

CatCracking Seminar
Düsseldorf, October 17-21, 2011

CatCracking.com

Tracerco
Providing Insight Onsite

**Online, Non-intrusive Trouble Shooting and Process Characterization of
FCCU's using Gamma Ray and Tracer Technology**

Presented by:
Lee Robins and Andrew Shaw


Johnson Matthey

- **Introduction to Tracerco Process Diagnostics™**
- **The Technology**
- **Applications of the Technology for FCC Diagnostics**
- **Case Studies**
- **Conclusion and Questions**

Tracerco, who are we?



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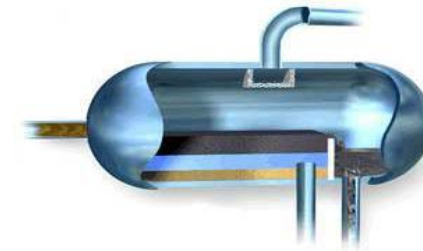
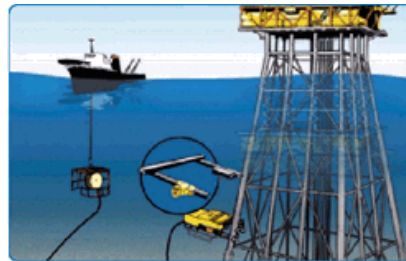
Tracerco: Part of Johnson Matthey Plc ...leaders in environmental catalytic solutions, precious metals and process technology

- Founded in London almost 200 years ago
- Publicly listed FTSE 100 Company
- Turnover excess \$10bn
- 10,000 employees in 50 countries



Upstream Oil & Gas - Reservoir to Refinery

- Separator Studies
- Flow Assurance
- Pig Tracking
- Integrity Assessment
- Flow Rate Studies



Downstream Industry – Refineries to Polymers

- Distillation Column Studies
- Reactor system trouble shooting & vessel inspection
- Heat Exchanger Leak Test
- FCC Unit Studies
- Flow Assurance
- Integrity Assessment
- Pipeline Assurance



Tracerco – Global Support



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**World leading technology specialists in radioisotope technology,
chemical tracers, measurement & instrumentation**

R&D Centre at HQ plus science institutes worldwide

350+ qualified scientists, engineers and technologists

Winner Queen's Award for Enterprise: Innovation 2003 and 2009

Winner Queen's Award for Enterprise: International Trade 2005

ISO 9001:2000 certified

SCC 2006 certified



HQ - Billingham, UK, Aberdeen (Scotland)

Argentina – Buenos Aires

Australia – Perth

Azerbaijan – Baku

Brazil – Rio de Janeiro

Belgium – Brussels

Canada – Sarnia, ON; Edmonton, AB

Germany – Oldenburg

Indonesia – Jakarta

Italy – Vaprio d'Adda (MI)

Malaysia – Kuala Lumpur

Netherlands – Rotterdam

Norway – Bergen

Singapore

Thailand – Bangkok

USA – Pasadena, TX; Corpus Christi, TX; Fresno, CA; West Valley City, UT; Merrillville, IN; Newark, DE; Baton Rouge, LA

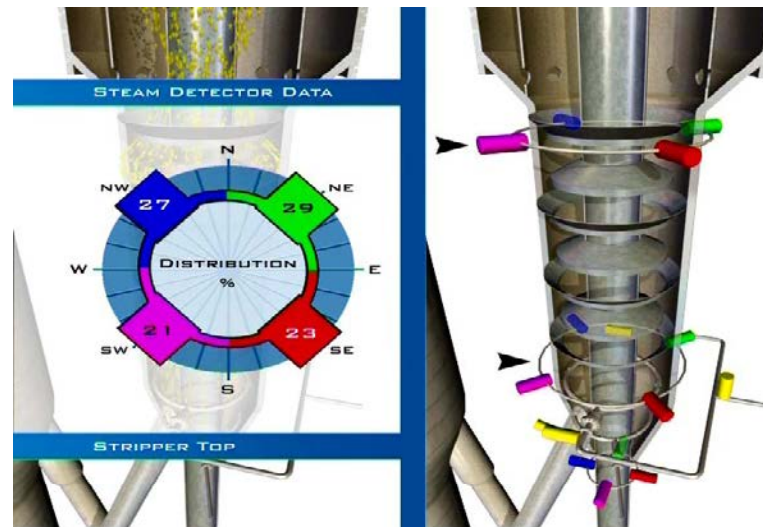


Tracerco Offices

Agency Offices

Pioneers in radioisotope science...

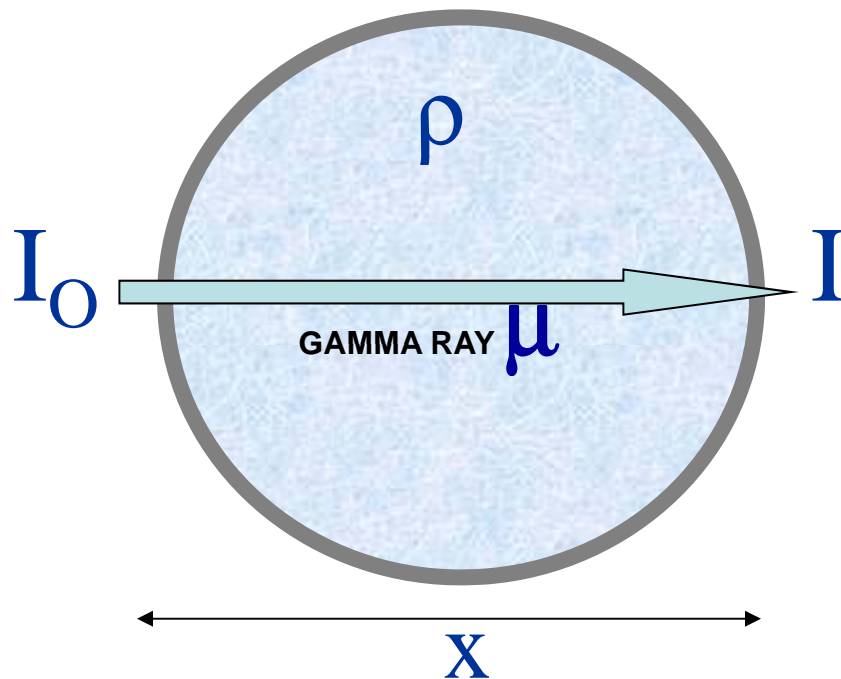
- Provide diagnostic scanning technology, tracer services, and specialist nucleonic instrumentation to the Oil, Gas and Process Industries to enhance process plant performance
- Experts at seeing inside process plant to verify real time process conditions and equipment integrity - Online and non-intrusive : *Insight Onsite*



The Technology – Gamma Ray Scan

- **Gamma Scanning** using sources and detectors to non-intrusively scan through vessels and pipelines for density and thickness integrity measurements

$$I = I_0 e^{-\mu \rho x}$$

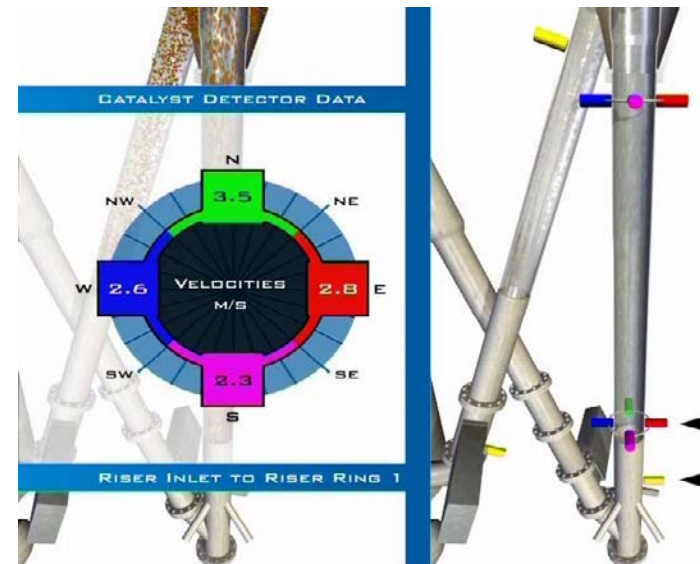
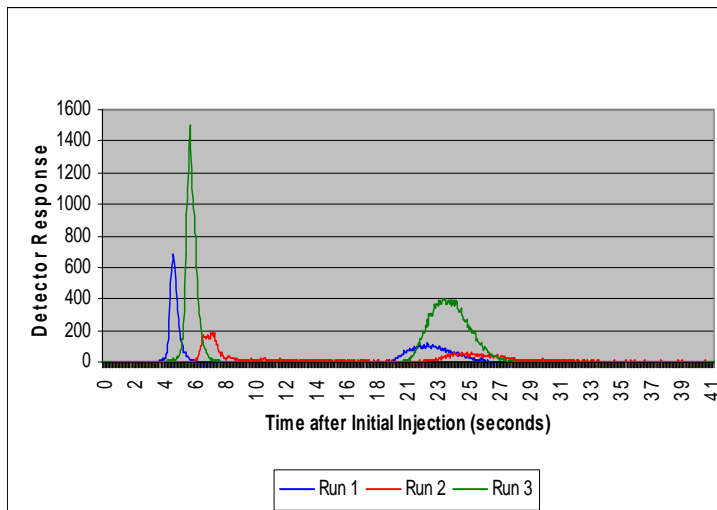


The Technology – Tracer Injection



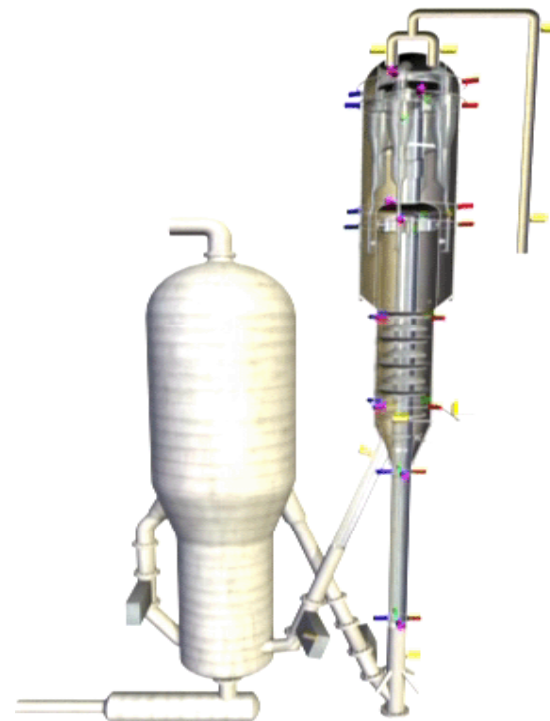
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- **Tracer Injection** using Unsealed Isotopes for tracking the different phases present in a particular process
 - Gas, liquid, or solid form (individually measure hydrocarbon, steam and catalyst)
 - Follows process material into which it is injected
 - Monitored by externally mounted detectors
 - Process parameters can be measured



*Improving profitability, increasing yields and reducing downtime are all key parameters for any FCCU. **Tracerco Diagnostic Solutions** are the only techniques available to effectively 'look inside' a working FCCU to accurately measure:*

- feed and catalyst distribution in the riser feed zone
- catalyst and vapour traffic velocities and slip through the riser
- determination of efficiency of the riser termination device
- flow distribution through the reactor and stripper
- cyclone distribution/operating characteristics
- reactor/stripper residence times

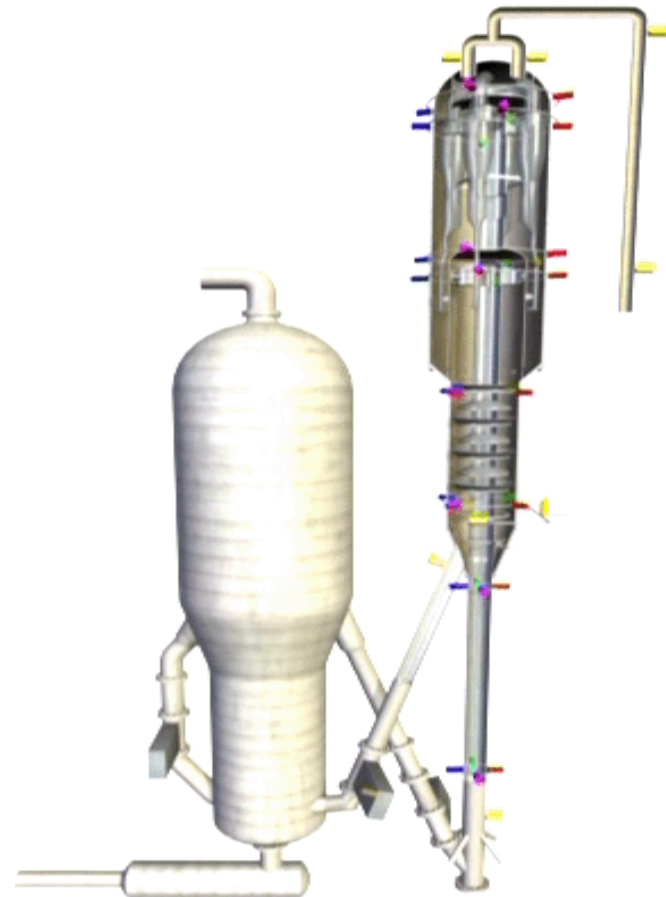


Technology used in 5 key sections of FCC unit:

- Riser
- Disengagement Chamber
- Stripper
- Regenerator
- Stand-pipe



- **When is the technology used?**
 - Trouble-shooting exercises
 - Fast response
 - Process optimisation trials
 - Immediate results
 - Pre-shutdown investigations
 - No effect on process
 - Commissioning trials

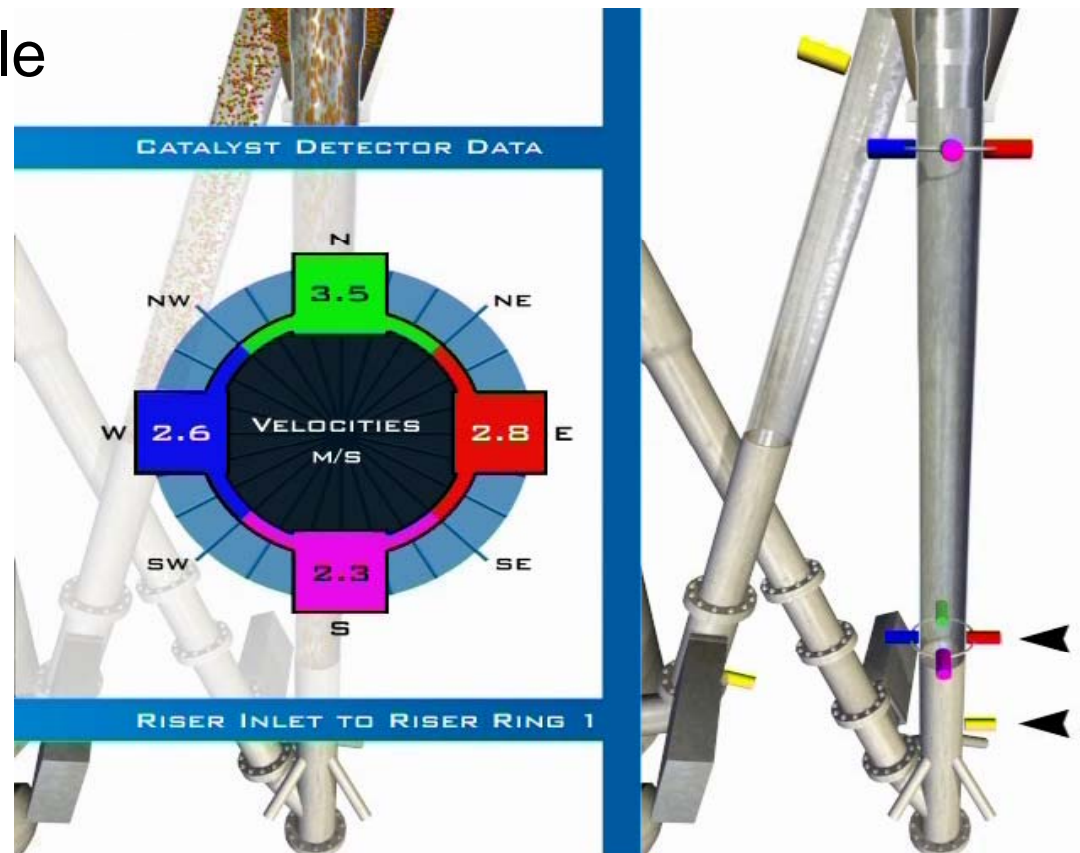


Benefits

- Minimise shut down time
- Increase production capacity
- Reduce operating costs
 - Minimise raw materials
 - Reduce utilities
 - Identify catalyst losses

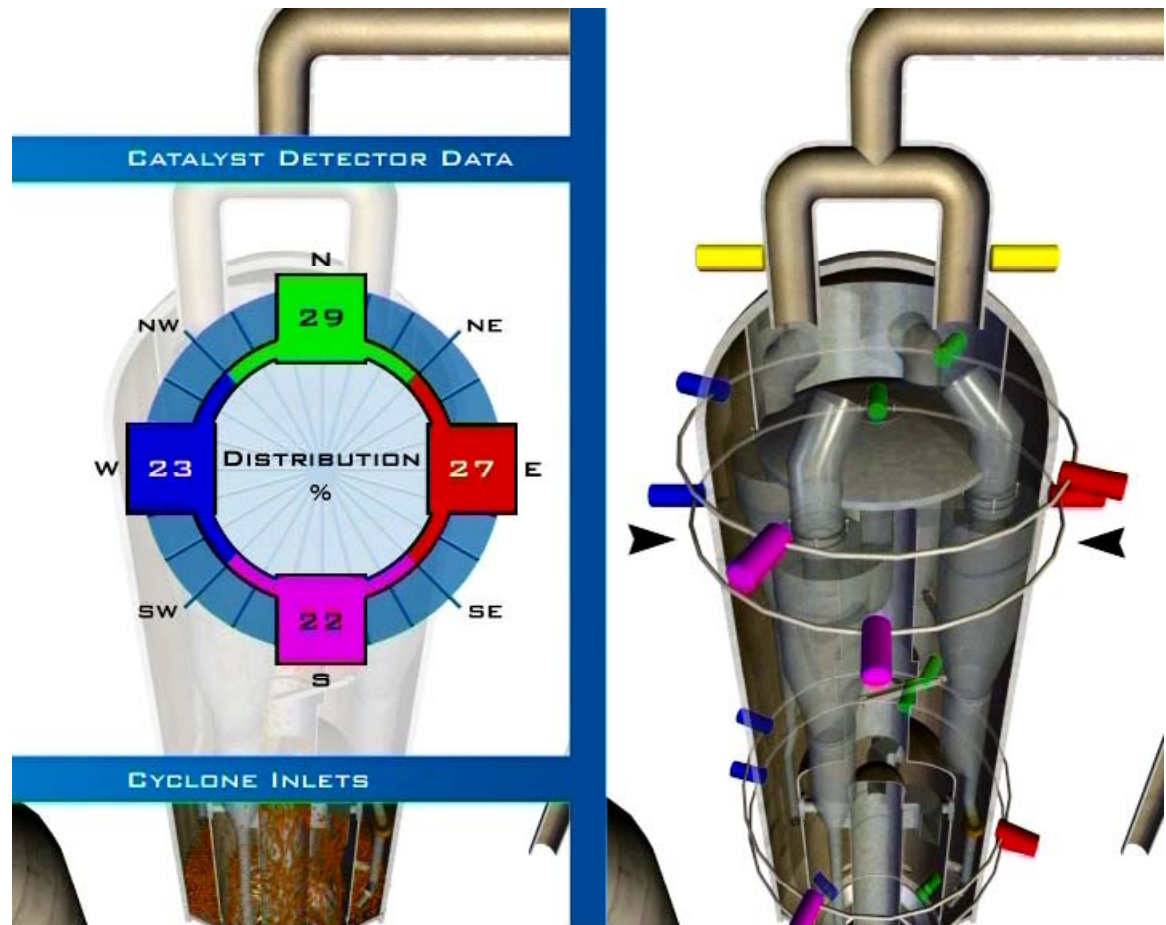


- Catalyst Density Profile
- Coke Deposits
- Velocity - slip ratios
- Residence times
- Distribution of feed, steam & catalyst



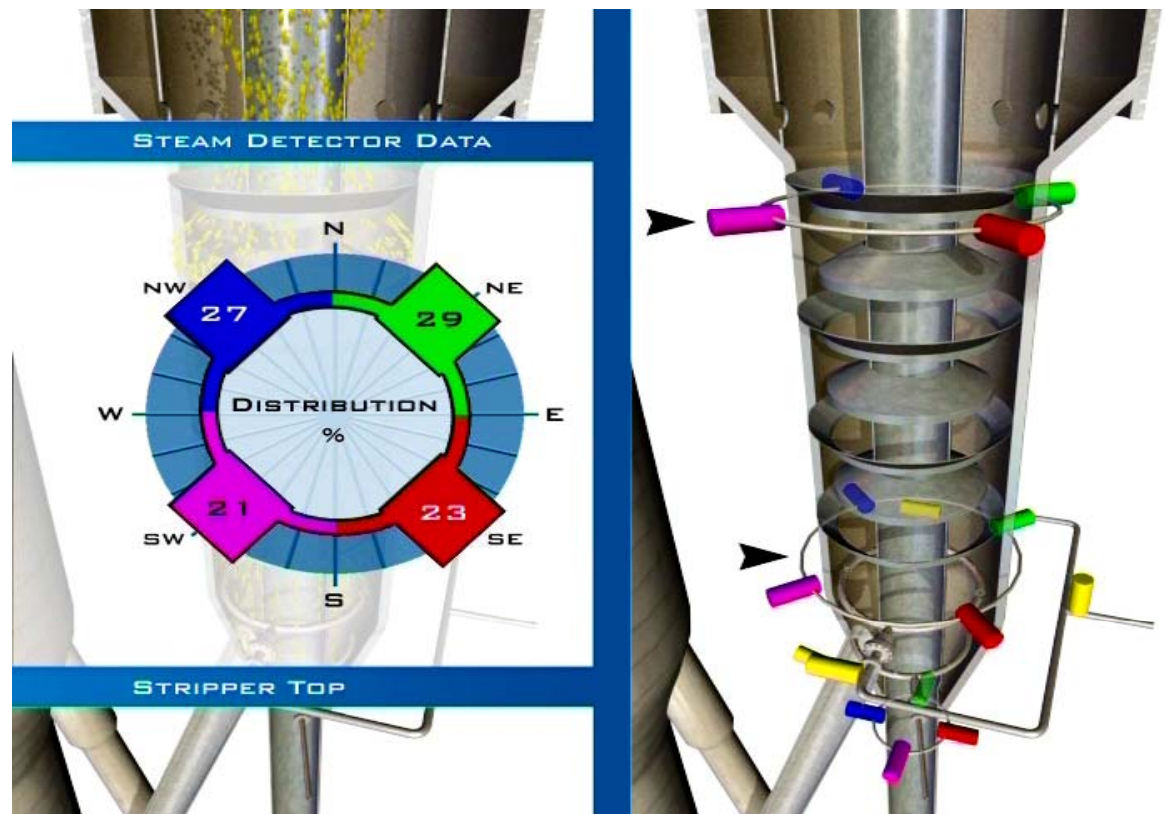
Applications – Cyclones and Disengagement Chamber

- Residence times
- Distribution
- Cyclone blockages
- Cyclone efficiency
- Vapour underflow
- Carryover



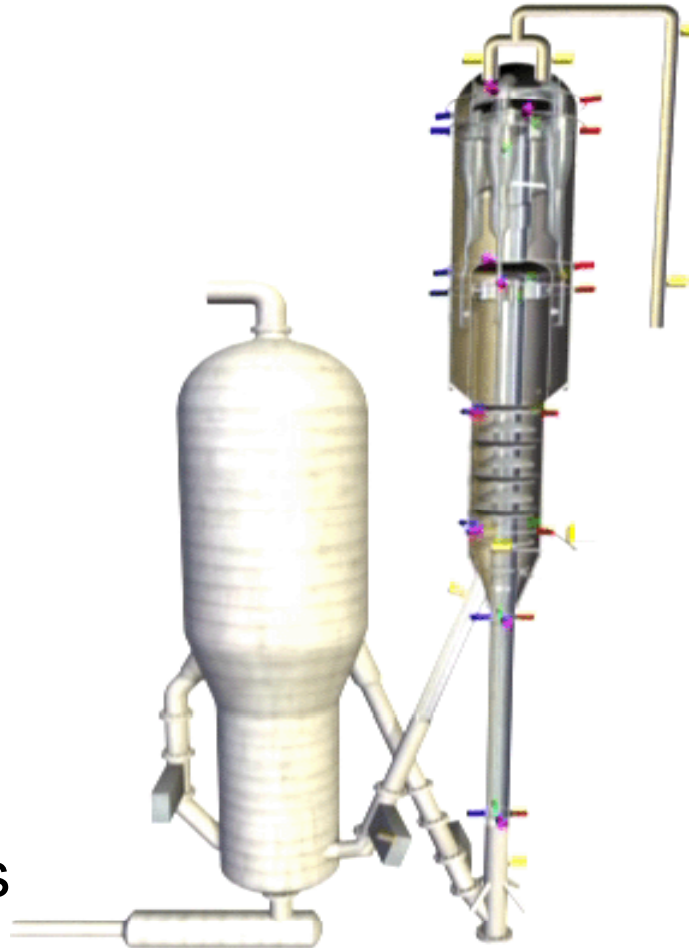
Applications – Stripper Section

- Residence times
- Velocities
- Distribution
- Steam underflow
- Catalyst Bed Level
- Dip-Leg Catalyst Levels



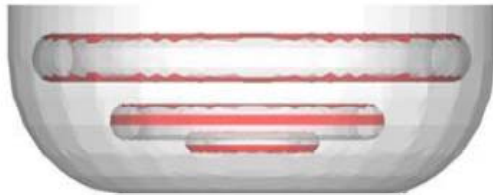
Applications – Regenerator and Stand Pipe

- Air distribution
- Cyclone efficiency
- Catalyst distribution
- Carryover
- Stratification of catalyst
- Slugging
- Catalyst Flow Patterns
- Catalyst Density Profiles

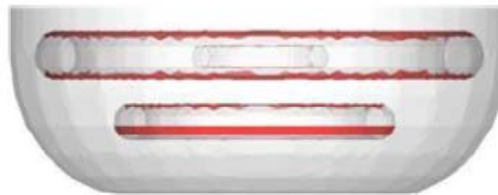


CFD vs Real time data

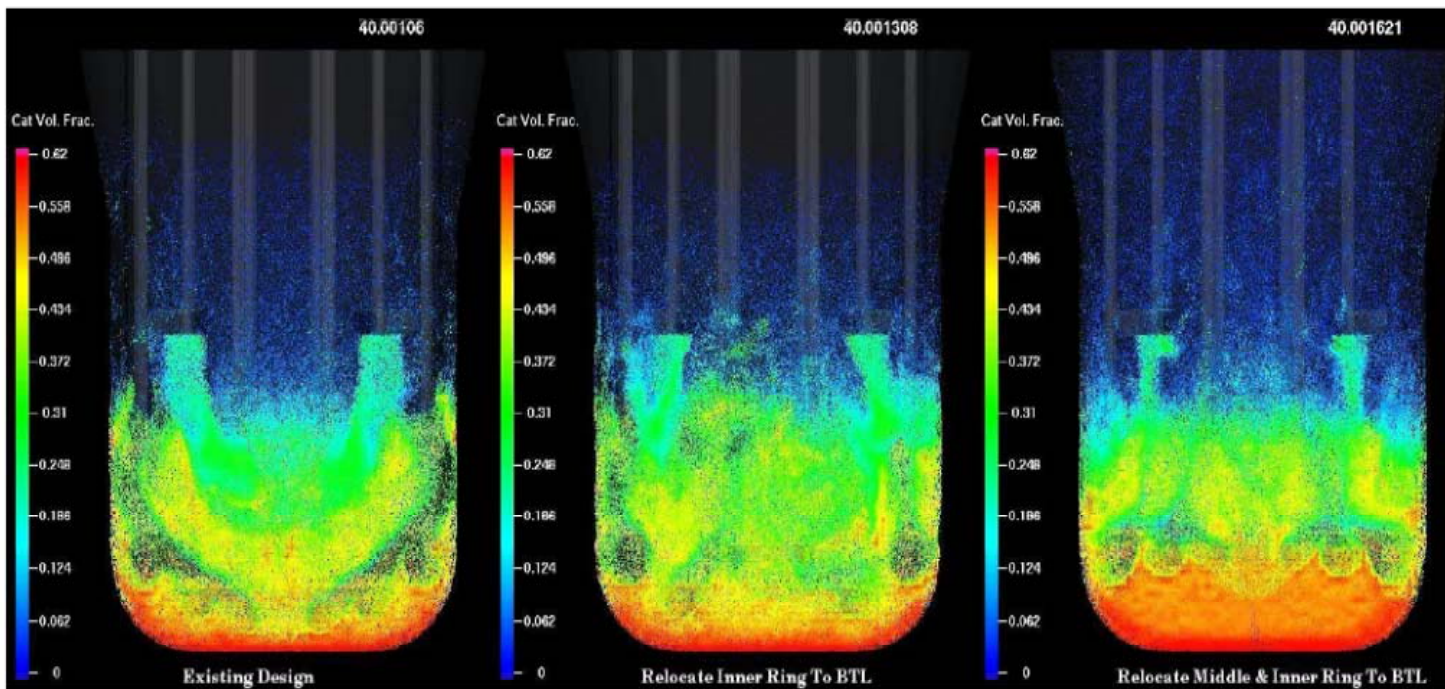
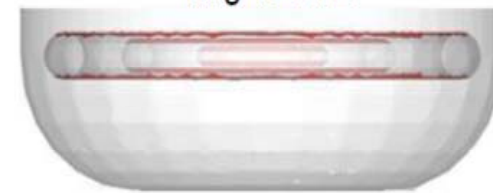
Staggered ring



Relocate inner ring to BTL



Relocate middle and inner ring To BTL

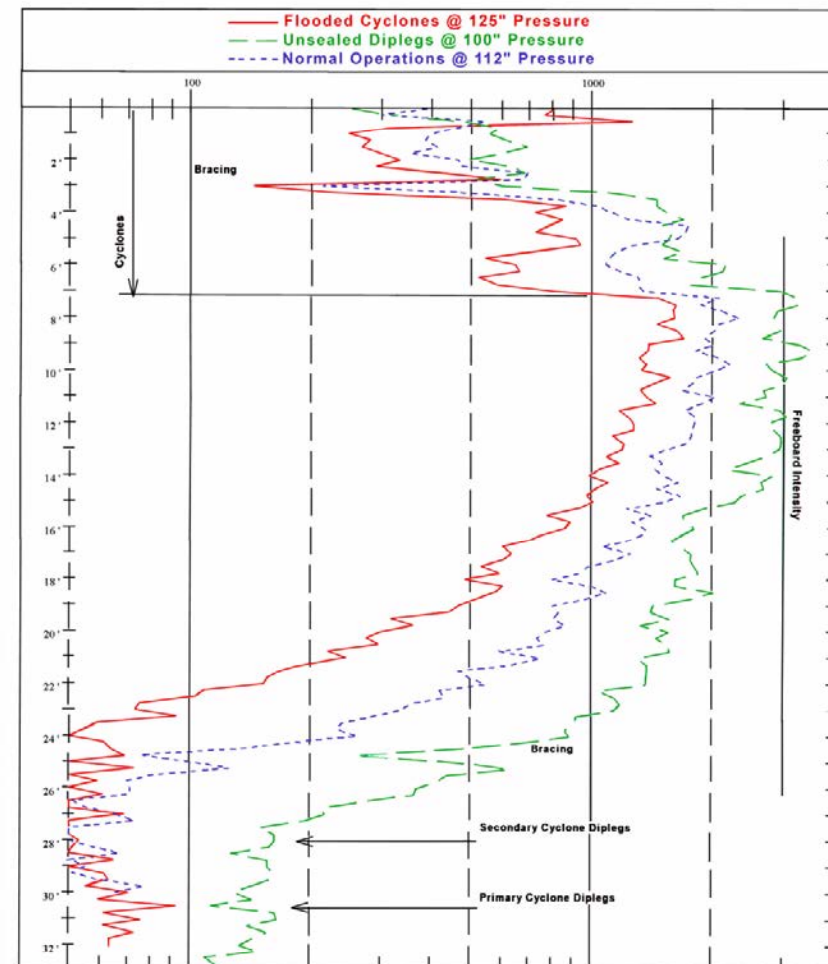


Case Studies – Regenerator Bed Level Scans



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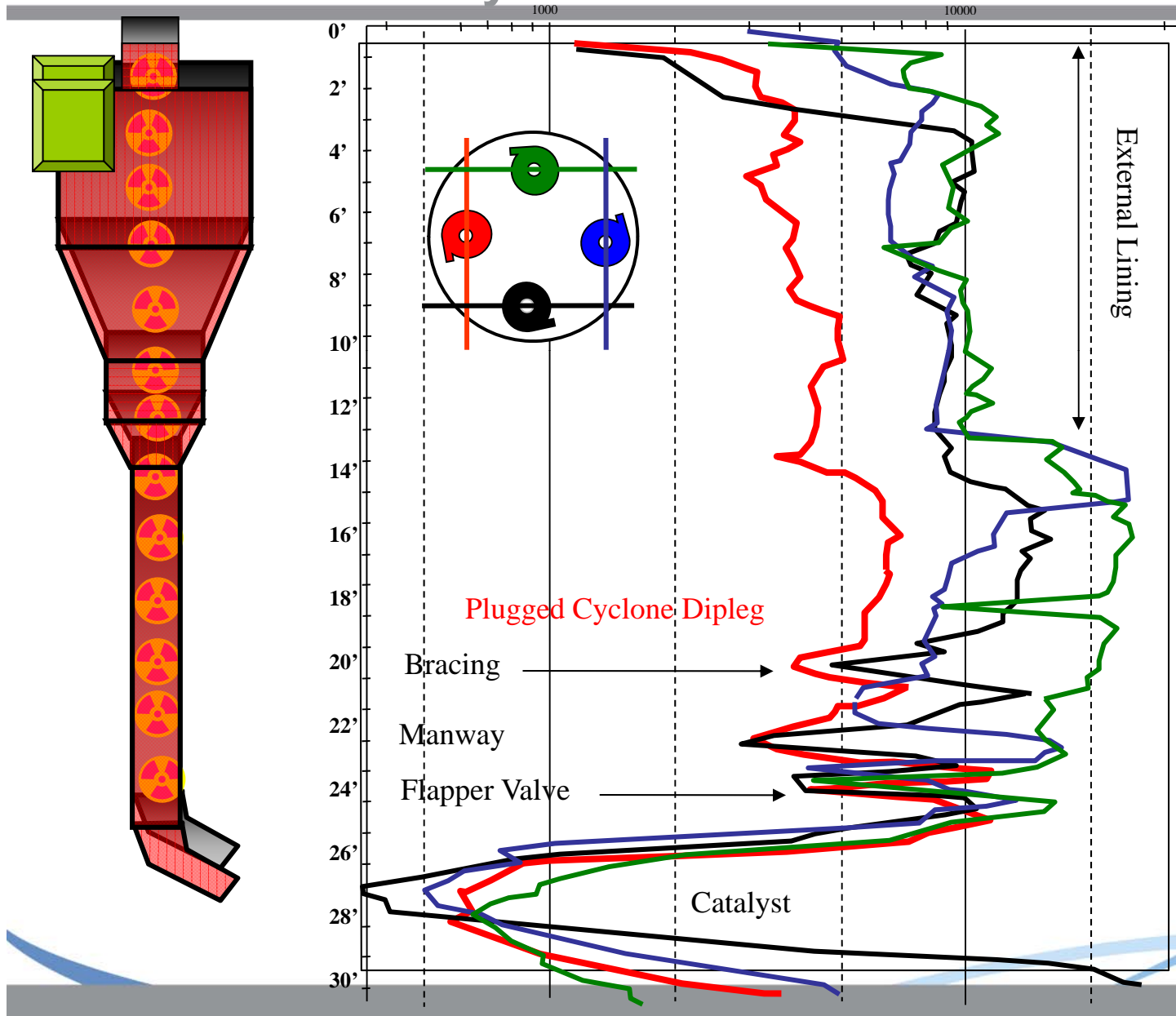
- Three different operating levels of the Regenerator
- Gamma Scan at each condition to optimize the bed level and reduce catalyst carryover.



Case Studies – Scan of Internal Cyclones to locate Blocked Cyclone

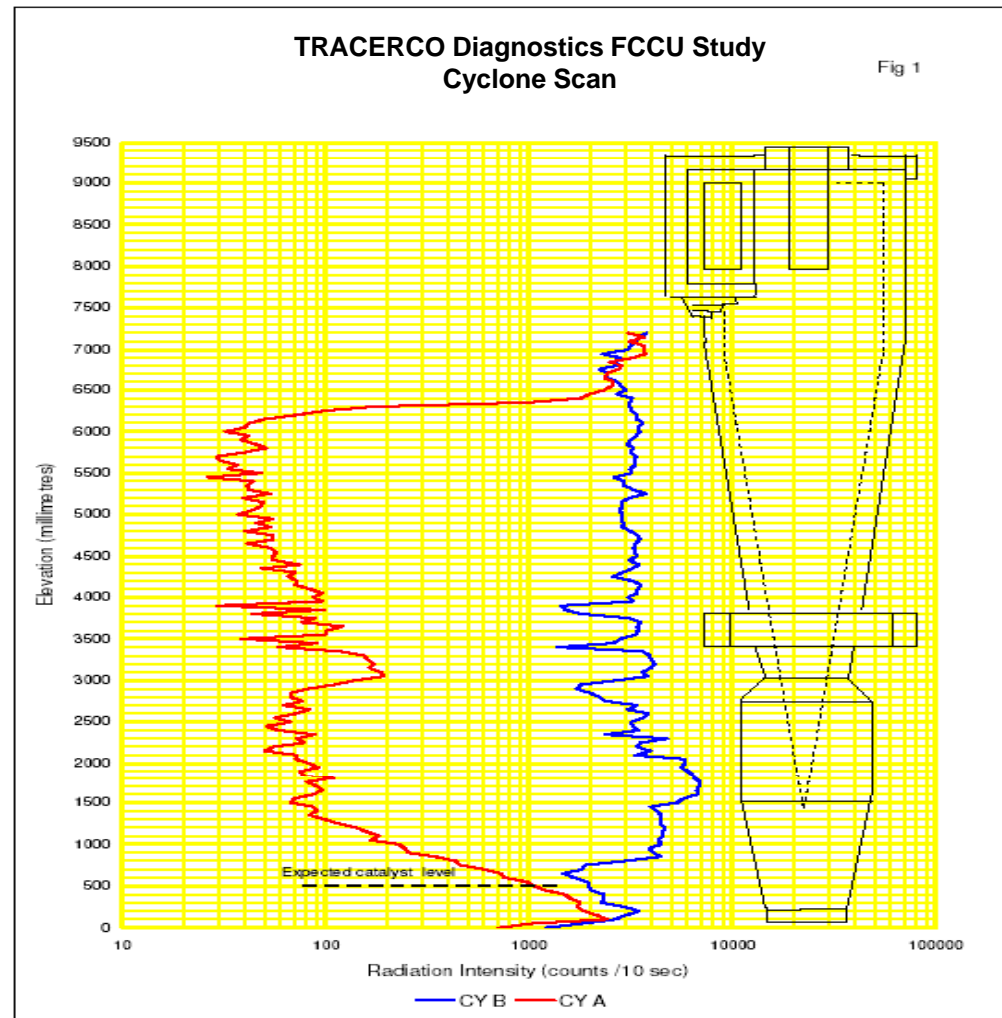


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Case Studies – Scan of Internal Cyclones to locate Blocked Cyclone – example 2

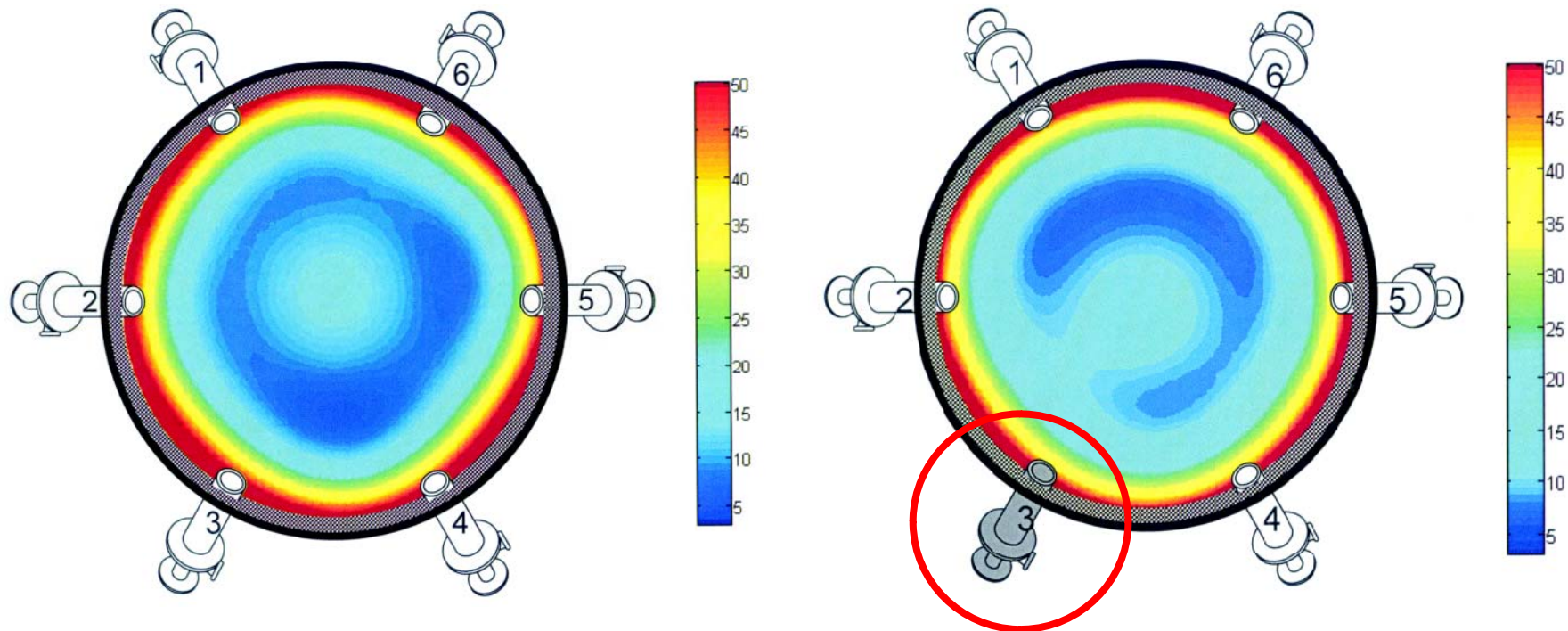
- Cyclone A was blocked.
- The blockage commenced at elevation 500mm, in the narrow part of the cyclone, but the catalyst had backed up to elevation 6300mm.
- Above elevation 6300mm, the blockage cleared and the scan profile from that point upwards is identical to that of Cyclone B.



Case Studies – Catalyst Distribution in Riser



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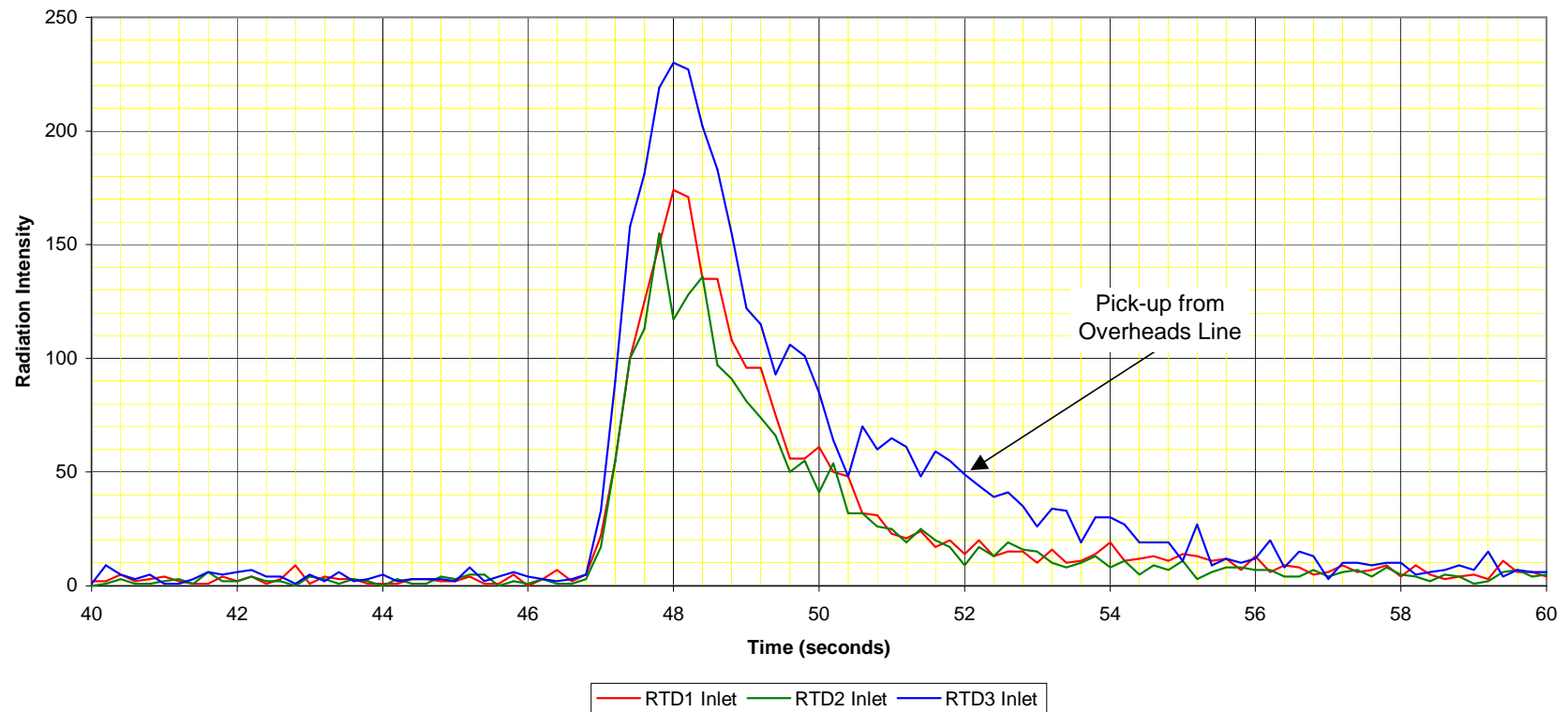


Case Studies (Tracer) - RTD Maldistribution



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TRACERCO Diagnostics FCCU Study
RTD Vapour Inlet Distribution

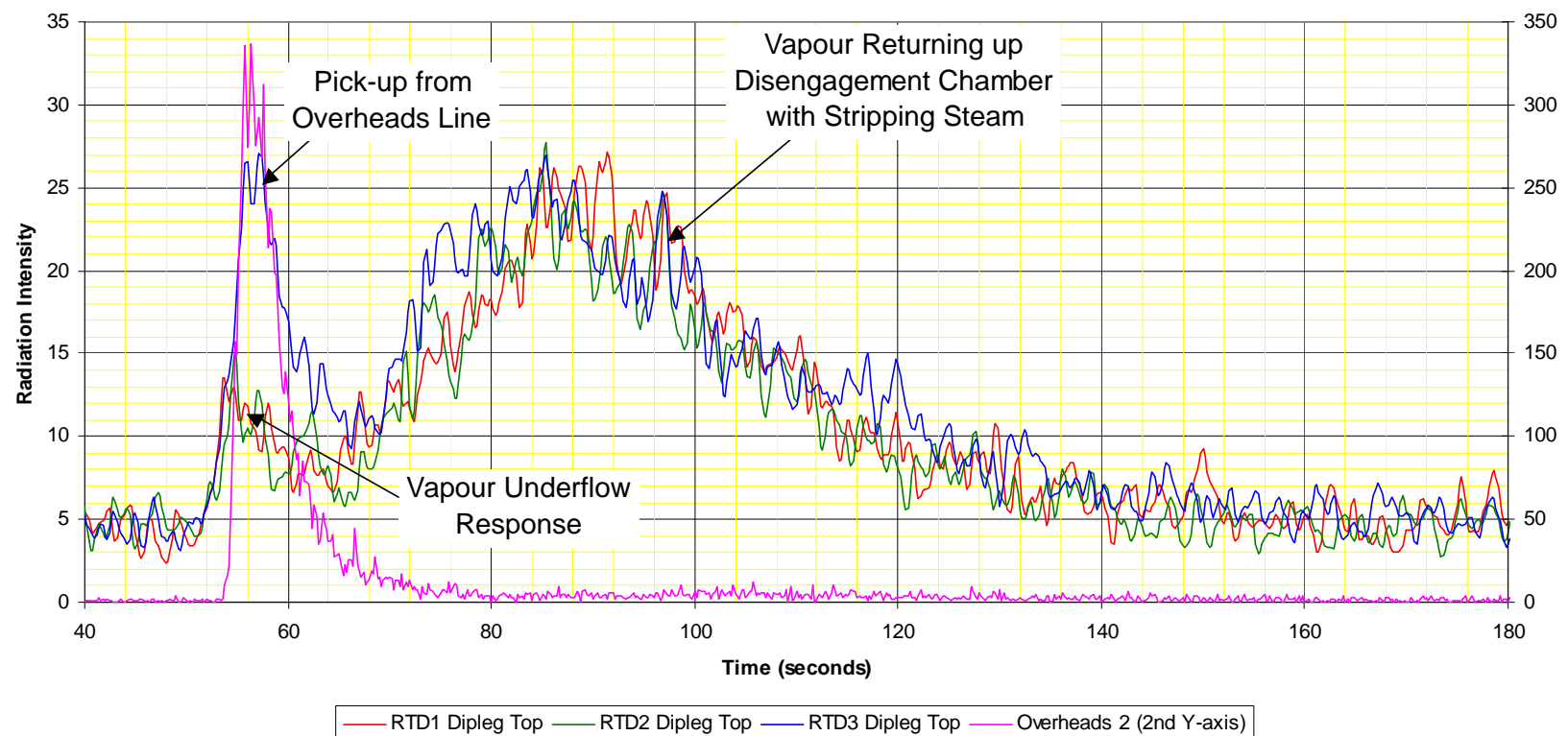


Case Studies (Tracer) – Vapour Underflow



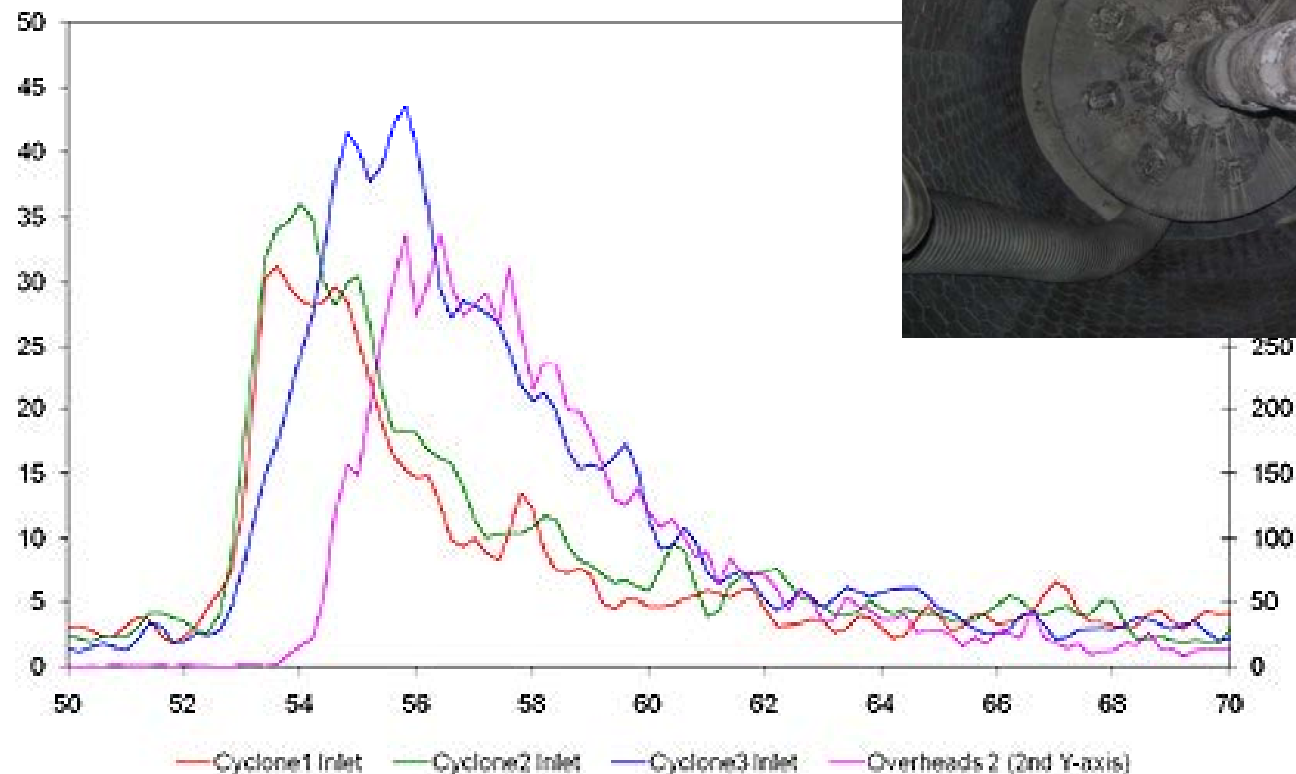
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TRACERCO Diagnostics FCCU Study
RTD Dip-leg Vapour Distribution



Case Studies (Tracer) – Cyclone Blockage

Results from distribution study

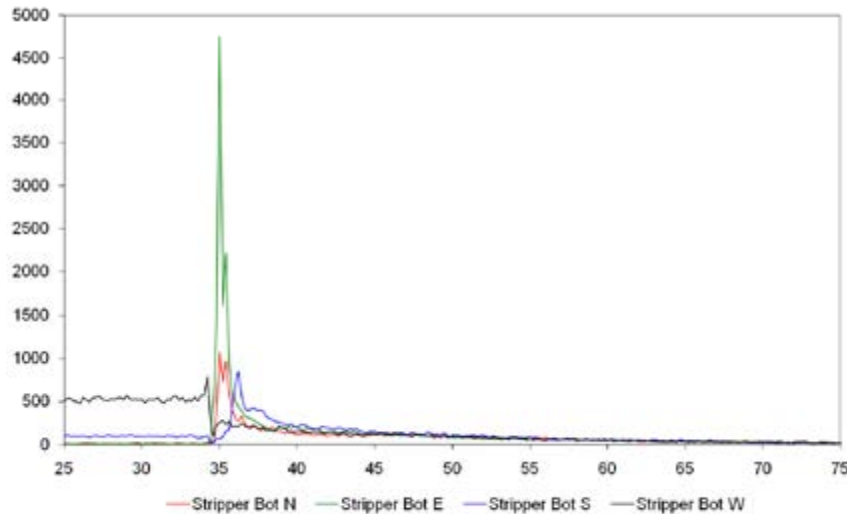


Case Studies (Tracer) – Stripper Maldistribution

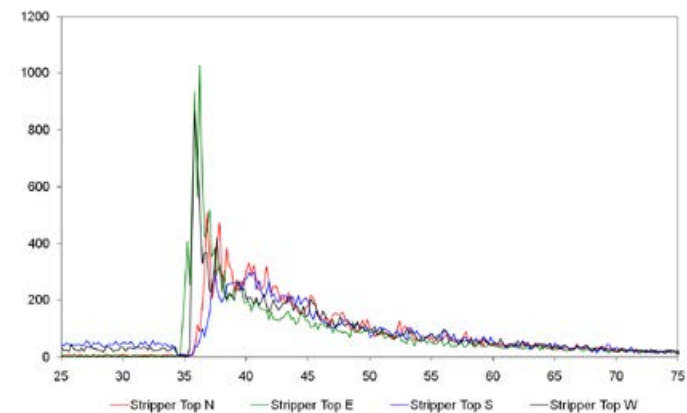


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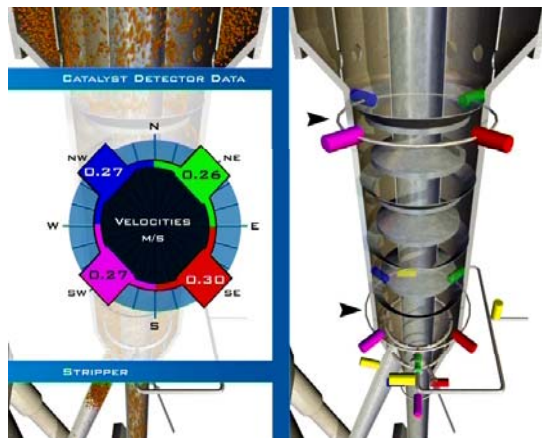
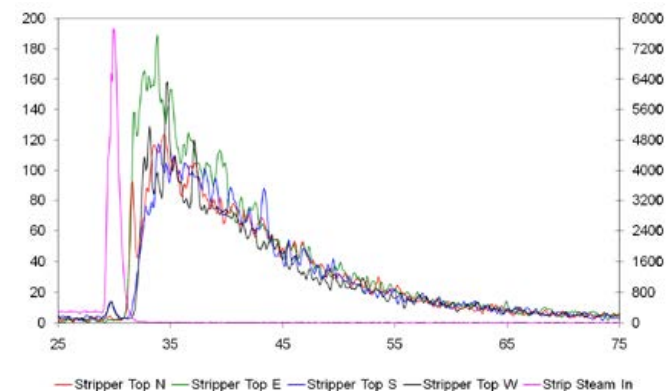
Gross maldistribution



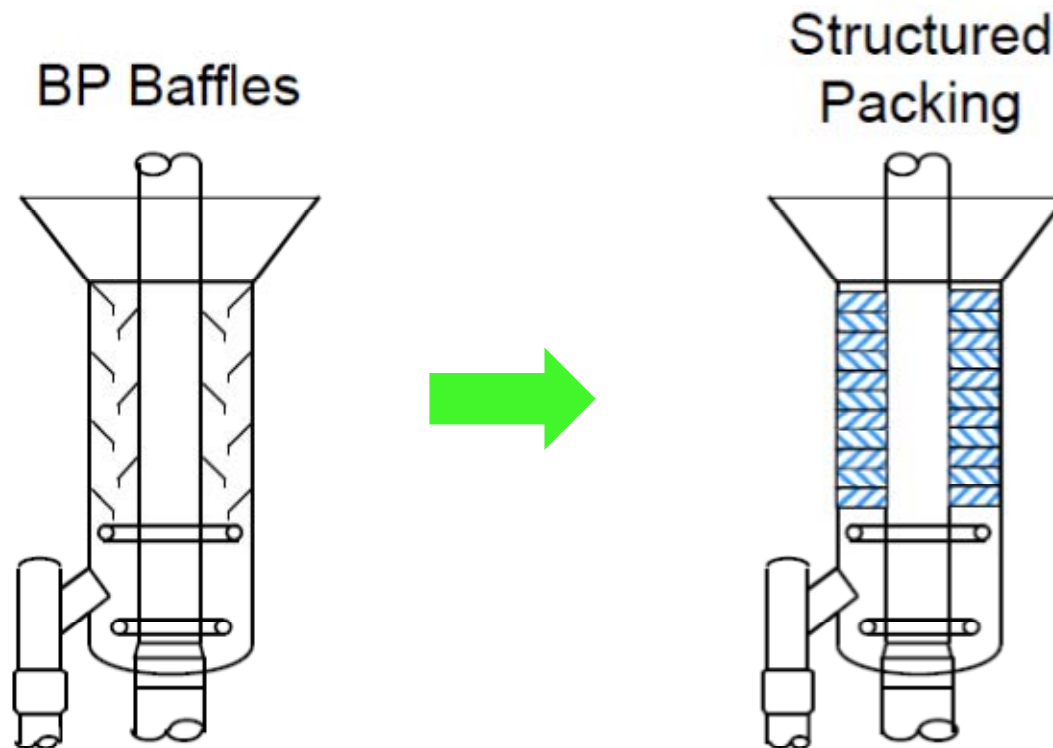
East/West maldistribution



East side maldistribution



Case Studies – Stripper Upgrade



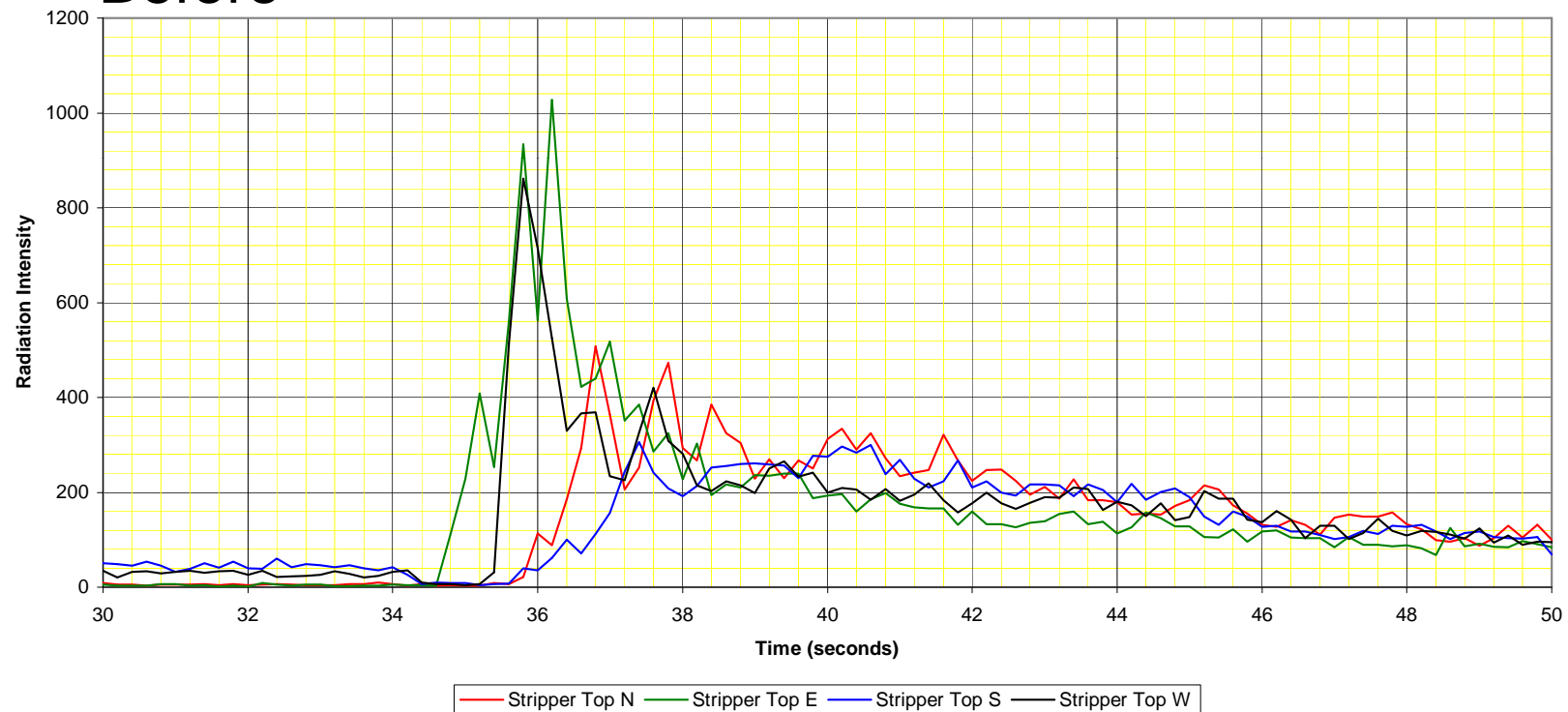
Case Studies (Tracer) – Stripper Maldistribution



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TRACERCO Diagnostics FCCU Study
Stripping Steam Distribution

Before

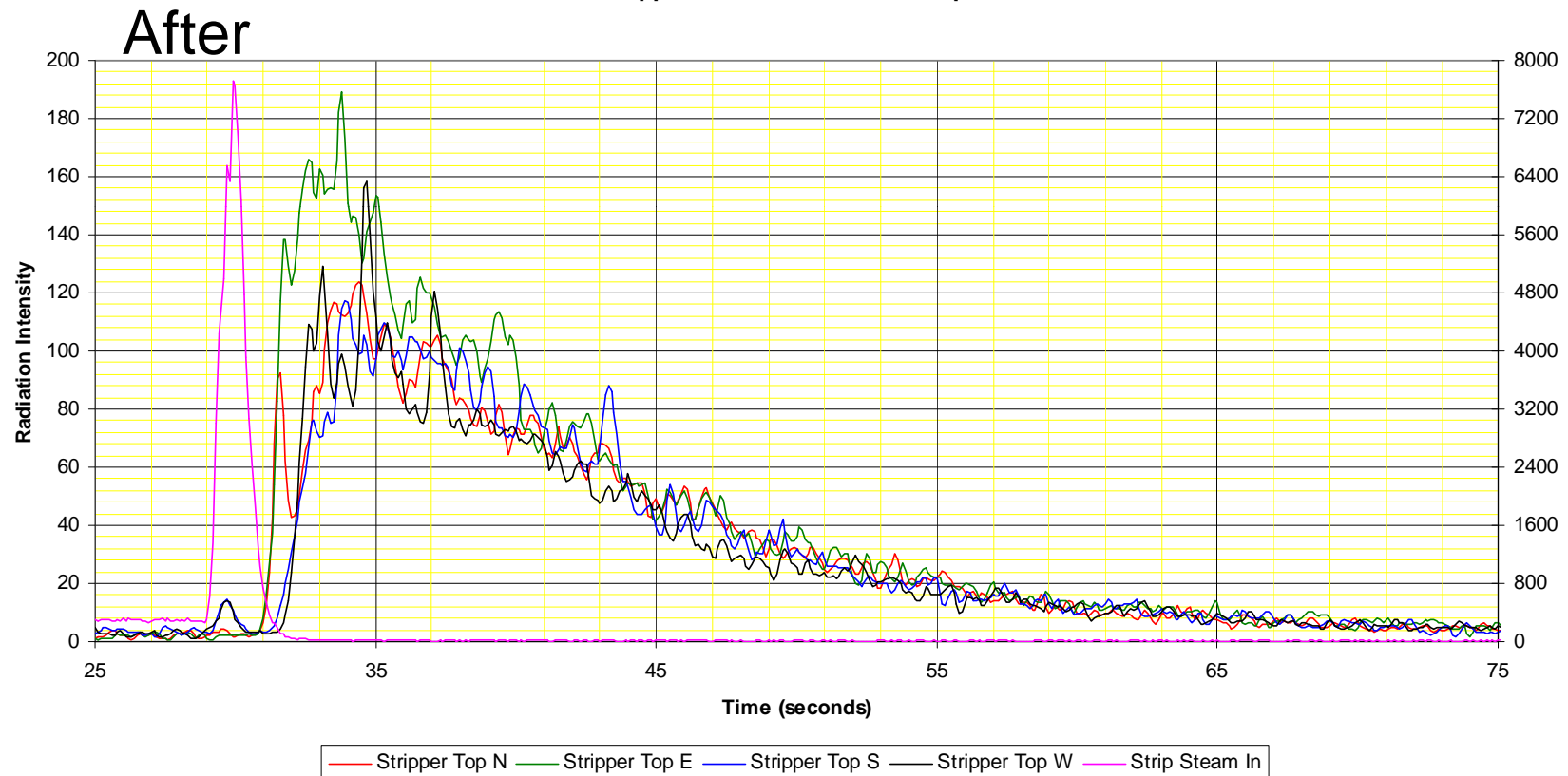


Case Studies (Tracer) – Stripper Maldistribution

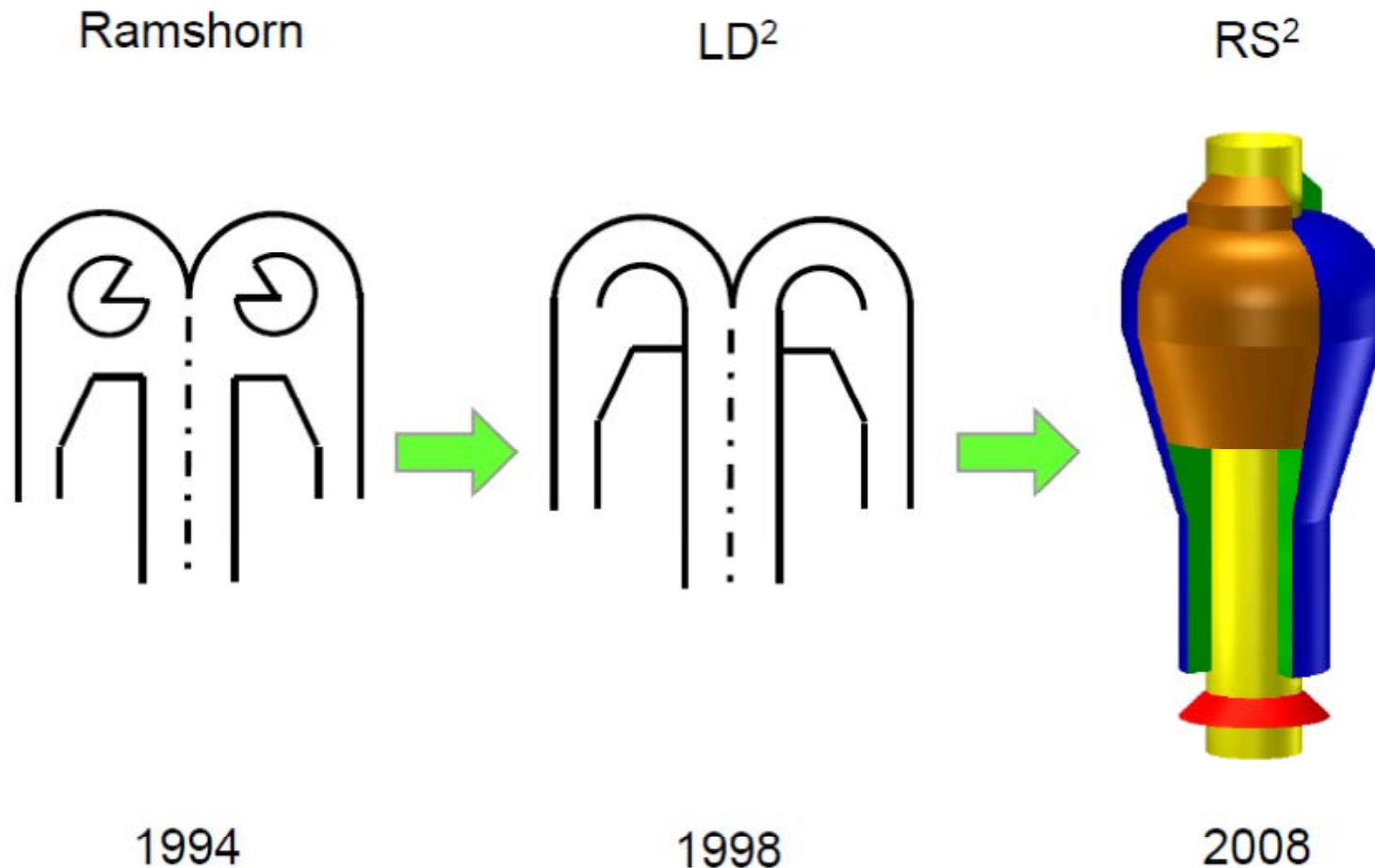


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TRACERCO Diagnostics FCCU Study
Stripper Steam Distribution - Top



Case Studies – Effectiveness of Equipment Upgrades (e.g. RTD's)

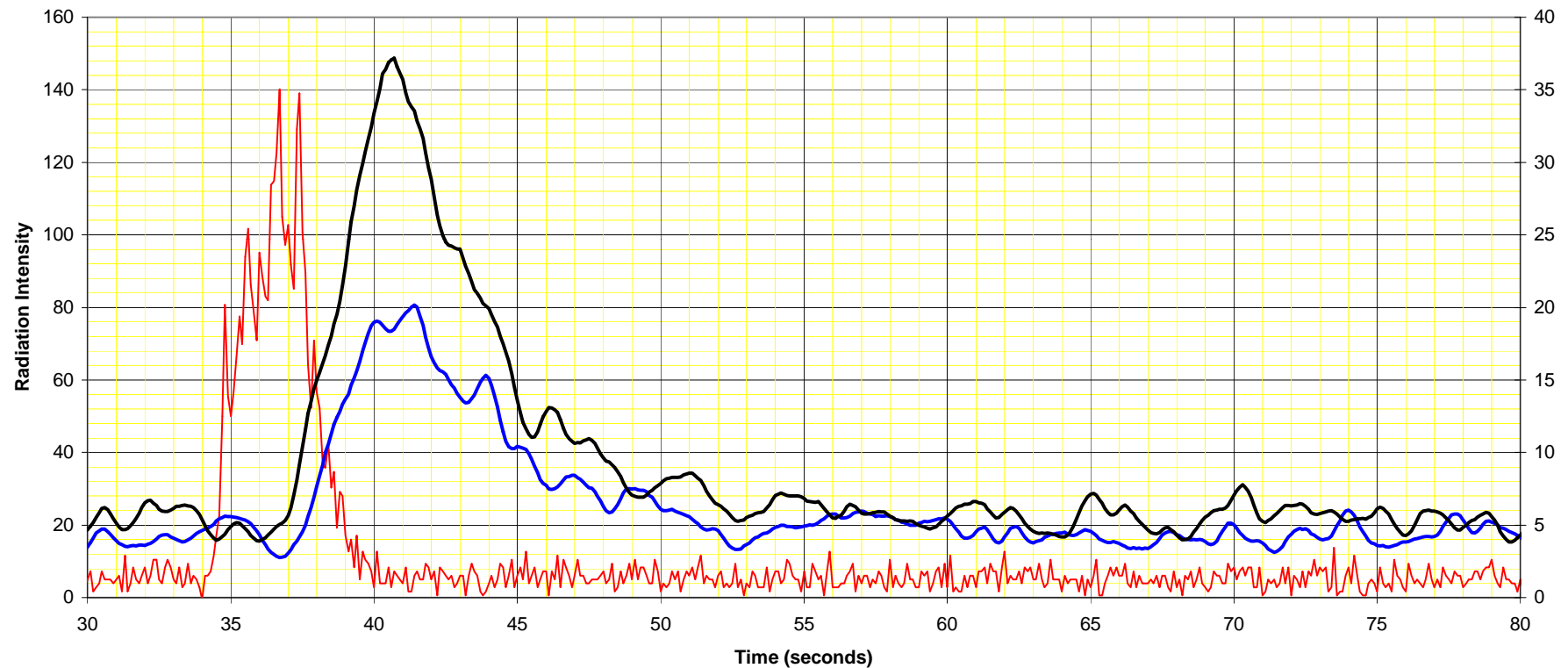


Case Studies (Tracer) – Vapour Maldistribution in Dip Legs



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Vapour Distribution in RTD Dip-Legs



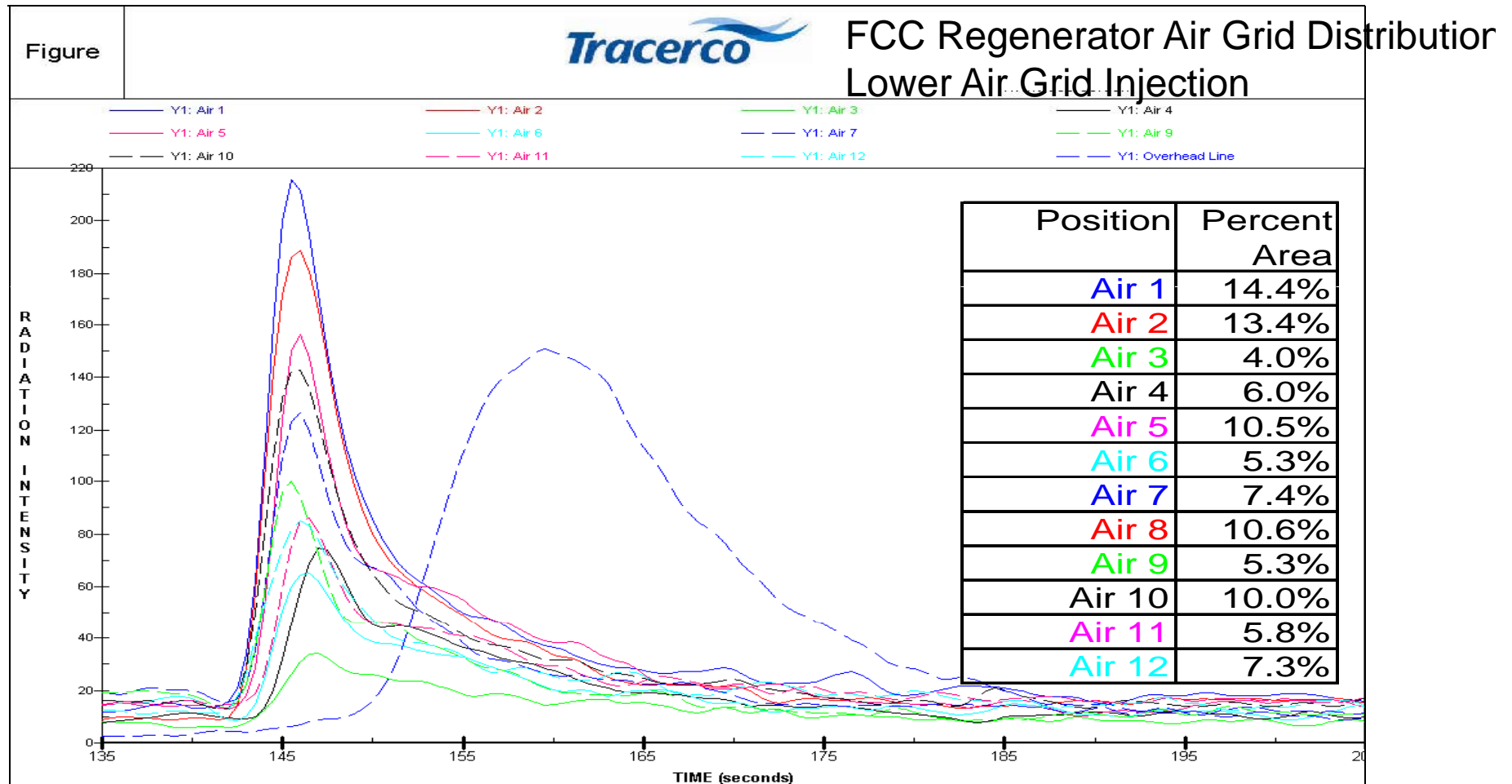
— Riser 1 — Dip-Leg Bot N — Dip Leg Bot S

Detector	Distribution
Dip-Leg Bottom North	40%
Dip Leg Bottom South	60%

Case Studies (Tracer) – Vapour Distribution Above Air Grids



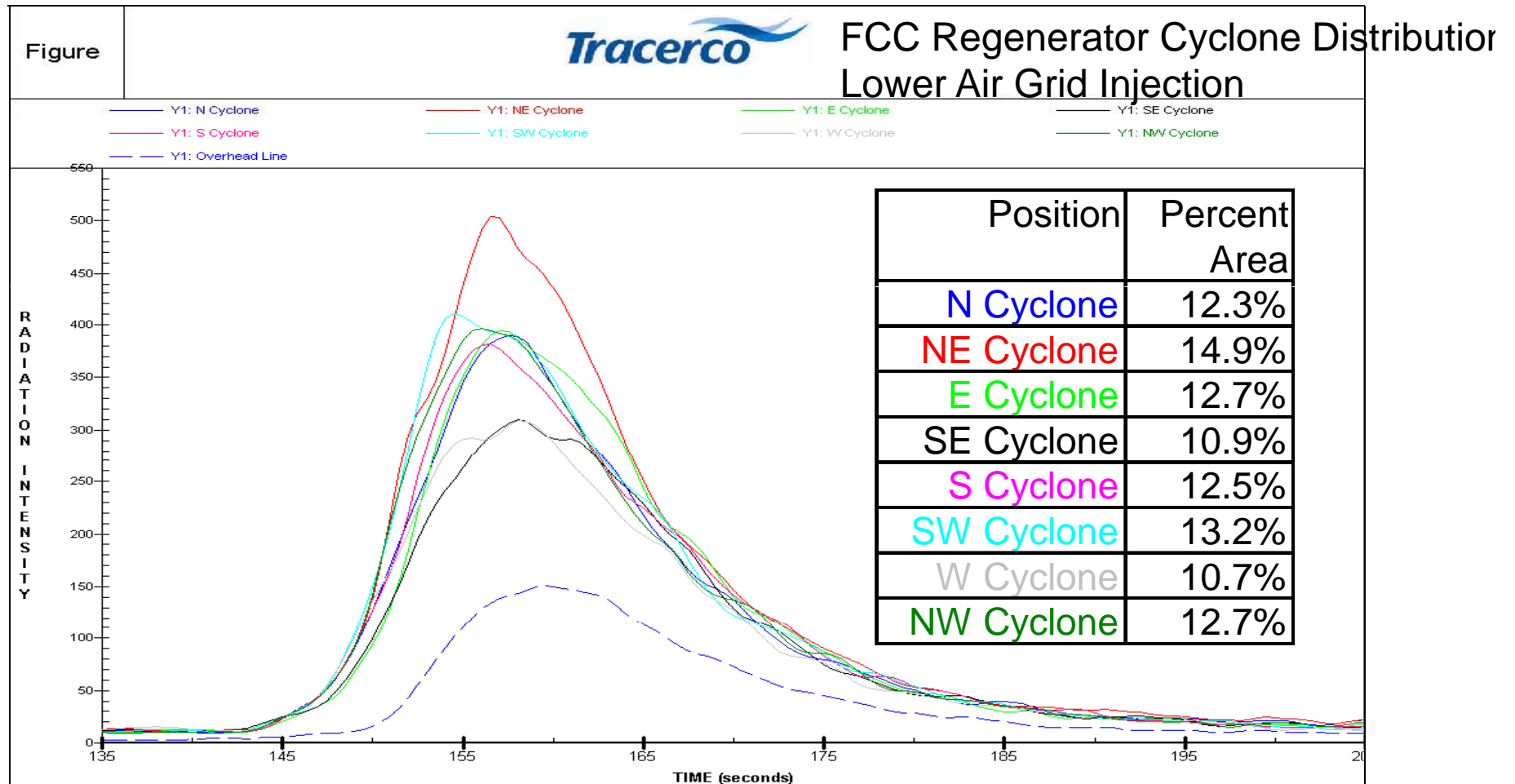
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Case Studies (Tracer) – Vapour Distribution Cyclone Inlets



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Example of Tracer Results - (Link to animation)

- Scanning and Tracer injection/detection are the only techniques that allow you to effectively 'look inside' your FCCU whilst in normal operating conditions.
- The perfect technology to:
 - Troubleshoot operating problems
 - Carry out a Process Optimisation Study
 - Plan a Turnaround more efficiently
 - Carry out a 'baseline' study of the unit during Commissioning or after a Turnaround
 - Measure Efficiency gains after a Retrofit
- CFD modelling has limitations. Tracerco measurement data can be used to complement/enhance CFD modelling for more accurate analysis.

Thank you and any Questions?

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