

CEMS EXPERIENCE IN ESKOM

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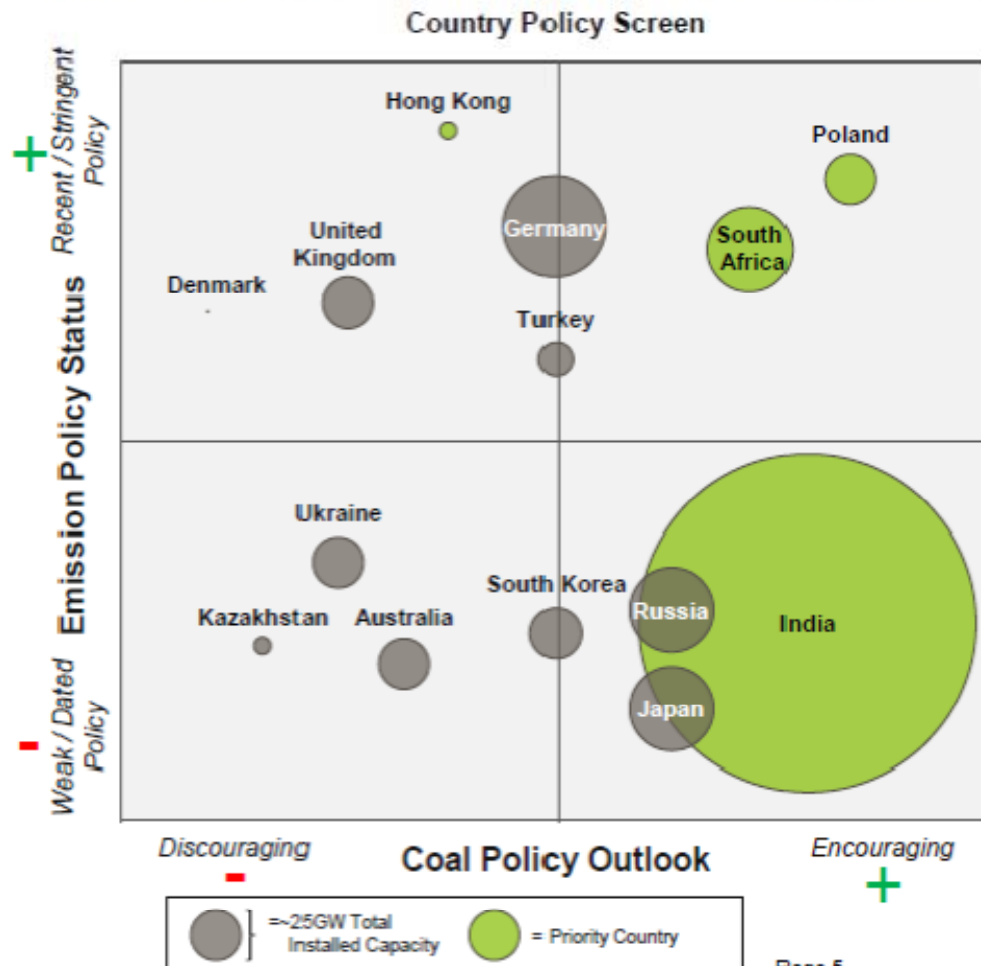
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POLICY SCREENING

A subsequent policy and regulatory screen narrows the priority markets for AQCS to Poland, South Africa, India; Hong Kong is also selected based on policy attractiveness and current BD activities



Selection Description

- Top-ranking countries are evaluated with a policy lens based on:
 - Recent emissions standards enacted
 - Policies in support of coal power
- The most attractive countries are those that are subject to recent or forthcoming emissions standards (2014-2020) and encourage the use of coal for electricity generation
- The most attractive markets for AQCS: retrofit / upgrade are:
 - Poland
 - South Africa
 - India
 - Hong Kong, due to policy attractiveness and recent AECOM BD activity
- Despite attractiveness of the coal policy outlook in Russia, Germany, and Japan, these countries are not selected for further study based on client feedback:
 - Russia has challenging business conditions, particularly in the energy sector
 - Japan and Germany are generally seen as closed to outside AQCS technology
- China and the US are excluded from this phase of screening due to prior AECOM experience and knowledge

MINIMUM EMISSION STANDARDS

Reducing Eskom's environmental footprint and pursuing low-carbon growth



- Eskom believes in a **balanced approach** to ensure environmental sustainability whilst supporting economic growth and access to affordable electricity
- **New atmospheric standards** come into effect in 2015. Eskom has received new atmospheric emission licenses for most of its power stations, except Kriel, where Eskom's request to increase the emissions limit and allow a grace period for when emissions exceed the limit of the new license, has been denied
- Eskom has embarked on an **extensive retrofit programme** to reduce emissions at the highest emitting power stations, but the execution of this programme will require long outages and a significant amount of capital (currently R72 billion in nominal terms)
- Despite the retrofit programme and Eskom's best efforts, there **remains a risk** that Eskom may not be able to fully comply with the new national emission standards, which come into effect in 2015 and 2020, for several reasons:
 - ❖ Certain of the required technologies requires additional water which is not yet available
 - ❖ Implementation of the required technologies requires plant outages of 120 to 150 days per unit; there is insufficient spare capacity to enable the required outages to be taken without impacting on the ability to meet national electricity demand
- Given the above, Eskom expects to achieve 57% compliance with the national emission standards by 2026
- Eskom submitted an application in February 2014 for a **five-year postponement** from compliance to the standards for cases where compliance within the legislated timeframe is not possible. A response from the authorities is expected within six to nine months

MES APPLICABILITY TO ESKOM



Substance or Mixture of Substances		Plant Status	Mg/Nm ³ under normal conditions of 10% O ₂ , 273 Kelvin & 101.3 kPa
Common Name	Chemical Symbol	Existing	
Particulate Matter	n/a	New	50
		Existing	100
Sulphur Dioxide	SO ₂	New	500
		Existing	3500
Oxides of Nitrogen	NO _x expressed as NO ₂	New	750
		Existing	1100

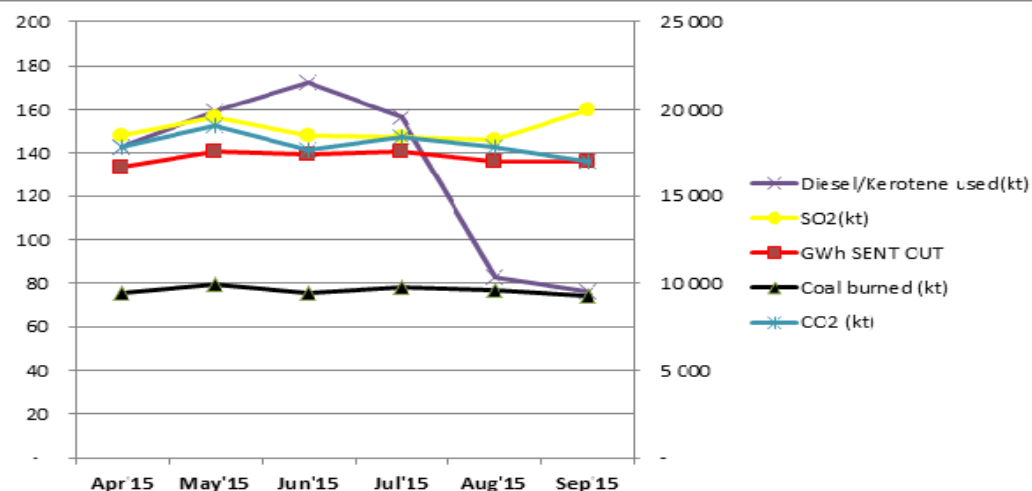
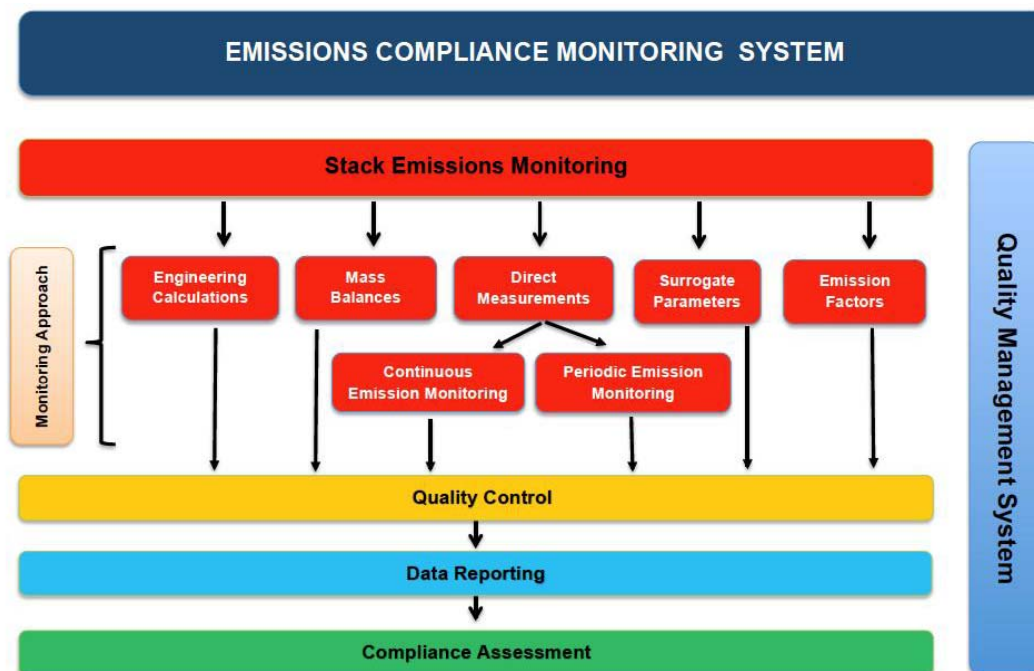
CONTINUOUS EMISSIONS MONITORING & EMISSIONS DATABASE



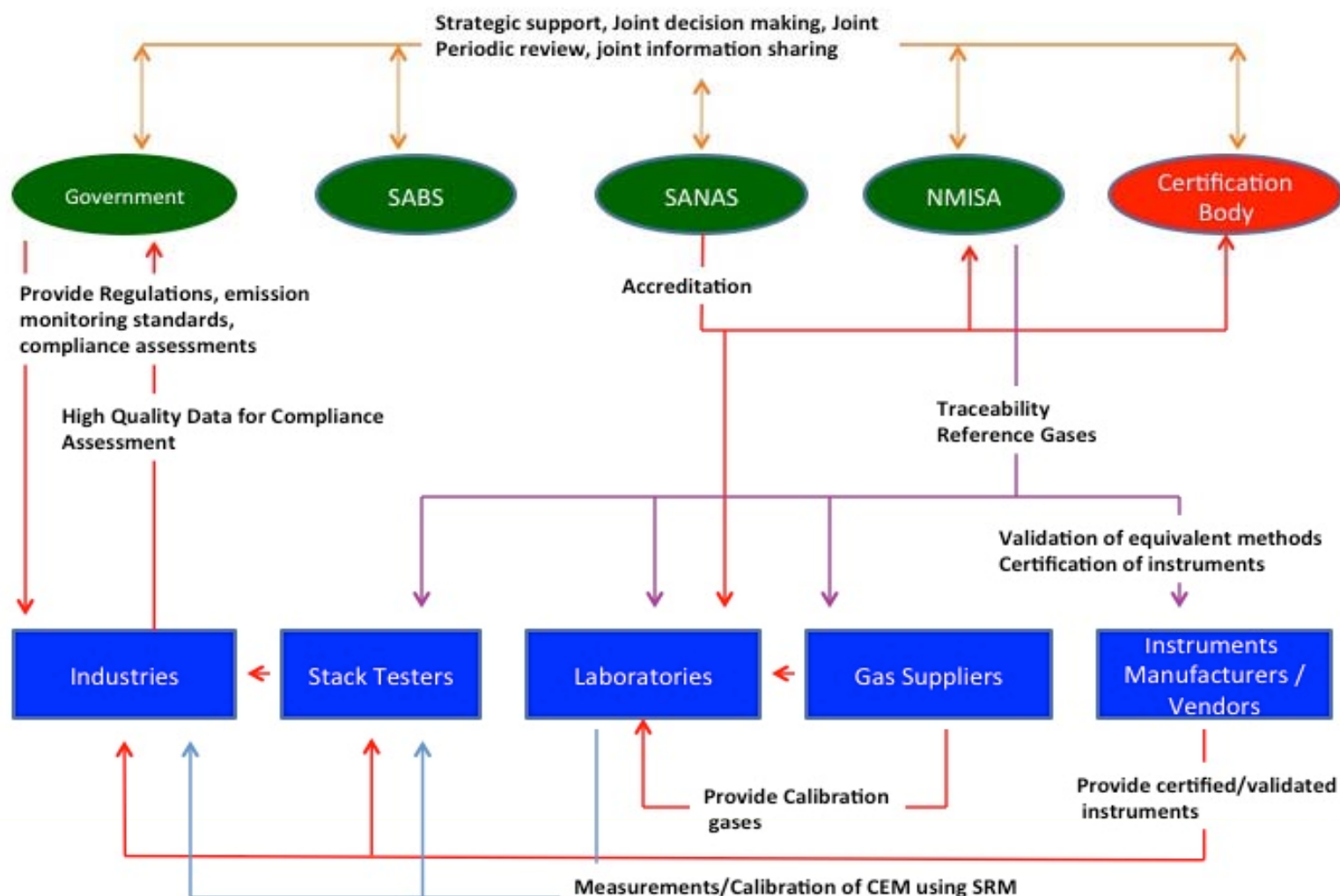
From 01 April 2015, minimum emission standards for the listed activities come into full effect, including the requirements to monitor and report emissions by licensed activities.

Emission monitoring mandate

- Section 21 (3) requires that the emission standards published include:-
 - The permissible amount, volume, emission rate or concentration of the substances that may be emitted; and
 - The manner in which measurements of such emissions must be carried out.
- The Act requires that the National Framework establishes amongst others, the norms and standards for air quality monitoring [Section 7(1)(d)].



AIR QUALITY GOVERNANCE STRUCTURES – INTER-RELATIONSHIPS



CEMS STANDARD



CEM entails the use of automated measurement systems to take measurements of pollutants in real-time, “with few - if any - gaps in the data produced. Measurement may be carried out in situ in the stack (often called cross-stack or cross-duct monitoring), or extractive sampling may be used with an instrument permanently located at or near the stack “(EA, 2007). Where CEM is required, only certified CEMS must be installed for compliance purposes. The three-part standard that has been adopted under S.21 Notice for certification of CEMS is BS EN 15267. This standard is detailed as:

- a) BS EN 15267-1 Air Quality - Certification of automated measuring systems. General principles (BSI, 2009a)
- b) BS EN 15267-2 Air Quality - Certification of automated measuring systems. Initial assessment of the AMS manufacturer's quality management system and post certification surveillance for the manufacturing process (BSI, 2009b)
- c) BS EN 15267-3 Air Quality - Certification of automated measuring systems. Performance criteria and test procedures for automated measuring systems for monitoring emissions from stationary sources (BSI, 2007)

Over and above certification, the S.21 notice requires that CEMS be calibrated and audited (i.e. correlation tests using standards reference methods) every two years as a minimum, or per manufacturer's specifications where it is required more frequently. Auditing and correlation tests of CEMS shall be done using **BS EN 14181- Stationary Source Emissions. Quality assurance of automated measuring systems** (BSI, 2004a)

QUALITY ASSURANCE LEVELS



EN 14181 defines three quality assurance levels (QALs) and an annual surveillance test (AST) for automated measuring systems (AMSs):

- **QAL 1:** Requirement for use of automatic measuring equipment that has had its suitability tested (the test complies with EN ISO 14956) and certified by MCERTS and/or TÜV.
- **QAL 2:** Installation of automatic measuring equipment (AMS), calibration of AMS using the standard reference measuring method (SRM), determination of measuring uncertainty / variability of AMS and check for observance of pre-set measuring uncertainties.
- **QAL 3:** Continuous quality assurance by the operator (drift and precision of the AMS, verification on control card).
- **AST:** Annual surveillance test including SRM measurements to check the uncertainty of the AMS values. This is also commonly referred to as parallel test. As per the South African legislation, this will be done every two years.

All Eskom CEM systems must conform to QAL 1, QAL 2 and QAL 3, and the AST must be performed.

Note: An automated measuring system (AMS) is exactly the same as a continuous emission monitoring system (CEMS). The continental European countries prefer to use the term AMS rather than CEMS.

CEMS SELECTION

The use of either in-situ or extractive systems is acceptable.

Due to the complexity associated with the extractive dilution systems, and the lack of experience and local technical support, their use is not recommended.

The following constituents need to be measured and logged continuously:

- Flue gas velocity, temperature, pressure, CO, CO₂, O₂, NO (expressed as total NO₂), SO₂ and H₂O.
- The measurement of CO is recommended for combustion and boiler performance optimisation.

When selecting monitors, the following needs to be adhered to as a minimum:

- Only MCERTS QAL1/TÜV certified CEMSs to be considered. Certifications can be found on the following website: www.siraenvironmental.com/userdocs/mcerts/mcertscertifiedproductscems
- The installed CEMSs must not deviate from the type of sampling system and installation set-up specified on the Quality Assurance Level 1 certificate to ensure the CEMS is not degraded, such that it no longer meets the required performance specifications.
- Extractive CEMS comprise the analyser(s) and the sampling system. The complete system, including the sampling system, must be QAL1 tested and certified.

CEMS IN-SITU VS EXTRACTIVE COMPARISON



In-situ	Extractive Dilution
Cannot multiplex (i.e. one analyser shared between two or more flues)	Can multiplex (i.e. one analyser shared between two or more flues)
Sample can alter due to changing of dilution ratio - characteristics of air can affect reading - dilution air must be checked regularly	Sampling components require greater maintenance
Fewer parts and less filters result in less maintenance compared to extractive systems	Analysers easily accessible if cubicle situated at the base of the stack
Instrument subject to severe conditions both outside and inside stack (temp, vibration etc.)	Difficult to repair on site; normally installed high up in the stack. Also, most systems use complex optics and electronic methods – gratings, slits, choppers
Particulates can affect analysis if not removed before measurement takes place	Requires higher sensitivity analysers to offset dilution - difficult to measure low ppm emissions

CEMS MAINTENANCE, RELIABILITY AND TESTING



To ensure accurate and repeatable emission results, the European Standards for Installation, Calibration and On-going Maintenance must be followed as in the following references:

- a) Installation of CEM: EN 15259: 2007.
- b) Calibration and Validation of CEMS (QAL2); On-going Quality Assurance during Operation (QAL3) and Annual Surveillance Test (with a parallel Standard Reference Method): EN 14181.

A performance based maintenance contract is entered into as part of the scope of supply for a minimum of two years.

Equipment is reliable if valid results are produced with more than 95% of the available time.

As detailed above and in accordance with the relevant standards, with the relevant sections of EN14181 taking precedence.

For the stratification and parallel tests, consideration must be given to selecting data that is representative of the normal operating load conditions, i.e. typically 60%, 80% and 100% loads. The actual selection of representative data is dependent on the methodology used by the test service provider and must be agreed upon between the client and the service provider prior to commencement of the tests.

AVAILABILITY AND RELIABILITY OF CEMS



Availability is when the analyser is operating and Reliability is when the analyser is operating and gives credible values. The availability of the currently installed CEMS for financial years 2014 to 2015 is detailed in the table below. The numbers reflect availability of at least reasonably accurate data.

FY	April	May	June	July	August	September	October	November	December	January	February	March	Average
2013/14	0	50	88	100	100	60	100	100	90	63	25	30	67
2014/15	50	100	80	50	100	90	88	75	100	100	100	100	86
	25	75	84	75	100	75	94	88	95	82	63	65	77
2013/14	60	75	88	100	88	80	100	100	100	100	88	80	88
2014/15	100	100	100	100	100	100	75	63	100	100	88	80	92
	80	88	94	100	94	90	88	82	100	100	88	80	90
2013/14	100	50	88	90	100	100	100	100	100	100	100	100	94
2014/15	100	100	100	100	100	100	88	75	100	75	38	100	90
	100	75	94	95	100	100	94	88	100	88	69	100	92
2013/14	40	100	75	90	50	80	75	100	80	100	88	80	80
2014/15	75	50	40	0	25	0	0	13	0	38	63	60	30
	58	75	58	45	38	40	38	57	40	69	76	70	55
2013/14	10	0	0	0	50	70	13	0	30	50	13	10	21
2014/15	13	25	30	13	38	10	25	0	0	13	100	70	28
	12	13	15	7	44	40	19	0	15	32	57	40	24
2013/14	100	50	88	60	100	60	100	75	100	75	100	50	80
2014/15	50	0	100	100	75	100	100	100	100	100	100	100	85
	75	25	94	80	88	80	100	88	100	88	100	75	83
2013/14	0	0	0	90	75	60	50	88	60	50	75	30	48
2014/15	100	100	80	100	88	100	100	100	80	38	50	60	83
	50	50	40	95	82	80	75	94	70	44	63	45	66
2013/14	70	38	100	80	50	10	50	50	60	88	75	30	58
2014/15	38	38	40	50	25	60	63	25	80	25	100	100	54
	54	38	70	65	38	35	57	38	70	57	88	65	56
2013/14	0	0	0	0	0	0	100	100	100	100	100	100	50
2014/15	100	100	100	100	100	100	100	100	100	100	100	100	100
	50	50	50	50	50	50	100	100	100	100	100	100	75
2013/14	75	63	100	60	100	70	13	100	100	100	88	30	75
2014/15	100	100	100	100	100	70	50	50	10	50	100	60	74
	88	82	100	80	100	70	32	75	55	75	94	45	75
2013/14	100	100	100	60	63	100	100	50	90	100	100	100	89
2014/15	100	100	100	100	100	100	100	100	100	100	100	100	100
	100	100	100	80	82	100	100	75	95	100	100	100	94
2013/14	80	0	0	100	88	60	100	100	100	100	100	100	77
2014/15	100	100	100	100	100	80	75	100	100	100	100	100	96
	90	50	50	100	94	70	88	100	100	100	100	100	87
2013/14	0	0	0	0	50	70	100	100	100	100	100	100	60
2014/15	25	25	40	88	50	100	100	100	100	63	88	90	72
	13	13	20	44	50	85	100	100	100	82	94	95	66

CLOSING REMARKS



- The Norms and Standards provide the foundation for CEM introduction into an application environment.
- The associated selection of CEMS is therefore key in achieving the desired outcome based on the understanding of the application environment.
- Local service provider support remains a vital success element relating to support and maintenance.
- Training and skilling of on-site system engineers responsible for CEMS hold key to the ultimate success of the CEMS application.



Thank you

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