



Powertech

The Power of Trust. The Future of Energy.

On-Line Transformer Oil Purification

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Powertech Labs, Inc.



Powertech (a subsidiary of BC Hydro) is an independent, multi-disciplinary lab facility that provides specialized...

- Testing
- R&D
- Consulting services

for Electric Utilities, OEM's, Government and Research organizations.

Offer a ***one-stop-shop*** approach for ***Standards & Certification Testing, T&D Asset Management Services, Grid Modernization Services and Failure/Forensic Analysis Services.***

Substations – Applied Chemistry

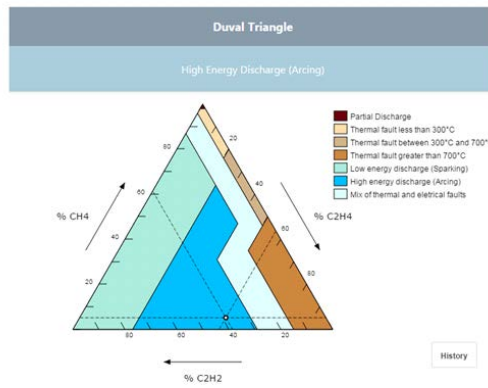
Services



Research



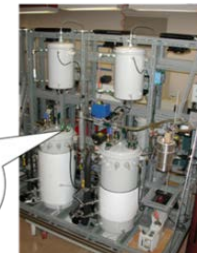
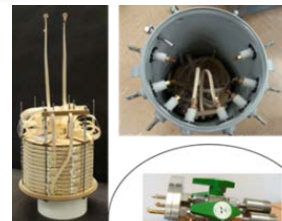
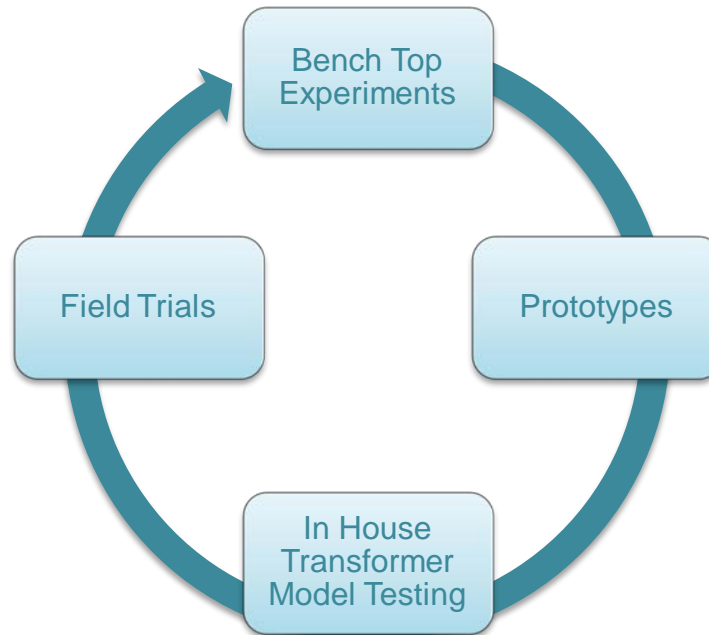
Consulting



Products



Research: Unique, World Class R&D Facility

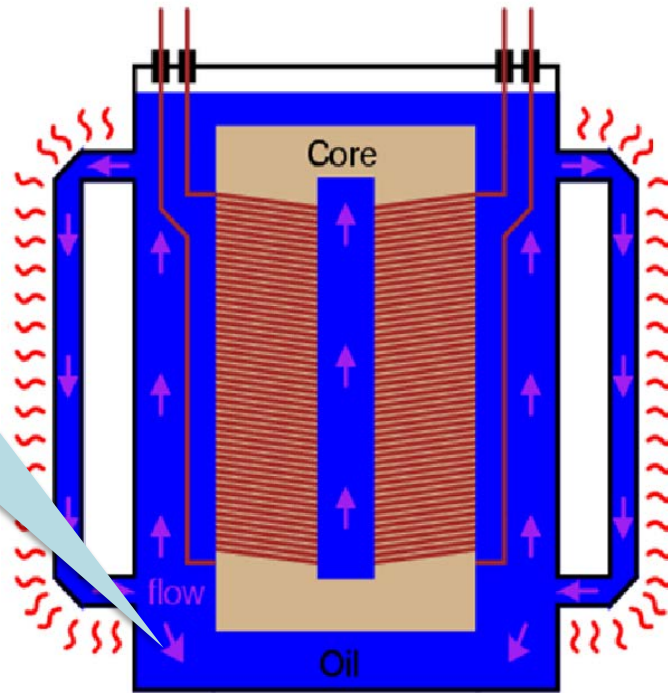


What a Transformer owner wants ?

- **No down time –clean when it is Energized**
- **Remove all types of Contaminants**
- **Improved quality – electrical and physical properties**
- **Meet regulatory requirements (PCB's concentration)**
- **Minimum waste is generated**
- **Ease of operation**
- **Safe and no spillage**
- **Economical**

Problem – Moisture & other Contaminants in Transformer Oil

Moisture in Transformer Oil – What does it Indicate ?

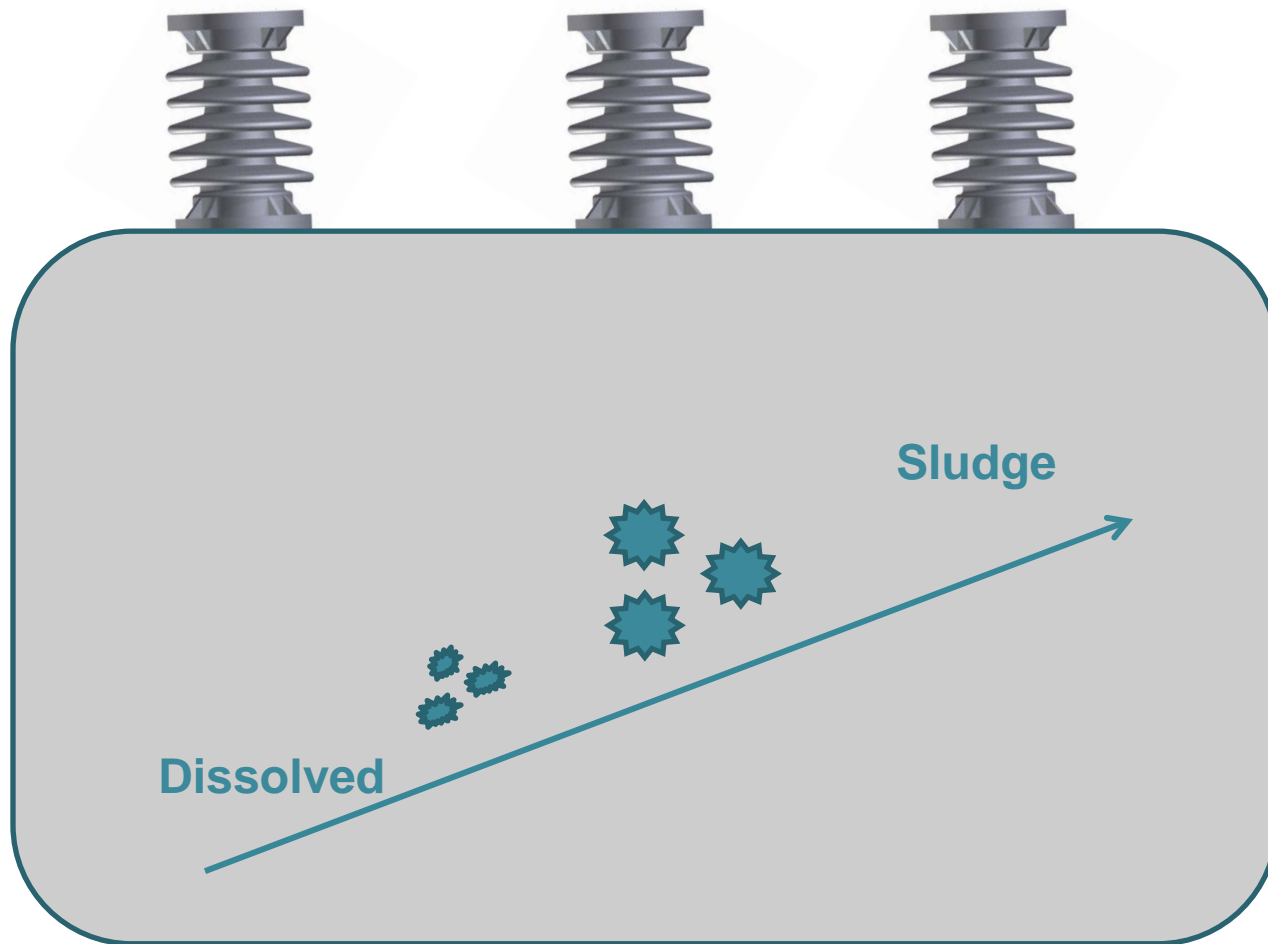


What about -

- Paper degradation products
- Furanic compounds
- Acid products
- Oxidation products
- Sludge
- Corrosive Sulphur
- Particulate matter
- Gasses (H_2 , CO , CH_4 , etc.)

Removing Moisture is only Part of the Solution

Technology to remove contaminants of all sizes



Solution - Powertech Technology

- Dehydration technology is available – but is moisture removal the only issue?
- No - removal of moisture is only part of the solution
- What about other contaminants which are equally harmful to transformers?
- Need a single platform that can deal with different contaminants at the same time
- Powertech offers a single platform to remove all the contaminants
 - Effective
 - Saves time and money
 - Enhances reliability, performance and life of the transformer

Need Technology – One platform & multiple uses



Dehydration Unit



Regeneration Unit



Degassing



LTC Oil Purification Unit



Corrosive Sulfur & PCB Removal Unit

common platform, different cartridges for different functions

Benefit of these Units: Transformer Life Extension

- Increase Dielectric breakdown strength
- Decrease Dissipation factor
- Reduce Moisture content (and free water)
- Oil conditioning
- Reduced maintenance
- Avoid catastrophic failure



ODOU

Corrosive Sulfur Removal

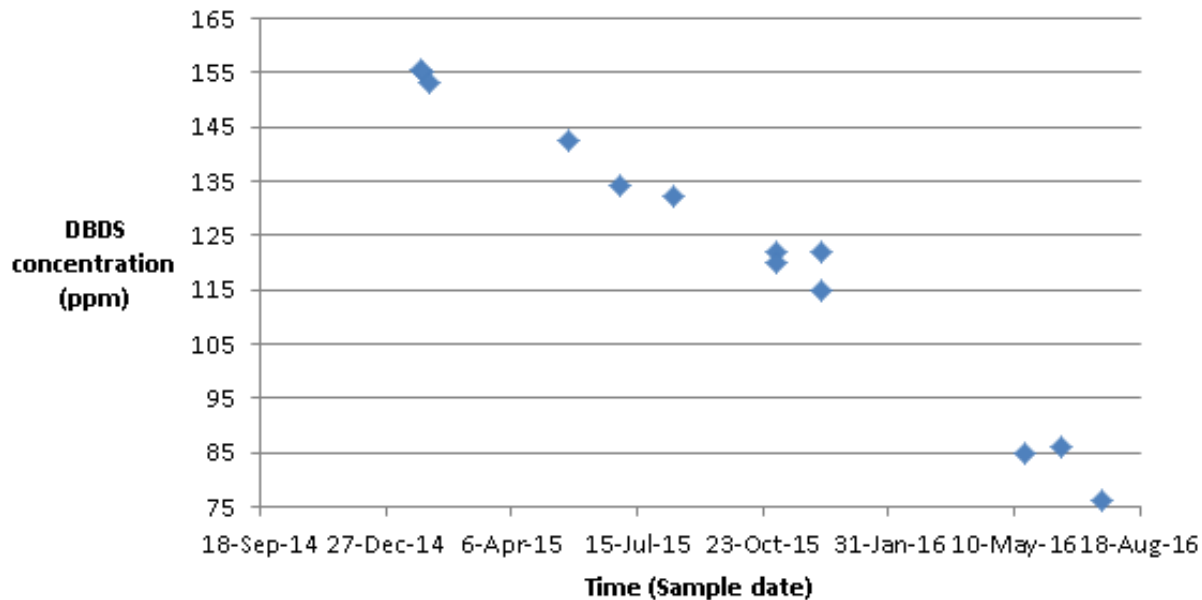


- Corrosive sulfur is a component in oil that corrodes the copper core itself.
- Byproduct of the corrosion can make the paper conductive leading to a **catastrophic failure**.
- **The corrosive sulfur removal unit specifically targets sulfur species, resulting in non-corrosive oil:**



Corrosive Sulfur Removal – Field Results

- Utility in Canada - DBDS reduced from 22 ppm to less than 1 ppm
- Utility in the US – DBDS reduced from 42 ppm to less than 10 ppm
- Utility in the US (Ongoing Project) – DBDS reduced from 155 ppm to 75 ppm



Regeneration Unit



- Restores transformer oil properties to the level of new oil
- Removes oil oxidation and paper degradation products
- Removes moisture from oil
- Removes particulate matter
- Removes dissolved metals
- Restores all relevant oil properties (IFT, KV, PF, NN, etc.) to the level of new oil

Regeneration Unit – Field Results

Example I: On in-service 500 kV power transformer multipurpose system (dehydration and decontamination)

	IFT	Neut No.	Dissipation Factor at 100 °C	Dielectric (kV)
Start (before treatment)	36.8	0.014	0.935	32
After treatment	41.6	<0.01	0.06	61

Example II: On de-energized 60 kV power transformer decontamination unit

	IFT	Dissipation Factor at 100 °C	Dielectric (kV)
Start (before treatment)	37.6	0.325	51
After treatment	43.6	0.089	62

Regeneration Unit – Field Results

Example III: Substation in BC Hydro - on in-service 60 kV power transformer – decontamination system

	IFT	Neut No.	Dissipation Factor at 100 °C	Dielectric (kV)	Polar (ppm)
Start (before treatment)	20.5	0.07	0.893	37	2050
After treatment	42.3	< 0.01	0.033	64	55

Example IV: Substation in BC Hydro - on in-service 60 kV power transformer – decontamination system

	IFT	Neut No.	Dissipation Factor at 100 °C	Polar (ppm)
Start (before treatment)	21.2	0.08	0.66	2011
After treatment	36.7	0.01	0.073	195

Example V: Substation in BC Hydro - on in-service 60 kV power transformer – decontamination system

	IFT	Neut No.	Dissipation Factor at 100 °C	Dielectric (kV)	Polar (ppm)
Start (before treatment)	21.4	0.07	1.21	34	2185
After treatment	32.2	0.01	0.32	60	790

Degassing and/or Dehydration Unit



- Removes dissolved gasses from oil
- Removes moisture from oil
- Removes particulate matter
- Dries out paper insulation

Degassing and/or Dehydration Unit – Field Results

Example I: In-service 60 kV reactor transformer – Degassing/dehydration system

	H ₂ O	O ₂	CO	CO ₂
Percentage of gas removed	32	71.7	65.7	39.1

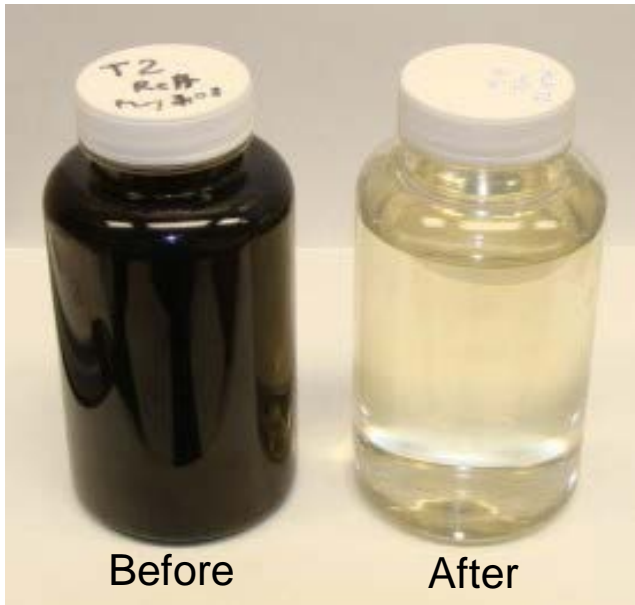
Example II: Utility in New York - In-service 762 kV power transformer – dehydration system

	H ₂ O
Start (before treatment)	20 ppm
After 140 days	5 ppm

Example III: Utility in New York - In-service 35.5 kV power transformer – dehydration system

	H ₂ O
Start (before treatment)	30 ppm
After 60 days	1 ppm

Load Tap Changer Oil Purification Unit



- Removes coking precursors from oil
- Slows down coke formation rates
- Restores KV and other oil properties to near new levels
- Removes carbon particulates & H₂O

Powertech's Online Oil Decontamination Unit



Back



Front

Online Decontamination Unit - Features

- One unit, multiple uses
- De-contaminate while transformer is energized
- Easily deployable – plug and play
- On wheels & easily transportable
- Cartridges can be easily disposed/regenerated
- Can be used to decontaminate several transformers
- Low maintenance, cost effective & proven technology

Online Decontamination Unit - Features



NEMA 3 R enclosure – extreme weather conditions

Wide operational temperature (-40 °C to +50 °C)

PLC controlled with HMI

Leak detection system - sensors

Normally closed isolation solenoid valves for secure shutdown

Online Decontamination Unit - Features



- External alarm with beacon
- Shuts down in case of any malfunction
 - Spillage, pressure build up, clogging
- De-aerator / bubble trap
- Communication box for information exchange

Online Decontamination Unit – Installation Process



Online Decontamination Unit – Unit at Site



Installation Process– Step I

Gather oil quality information (specific values of the parameters which need to be improved are to be determined): **Physical**, Chemical and Electrical Properties

- Moisture content (Dehydration)
- DBDS content/D1275 results and Oxygen inhibitor content (Corrosive sulfur).
- Acid Number, Color, Dielectric Breakdown Voltage, Interfacial Tension (Oil regeneration).

Installation Process – Step II & III

Step II: Gather preliminary transformer information:

- Volume of oil
- Transformer ratings/specification

Powertech estimates number of cartridges, time and cost to obtain the desired improvement.

Step III: Gather detailed transformer information:

- Number and sizes of oil-access ports
- Availability of 120V single phase power
- Position and distance of ports from where unit can be placed
- Position and distance of power outlet from where unit can be placed

Installation Process– Step IV

Installation of Online Oil Decontamination Unit

- Unit and cartridges are shipped to transformer location
- Depending on utility regulations, oil access port locations and limits of approach some coordination for an outage may be required.
- Connect inlet and outlet line
- Connect 120V power
- Unit is started and checked to confirm smooth operations

Installation Process– Step V

Monitor/sampling and cartridge replacement:

- As per the schedule determined between Powertech and the client, oil samples will be taken and cartridges replaced
- Powertech will supply replacement cartridges
- Used cartridges can be returned to Powertech for disposal

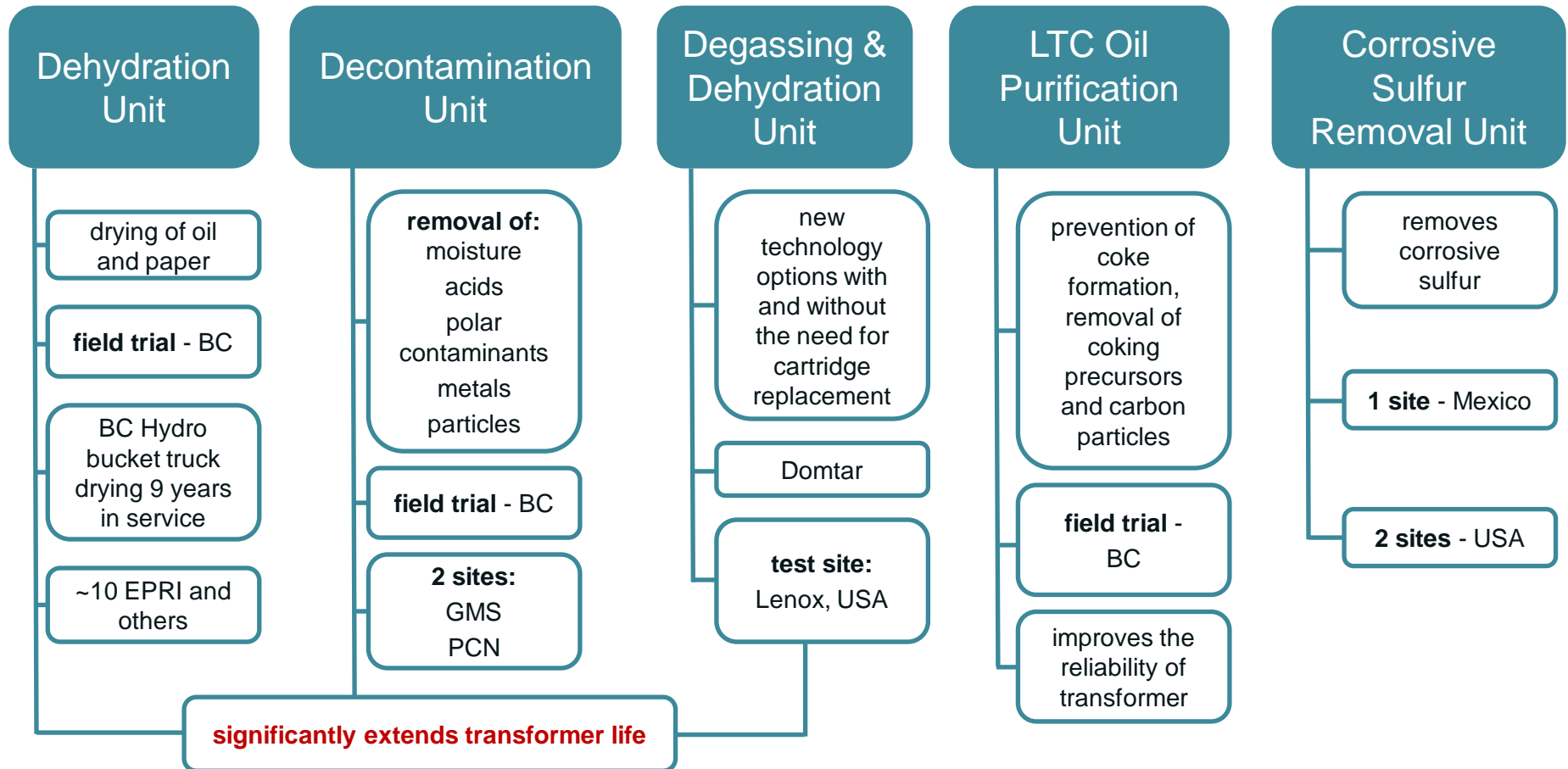
Report results to all stakeholders

Once the required goal is achieved and confirmed by oil tests, the unit can be removed

Why Powertech's solution?

- No shutdown required - energized
- Stand alone unit equipped with features for unattended operation
- Environment – Low Carbon foot print
- Less waste generated
- Overall oil conditioning
- Adsorbent used can be regenerated- less waste for disposal
- Saves precious man hours

Proven Technology



Summary

- **Powertech Online Decontamination technology can be deployed in energized condition**
- **One unit, multiple uses - flexibility of use depending on contaminants**
 - Moisture
 - Corrosive Sulphur
 - Other contaminants
- **Proven Technology**
 - Proactive approach/Preventive maintenance
 - Robust and tested at various locations
 - Cost effective
 - Easy to deploy



Powertech

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Thank You!

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