AES Greenidge Multi-Pollutant Control Project

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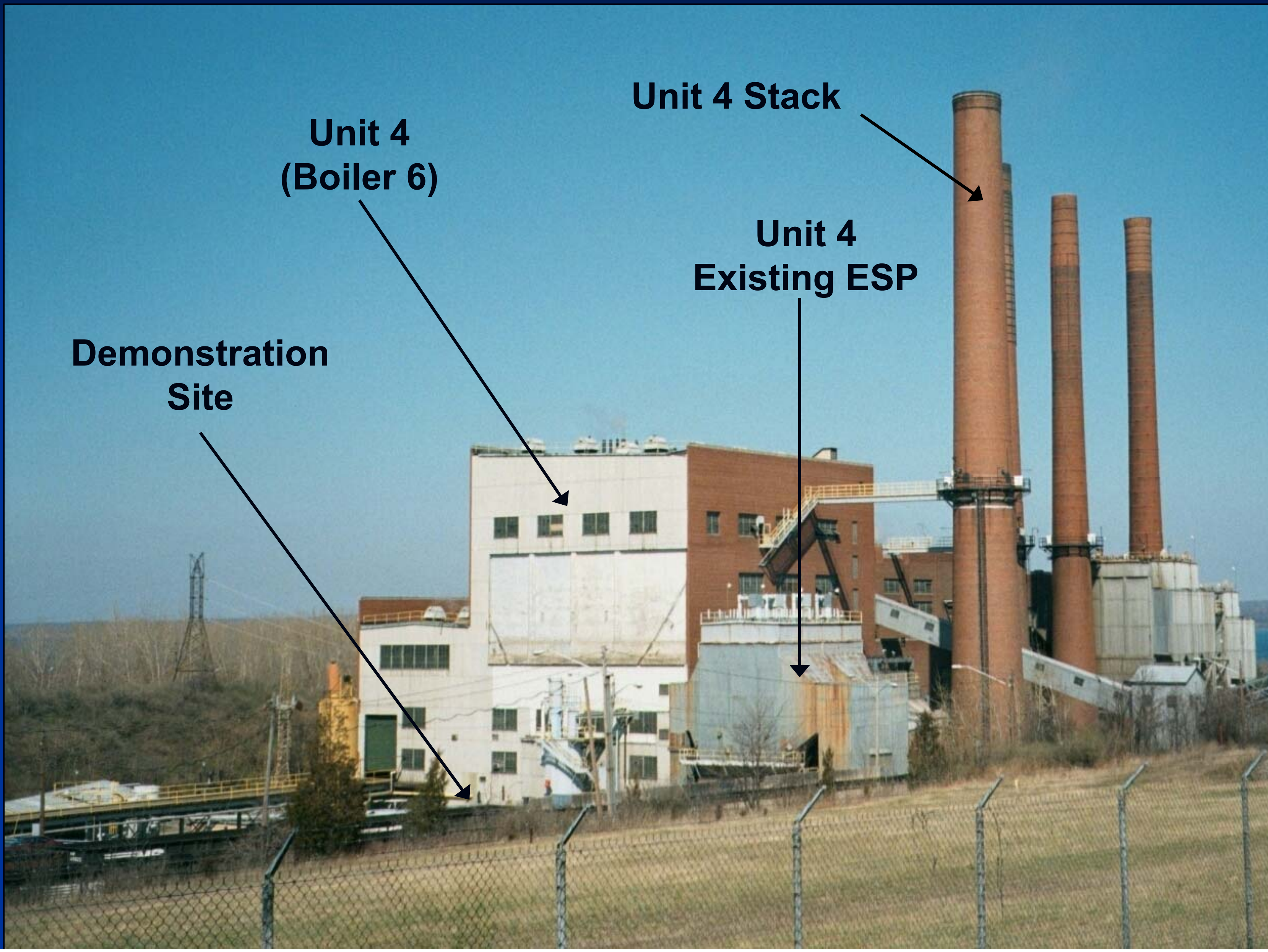
The Greenidge Multi-Pollutant Control Project

- Power Plant Improvement Initiative
  - Cost-shared collaboration between U.S. DOE and industry
  - Commercial demonstration of coal-based technologies
  - Goal: Help to ensure the reliability of the nation's energy supply by improving the efficiency, cost-competitiveness, and environmental performance of new and existing coal-fired electric generating facilities
- Greenidge Project
  - DOE Cooperative Agreement signed May 2006
  - Goal: Demonstrate a multi-pollutant control system that can cost-effectively reduce emissions of NO_x, SO_2, mercury, acid gases (SO_3, HCl, HF), and particulate matter from smaller coal-fired power plants

AES Greenidge Unit 4 (Boiler 6)

- Dresden, NY
- Commissioned in 1953
- 107 MWe (net) reheat unit
- Boiler:
  - Combustion Engineering tangentially-fired, balanced draft
  - 780,000 lb/h steam flow at 1465 psig and 1005 ºF
- Fuel:
  - Eastern bituminous coal
  - Biomass (waste wood) – up to 10% heat input
- Current emission controls:
  - Overfire air (natural gas reburn not in use)
  - ESP
  - No FGD - mid-sulfur coal to meet permit limit of 3.8 lb/MMBtu

AES Greenidge Unit 4 (Boiler 6)



Multi-Pollutant Control Process

- Combustion modifications
- Hybrid SNCR / SCR
  - Urea-based, in-furnace selective non-catalytic reduction
  - Single-bed, in-duct selective catalytic reduction
- Activated carbon injection
- Turbosorp® circulating fluidized bed dry scrubber
- Baghouse

Greenidge Project Performance Targets

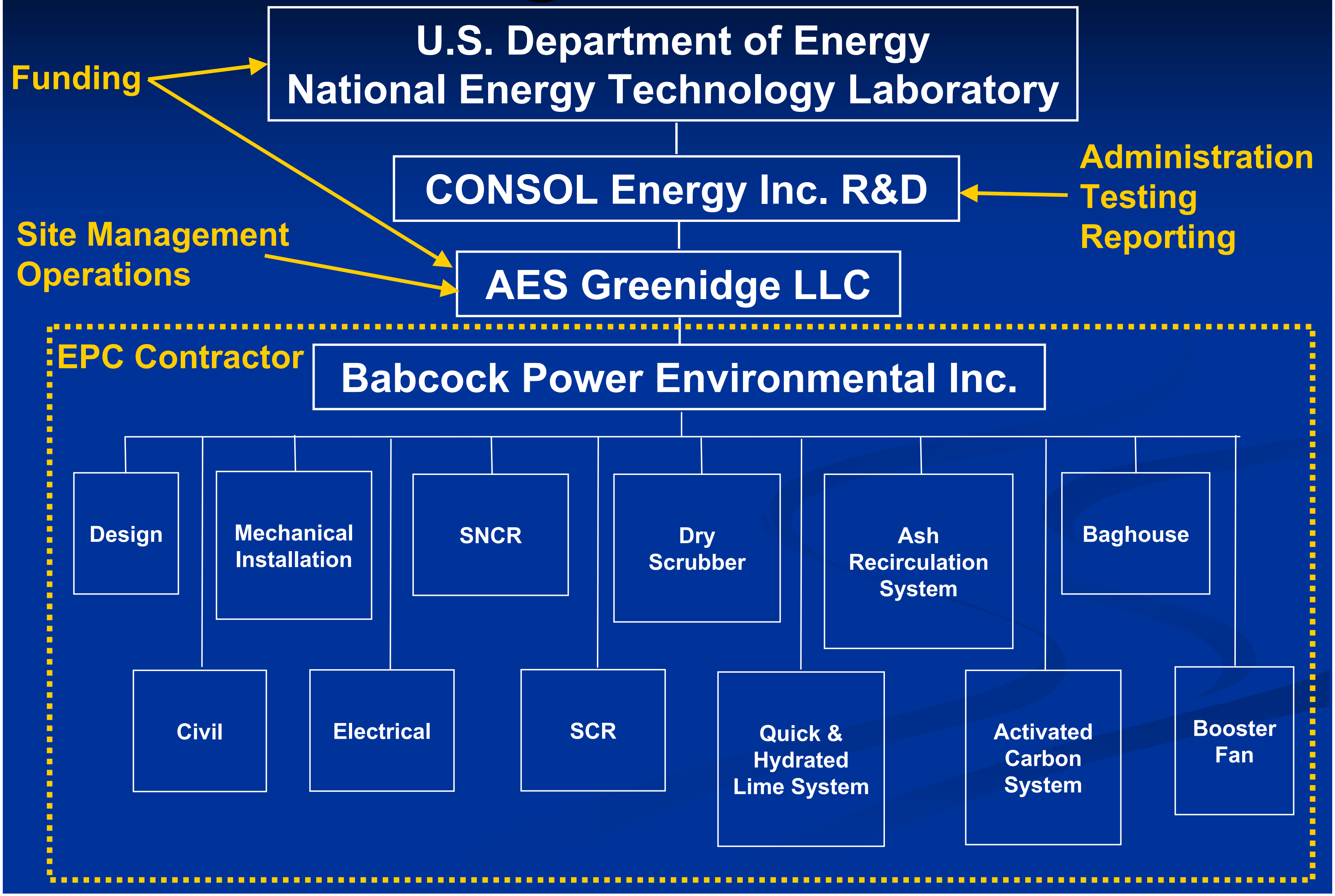
Fuel: 2-4% sulfur bituminous coal, up to 10% biomass

Parameter	Goal
NO_x	≤ 0.10 lb/MMBtu (full load)
SO_2	≥ 95% removal
Hg	≥ 90% removal
SO_3, HCl, HF	≥ 95% removal

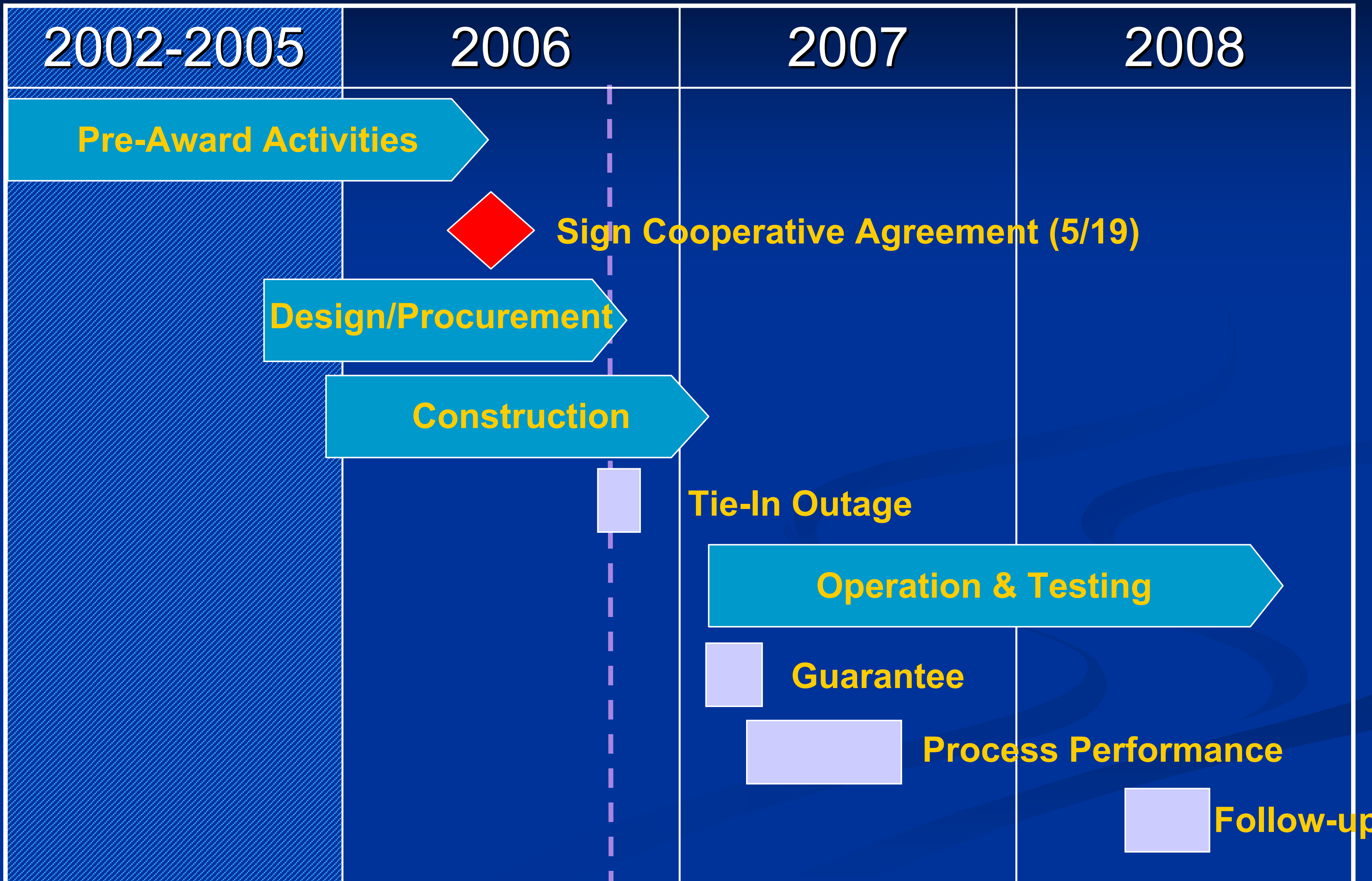
Capital (EPC) Cost: ~ $330 / kW

Footprint: ~ 0.4 acre

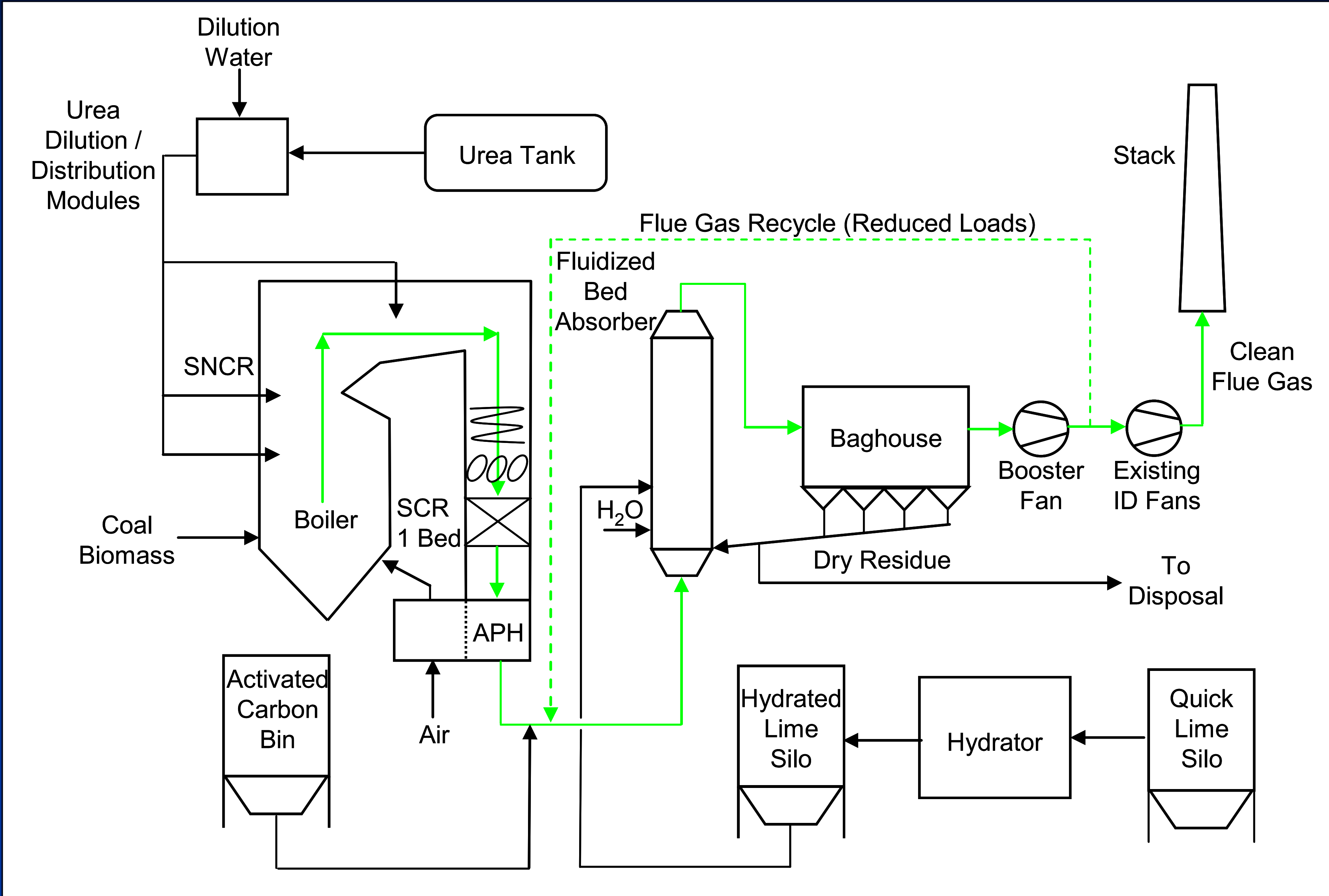
Organization



Project Schedule



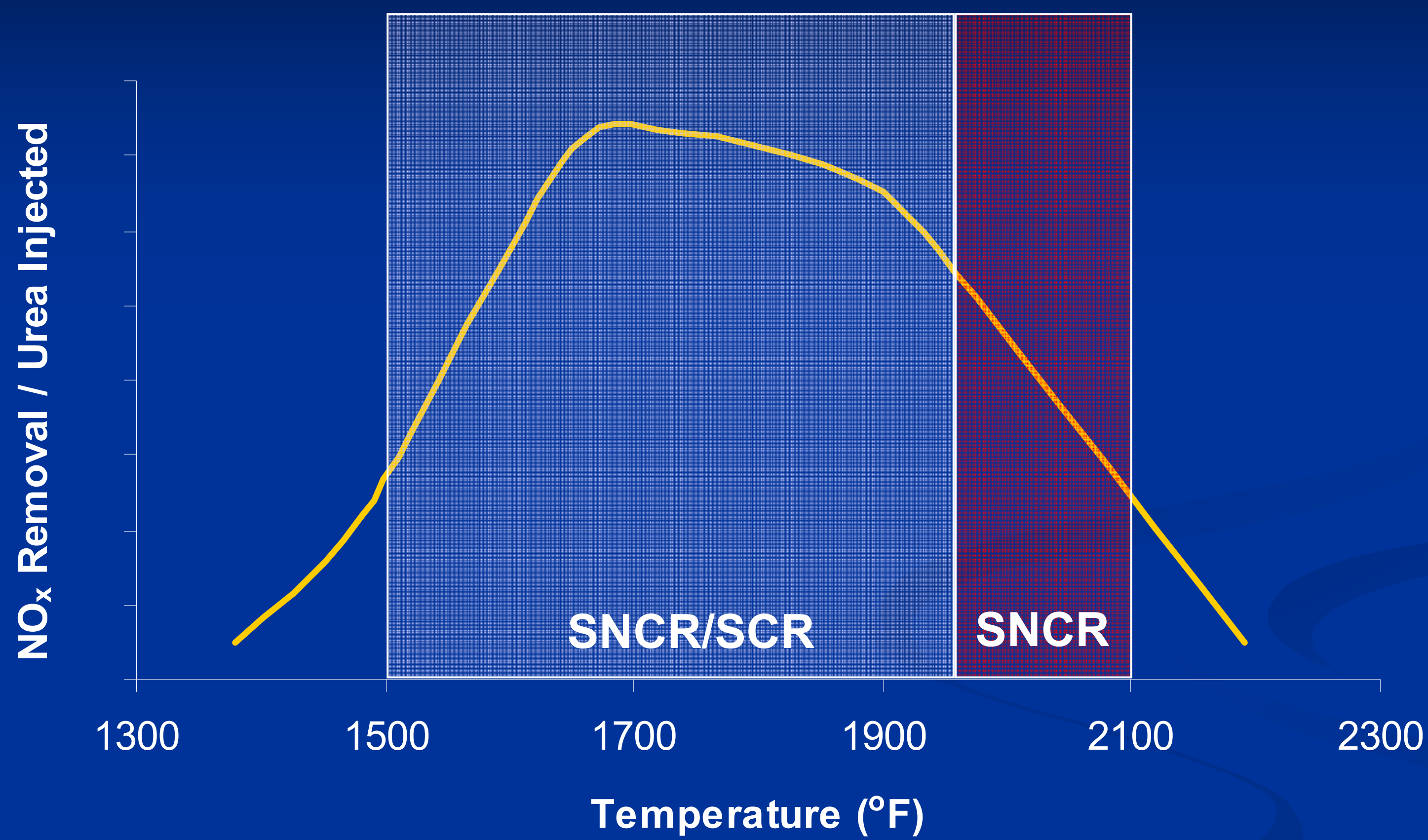
Process Flow Diagram



Hybrid NO_x Control

- Combustion Modifications
  - Replace coal, combustion air, and overfire air nozzles
  - Improve fuel/air mixing, burner exit velocity, secondary airflow control, and upper furnace mixing; reduce CO
  - Reduce NO_x to 0.25 lb/MMBtu
- SNCR
  - $CO(NH_2)_2 + 2\ NO + ½\ O_2 \rightarrow 2\ N_2 + CO_2 + 2\ H_2O$
  - Reduce NO_x by ~ 42.5% (to 0.144 lb/MMBtu)
- SCR
  - $4\ NO + 4\ NH_3 + O_2 \rightarrow 4\ N_2 + 6\ H_2O$
  - $6\ NO_2 + 8\ NH_3 \rightarrow 7\ N_2 + 12\ H_2O$
  - Reduce NO_x by > 30% (to ≤ 0.10 lb/MMBtu)

SNCR for Hybrid System

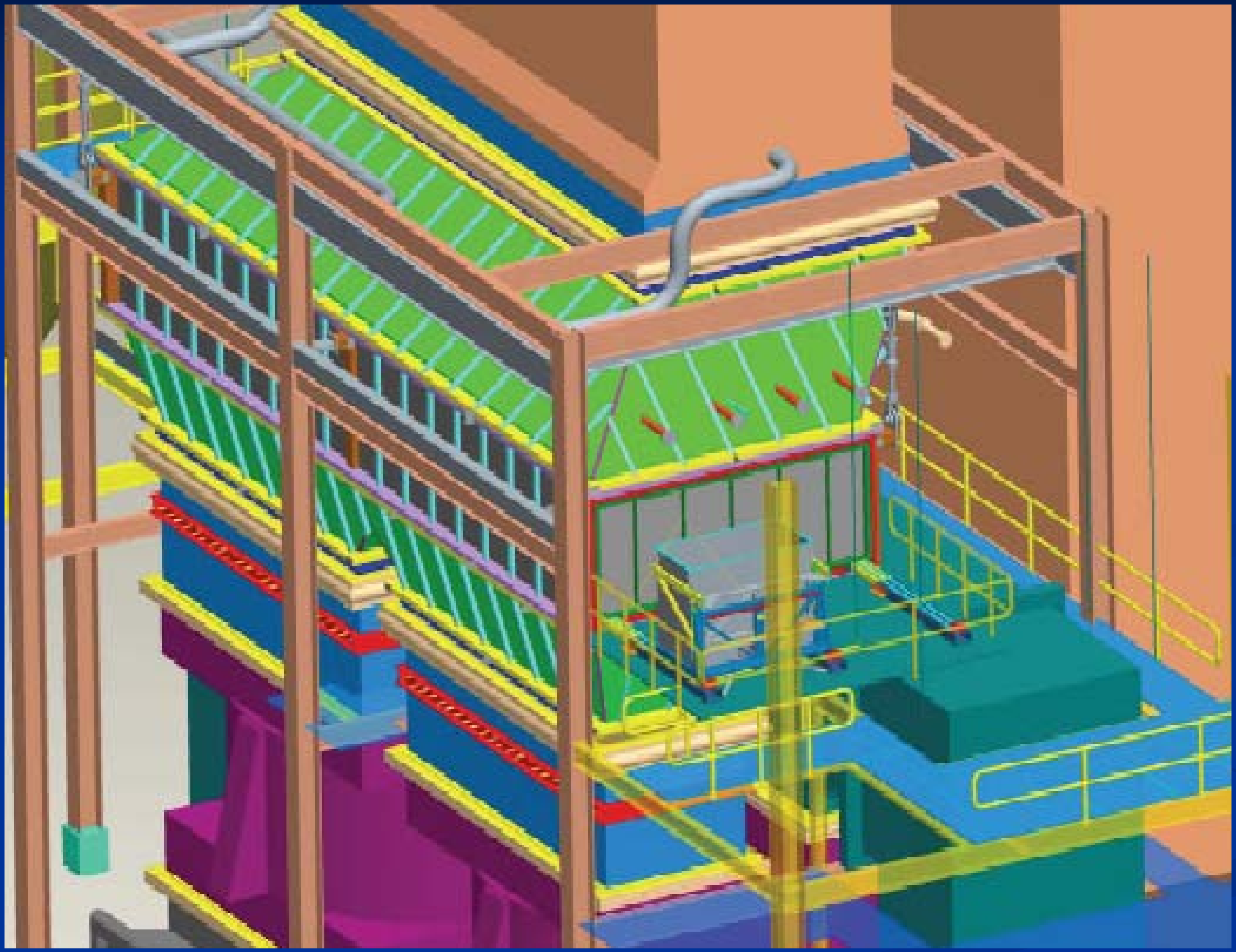


- Greenidge Design:
  - 2 Levels of Wall Injectors (Higher Temperature)
  - 2 Multiple Nozzle Lances in Convective Pass (Lower Temperature)

Delta Wing™ Static Mixers

- Homogeneous flue gas at catalyst face
  - NO_x / NH_3 mole ratio ± 5% RMS deviation
  - Velocity ± 12% RMS deviation
  - Temperature ± 30 °F
- Minimize NH_3 slip
- Maintain mixing at reduced load operation
- Maintain ash entrainment and distribution

Single-Bed, In-Duct SCR



Bed Depth

~ 1.3 m

$SO_2 \rightarrow SO_3$

< 1.0 %

NH_3 Slip

< 2 ppmv

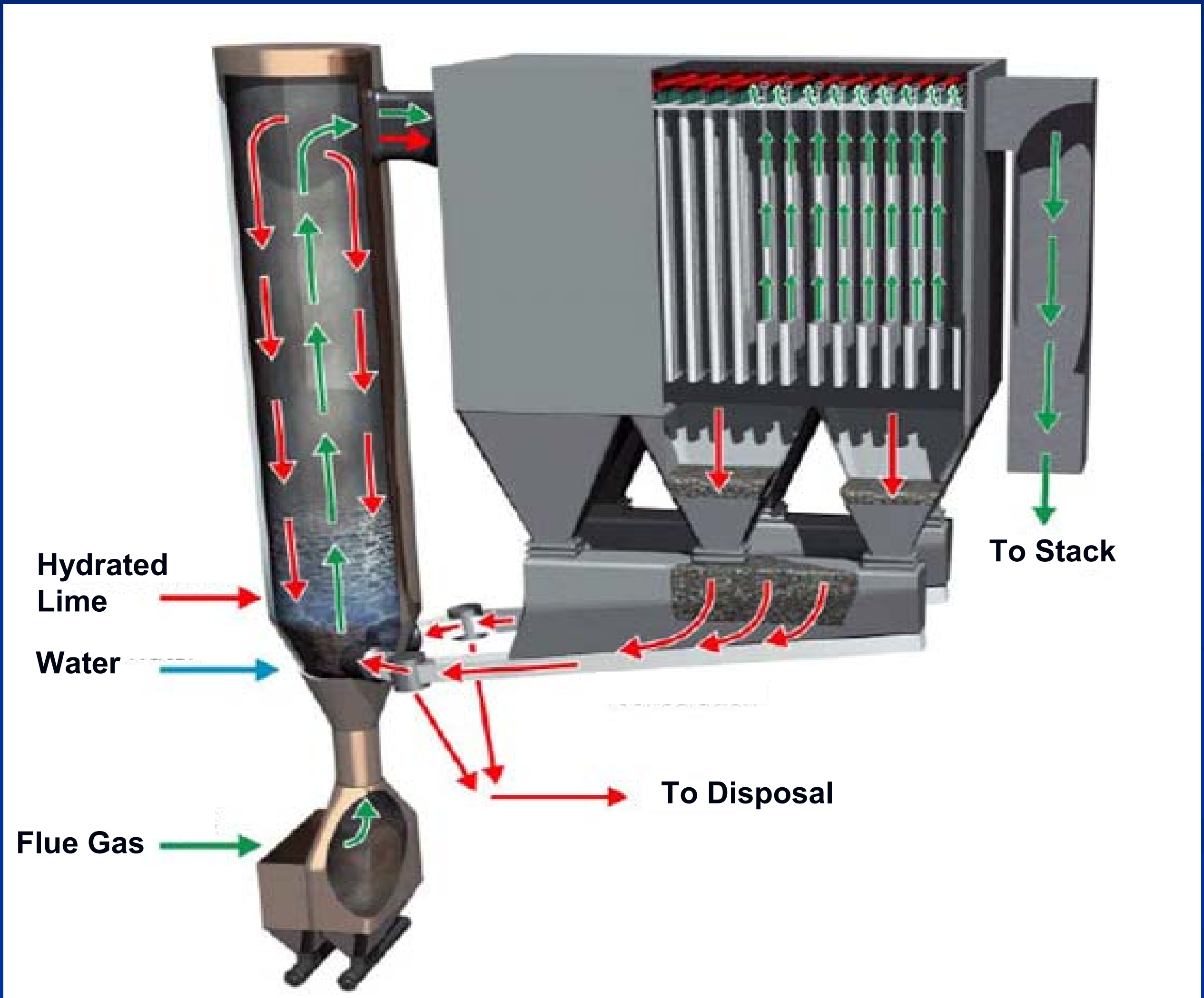
NO_x Removal

> 30%


10/13/2006


12/01/2006

Circulating Fluidized Bed Dry Scrubber Process Concept



- Completely dry
- Separate control of reagent, water, and recycled solid injection
- High solids recirculation
- Applicable to high-sulfur coals
- 15-25% lower reagent consumption than SDA
- Low capital and maintenance costs relative to other FGD technologies

Turbosorp® System at AES Greenidge

- On-site lime hydration system
- 8-compartment pulse jet fabric filter
- Projected Ca/S of 1.5-1.6

Mercury Control

- Expect ≥ 90% removal with low carbon injection rate
  - Similarity to SCR / SDA / FF with bituminous coal
    - Field sampling shows 90% Hg removal often achieved with no ACI
  - Projected activated carbon requirement: 0 – 3.5 lb/MMacf
- SCR catalyst
  - Oxidize Hg^0 to Hg^{2+}
- Activated carbon injection
  - Adsorb Hg^0 and Hg^{2+}
- Circulating fluidized bed dry scrubber / baghouse
  - Reduce temperature (~ 170 ^oF)
  - Facilitate contact between Hg and carbon, fly ash, $Ca(OH)_2$
    - Filter caking
    - Recirculation = high sorbent residence time


12/08/2006