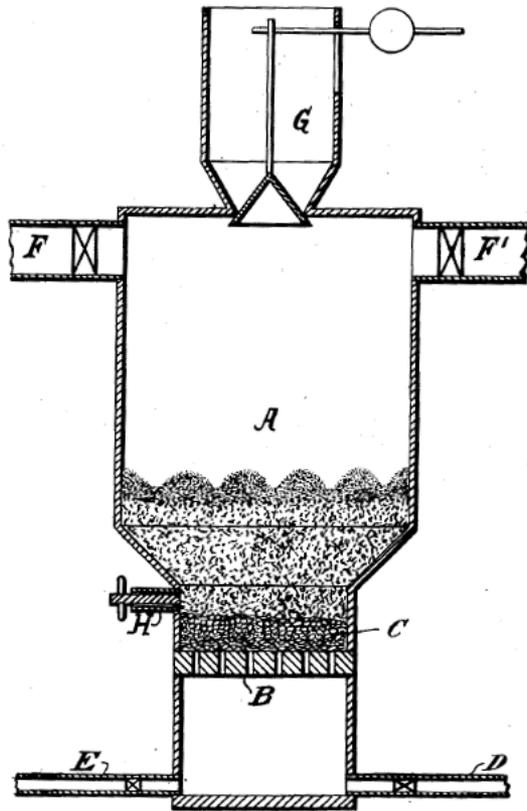


# **Evolution of Coal-Fired Fluidized Bed Technology and Potential Operations Constraints**

# First Fluidized Bed Patents (US)



**“Manufacturing Fuel Gas”**

**Fritz Winkler, Ludwigshafen-am-Rhine**

**1,687,118**

**Applied: 1923**

**Granted: 1928**

**Assigned to I.G. Farbenindustrie Aktiengesellschaft**

INVENTOR  
*Fritz Winkler*  
BY  
*Hayffelsland*  
ATTORNEYS



# Early Fluidized Bed Developments

- **Winkler Gasifiers, I.G. Farben Works at Leuna\* (1929-1931)**
- **Fluid Bed Calcining and Ore Roasting (1950's)**
  - **Fluid Bed Roasting = Fluid Bed Combustion**
- **Fluidized Bed Combustion Developed for Power Generation (Babcock Atlantique, 1950's)**

**\*Dr.'s Sabel und Jeltsch from the Plant were Interviewed (Interrogated) by Odell et al., April 1945**

# More Recent Developments

- **Public Utility Regulatory Policy Act (1978)-  
Independent Power Producers**
  - **Qualifying Facility Status for Fluidized Bed-Friendly Fuels**
- **CFB Boiler Installed Capacities grow to 300 MW (Sub-Critical), 460 MW (Supercritical)**
- **Fuels:**
  - **Coal**
  - **Coal Waste**
  - **Pet Coke**
  - **Biomass**
  - **MSW**

# **DOE FE and Fluidized Beds**

- **R&D- Waste Coal (1960's- as the Bureau of Mines)**
- **Shamokin Demonstration Project (Late 1970's)**
- **Nucla CFB Demonstration (1980's)**
- **JEA Northside Project (early 2000's)**
- **Development of the TRIG Gasifier**
- **Ongoing R&D in Fundamentals**

# Recent DOE Involvement in Fluidized Bed Technology Development

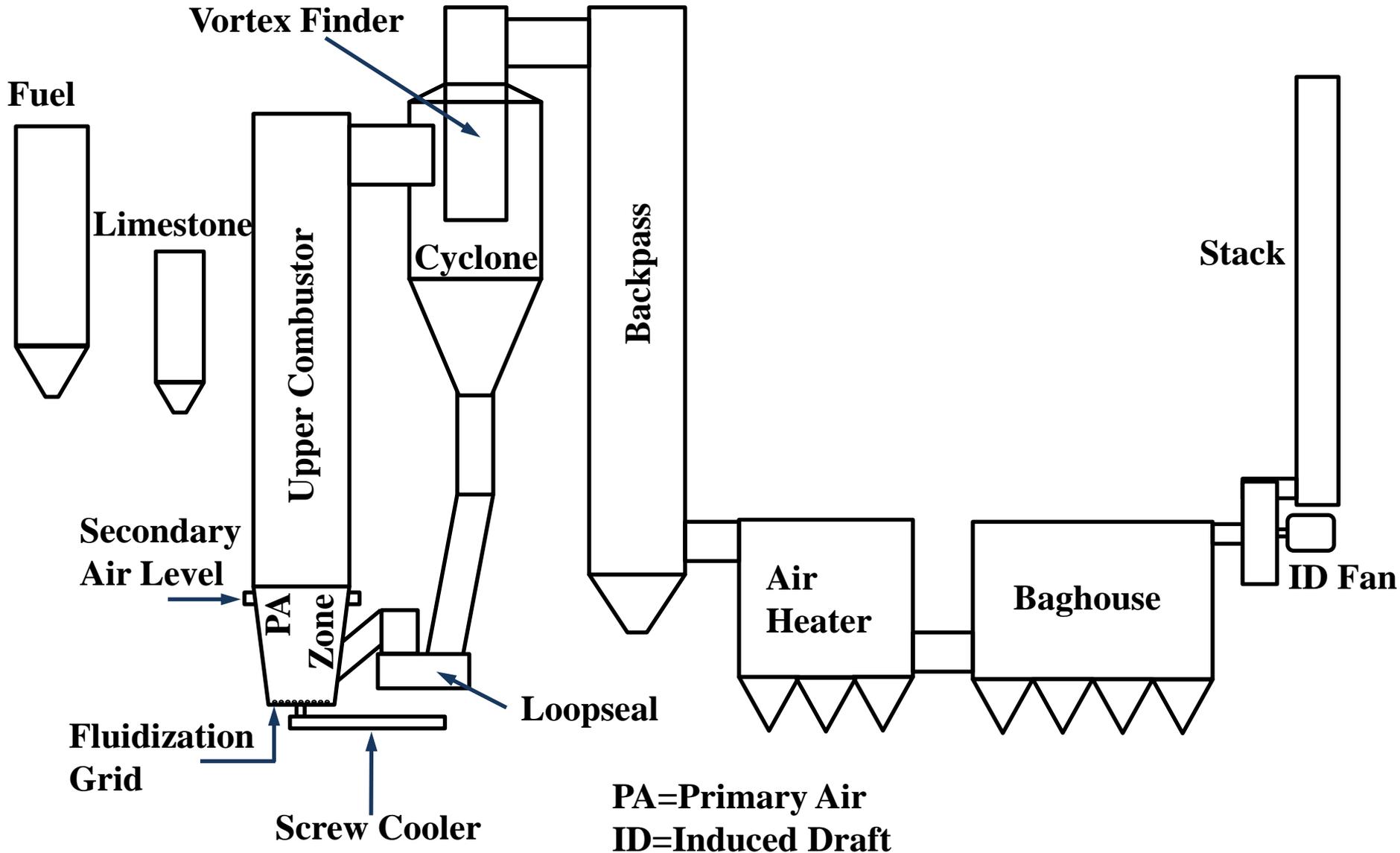


**JEA Northside Station, 2 X 300 MW  
Repowering with CFB Boilers**

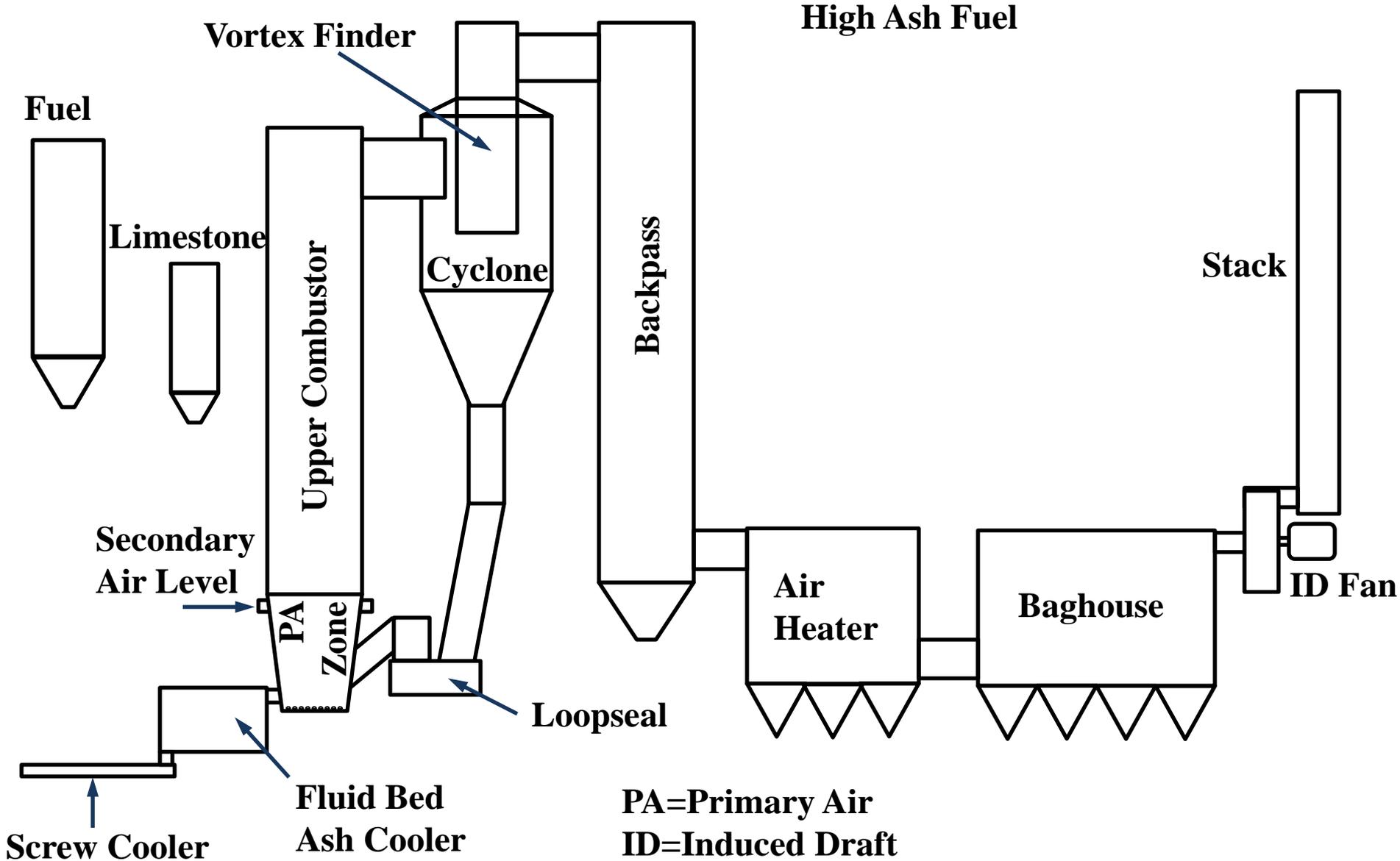
**Southern Company Kemper IGCC  
Project, 582 MW with 2 TRIG Gasifiers**



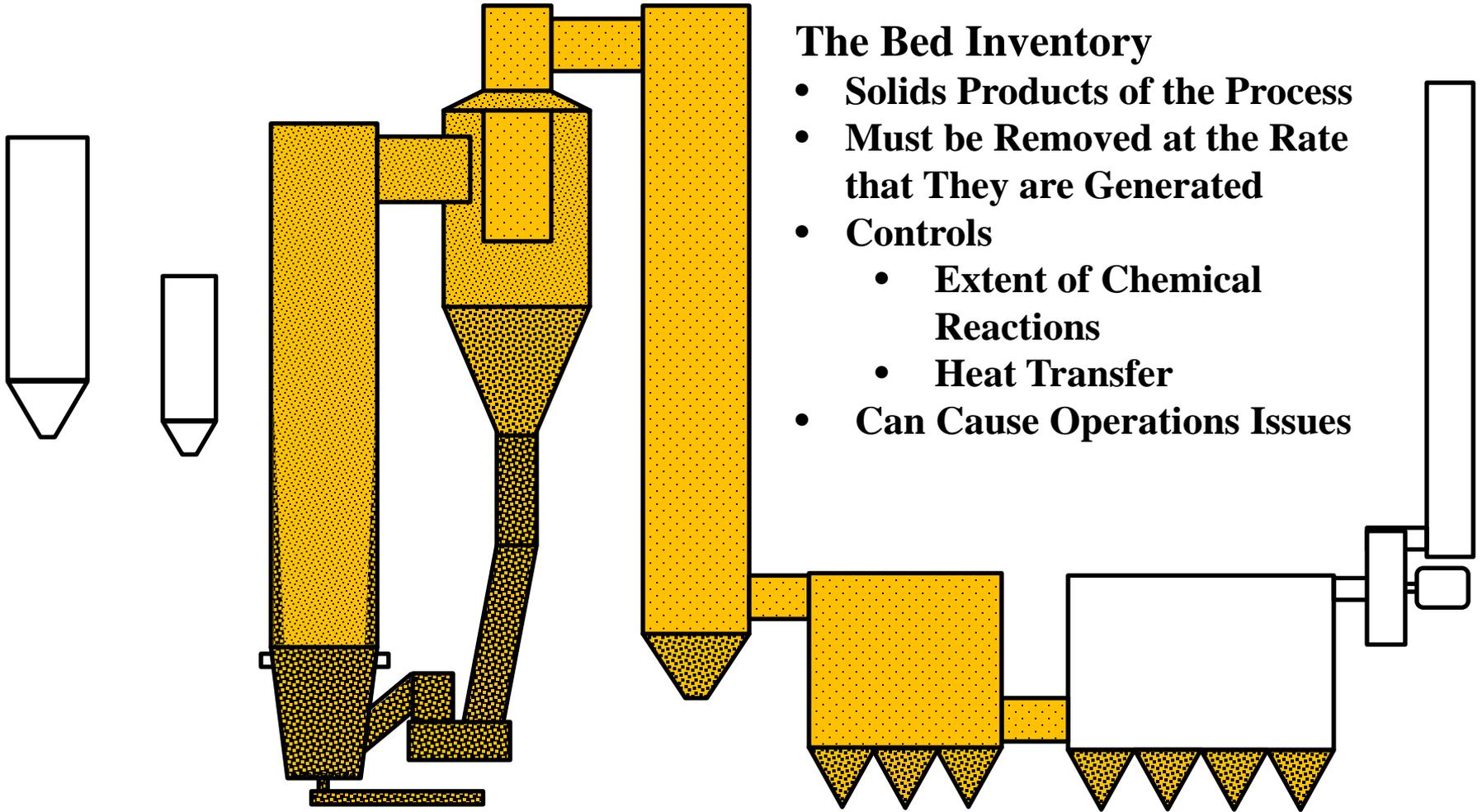
# Common CFB Boiler Component Terms



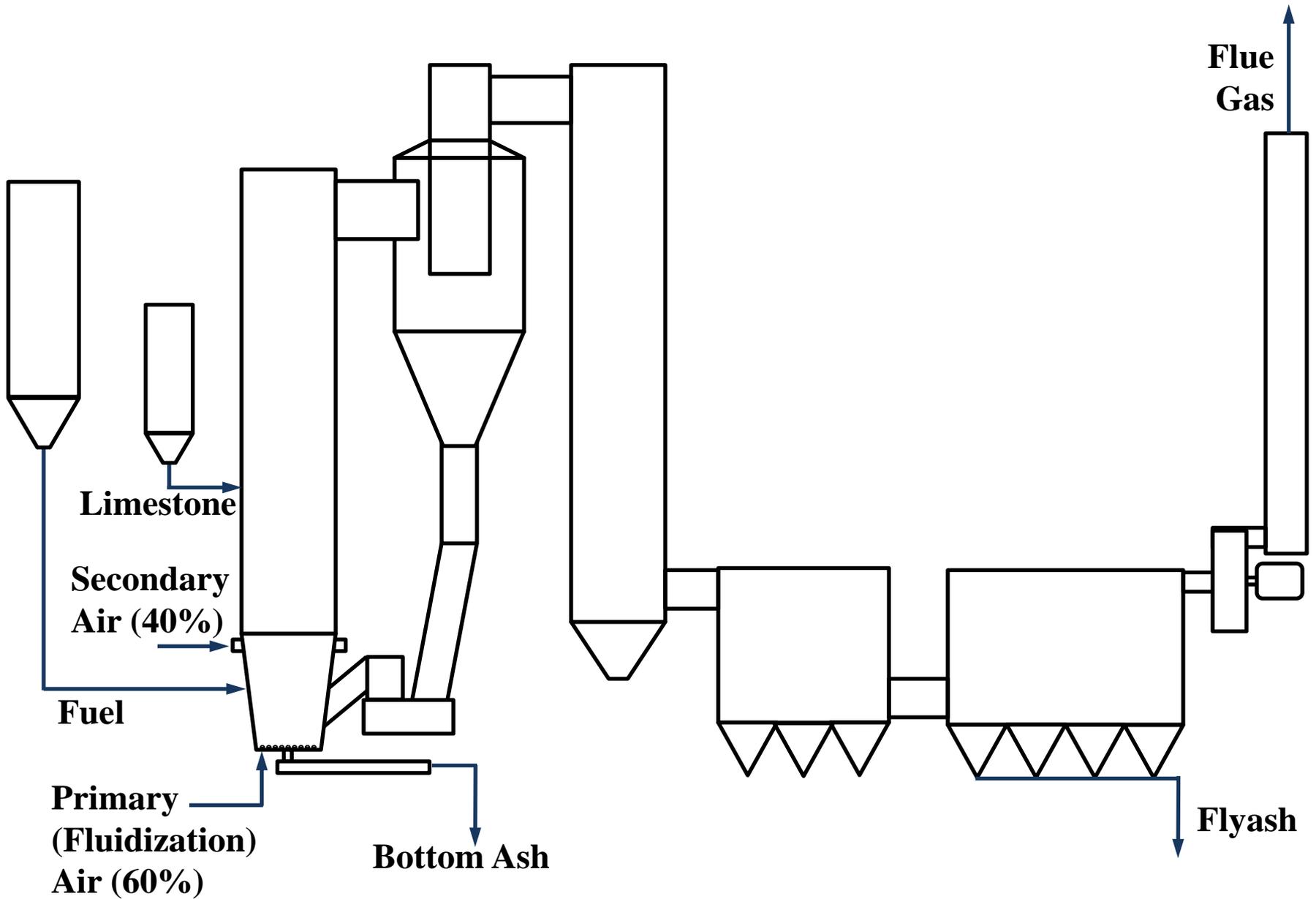
# Common CFB Boiler Component Terms



# Common CFB Boiler Component Terms



# Material Balance Around a CFB Boiler

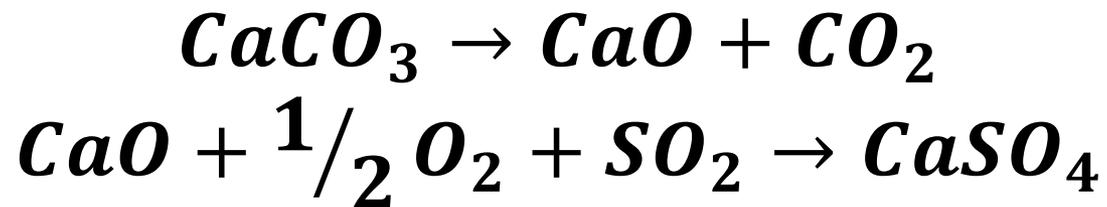


# Some Definitions

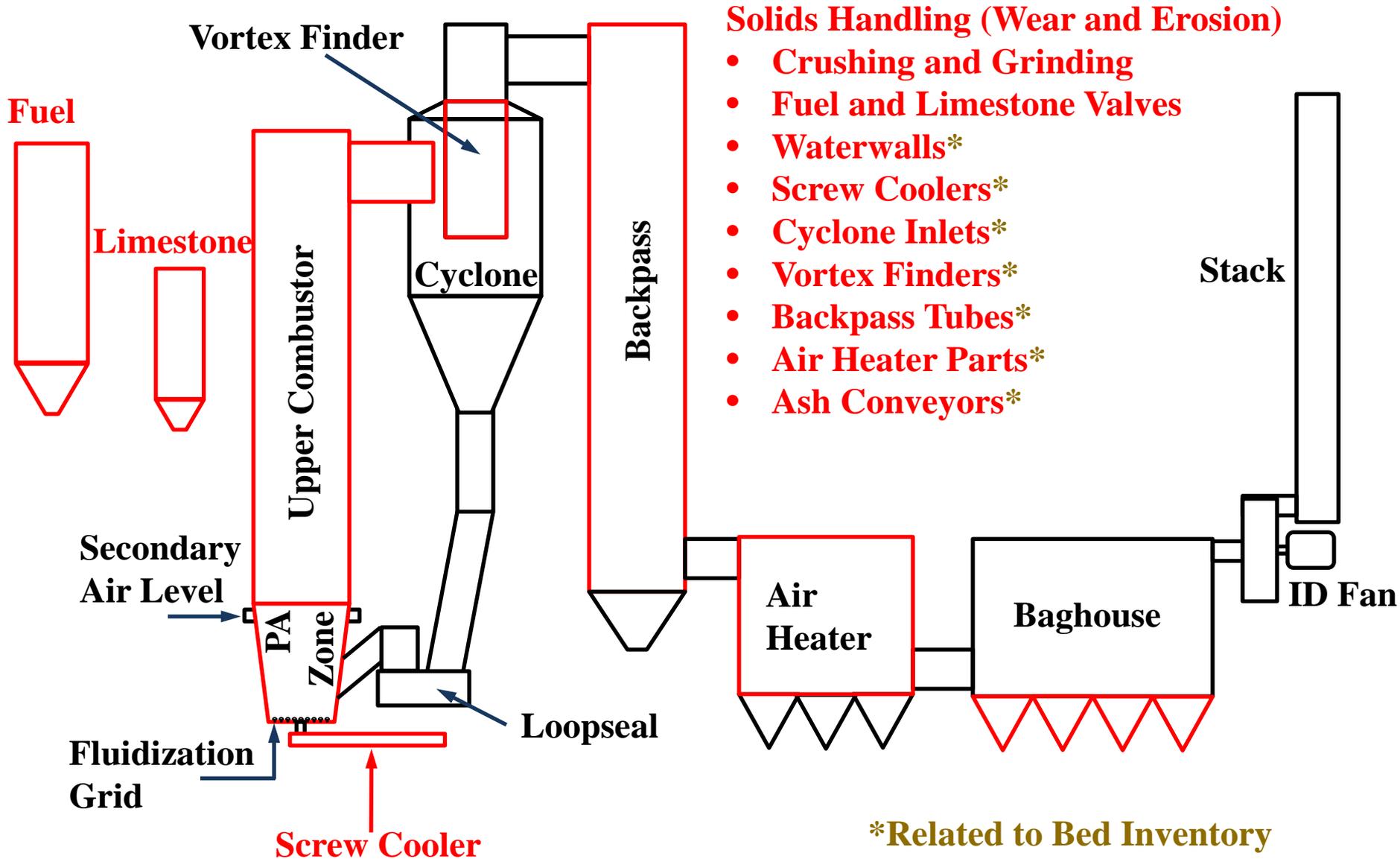
- Bottom Ash: Solids that are Removed Directly from the Bed to Maintain DP while New Solids are being Generated
- Flyash: Solids that are Removed from the System Entrained with the Fluidization Medium (Cyclone Overflow)
- Ash Split- Relative Proportions of Bottom Ash and Flyash Generated by the System(for Example, 55% Bottom Ash)

# What Happens in a Coal-Fired CFB

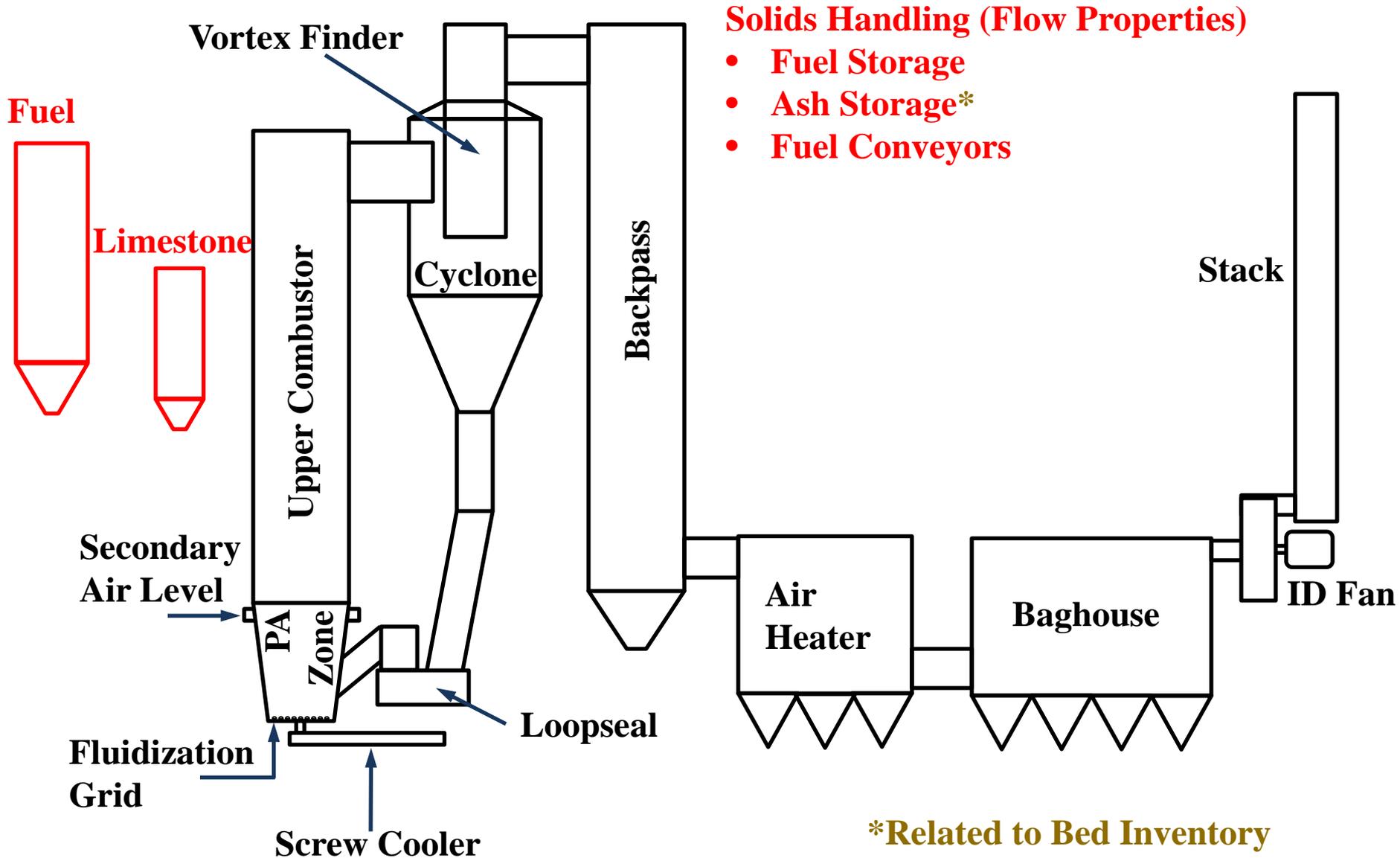
- **Devolatilization (Boilers and Gasifiers)**
- **Combustion (Boilers, Gasifiers near Grid)**
- **Gasification (Gasifiers, Boilers in PA Zone)**
- **NO<sub>x</sub> Reduction (Including Reaction of NO<sub>x</sub> with Char)**
- **Sulfur Capture by Sorbent (Limestone):**



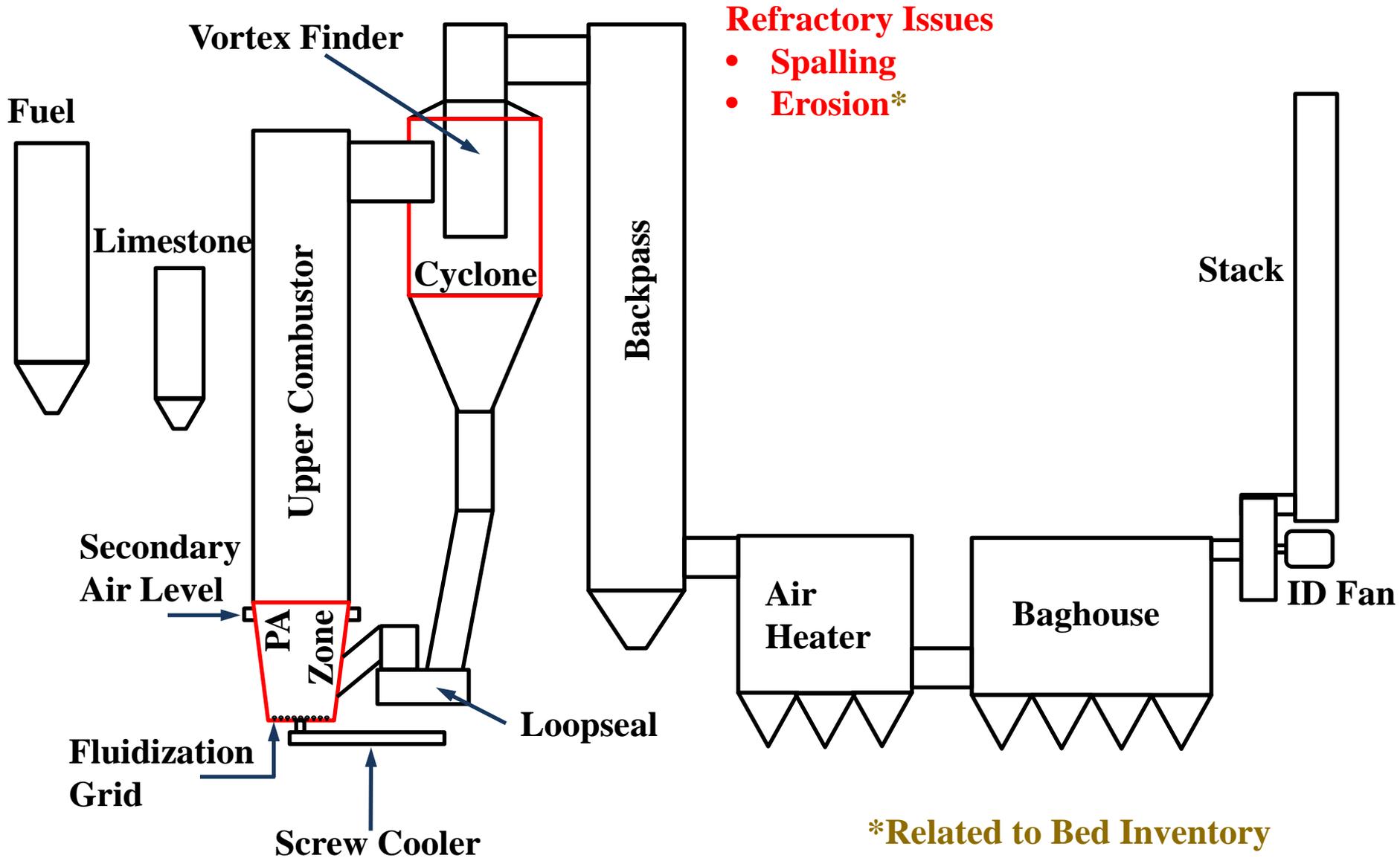
# CFB Boiler Potential Operations Constraints



# CFB Boiler Potential Operations Constraints



# CFB Boiler Potential Operations Constraints



# CFB Boiler Potential Operations Constraints

