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EERC Technology… Putting Research into Practice

Water and Energy Sustainability and Technology (WEST)

NETL – EXISTING PLANTS WATER PROJECTS MEETING

October 27 and 28, 2008

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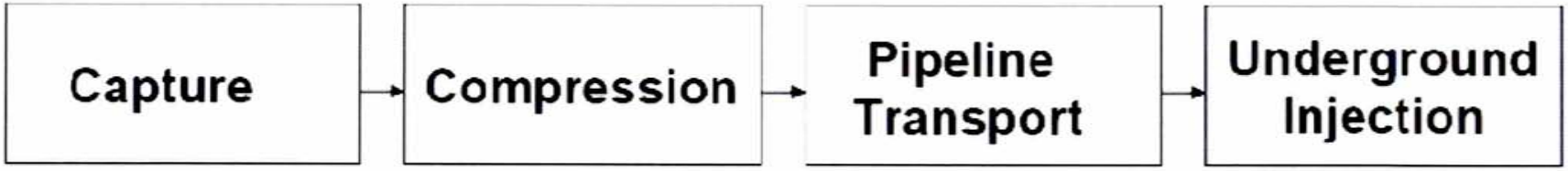
Carbon Dioxide Capture, Transportation, and Sequestration Process



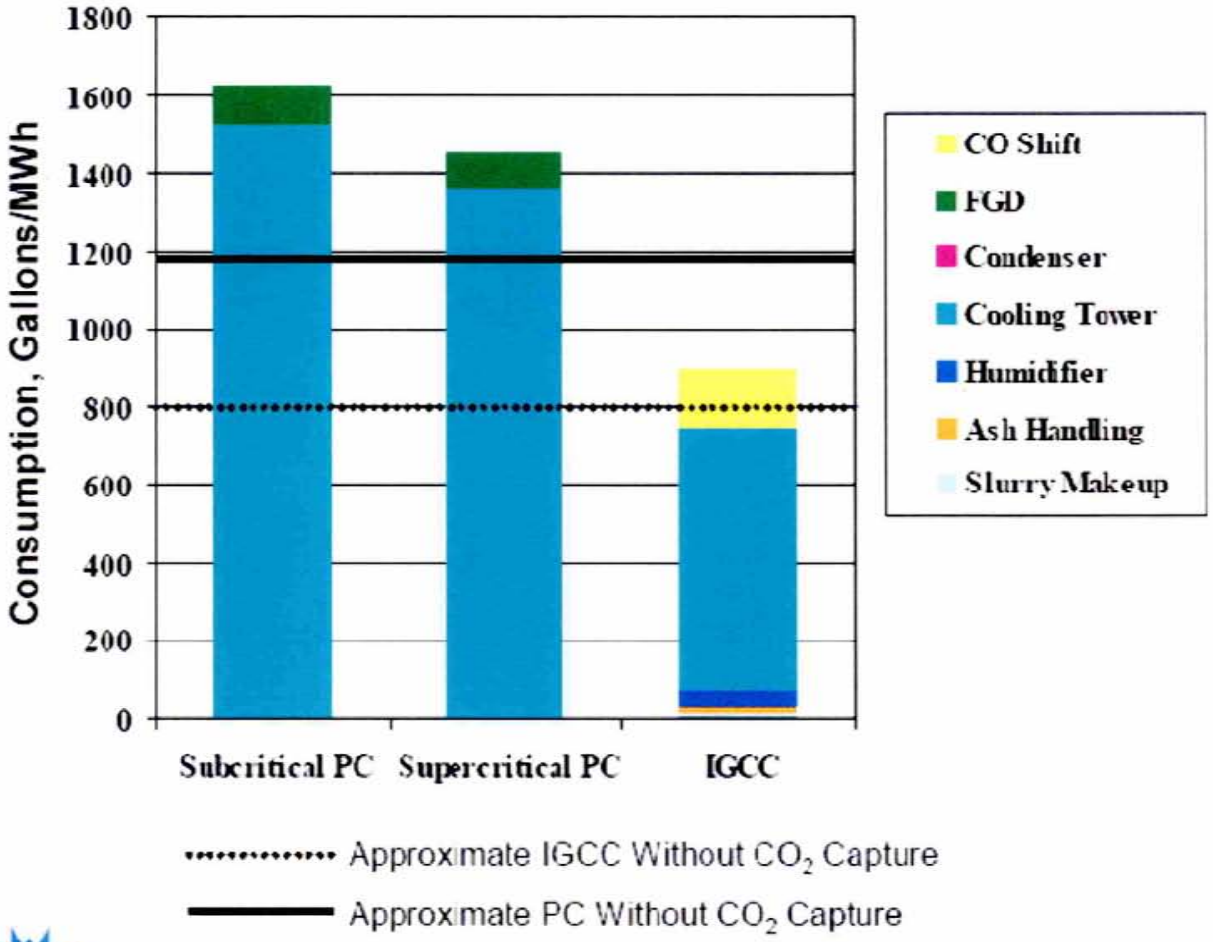
Impacts of Operation on Water:

Capture & Compression: Increased power consumption for capture and compression directly reduces the facility power output -- results in increased water consumption above that for a similar facility without capture

Pipeline Transport: Pumping power required to boost carbon dioxide pressure during pipeline transport to maintain supercritical conditions further diminishes power generation facility output -- results in increased water consumption

Underground Injection: Additional power may be required for injection operations -- indirectly increases water consumption; water may be produced by sequestration operations which displace reservoir fluids

CO_2 Capture & Compression Impact on Water Usage at PC & IGCC Power Generation Facilities



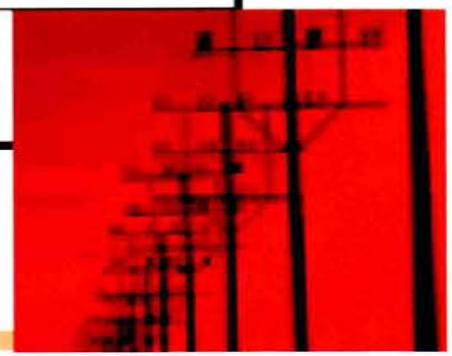
Water Consumption (gallons/kWh)

Subcritical PC	1.6
Supercritical PC	1.4
IGCC	0.9

Source: DOE/NETL Calculations

Summary

Operation	Water Consumption/Production (gallons/kWh)
Electricity Production, CO_2 Capture and Compression:	
Subcritical PC	1.6
Supercritical PC	1.4
IGCC	0.9
Transport	0.01
Enhanced Oil Recovery (EOR)*	0 – 1+
Coal Bed Methane (CBM) Recovery*	0.01 – 1+
Salt-water Formations*	0 – 0.5
Depleted Oil and Gas Reservoirs*	0 – 0.5



* Potential water consumption during sequestration under certain conditions

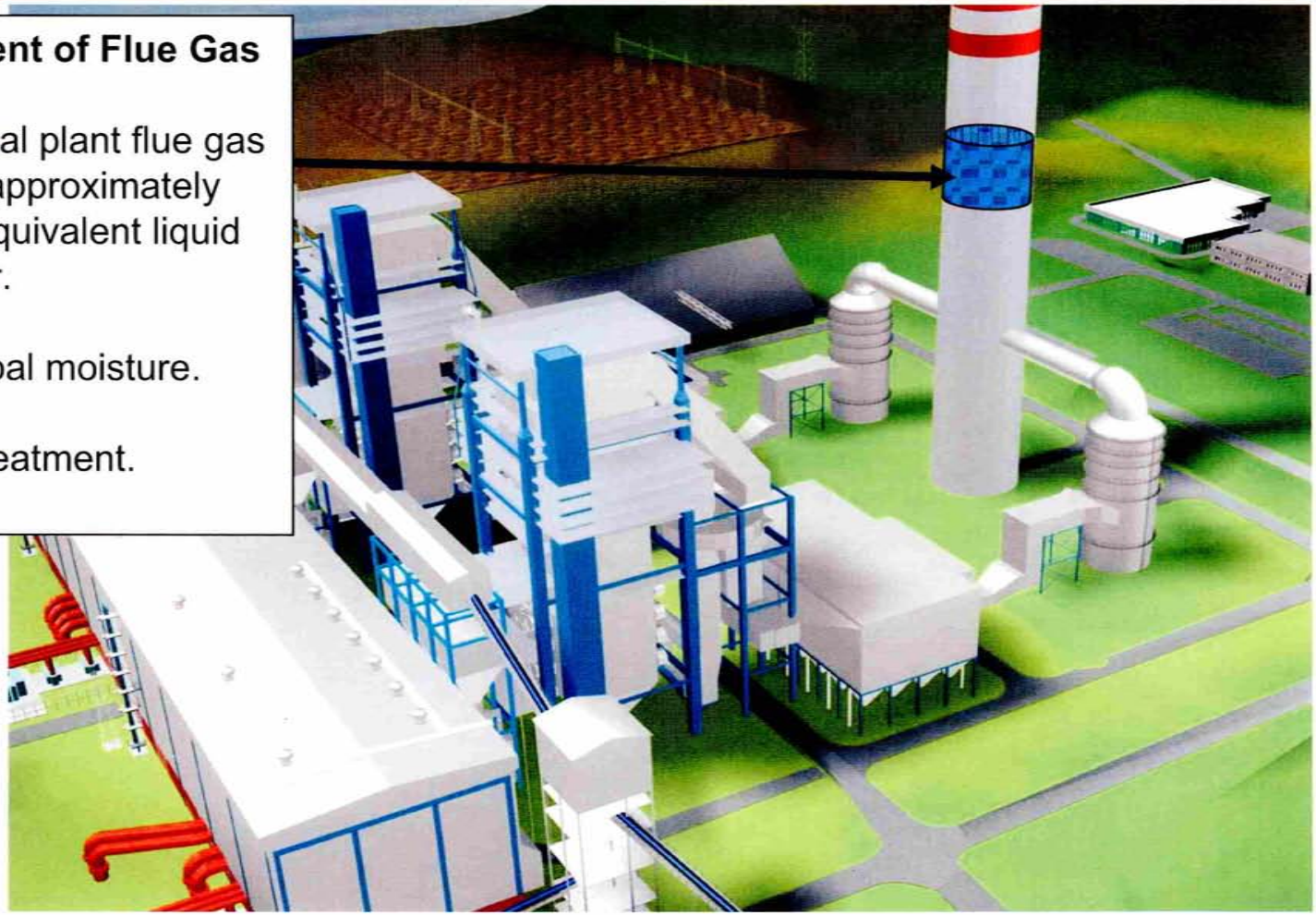
Potential Water Available (coal)

Water Content of Flue Gas

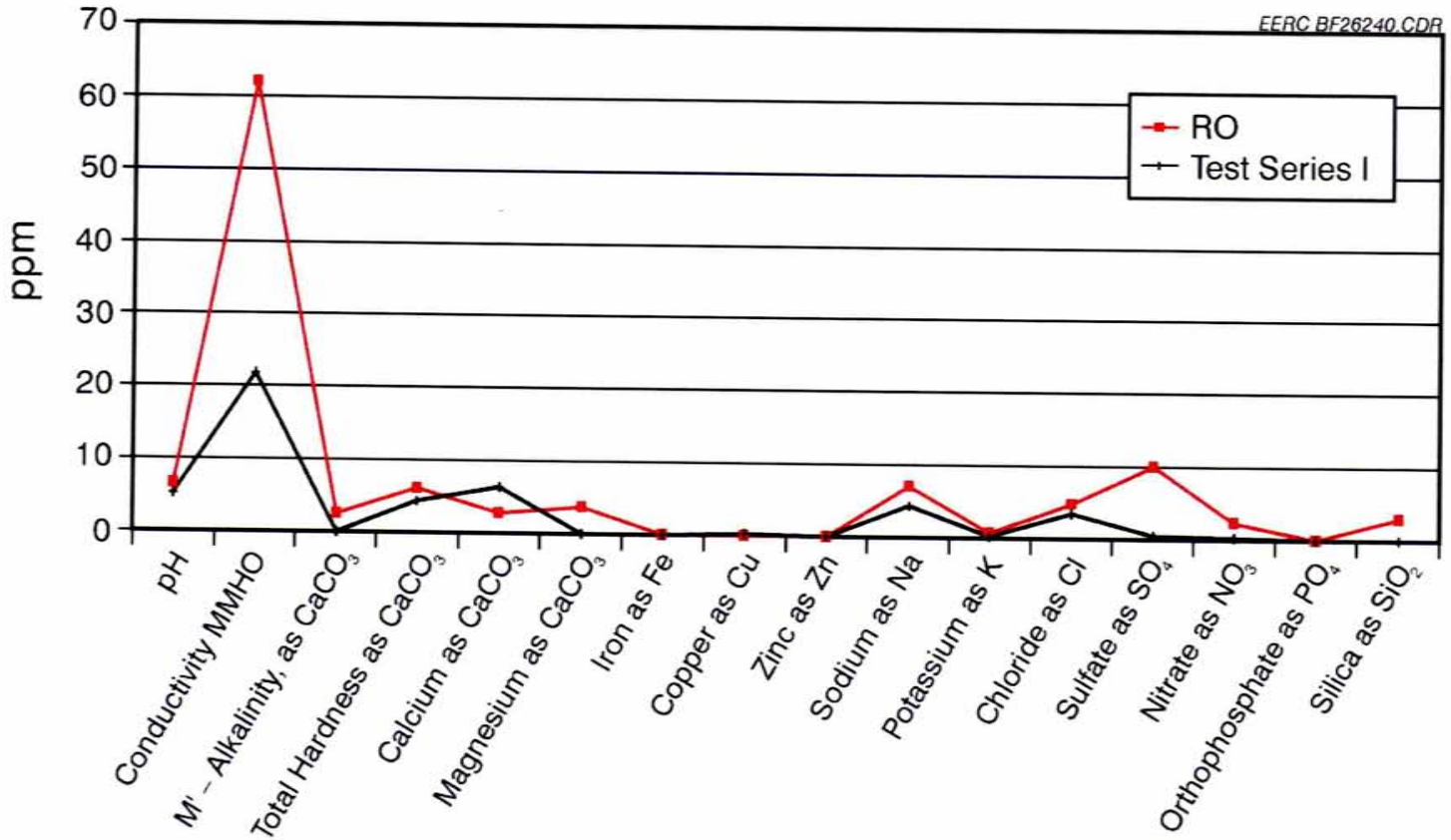
A 700-MW coal plant flue gas may contain approximately 1000–2400 equivalent liquid GPM of water.

Varies with coal moisture.

Varies with treatment.



Water Quality of Liquid Desiccant Dehumification System (LDDS)



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Current Study

- In previous work, the cost of heating and cooling desiccant solution was the largest operational cost. This study will investigate the use of a condensing heat exchanger to provide the heat loads required to run the LDDS at high-performance levels and the effect of the LDDS on water consumption in a CO_2 capture and sequestration train.

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Statement of Work

- Design and construction of pilot-scale system for postcombustion testing of water removal and capture technologies in conjunction with the EERC-led Partnership for CO_2 Capture (PCO_2C) Program.
- Conduct initial shakedown and testing of selected water separation technologies.
- Perform systems engineering analysis of selected systems for incorporation into existing facilities as well as future energy systems.

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Project Structure

- Activity 1 – System Design and Modeling
- Activity 2 – Materials Fabrication and Procurement
- Activity 3 – Test Equipment Installation
- Activity 4 – Test Plan Development
- Activity 5 – Testing
- Activity 6 – Project Management and Reporting

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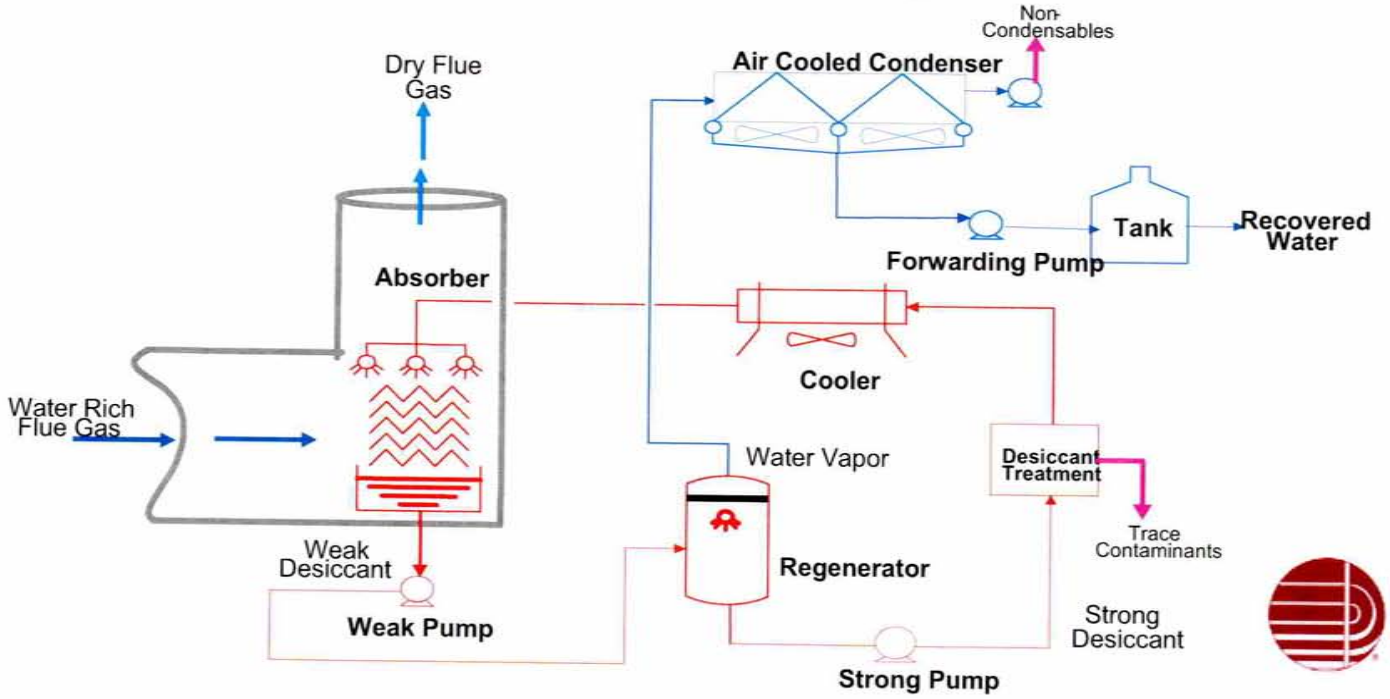
Activity 1 – System Design and Modeling

Aspen Plus®, CHEMKIN™, and FactSage™

P&ID, Preliminary Material and Energy Balances

H_2O Absorber/Stripper Column Design



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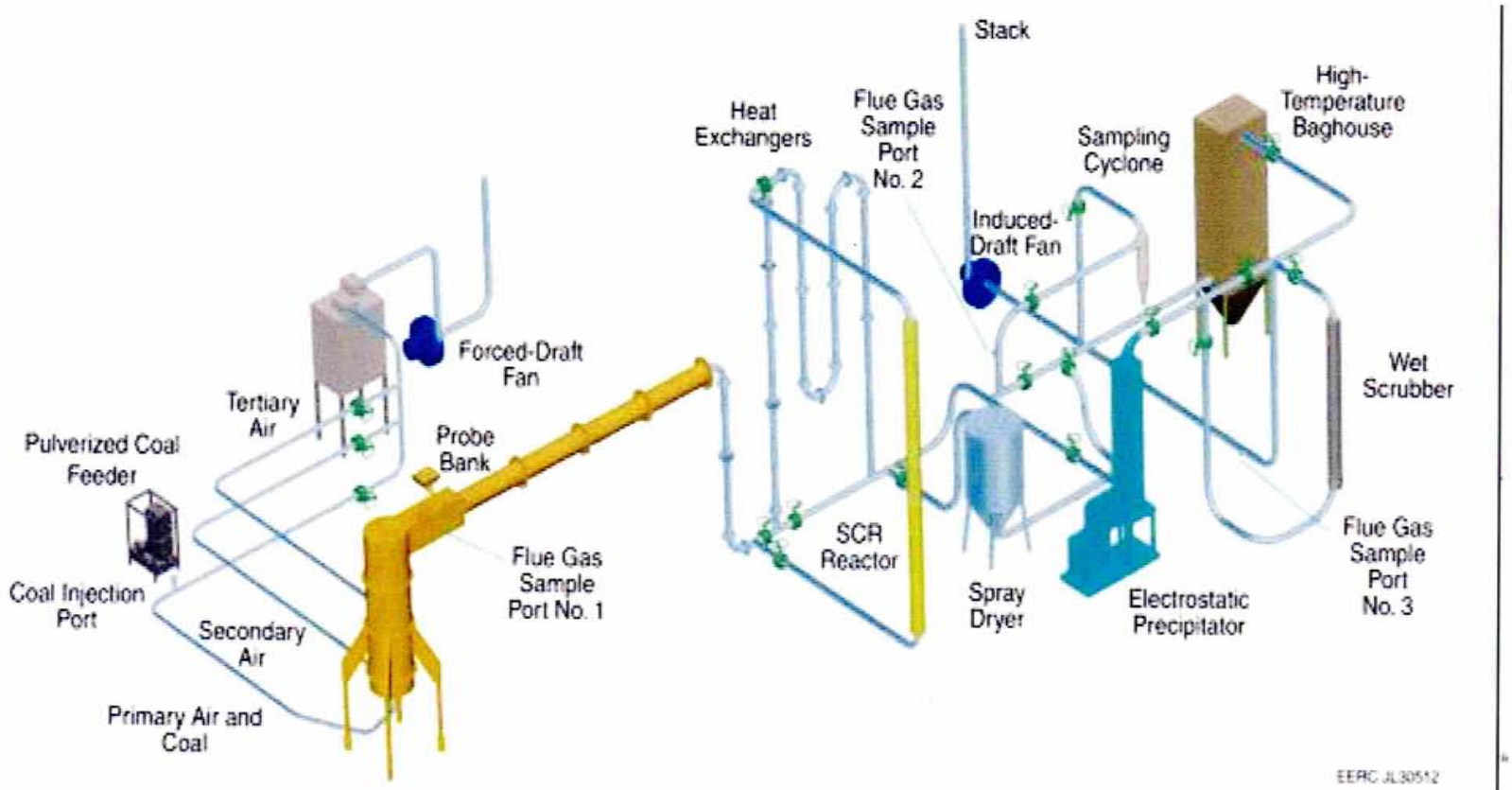
Activity 3 – Test Equipment Installation

EERC Combustion Test Furnace



Activity 4 and 5 Test Plan Development and Testing

- Will coincide with PCO_2C Program testing to reduce cost.
- PCO_2C Program has up to 8 weeks of testing planned.
  - 2 weeks of system shakedown
  - 2 weeks of baseline testing, air and O_2
  - 3 weeks of capture technology testing
  - 1 week of O_2 firing for sequestration

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WEST Project Task Schedule

Period of Performance: October 1, 2008 – September 30, 2009

Activity 1 – System Design and Modeling

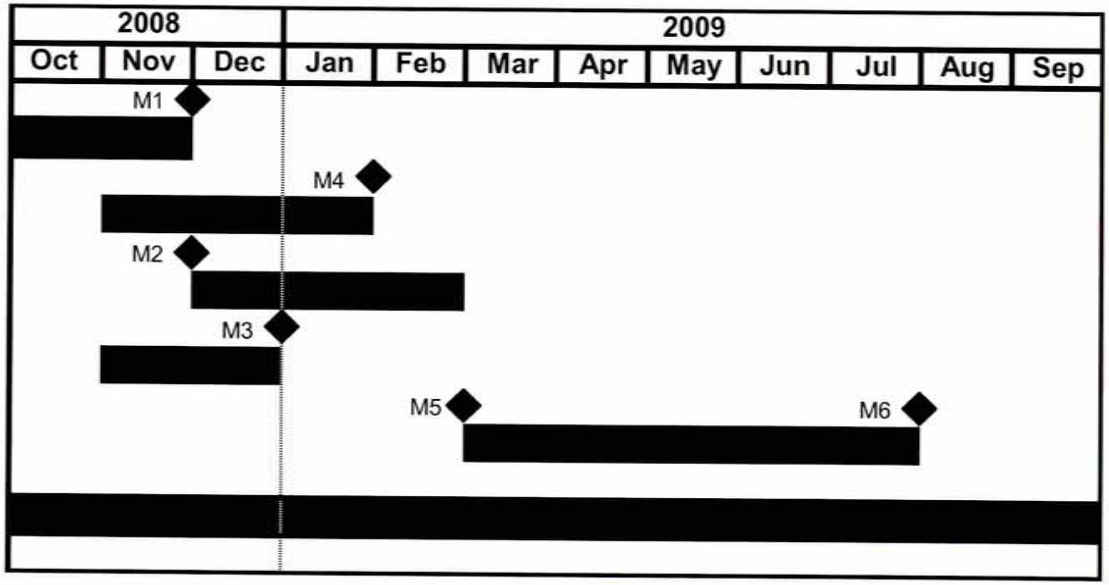
Activity 2 –Materials Fabrication and Procurement

Activity 3 – Test Equipment Installation

Activity 4 – Test Plan Development

Activity 5 – Testing

Activity 6 – Project Management



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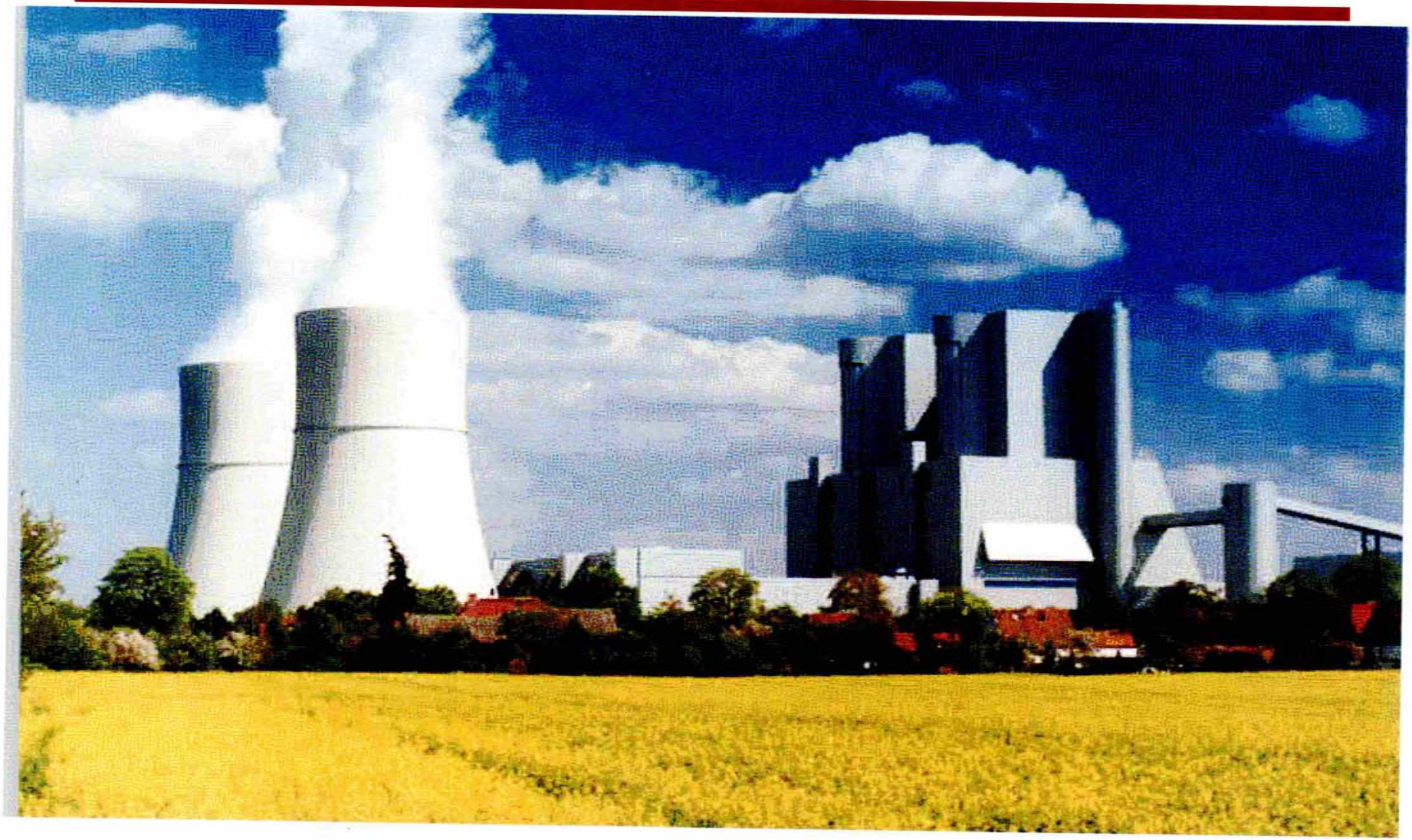
Anyone who can solve the problems of water will be worthy of two Nobel prizes – one for peace and one for science."
John F. Kennedy