

Solid Oxide Fuel Cells

- Utilizes Hydrogen from gaseous fuels and Oxygen from air
- 650 – 1000 °C temperature
- Atmospheric pressure

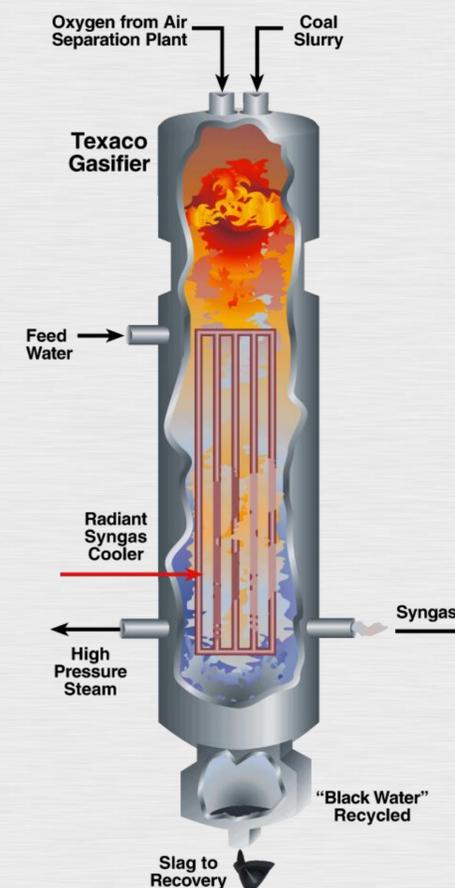
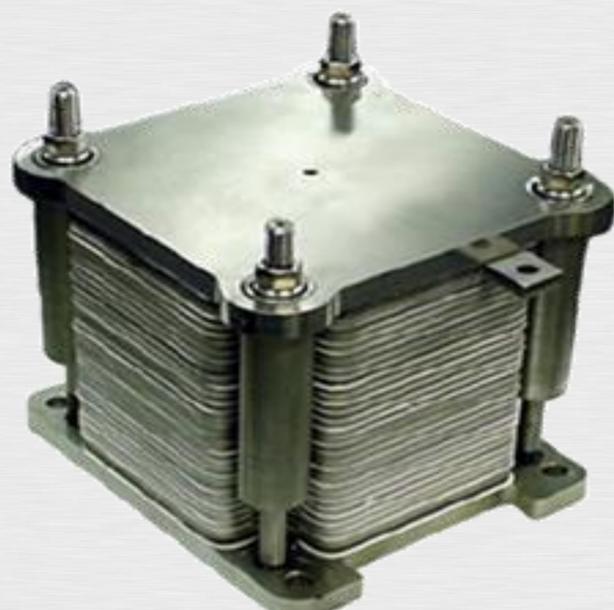


Advanced Turbines

- Fuel - Natural Gas, Hydrogen, or Coal Derived Synthesis gas
- Pressure ratios of 30:1 and up to 1300 °C combustion temperatures

General Sensor Requirements

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|----------------------|---|
| Fuel Quality | Coal – Heating Value (C,H, O), Minerals and ash |
| Fuel Quality | Natural Gas – CH ₄ , other hydrocarbons, include LNG Synthesis Gas – H ₂ (~26%), CO (~37%), CO ₂ & H ₂ S Conditions near 500 C & up to 800 psi, Fast response |
| Exhaust Gas | NO _x – 2-5,000 ppm, SO _x 3-5,000 ppm, Particulate, Mercury (ppb), CO (ppm-%), CO ₂ (%) |
| Temperature | 1000-1600 C, highly erosive and corrosive Packaging for extreme conditions |
| Pressure | Up to 1000 psi, high temperature, erosive & corrosive Dynamic pressure for turbine applications |
| Materials Assessment | Refractory Life, Thermal Barrier Coating Life Piping and tubes for stress/strain, corrosion, cracking |



UltraSupercritical Boilers/ Turbines

- Development of ferritic, austenitic, and nickel-based alloy materials for USC boiler conditions
- Up to 760 °C temperature
- 5000 PSI pressure



Gasifiers

- Up to 1600 °C
- Up to 1000 PSI
- Variety of gasifier designs and operating conditions. Harsh conditions found in slagging gasifiers.