Aviation Fuel Quality – We can’t afford to take chances

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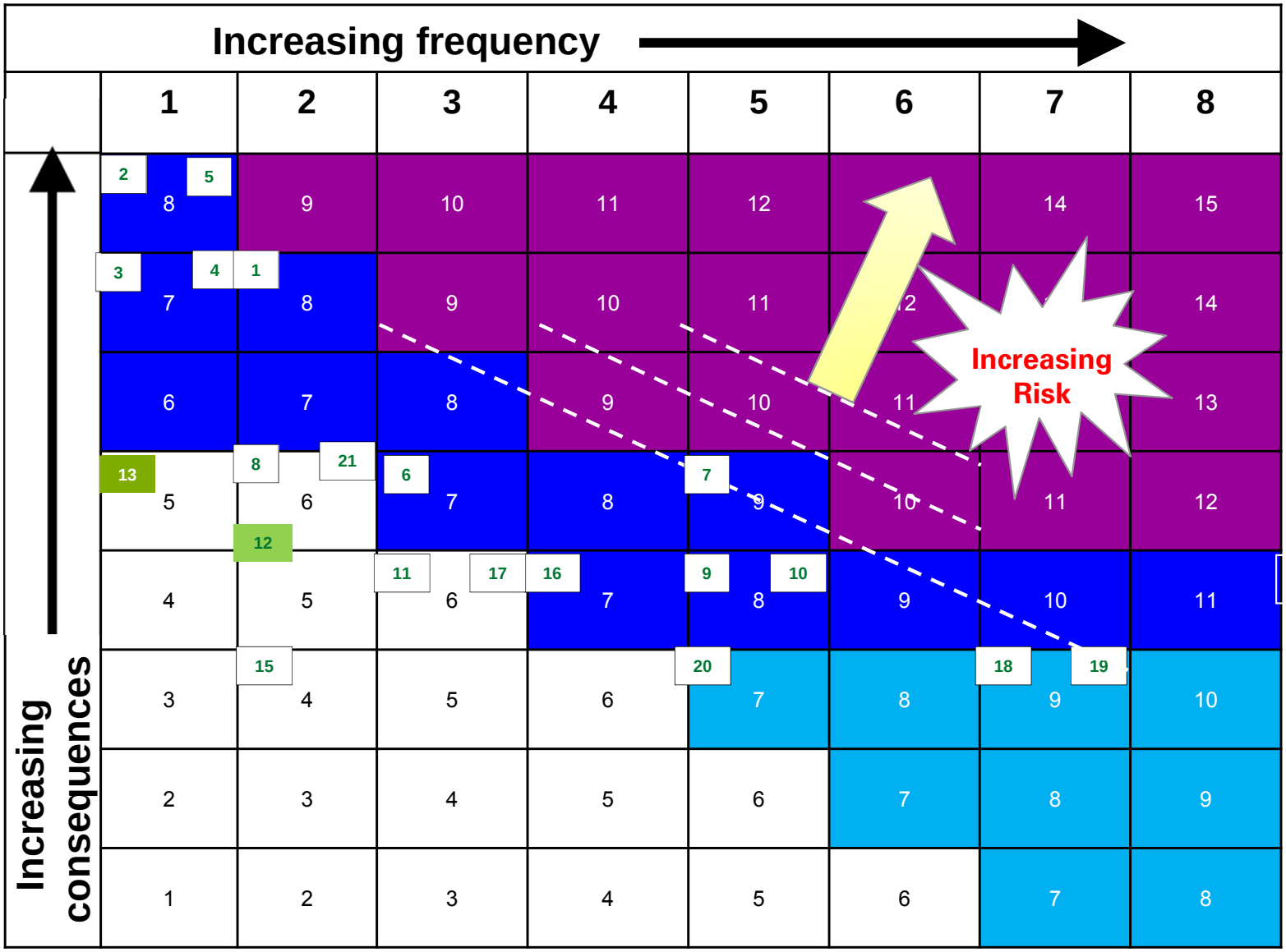
Aviation Safety

Aviation in itself is not inherently dangerous, but to an even greater degree than the sea, it is terribly unforgiving of any carelessness, incapacity, or neglect.

Major risk events



1. Aircraft Fire - Hydrant pit valve to refuelling vehicle system failure
2. Aircraft Fire - Refuelling vehicle fire, Loss of containment due to vehicle(s) / aircraft accidents
3. Aircraft Fire - Refuelling vehicle to aircraft hose/coupling system failure
4. Aircraft Fire - Aircraft fuel system failure (Wing Venting)
5. Aircraft Crash - Engine failure caused by water, dirt or debris
6. Aircraft Crash - Engine failure caused by lack of FSII
7. Aircraft Crash - Operator misfuels an avgas aircraft, Operator misfuels a jet aircraft or diesel aircraft
8. Aircraft Crash - Contaminated fuel, includes FAME
9. On airport driving incidents
10. Vehicle Accident - on road - spill/fire and personal injuries
11. Environmental - Leak from hydrant or cross-country pipeline
12. Depot fire – non tank related and Aircraft hits BP fixed or mobile facilities
13. Depot fire – fixed storage
14. Plane Crash - Wrong quantity of fuel delivered to plane (not plotted)
15. Crisis Management - Emergency Response
16. Security - Air BP facilities used for terrorist activities
17. Personal Injury - Health - Exposures (benzene/lead etc.) and International Travellers
18. Personal Injury - Slips, Trips and Falls (excluding non routine Working at Heights)
19. Personal injury - Musculoskeletal injuries
20. Personal Injuries - Non Routine Activities
21. HSE Legislation - non compliance

Aviation Supply Chain

- Every day 5 Million barrels of Jet transported
- 95,000 flights powered by Jet fuel
- 8 Million passengers transported daily

Preventing delivery of grossly contaminated fuel to aircraft

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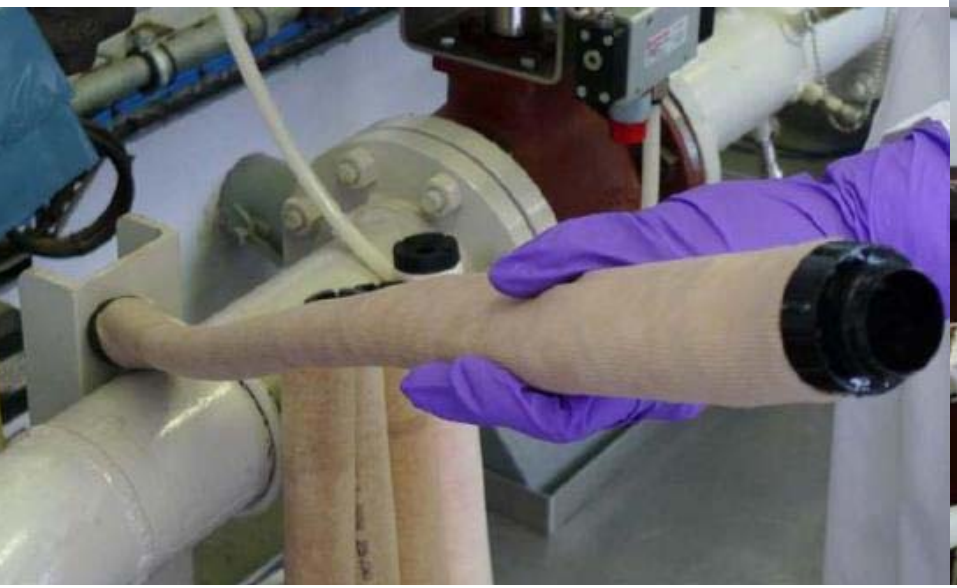
Emergency landing of CX 780 in Hong Kong following delivery of grossly contaminated fuel in April 2010

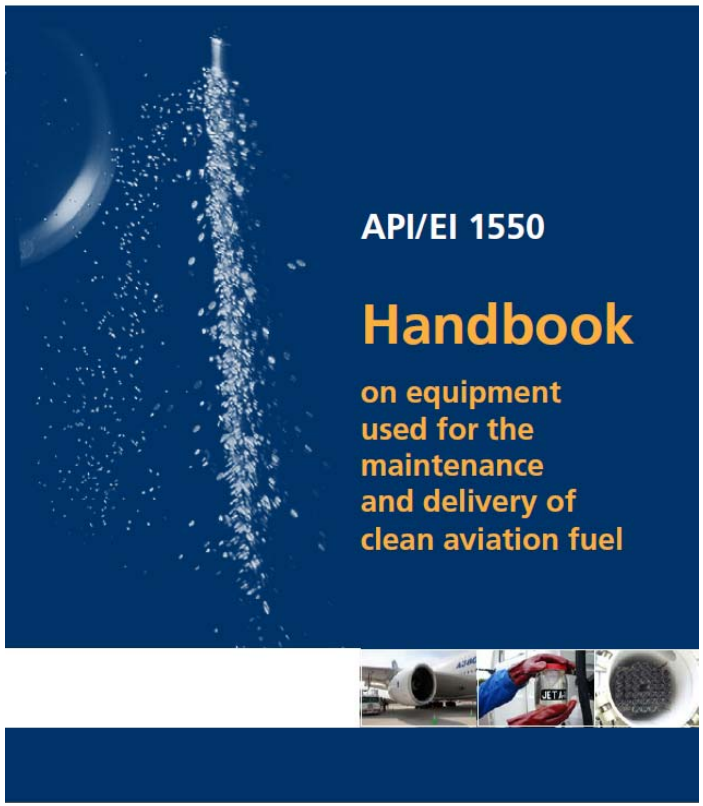


Standards

- To ensure good operability and long service life, the Aviation Industry seek to supply clean fuel to aircraft/engines.
- Cleanliness specifications are cited in API/EI 1550:

'Handbook on equipment used for the maintenance and delivery of clean aviation fuel'.

  - Maximum particulate content 0.00044 or 0.001 grams per litre.
  - Typical into-plane particulate content is 0.00007 grams per litre.



Courtesy of the API/Energy Institute

Fuel Quality Requirements - what the standards require

ASTM D 1655

- *'7.1 The aviation turbine fuel specified in this specification shall be visually free of undissolved water, sediment, and suspended matter.'*

Defence Standard 91-91

- *'1.1 Appearance – Clear, bright and visually free from solid matter and undissolved water at ambient temperature.'*

Quality requirements

- expected time before overhaul of modern turbine engines
- long-haul aircraft carry more than 240,000 litres of product
- the aviation Industry has moved beyond simple visual quality control.
- Guidelines set stringent limits, typically less than 0.20 mg/litre dirt and less than 30 ppm of water at the point of delivery into plane.
- These are important as even small amounts of contaminant can quickly accumulate given the large volumes of fuel up-lifted for commercial flight

Keeping the contaminants out

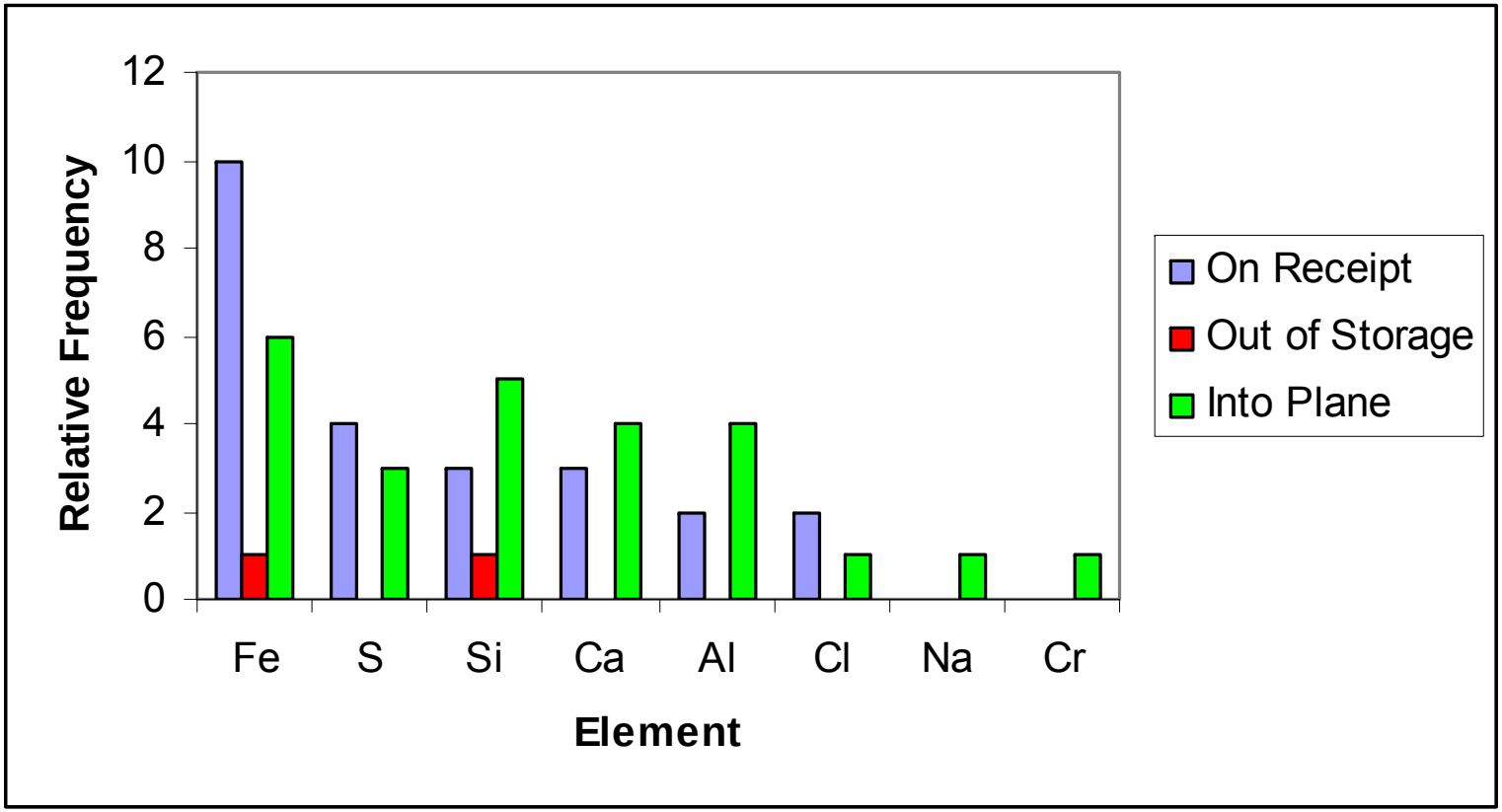
The Aviation Industry have developed equipment and procedures through-out the distribution chain to meet the challenge of clean, fit-for-purpose fuel on delivery.

- Three primary methods are used:
  - Engineering
  - Settling
  - Filtration

In this session we will look at some interesting aspects of filtration from a practical perspective....

Particulates in Aviation Fuel

- Particulate level and type can vary dependent on the point in the distribution chain where the sample is taken.



Vic B. Hughes and Phil D. Rugen, IASH 2000, the 7th International Conference on Stability and Handling of Liquid Fuels, Graz, Austria, September 24-29, 2000

Advances made by the industry

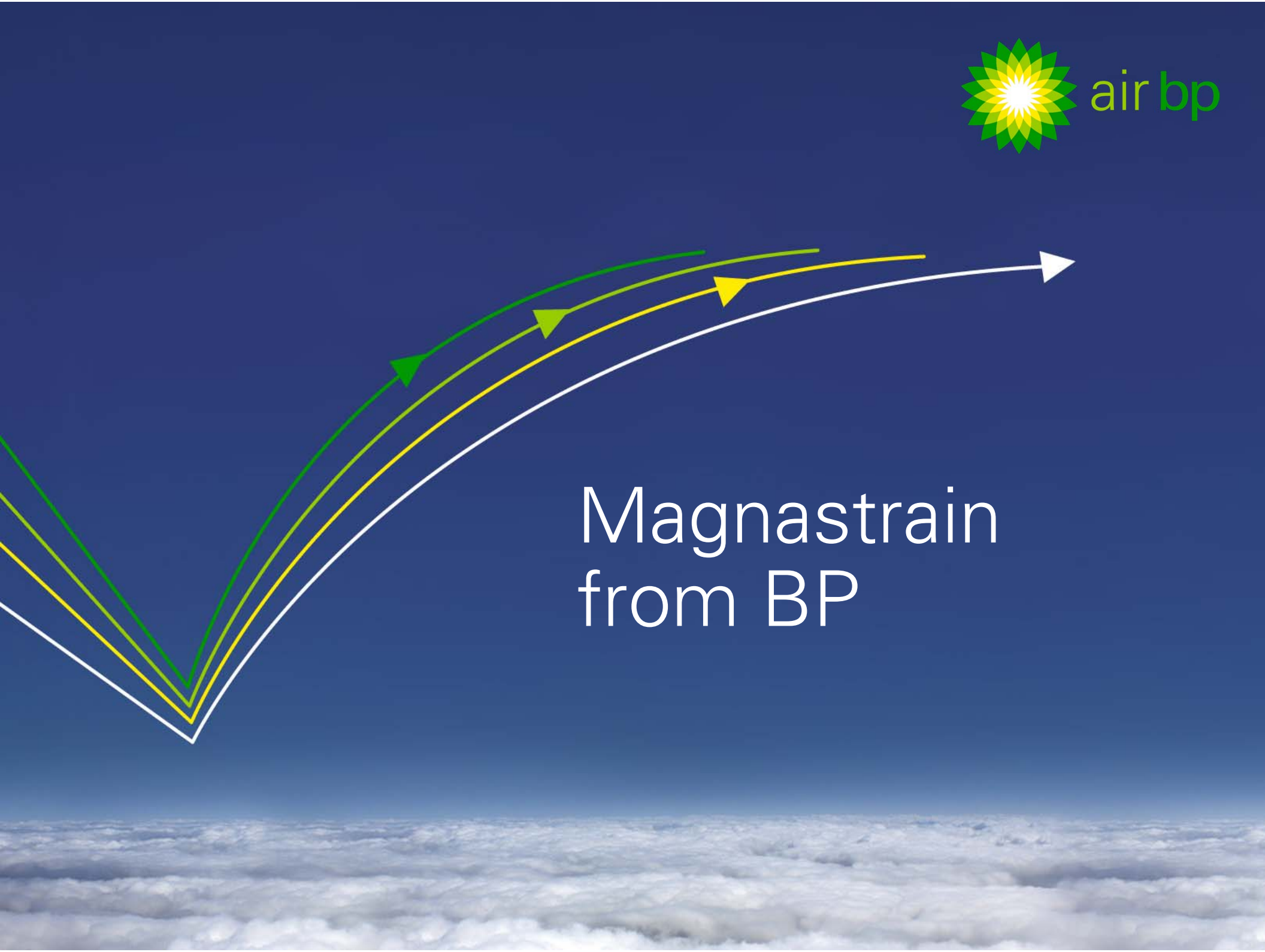
- Edition 6 monitors have now been implemented industry wide
- DP Limiting devices have been implemented in most locations
- Sampling processes have been tightened
- Training and assurance processes have been tightened

Do we need to do more …

Case for doing more to keep particulates out

- However these are still inadequate in many systems as
  - Number of legacy pipelines in the system
  - Mostly not internally lined (epoxy coated) – except airport piping systems
  - Filters change outs are expensive and time consuming
  - Rust is a major cause of particulate contamination
  - A serious incident like that of Surabaya can have disastrous results

So what did we do …..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Magnastrain
from BP

Air BP Magnetic Strainer

- Intended for use as receipt filtration from third party pipeline systems with known problems of rust
- Extensive design and performance testing carried out
- Fully optimised and in service

Unique features

- Unique modular design for ease of maintenance.
- Equipped with a fast open and close lid, and requires NO tools during maintenance, not even spanners!
- Operates without attention over its specified service interval
- Service times of less than 2 hours.
- Constructed from stainless steel and an operational life of >50 years.
- No significant running costs and no electrical requirements.

Capabilities and advantages

- Operates at up to 500m3/hr, with the potential for increase due to its modular design.
- No detectable rust getting past the filter
- Have achieved a 100% increase of microfilter life
- Debris in conventional filter elements downstream of the Magnastrain reduced by >95%
- Service interval between 4 to 6 weeks.
- Valves downstream of the magnetic strainer can also benefit from increased life due to the removal of abrasive rust.

Magnastrain data

- Vessel is manufactured from stainless steel
- All seals are Viton seals (chlorine resistant)
- Vessel build to UK and Industry codes and standards
- Rated to 18 bar

Ease of operability

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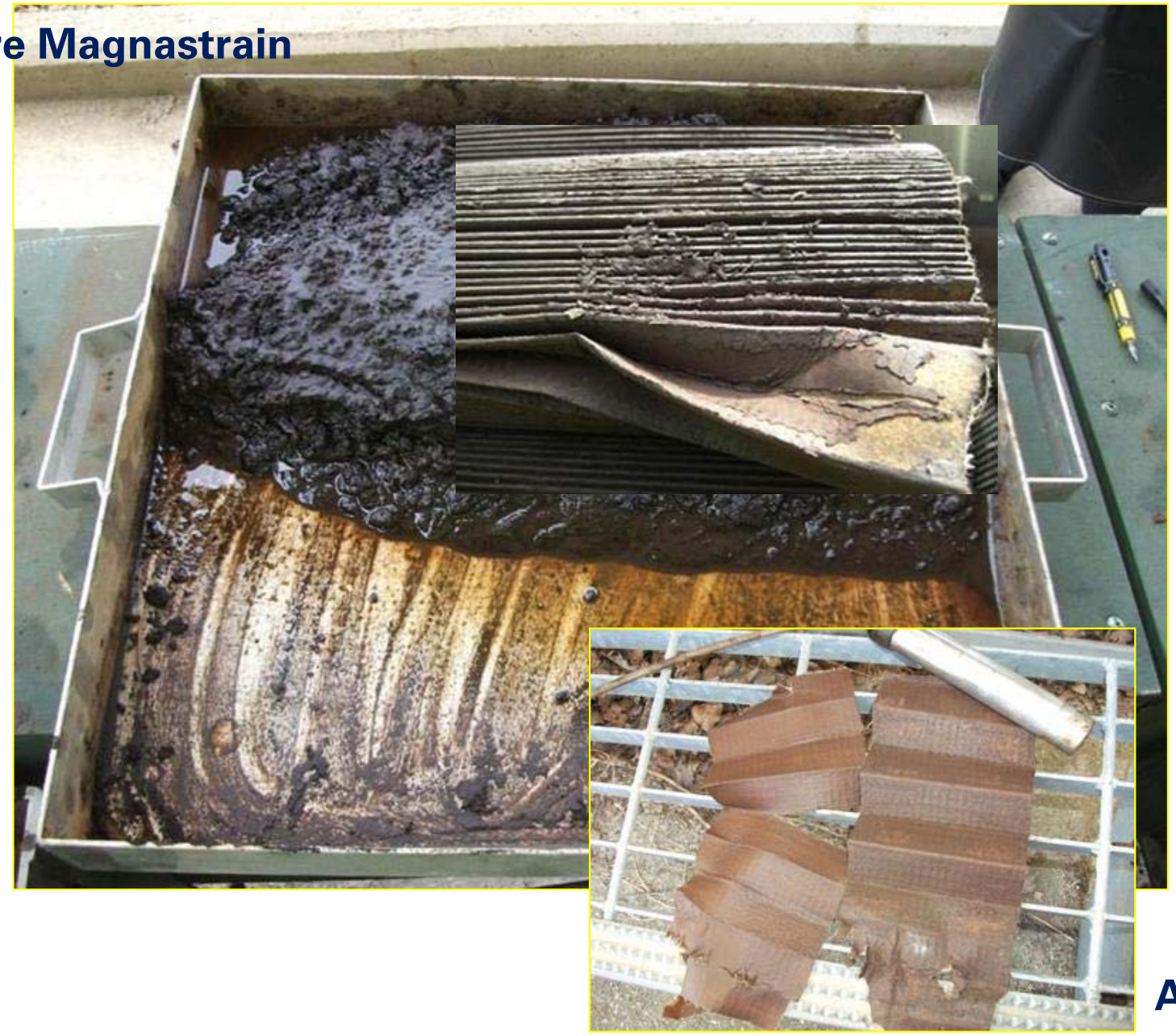
The results speak for themselves …

Before Magnastrain



After Magnastrain

At your service …

- Air BP can design & install equipment
- Air BP can provide the commissioning services which include for vessel capture rates and metallic particle analysis.
- Provide procedures for operation & maintenance
- Train staff
- Provide on-going health & performance monitoring

We design, we innovate, we operate

Prasad Ayyakad
Air BP