BREAKOUT GROUP 3: HIGH TEMP (SOFC) SYSTEM AND BOP
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KEY TECHNICAL BARRIERS

SEALS	DURABILITY/RELIABILITY/DEGRADATION	CONTAMINANTS
• Seals for stacks tolerant to high thermal cycling	• A better understanding of degradation mechanisms within the stack and at the system component level • The requirement for performance degradation to be <1%/10,000 hours for 'real-world' stationary applications • The need for stack failure prevention during operational transients and system upsets • Lack of accelerated durability testing protocols • Thermal cycling issues • Control system requirements to accommodate transients • The need for low-cost and durable coatings • The need for low-cost, high-temperature, low-creep alloys • Carbon formation during load and temperature transients	• Sulfur containing odorants in fuel • Cathode tolerance to Cr and other impurities

BOP EFFICIENCY/COST	SENSORS/CONTROLS	SYSTEM INTEGRATION
• Cost and durability of high temperature blower (anode and cathode recycle and cathode cooling), heat exchanger • Thermal management/integration • The need for simplicity: eliminate and integrate functions • Post reformer syngas clean up requirements	• The need for affordable, reliable, high temperature sensors/controls (H_2S; Voltage; diagnostics) • The need for affordable, long-life, non-pulsing liquid metering	• The need for a technical validation program to assess cost and reliability under 'real life' conditions • The need for low cost, high yield, at low volume manufacturing processes

BREAKOUT GROUP 3: HIGH TEMP (SOFC) AND BOP CRITICAL R&D NEEDS

SEALS	DURABILITY/RELIABILITY/DEGRADATION	MATERIALS	CONTAMINANTS	BOP EFFICIENCY/COST
• New stack seal designs that can withstand numerous thermal cycles	• Fundamental understanding of materials degradation, from cell to stack • Accelerated testing protocols for stacks and integrated systems • Understanding of oxidation resistance/creep strength of alloys for >800°C • Stack aging/durability test facility and program • Generic integrated BOP degradation mechanisms and prediction	• Materials/architecture development to support internal reforming of C_2^+ hydrocarbons • Validation of low cost coating and alumina forming alloy for hot section BOP components	• Collaborate with odorant developers (N.G. & H_2) to eliminate sulfur • Identification of non-coal contaminants and impact on performance - environmental air contaminants • Reforming alternative liquid fuels	• Develop low cost heat exchanger alloy and coatings • Low temperature metal supported cell stack for rapid start-up and robustness to thermal cycling, minimizing Cr-poisoning issue, and improved durability • Develop SOFC stack 'mule' for BOP subsystem component development and validation • Improved cheaper more reliable power electronics

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CRITICAL R&D NEEDS (CONT'D)

SENSORS/CONTROLS	SYSTEM INTEGRATION	FUEL PROCESSORS
• Develop a low cost manufacturable temperature sensor for high temperature environments (500°C - 1100°C) • Develop a low cost, manufacturable chemical or H_2S sensor that operates at high temperature (700°C) • Individual cell performance measurements in stacks (sensors) • Model - predictive process control - take advantage of sensors	• 200 kW – 1MW fuel cell system development for medium to large commercial/small industrial applications • System demo at 10 to 1000kW to understand cost ,durability and performance in real life • SOFCEL (250 kW - 1 MW)	• Rugged, robust, high temperature fuel reforming catalysts • Integrated fuel processor / heat exchanger for < 100 kW • Develop multi fuel capability for SECA stacks • High temperature CO_2 membrane to improve fuel processor durability (reduce coking)