LESEDI
ENERGY ENGINEERING

FUELTECH
Technologies for clean air & pure water

Flue Gas Conditioning – when, why and how

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Dual Flue Gas Conditioning for Emissions Control, when, why and how.

Author:

Mr. James J. Ferrigan, Fuel Tech Inc.

Presented by:

Mr. Kobus Griesel, Lesedi Nuclear Services

Mr. Hanif Suchwani, Fuel Tech Inc

Mr. Piers de Havilland, Fuel Tech Srl

AGENDA

- Company Backgrounds
  - Lesedi Nuclear Services
  - Fuel Tech Inc
- Dual Flue Gas Conditioning for Emissions Control
  - When
    - Reducing dust emissions due to Regulatory Changes, Fuel Diet
  - Why
    - Elevated Resistivity of ash, fine particle size
  - How
    - NEP Modelling
    - Dual Flue Gas Conditioning (DFGC)
      - SO3 Conditioning System
      - Ammonia Conditioning System
  - Proof of How
      - Shenhua Zhungeer
      - Confidential Mining Application
  - Conclusions
  - Questions

LESEDI BACKGROUND

Lesedi evolved from Intens Engineering which was **founded in 1984**. We have since diversified into a major engineering, procurement and construction **(EPC) company**.

Being technology agnostic, we form strategic relationships in order to provide best technical solutions to our clients. This increases local reach for foreign entities and reduces participation risks for international OEMs as we (1) understand the local market landscape (2) we have an in-depth technical understanding of the systems we get involved with (3) BBBEE Compliant.

Lesedi Industrial:

Innovatively executing industrial process plant projects by providing in-house multi-disciplinary engineering and implementation, including procurement, construction, and commissioning to achieve beneficial use. This is done though a dynamic, can-do attitude and extensive network of technology partners - endeavouring to realise the best solution for every requirement.

MARKET OVERVIEW

POWER GENERATION

Lesedi is experienced in supporting nuclear, coal to power, gas to power and renewable power generation (including biomass and waste to energy) as well as storage.

MINING

Lesedi works with various ancillary plants to ensure mines operate effectively. We do material handling, water systems, CNI and emissions control.

OIL & GAS

Lesedi specialises in downstream and midstream, including storage facilities and above-ground piping networks and peripherals.

PRODUCTS

Lesedi supplies a number of "best of breed" engineering products from around the world.

CORE BUSINESS FUNCTIONS

ENGINEERING

Lesedi's experienced design teams produce designs from concept/feasibility studies through to full detail design packages for greenfield or plant modification projects. We also provide EPCM services in various industries.

PROJECT & CONTRACT MANAGEMENT

Lesedi conforms to the PMI's 10 knowledge areas of the five project management processes of initiating, planning, executing, closing, and monitoring and controlling, as well as a full project management function.

OPERATIONS & MAINTENANCE

Lesedi supports clients by generating comprehensive operating and maintenance manuals and providing operations and management services which assist clients to protect vital and valuable infrastructure assets.

Engineering is at the core of Lesedi's capabilities and forms the major foundation of our business. Lesedi's experienced design teams produce designs from concept and feasibility studies through to full detail design packages for greenfield or plant modification projects.

FEASIBILITY STUDIES

DESIGN

OPERATING INPUT

LESEDI AND FUEL TECH

A partnership bringing

30 + years of ESP Experience to Africa

- Both parties have Turnkey Experience in respective markets
- Robust Proven Designs
- Tailored to local fuels
- Optimised local content
- Guaranteed Performance Results
- Local Service

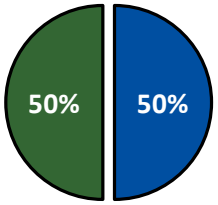
FUEL TECH – COMPANY INFORMATION

- $30 - $40 Million Annual Revenue
  - 35+ Years in Operation
- Publicly Traded on the NASDAQ (FTEK)
- Offices
  - Warrenville, IL – Project Management, Financial, and Corporate Office
  - Durham, NC – SCR Project Management, Process and Modeling
  - Westlake, OH – Particulate and FGC System Support
  - Milan
- 75+ Employees Worldwide
- Financial Strength and Bonding Capabilities

GLOBAL FOOTPRINT

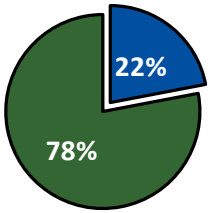
Revenues by Segment

APC CHEM TECH



Revenue by Geography

U.S. INT'L



>1,200 Installations in 29 Countries

Belgium	*Czech Republic*	*Germany*	*Jordan*	*Romania*	*Turkey*
Canada	*Denmark*	*India*	*Mexico*	*South Africa*	*United Kingdom*
Chile	*Dominican Rep.*	*Indonesia*	*Poland*	*South Korea*	*United States*
China	*Ecuador*	*Italy*	*Portugal*	*Spain*	*Venezuela*
Colombia	*France*	*Jamaica*	*Puerto Rico*	*Taiwan*	

FUEL TECH
Technologies for clean air & pure water

BUSINESS OVERVIEW

Technologies to Enable Clean, Efficient Energy

» Air Pollution Control (APC)

- Robust suite of low cap-ex NO_X and Particulate Control solutions that reduce emissions from 30% to 85%
- Global presence and brand name with 1,000+ installations over a 30+ year history
- Capital project sale, typically fixed-price, with turn-key capabilities
- Typical customers: fossil fuel-fired utilities and industrial boilers
- Capitalizing on recent trend of deployment of natural gas turbines in support of domestic manufacturing expansion

» FUEL CHEM® (Chemical Technologies)

- TIFI® Targeted In-Furnace Injection™ process promotes boiler efficiency, reliability and environmental status by reducing slag, SO_3, NO_X, ABS, PM2.5, and CO_2
- Provides fuel flexibility: customers can burn more economical coal
- Annuity-type model with applications in utility and industrial sectors
- Programs in place on combustion units and black liquor recovery boilers (pulp & paper industry) in the Americas, Europe and Asia

» Dissolved Gas Infusion Technology

- Emerging DGI® Dissolved Gas Infusion technology business segment targeting large addressable markets for water and wastewater treatment
- Innovative alternative to current aeration technologies
- Micro- and nano-bubbles are infused into water / wastewater to optimize environmental remediation, aerobic digestion, and biological treatment


DUAL FLUE GAS CONDITIONING
FOR EMISSIONS CONTROL
When, why and how?

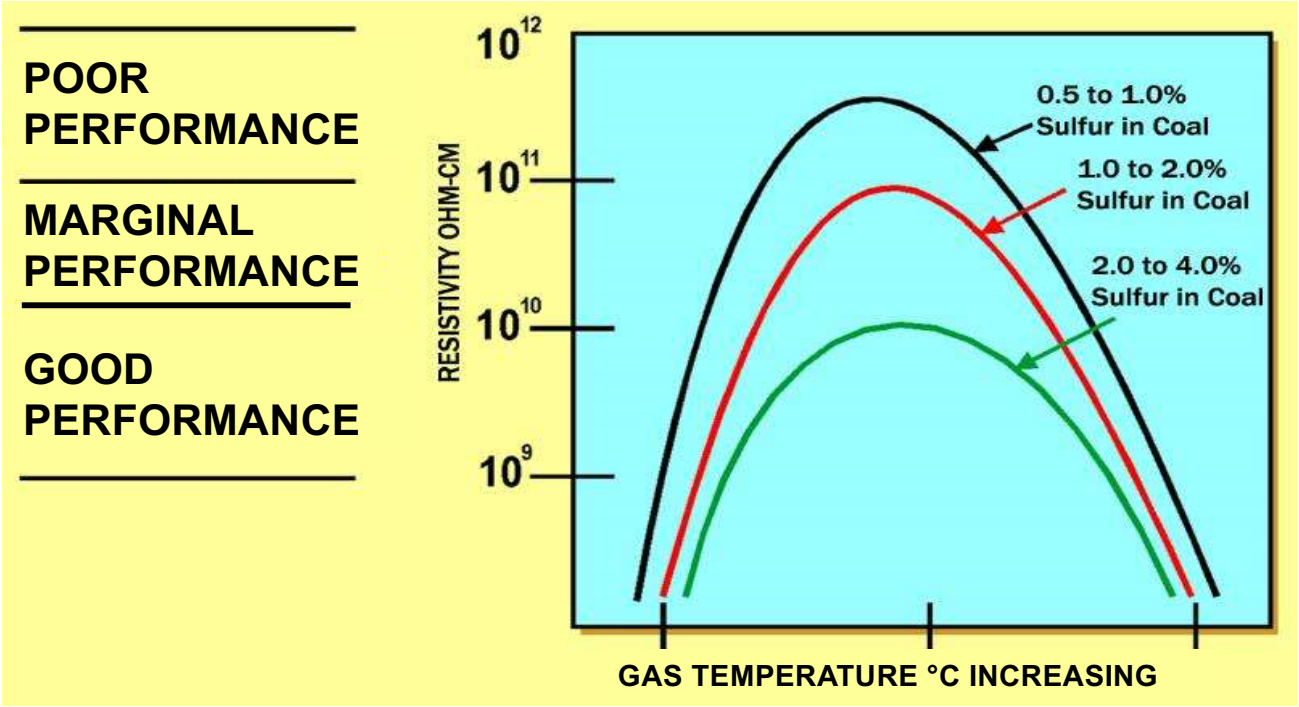
WHEN DUAL FLUE GAS CONDITIONING IS REQUIRED

- Changing fuel mix
  - Many factors go into the design of particulate collection but ultimately the fuel mix has to be restricted due to economics.
- Changing regulations
  - Emissions limits become more restrictive as technologies develop and economics permit.
- Lower Sulphur Fuels and Higher Temperatures produce High Resistance Dust
  - Reduces the speed of the dust towards the collecting plates (migration velocity).
  - Reduces ESP collection efficiency, often dramatically.
- Fabric Filter applications
  - Small dust particle size can increase the pressure drop across the filter cake.
  - Increased pressure drop will reduce bag life due to aggressive cleaning

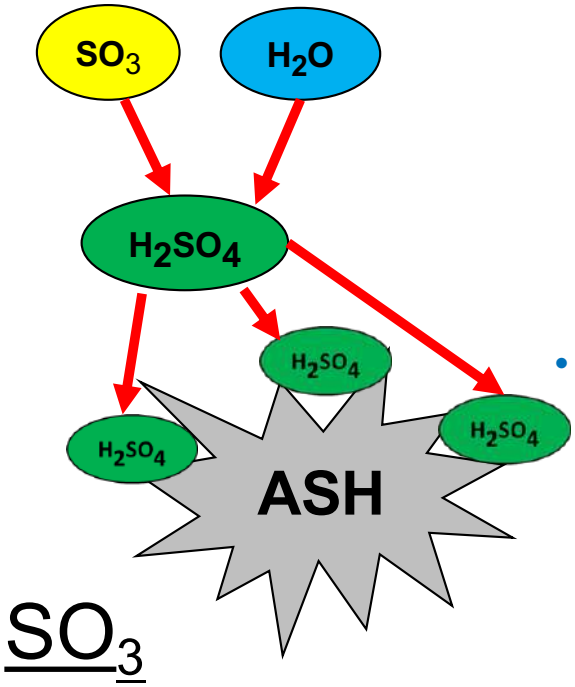
WHY DUAL FLUE GAS CONDITIONING IS REQUIRED

Reducing resistivity is only part of the story

- Agglomeration of fine particles can reduce re-entrainment in ESPs
- Agglomeration of fine particles can reduce dP in Fabric Filters

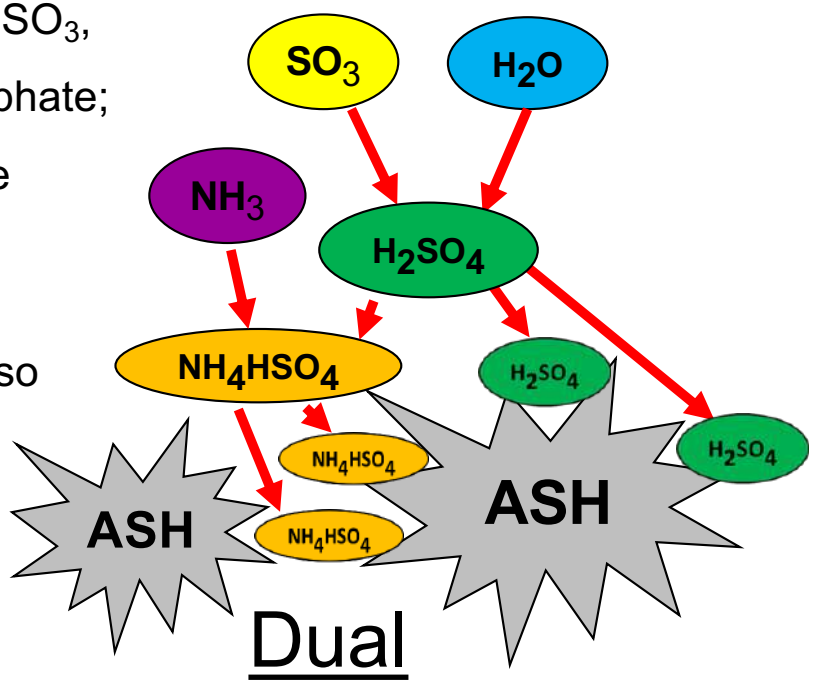


WHY DUAL FLUE GAS CONDITIONING IS REQUIRED



SO3

- Injecting ammonia can improve utilization (uptake) of the SO_3, forming ammonium bisulphate; resulting in more effective resistivity control.
- Injecting ammonia can also promote agglomeration



Dual

HOW DUAL FLUE GAS CONDITIONING IS USED

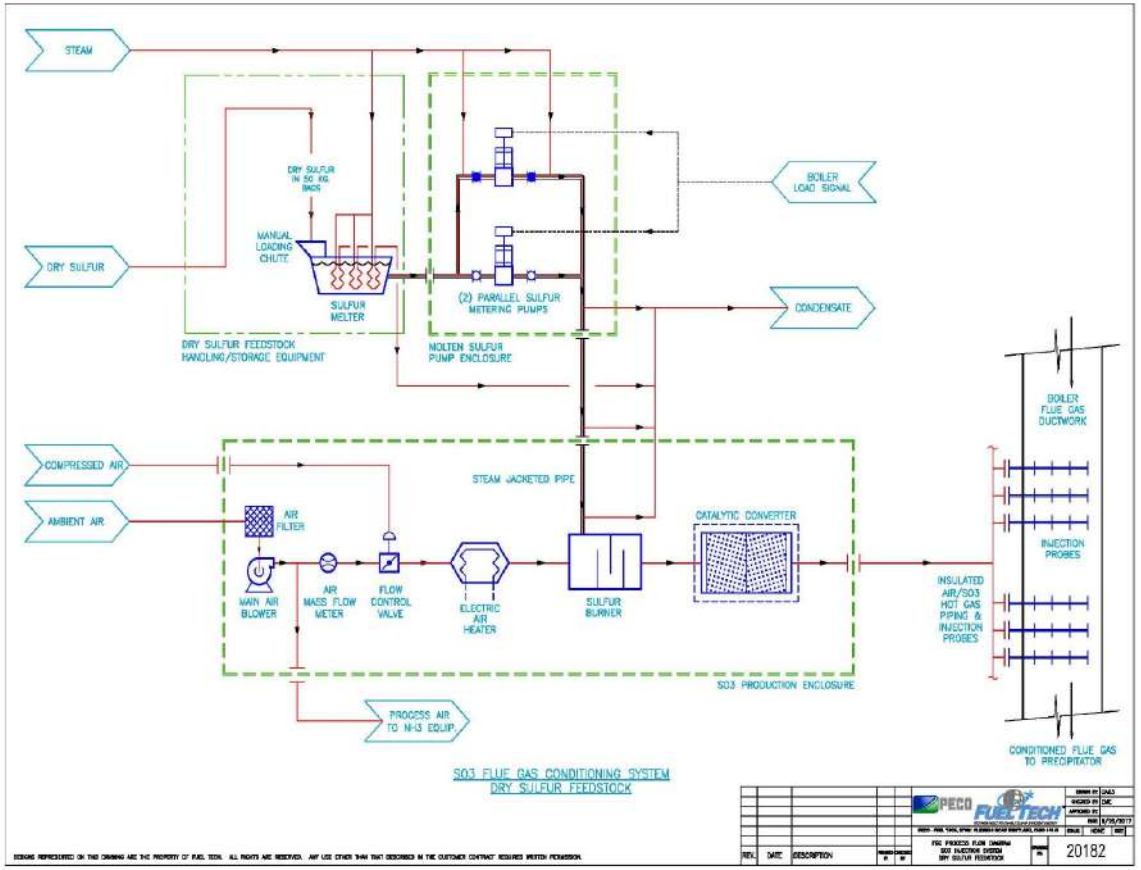
Numerical **E**lectrostatic **P**recipitator Performance Modeling Capability Incorporates Several Integral Parts:

- Coal and Ash Analysis Evaluation and Assessment
- Combustion Calculations
- Fly Ash Resistivity Estimation and Evaluation
- Flue Gas Conditioning Application Assessment
  - SO_3 Requirement Evaluation
  - Dual Conditioning Application Assessment
- ESP Performance Simulation

HOW DUAL FLUE GAS CONDITIONING IS USED

On demand SO_3 Generation

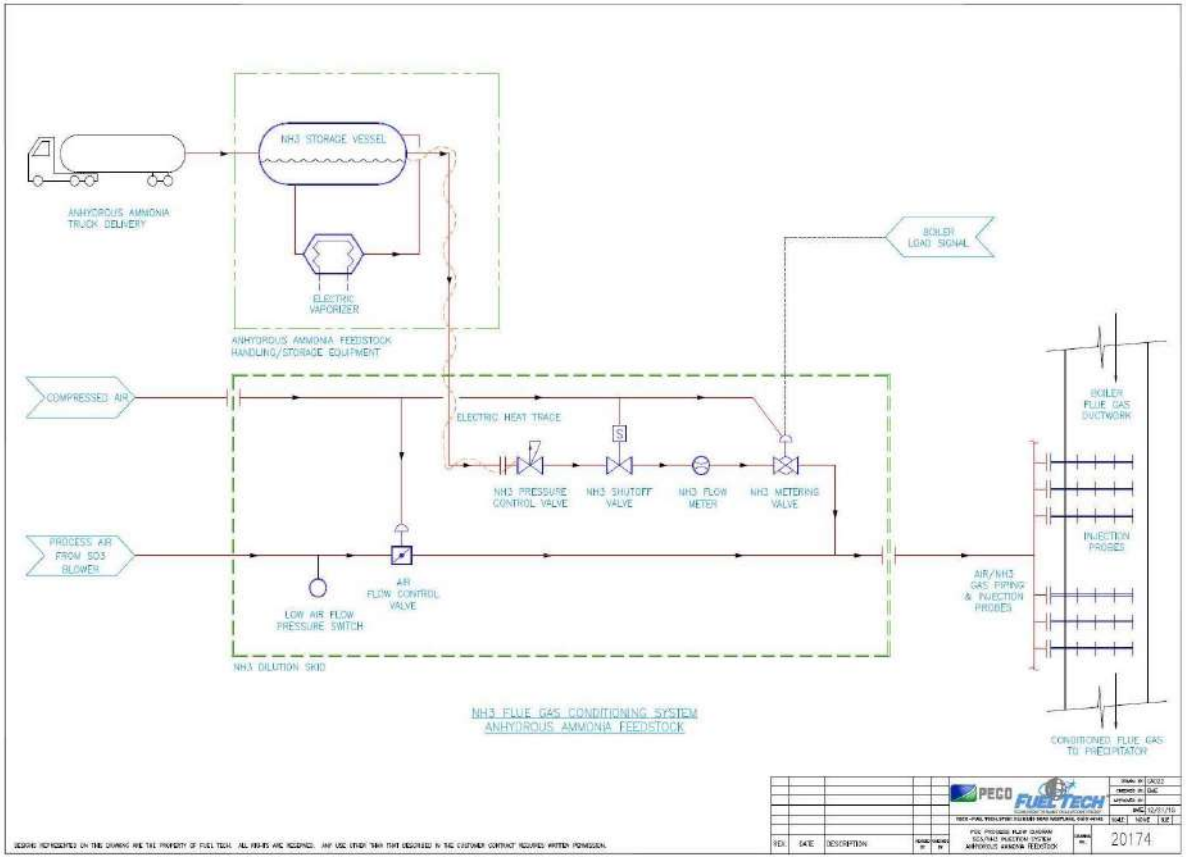
- Molten sulphur storage



HOW DUAL FLUE GAS CONDITIONING IS USED

Ammonia Injection

- Anhydrous ammonia storage
- Urea to Ammonia conversion as option for safer storage



PROOF OF HOW; CASE STUDIES FOR DUAL FLUE GAS CONDITIONING

740 Worldwide applications of SO3 FGC

40 Units totalling 25 GW Worldwide DFGC Installations

Inner Mongolia – Shenhua Zhungeer Power Station
SO3 FGC Application – 2 x 330 MW

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Confidential African Site
Dual FGC Application – 2 x Dryers

ZHUNGEER: ULTIMATE, PROXIMATE AND ASH ANALYSIS

Ultimate Analysis %	
Carbon	43.21
Hydrogen	3.42
Oxygen	10.55
Sulphur	0.43
Nitrogen	0.69
Water	10
Ash	31.7

Proximate Analysis %	
Fixed Carbon	17
Volatiles	40.87
Sulphur	0.43
Moisture	10
Ash	31.7
CCV (kcal/kg)	3894

Ash Analysis %	
Li_2O	0.01
Na_2O	0.02
K_2O	0.43
MgO	0.23
CaO	1.36
Fe_2O_3	1.38
Al_2O_3	51.72
SiO_2	38.22
TiO_2	1.3
P_2O_5	0.035
SO_3	1.75

SHENHUA ZHUNGEER PROJECTED PERFORMANCE NO SO_3

	NEP Model No SO3	Test Avg. No SO3
Efficiency, %	99.66	99.64
Emissions, mg/Nm3, dry	84.54	84.59
Emissions, gr/scf, dry	0.0369	0.0369

SHENHUA ZHUNGEER PROJECTED PERFORMANCE WITH SO_3

	NEP Model w/ SO3	326 MW Test Avg. w/SO3	325 MW Test Avg. w/SO3
Efficiency, %	99.94	99.94	99.95
Emissions, mg/Nm3, dry	14.92	14.71	10.82
Emissions, gr/scf, dry	0.0065	0.0064	0.0047

SHENHUA ZHUNGEER PROJECTED PERFORMANCE DUAL FGC

	No FGC	SO3 FGC	Dual FGC	DGFC + HFPS
Efficiency, %	99.66	99.94	99.98	99.99
Emissions, mg/Nm3, dry	84.54	14.92	4.97	2.49
Emissions, gr/scf, dry	0.0369	0.0065	0.0022	0.0011

ADVANCED ESP PERFORMANCE ASSESSMENT – CONFIDENTIAL CLIENT

- Multinational mining corporation based in Southern Africa, specializing in the extraction, refining, and marketing of Platinum Group Metals (PGMs).
- Electrostatic precipitators (ESPs) used in four PGM ore concentrate dryer plants. These ESPs effectively capture particulate matter emitted during the smelting process.
- Client initially commissioned Numerical ESP Performance (NEP) modeling technique at a confidential industrial processing facility in Southern Africa.
- **Goal**: Improve emissions control and comply with national air quality standards.

METAL ORE CONCENTATE DRYER ESP's BASELINE

- **Initial Findings**:

  Baseline ESP efficiency

  - Concentrate Dryer ESP A is 99.945% efficient, emissions at 181.50 mg/Nm^3
  - Concentrate Dryer ESP B is 99.95% efficient, emissions at 162.50 mg/Nm^3

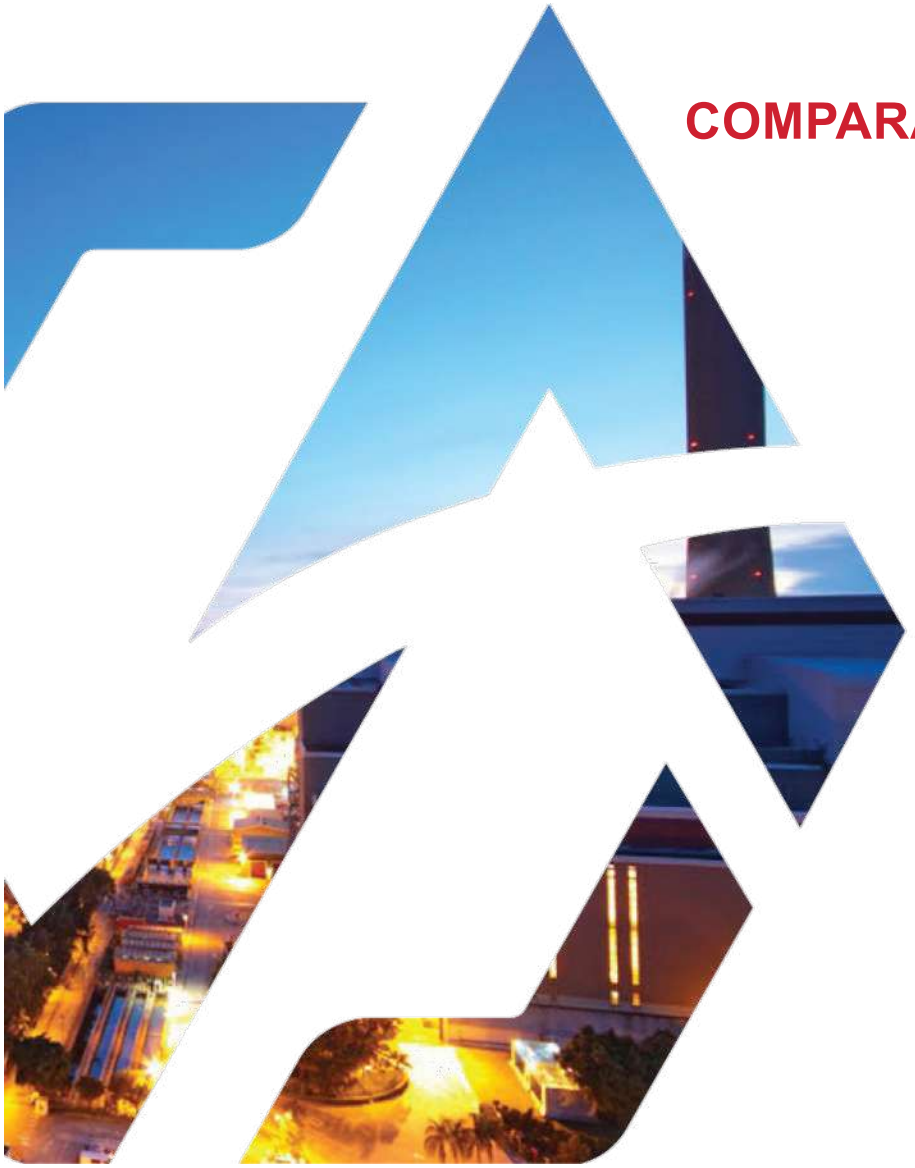
- **Highlight**:

  Current emission rates exceed the Minimum Emission Standards (MES) under South Africa's National Environmental Management: Air Quality Act, necessitating upgrades.

ESP BASELINE PERFRMANCE ASSESSMENT

Units A and B ESPs Projected Performance

Item	Concentrator Dryers A & B ESP Projected Performance							
FGC Operating Condition	Base w/o FGC		w/SO_3 FGC		w/Dual FGC		w/Dual FGC+HFPS	
Dryer	A	B	A	B	A	B	A	B
Efficiency, %	99.945	99.95	99.983	99.975	99.993	99.9925	99.995	99.9947
Emissions, mg/Nm³	181.50	162.50	56.10	81.25	23.10	24.37	16.50	17.23



COMPARATIVE IMPACT OF DFGC IMPLEMENTATION

Performance with DFGC:

Implementation of Dual FGC reduces emissions significantly to 23.10 mg/Nm^3 and 24.37 mg/Nm^3 for Dryer A and B, respectively.

Efficiency Gains: Improved efficiency metrics to 99.993% and 99.9925% post-DFGC for Dryer A and B respectively.

FUELTECH

LESEDI AND FUEL TECH CONCLUSIONS

Dual Flue Gas Conditioning can be retrofitted to existing ESP and Fabric Filter applications to lower emissions to new legislative standards.

The Lesedi and Fuel Tech partnership has:

- Extensive experience across
  - Multiple fuels
  - Diverse applications
  - Ability to scale up or down to the application
- Market Presence
- Ability to conduct audits
- Established Supply Chain

QUESTIONS?

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LESEDI AND FUEL TECH | CONTACT DETAILS

Lesedi Nuclear Services	Fuel Tech Inc.
www.lesedins.co.za	www.ftek.com

Kobus Griesel
General Manager: Gauteng
Lesedi Nuclear Services
River Falls Office Park, Bushwillow Building
262 Rose Avenue, Centurion 0157, Gauteng
South Africa
Office: +27 12 003 3835
Mobile: +27 83 789 9118
Email: Kobus.Griesel@Lesedins.co.za

LESEDI
ENERGY ENGINEERING

FUEL TECH
Technologies for clean air & pure water

Hanif M. Suchwani
Vice President International Operations
Fuel Tech, Inc.
27601 Bella Vista Parkway
Warrenville, IL 60555, USA
Office: +1 630 845 4498
Mobile: +1 847 977 0306
Email: hsuchwani@ftek.com

Piers de Havilland
Director Marketing & Business Development EWA
Fuel Tech Srl
Via Marsala 34/A,
21013 Gallarate (VA), Italy
Office: +39 0331 701 110
Mobile: +39 348 933 0380
Email: pdehavilland@ftek.com