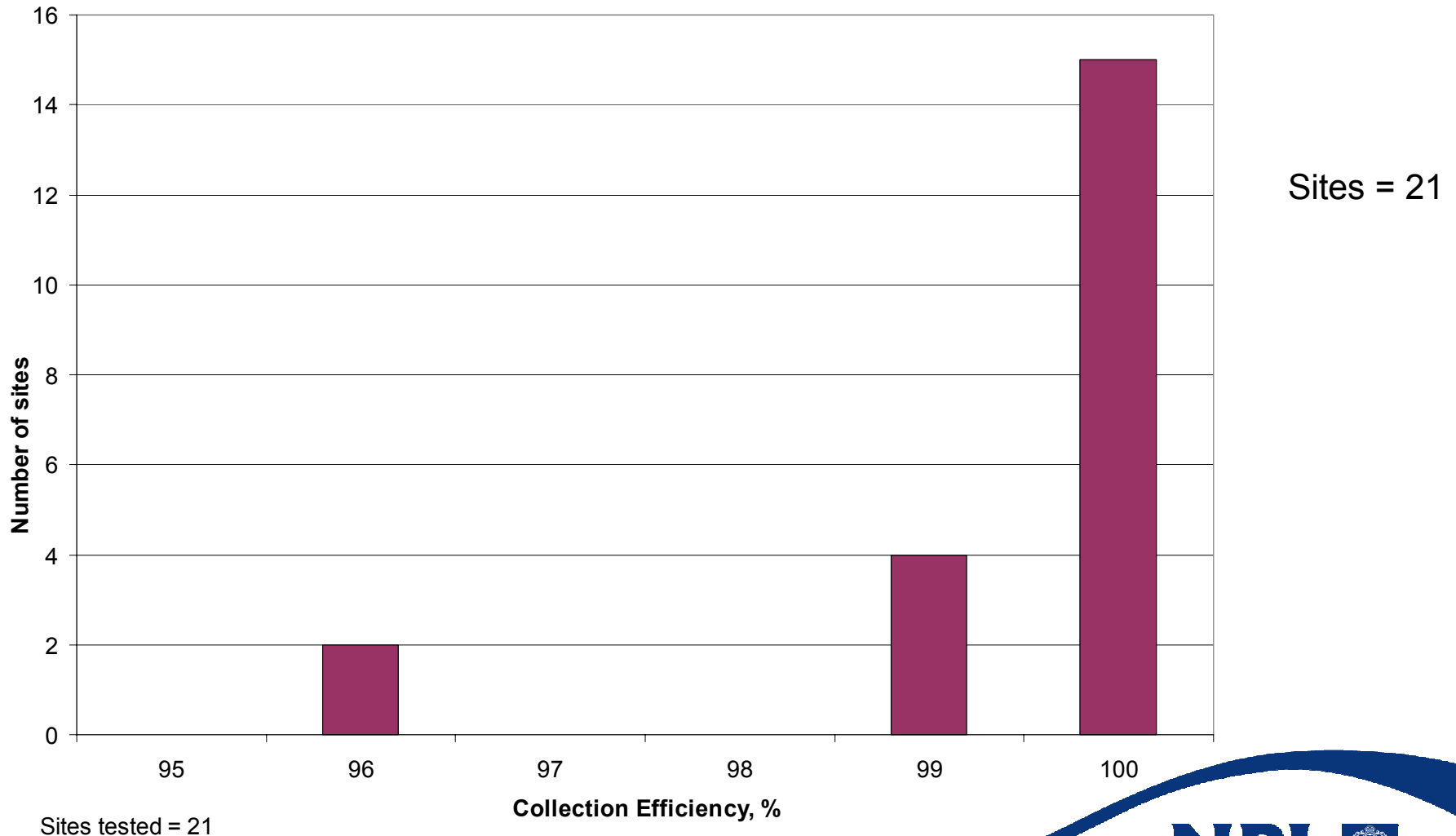


Overview – Phase 2



Sample System Collection Efficiency Results

Nitrogen Dioxide



Sample System Collection Efficiency Results

Pollutant	Collection Efficiency, %	
	Minimum	Maximum
Sulphur Dioxide Sites = 6	96	100
Ozone Sites = 4	90	100
Carbon Monoxide Sites = 2	96	100

Traced to a very long sample line

Summary

Site audits provide a vital element of external quality assurance, significantly increasing the accuracy of some of the data produced and confidence in all of it.