Wessex Water

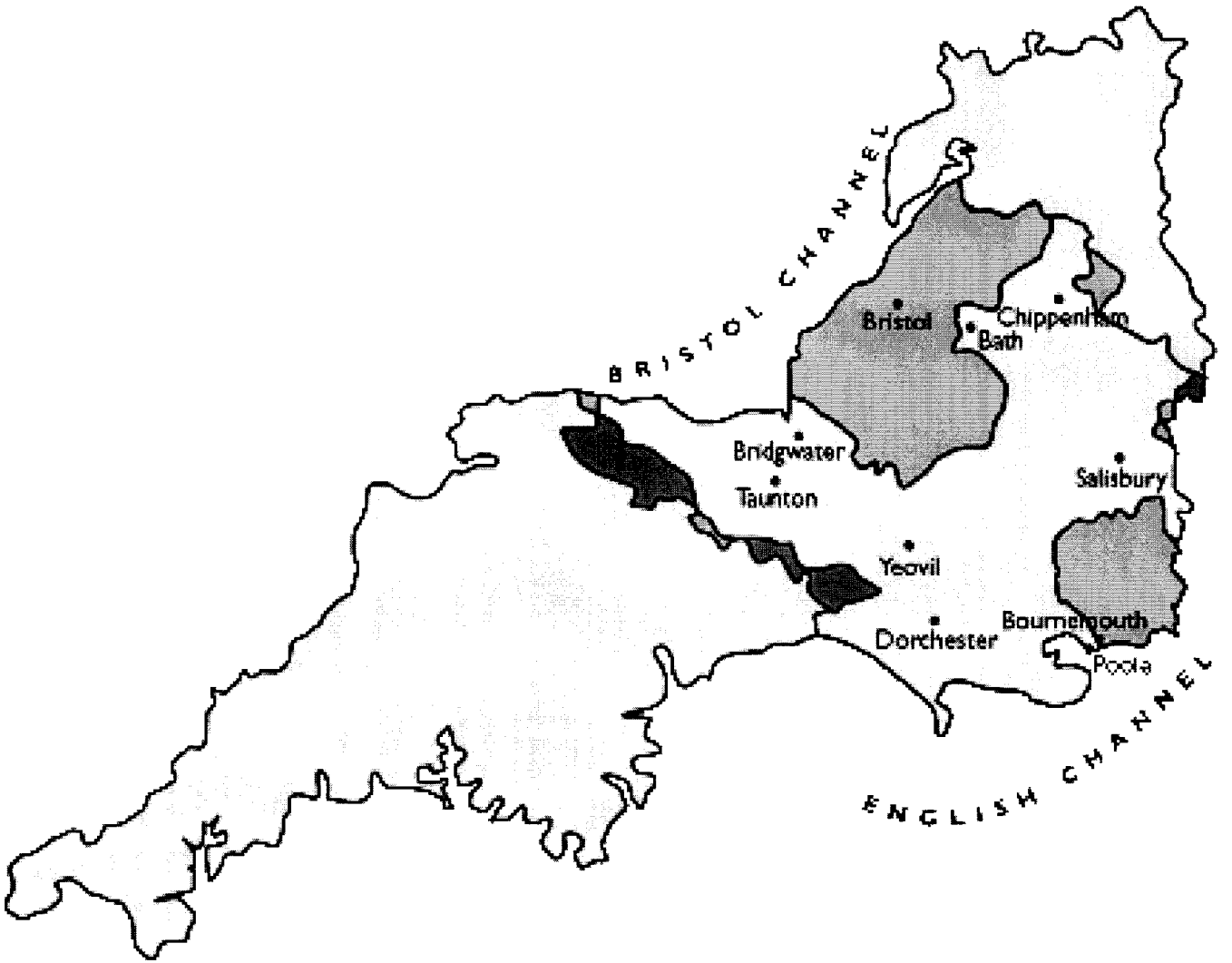
a YTL company

LOCATION & CUSTOMER BASE

a YTL company

2.5m Sewerage customers

- **1.35m sewerage only**
- **1.1m water and sewerage**
- **0.13m water only**



Wessex Water – Overview

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Water Supply

- 53 treatment plant, 366 pumping station
- 11,[illegible] km water main

Wastewater

- 362 treatment plant, 1,314 pumping station
- 15,0[illegible] km sewers

Wessex Water – Energy costs

- **Energy is one of the largest operational costs**
  - **Clean Water treatment and supply ~ € 6 million**
  - **Wastewater collection and treatment ~ € 9 million**
- **Overall Electrical use is about 27 MW = one 747 jet engine output – 1/10% of all UK average demand of 27 GWe**
- **CHP generation is about 3.6 MW continuous – 13.3% - we can double this.**
- **Also 20 MW of diesel used to support National Grid, 4 minute start up and paralleling. (*that's another story!)***

Current Engine Fleet – Wessex Water has operated large CHP engines for over 40 years

Wessex Water
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- Avonmouth – 5 x 1.15 MW Caterpillar (USA) V-16 cylinder spark ignited engines, 2 - 3 MW average output - 2002
- Trowbridge, Salisbury, Christchurch, Taunton – 5 x 0.086MW – single 6 cylinder in-line spark ignited engines MAN (Germany) – 1980s
- Berry Hill – 1 x 1MW - Caterpillar V-16 cylinder spark ignited engine - 2005
- Poole - 1 x 0.8MW Jenbacher (Austria) V-16 cylinder - spark ignited engine - 2004

Avonmouth works – population served 900,000 – *also tankered in commercial wastes!*

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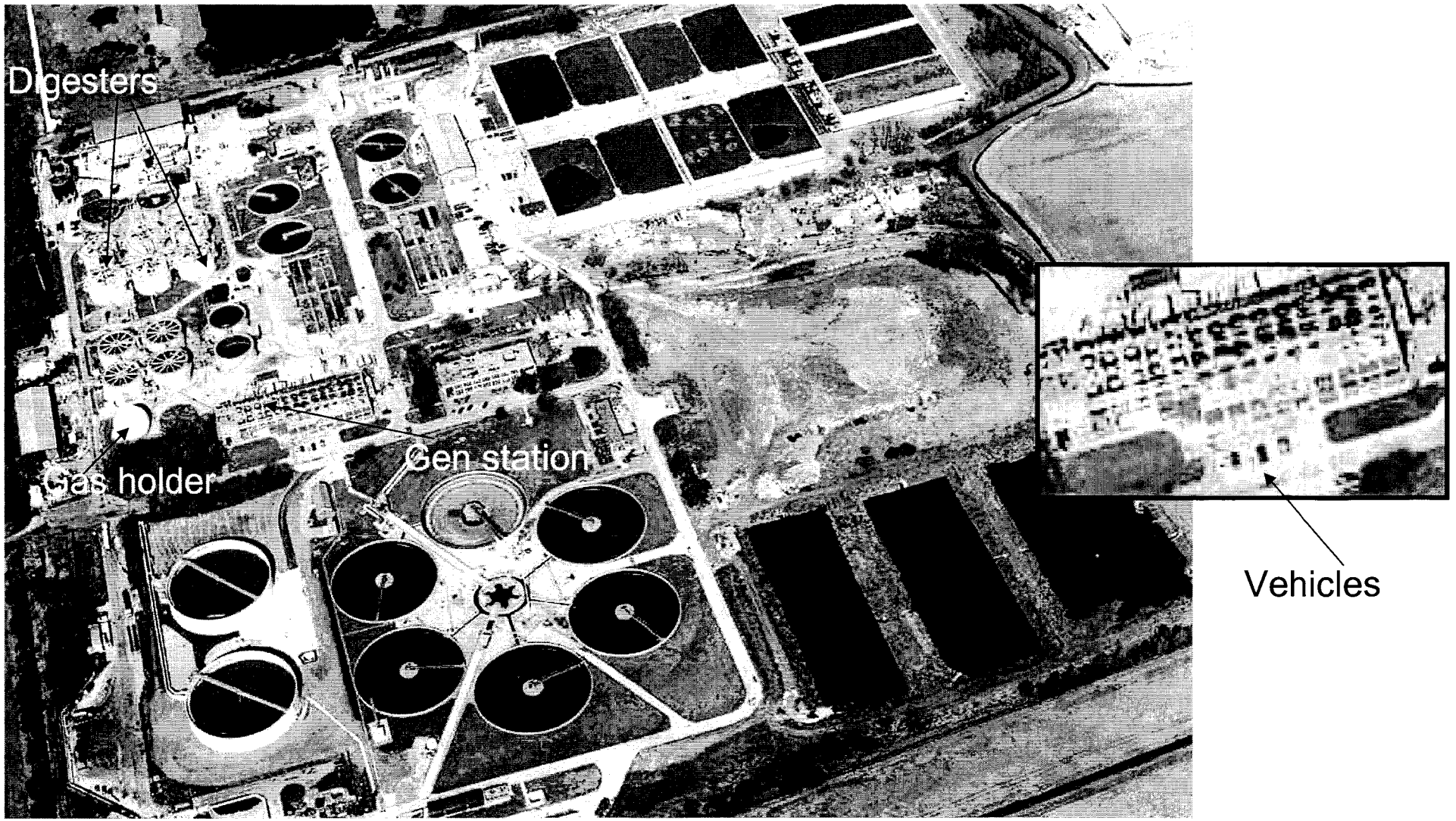
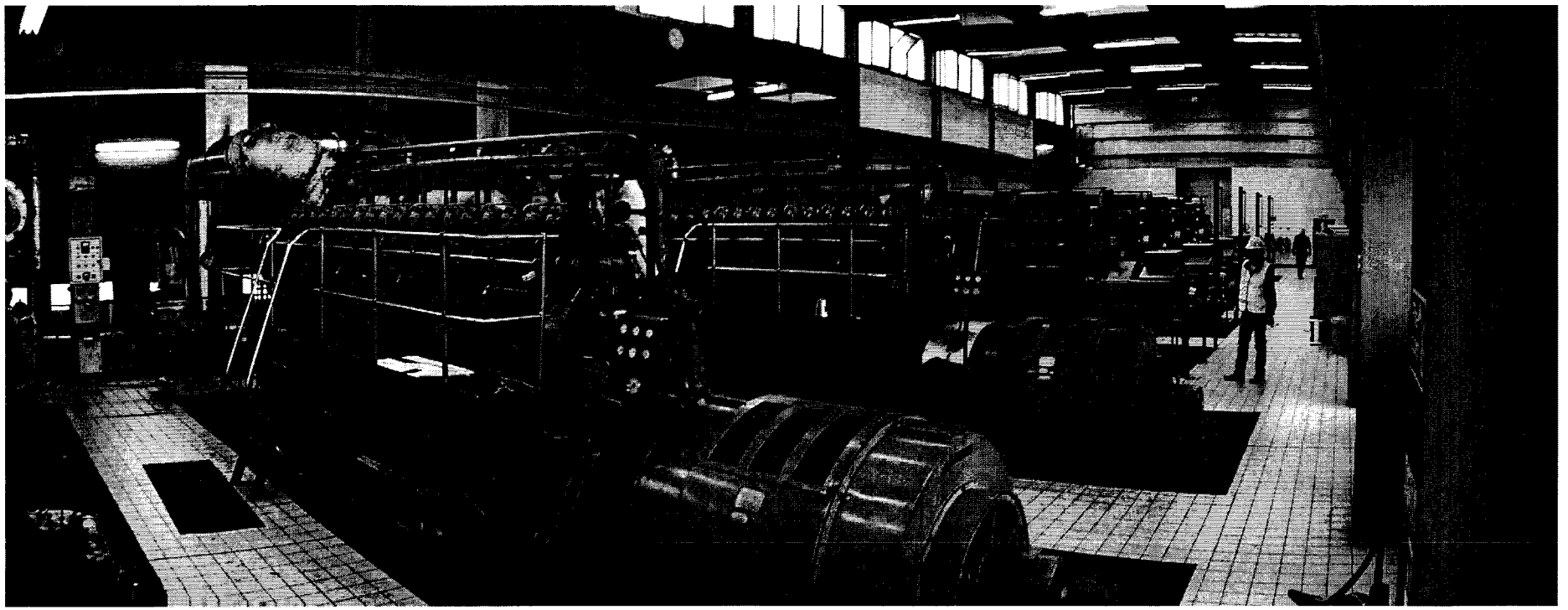


Avonmouth old engines



Old Engines – 7 x Allen (UK) gas / diesel engines 5 MW, 500 rpm, installed 1964

These engines originally provided the sole site supply, and provide essential standby power supply so therefore redundancy is needed – multiple engines – site load is only 3 MW

Avonmouth Generating Station Old engines

Seafield Water
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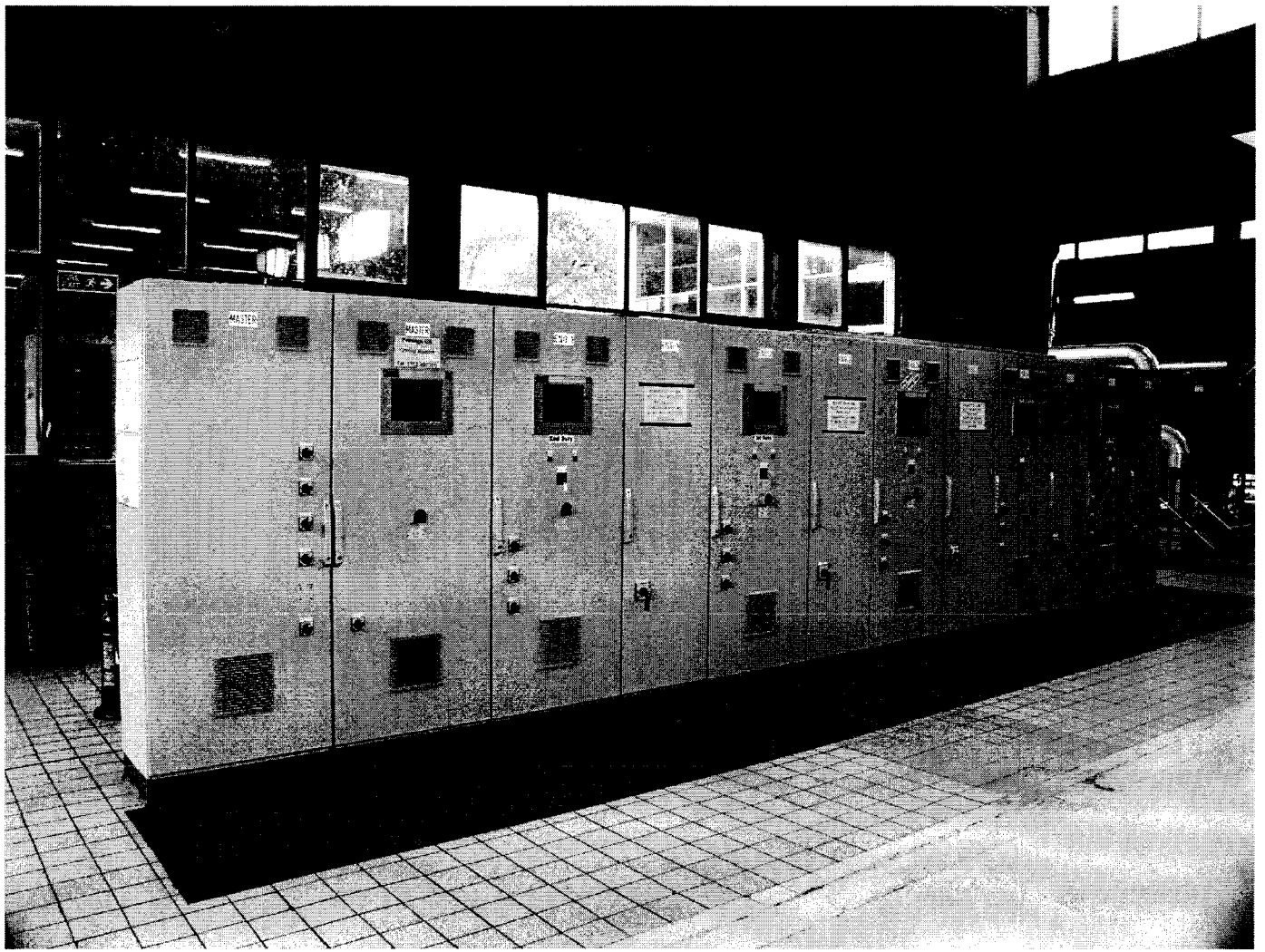
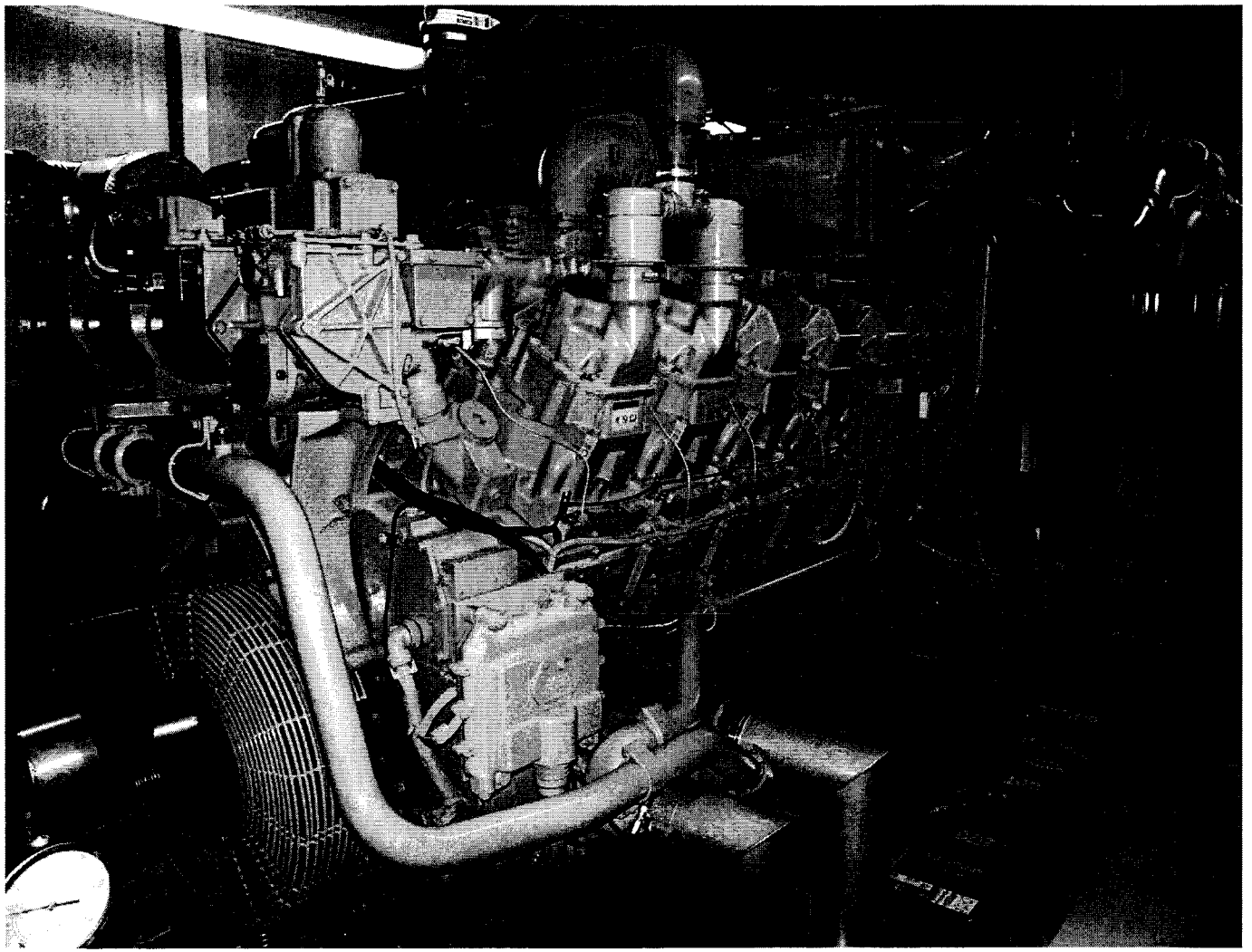
- Replaced due to inability to earn ROCS - Renewable Obligation Certificates – a government renewable energy subsidy
- Near end of life.
- But were very reliable –
- Only one major failure destroying whole engine, and one engine fire during entire lifetime.
- Efficiency – 28% HHV – new engines 35%
- Maintenance cost about .03 e/kWh / 2pkWh
- Needed attendance
- Needed expensive diesel fuel for pilot ignition

Avonmouth new engines – control panel



Avonmouth New Engines 2002



These engines operate with jacket water temperatures of 120C to avoid acid condensation and subsequent and corrosion.

When stationary :

- Jacket water heaters,
- electric engine rotators
- constant lubrication flow

All assist in keeping corrosion low

Avonmouth new engines – outside of generating station

Air blast engine coolers, used in summer when not all the heat is needed for digester heating.

Peak winter heat load on digesters is about 2.0 MW

Avonmouth New Engines - acoustic canopies

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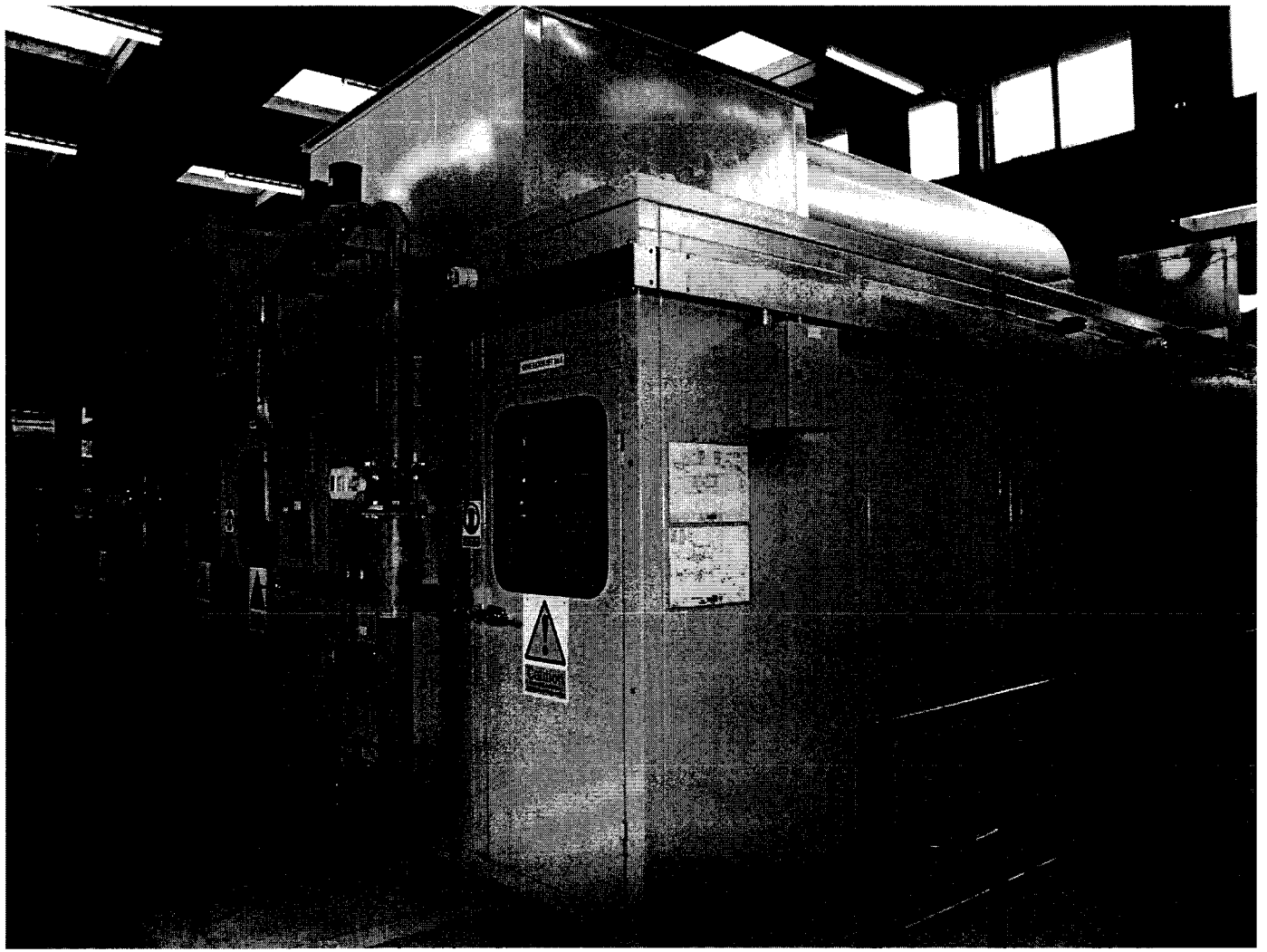


acoustic canopies

Avonmouth Generating Station

Veolia Water
a YTL company

Performance

- Caterpillar V16 – 1500 rpm
- Electrical output – 1.175 MW/engine, 415 V
- Electrical efficiency 35% HHV - 38.5% LHV
- Heat efficiency 45%
- Can operate on continuously varied blend of bio and natural gas.
- Maintenance costs – over life of engines to include all overhauls estimated €0.013/kWh, (0.9p/kWh) –contract – €0.007/kWh – (0.5pkWh) in-house.
- Availability – 5 engines – give 100% availability
- No major problems, apart from limited turn down
- Routine maintenance in house, call in experts for major work.

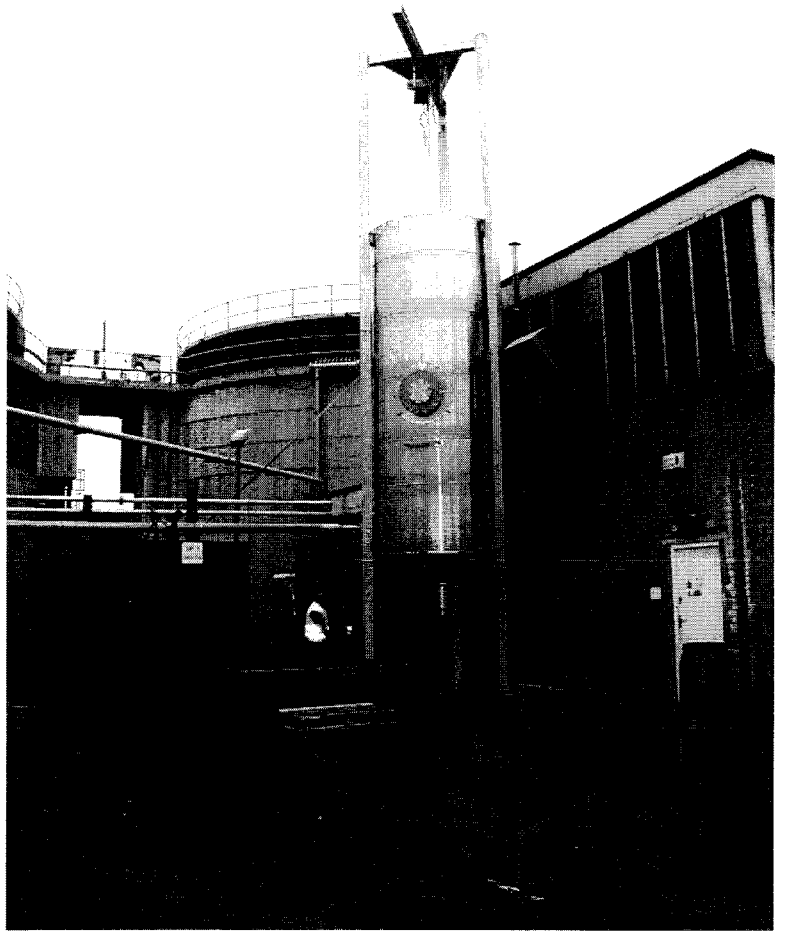
Experience with new engines

- Maintenance costs initially considerably higher than expected due to siloxane issue (see later) - heads only last 6,000 hours – we expect 22 – 25,000 hours.
- Oil change every 250 hours instead of 1,000 hours - siloxane.
- One piston failure in 2 years due to gas blending and delays in mixing system causing ignition problems.
- Much less forgiving than old engines
- Less siloxane tolerant
- Oil analysis is essential to give forewarning of problems - Important not just for biogas
- Complex electronic control system – needs expert input, can be unreliable.

Siloxane issues

- Siloxane became a major issue in 2002
- Traced to new compounds in large range of products – cosmetics, detergents etc, ending up in water.
- Pistons and valves coated with hard glassy substance
- Partial solution to turn away high level of tankered-in waste but still residual domestic residues
- So we recently fitted removal plant – which performs
  - Chilling gas for dewatering
  - Re-heat
  - Pass through active carbon
- Cost €200k, (£140k). Expected to cut maintenance by €70k, (£50k)/, plus waste contract worth €360k/y, (£250k).

Siloxane removal plant



Poole – previous engines – (1)

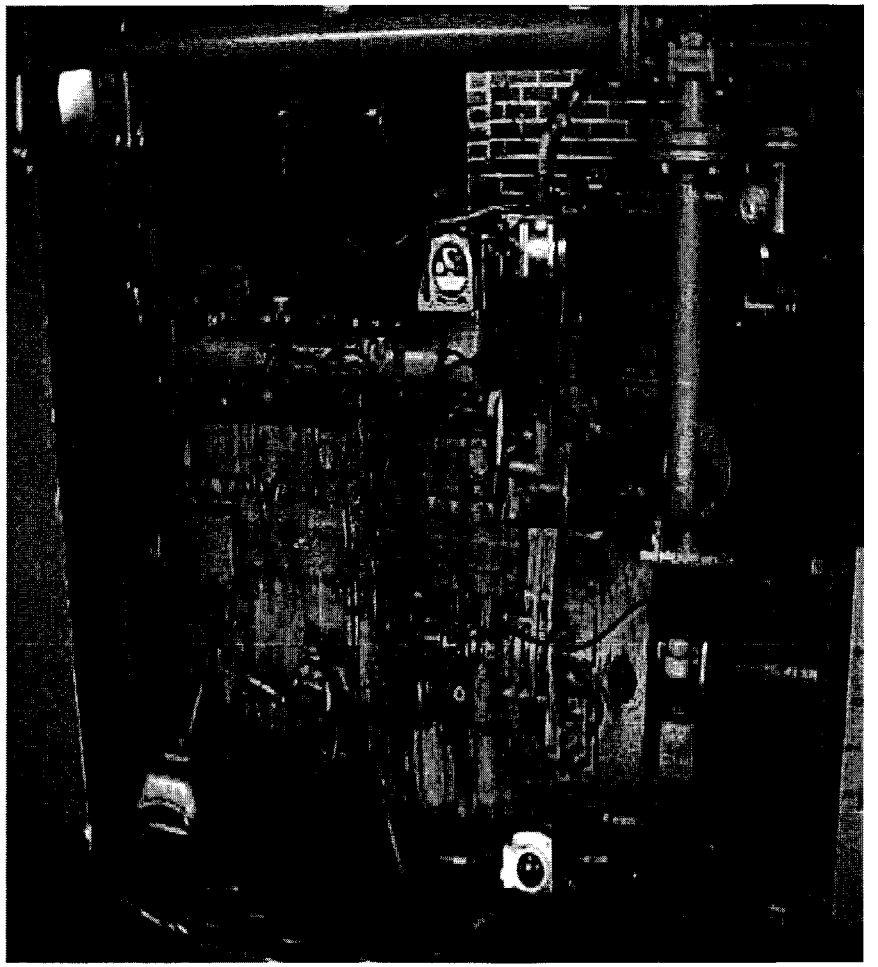
- Originally English Electric gas - diesel installed 1960s - no picture
- Replaced by 3 x 86 KW MAN – Installed circa. 1980
- maintenance cost €.02/kWh, (1.5p/kWh)
- "Scrapped" MANs held as spares for 5 remaining small digester CHP sites
- Very reliable and rugged these engines have achieved 100,000 hours operation ***each.***

Removed in 2004

Poole – previous engines – (2)

a YTL company

- These engine when originally installed in 1980 gave very good service. 100,000 hours.
- 3 engines tends to meant 3 times as many service visits as one large engine
- Poor re-installation in 1984 primarily of cooling circuits caused repeated and expensive engine damage.
- ***Emphasises need for expert installation – but it is not rocket science! – Follow the instructions!***

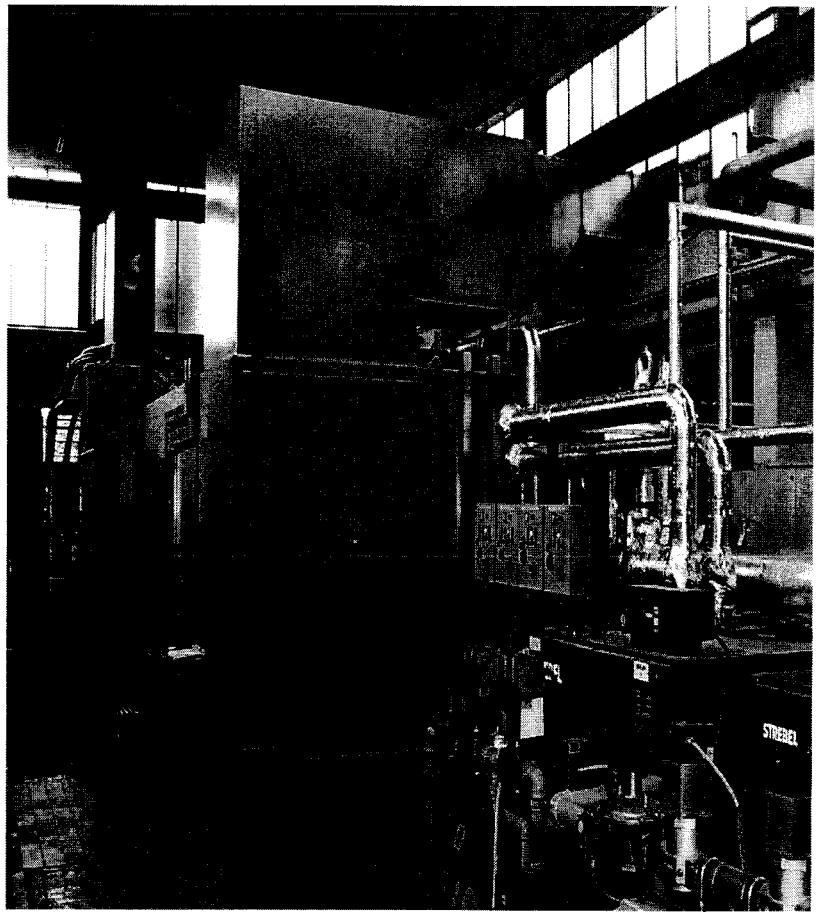


Poole - second hand Jenbacher 800kW

- MANs replaced 2004 with 1 x second hand Jenbacher 800kW.
- Maintenance contract for €.011/kWh, (0.8p/kWh).
- Poor initial reliability, solely due to ignition system now replaced has meant we initially only achieved 50% availability
- 1 single engine acceptable since not needed for standby

Berry Hill – MAN replaced with Caterpillar

- 3 x 86 KW MAN – maintenance cost about €0.03/kWh, (1.5p/kWh) installed 1980
- Very reliable and rugged, siloxane tolerant
- But still low head life and low oil life
- Replaced with 1 x Caterpillar 1000KWe plus siloxane plant.
- Maintenance contract for €0.011p/kWh, (0.8p/kWh).
- Just commissioned
- Watch this space!



Economics example (1) - Avonmouth

- Installed capital cost attributable to engines – €3.86m
- Expected income this year – ROCs plus electricity – €1.43m
  (100% availability due to spare engines)
- Maintenance costs €214,285
- Profit – €1.2m

Payback – 3.2 years.

Economics example (2) – MAN engine

- Installed capital cost attributable to engines – €100,000
- income this year say 85% availability – ROCs plus electricity – €59,000
- Maintenance costs €12,850
- Profit – €45,714

Payback – 2.1 years.

Small gas turbines

a YTL company

These are now available

We do not yet see a convincing economic case over reciprocating plant.

- Higher capital cost
- Not as efficient
- Not offset by undoubted lower maintenance costs

General Rules (1)

- Use one large engine rather than multiples, unless standby is essential – but in that case consider a single large gas engine with diesel back up.

- Sizing – preferable to slightly oversize than slightly undersize – marginal cost is not great, compared to extra revenues

- Ensure gas spec is analysed and appropriate corrective measure are taken – siloxane removal, H2S control

General Rules (2)

- Correct installation is essential – follow the manufactures guidelines
- Ensure specified maintenance procedures are followed exactly
- Preferably ensure manufacturer / installer gives a 10 year maintenance contract – forces him to a) install correctly without cutting costs, and b) forced to maintain correctly at least initially – can drop out and take in-house at any time once satisfied.
- .

General Rules (3)

- All the foregoing can only really be achieved by ensuring that a department with the experience and knowledge has the specific responsibly for engine matters – different skills and approach are needed from normal water company business

- If treated in normal water company way, success is not guaranteed!

Contact Details for further info.

Wessex Water
a YTL company

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- Richard Loyd Evans – First Energy – installations at Poole and Berry Hill. Richard@firstenergy.co.u

- Wolfgang Doczyck – Siloxane removal plant. wodoc@siloxa.com