Fuel Cells: Installation & Operation as Distributed Generation Assets

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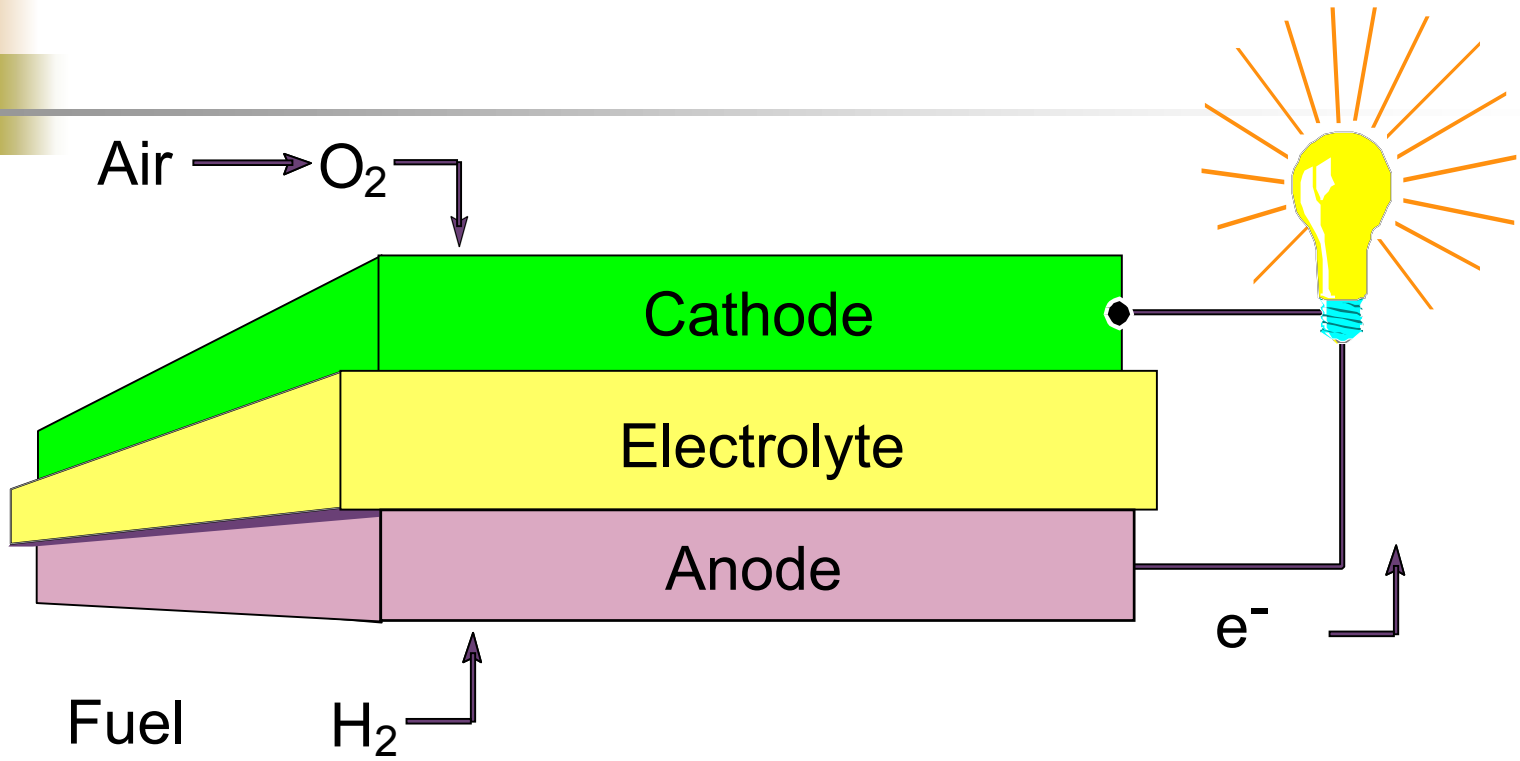
Overview

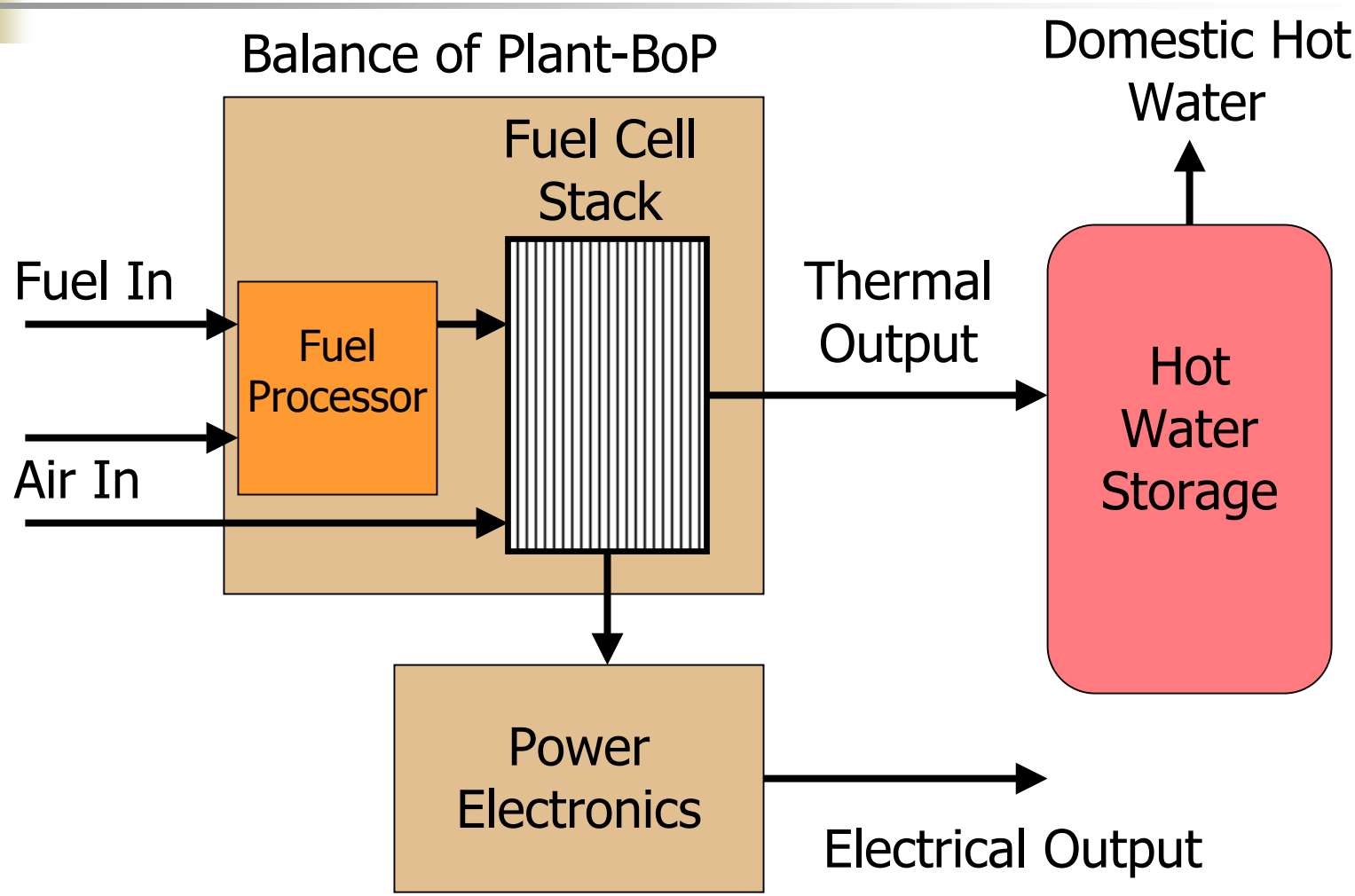
- What is a Fuel Cell?
- What is a Fuel Cell System?
- Fuel Cell Systems and Distributed Generation
- Codes and Standards
- Brooks City-Base Residential Fuel Cell Demonstration Project
- Fuel Cells in Future Distributed Generation

What is a Fuel Cell?



- Electrochemical Process
- Direct Conversion to Electricity
- 2H2 + O2 2H2O + Electricity + heat
- Continuous as long as Air (O2) & H2 are provided

What is a Fuel Cell System?



FUEL CELL TECHNOLOGIES

Fuel Cell Technology	Electrolyte	Operating Temperature	Efficiency (%)	
			Electrical	Overall
PEMFC	Ion exchange membrane	50 C	30-35	50-60
AFC	KOH	80 C	Low	Low
PAFC	Phosphoric Acid	200 C	36	80
MCFC	Alkali carbonates	650 C	45-55	75-80
SOFC - High Temp.	Solid metal oxide	980 C	45-47	75-80
SOFC - Reduced Temp.	Solid metal oxide	660 C	42-45	60-70

Source: SFCCG, Inc. (Aug. 1997)

Product Standards

- **ANSI Z21.83** - Standard on Fuel Cell Power Plants. Scope includes stationary FCS. Currently addresses natural gas and propane fueled systems.
- **ANSI CSA FC 1** - This proposed standard will replace Z21.83 and be broadened to include most types of fuels, gas and liquid, hydrocarbons and alcohols.
- **ANSI CSA FC 3 -** Draft Portable Fuel Cell Power Generators. Scope includes portable FCS.

Used to Certify Equipment – Not installations

Installation Standards

- **NFPA 70** - National Electrical Code, Article 692
- **NFPA 54** – National Fuel Gas Code
- **NFPA 31** – Installation of Oil-Burning Equipment
- **NFPA 853** – Design and Installation of Stationary Fuel Cell Power Plants.

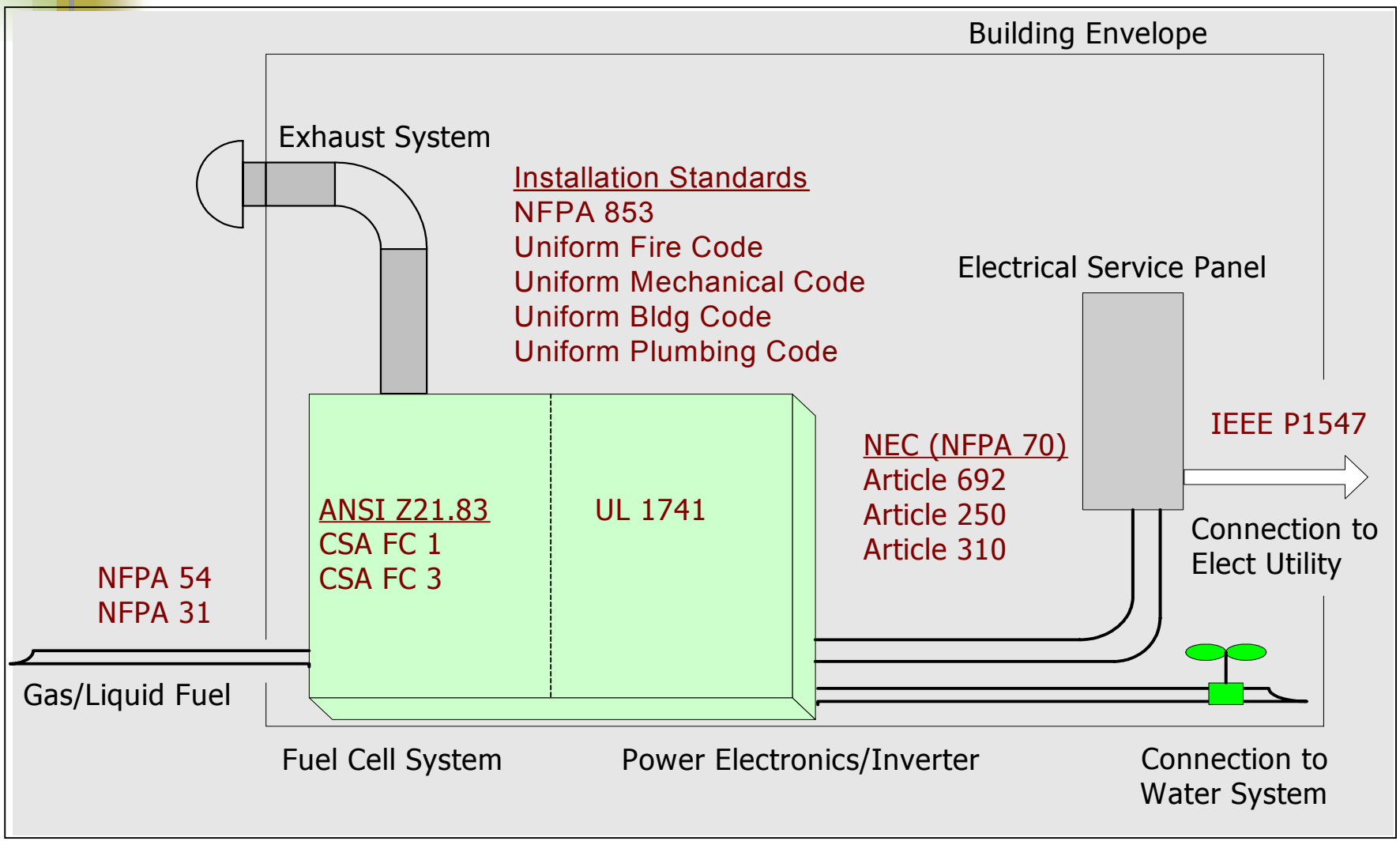
Electrical Interconnection

- **UL 1741** – Standard for Inverters, Converters, and Controllers for use in Independent Power Systems. Scope includes both Grid-Tied and Grid Independent systems.
- **IEEE P 1547** – Standard for Interconnecting Distributed Resources with Electric Power Systems.

- In the future these two standards will be harmonized, and the work done in P1547 will be adopted into UL 1741.

Interfaces

Stationary Fuel Cell System



Brooks Residential Fuel Cell Demonstration Project

- Sponsored by the US Army Corps of Engineers (COE)
  - Demonstrate three fuel cells
  - Each fuel cell provides up to 5 kW
  - Natural gas fuel
  - Grid connected, no combined heat and power
- Provide feedback to COE on fuel cell performance in local climate
- Disseminate fuel cell information and experience to partners, industry and public

Realtime Data From Brooks City-Base

- Data Acquisition System
- Accessible at www.swri.org/fuelcell
- Updates Every 15 Seconds

Fuel Cells in Future DG

- Conventional Generating Assets controlled real-time by central facility (*Hard Control*)
  - Fixed Communication Lines
  - Load following or Real and Reactive Power Control
  - Dispatchable
- Most Fuel Cell DG assets are currently grid connected and locally controlled
  - Controlled to set power output
  - Not load following
  - Real power management only

Fuel Cells in Future DG

- Future Fuel Cell DG Assets will be controlled from a central facility non-real time (*Soft Control*)
  - Internet connection based communications
  - Real and Reactive Power Control
  - Dispatchable
  - Increased revenue for asset owner
  - Increased operational efficiency for grid

For more information - Codes and Standards

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