MILESTONE M21 – OUTLINE OF WHITE PAPER ON NEXUS OF CO_2 CAPTURE AND SEQUESTRATION (CCS) AND WATER, PART SUBTASK 14.2 – WHITE PAPER ON NEXUS OF CCS AND WATER, TASK 14, ENTITLED "PLAINS CO_2 REDUCTION (PCOR) PARTNERSHIP PHASE III – REGIONAL CARBON SEQUESTRATION PARTNERSHIP (RCSP) WATER WORKING GROUP COORDINATION"

Outline of White Paper on Nexus of CO_2 Capture and Sequestration (CCS) and Water – M21

Prepared for:

Andrea McNemar

U.S. Department of Energy
National Energy Technology Laboratory
3610 Collins Ferry Road
PO Box 880
Morgantown, WV 26507-0880

Cooperative Agreement No. DE-FC26-05NT42592

Prepared by:

Charles D. Gorecki
Edward N. Steadman

Energy & Environmental Research Center
University of North Dakota
15 North 23rd Street, Stop 9018
Grand Forks, ND 58202-9018

February 2009

DOE DISCLAIMER

This report is available to the public from the National Technical Information Service, U.S. Department of Commerce, 5285 Port Royal Road, Springfield, VA 22161; phone orders accepted at (703) 487-4650.

EERC DISCLAIMER

MILESTONE M21 – OUTLINE OF WHITE PAPER ON NEXUS OF CO_2 CAPTURE AND SEQUESTRATION (CCS) AND WATER, PART SUBTASK 14.2 – WHITE PAPER ON NEXUS OF CCS AND WATER, TASK 14, ENTITLED "PLAINS CO_2 REDUCTION (PCOR) PARTNERSHIP PHASE III – REGIONAL CARBON SEQUESTRATION PARTNERSHIP (RCSP) WATER WORKING GROUP COORDINATION

OVERVIEW

The PCOR Partnership team at the Energy & Environmental Research Center (EERC) is leading the development of a Regional Carbon Sequestration Partnership (RCSP) Water Working Group (WWG) which will comprise representatives from each of the RCSP partnerships and other key personnel who will be identified by the U.S. Department of Energy (DOE). The purpose of the WWG will be to address a wide range of concerns and opportunities associated with the nexus of carbon sequestration in the subsurface and water resources.

One of the primary subtasks (Subtask 14.2) is to develop a white paper on the nexus of CO_2 Capture and Sequestration (CCS) to include the conditions and circumstances under which waters would need to be produced, a description of the produced waters, and a summary of their potential uses and water treatment needs for reuse. It is expected that the life cycle cost of a water management strategy in conjunction with CCS would also be evaluated in this document.

The white paper on the nexus of CCS and water will be developed in three subtasks; two milestones, M21 – Outline of White Paper and M22 – Draft of White Paper; and a deliverable D78 – Final White Paper on the Nexus of CCS and Water. After each milestone, DOE and WWG participants will have the opportunity to comment. Milestone M21 – Outline of White Paper is presented in the following pages for comment. The contents of the Outline of the White Paper on the Nexus of CCS and Water were identified as the key areas of concern and opportunity by the EERC, and it is expected that other WWG participants will review and comment on this outline's content to ensure that all areas of concern and opportunity are addressed from their individual perspectives.

M21 – OUTLINE OF WHITE PAPER ON NEXUS OF CCS AND WATER

I. EXECUTIVE SUMMARY

II. BACKGROUND
- A. CO_2 Capture and Sequestration (CCS) Overview
- B. Additional Water Needs for CCS
- C. Current Produced Water Technology Associated with the Oil and Gas Industry and Other Industries

III. INTRODUCTION

IV. CONNECTION BETWEEN WATER AND CCS – General Overview of the Following Processes or Technologies
- A. Carbon Capture Technologies
  1. State-of-the-Art Capture Technologies
  2. Use More Power, More Water Used for Cooling
  3. Water Needs for Capture Technologies
  4. Other
- B. CO_2 Compression
  1. State-of-the Art Compression Technologies
  2. More Power Use, More Water Used for Cooling
  3. Other
- C. Transportation
  1. Dehydration of CO_2 to Prevent Corrosion in Pipelines
  2. Other
- D. Injection of CO_2/Production of Water
- E. Other

V. WATER PRODUCTION ASSOCIATED WITH CCS
- A. Conditions under Which Water May Need to Be Produced
  1. Water Production to Control CO_2 Migration – CO_2 Migration may be controlled by a carefully designed injection/production scheme.
     a. Production of water could be used to draw the injected CO_2 away from higher risk areas such as away from population centers, possible faults and fractures, etc.
     b. Water production could also be used to obtain higher CO_2 storage efficiency.
  2. Water Production to Reduce Pressure in Pools/Reservoirs/Formations
     a. Water could be produced to allow higher injection rates by reducing formation pressure near the injection site.
     b. If multiple large-scale injections occur within the same formation there may be a need to produce water to relieve formation pressure so that CO_2 injection can continue without exceeding the designated maximum allowable formation pressure.

3. Other

B. Description of Produced Waters – Aquifer waters vary in quality from potable to total dissolved solids (TDS) levels in excess of 300,000 parts per million (ppm), although it is expected that most CO_2 sequestration projects will inject into saline formations with TDS levels in excess of 10,000 ppm.
   1. Water Chemistry
      a. Salts
      b. Bicarbonate
      c. Organics
      d. pH Level
      e. Other Contaminants
   2. Temperature
   3. Other

C. Potential Uses for Produced Waters – It is expected that when water needs to be produced in a CCS project, it would have TDS levels in excess of 10,000 ppm and, as a result, would need to be treated for most uses.
   1. Use for Cooling or Other Processes at Power Plants
   2. Use in Other Industrial Processes
   3. Harness the Geothermal Energy from Produced Waters
   4. Crop Irrigation
   5. Use for Hydraulic Fracturing in Oil and Gas Plays
   6. Human Consumption
   7. Surface Water Recharge
   8. Reinjection into the Subsurface
      a. Into Another Saline Formation
      b. Recharge a Potable Aquifer after Treatment
   9. Other

D. Water Treatment Needs for Reuse
   1. Different Uses Requiring Different Levels of Treatment
   2. Different TDS Levels and Contaminant Types Requiring Different Types of Treatment.
      a. Ion Exchange – low TDS
      b. Reverse Osmosis – up to 40,000 TDS
      c. Thermal Distillation and Evaporation – 100,000+TDS
      d. Other
   3. Cost of Different Treatment Options

E. Life Cycle Cost of Water Management in Conjunction with CCS

VI. SUMMARY

VII. REFERENCES