Class VI UIC Area of Review and Corrective Action

This submission is for:

Project ID: R06-AR-0001

Project Name: Blue

Current Project Phase: Pre-Injection Prior to Construction

Overview

Simulator Used for AoR delineation modeling: Eclipse

Version Used: 2019.3

Simulator Description/Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--Simulation--Manual.pdf

Total Simulation Time From Start of Injection: 70 yrs

Additional AoR Delineation Information: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2.--Primacy--AoR_Rev0_Jan2023.pdf

Model Domain

Coordinate System: State Plane

Horizontal Datum: NAD27

Coordinate System Units: ft

Vertical Datum: Mean Sea Level

Describe Vertical Datum: mean sea level

Zone: Arkansas State Planes South

FIPSZONE: 302 ADSZONE: 3251

Mesh Type: Hexahedral Cartesian

Domain Size in Global Units Specified Above

Hexahedral Cartesian

Domain Coordinates File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1--Model--Domain--Coord--Template_Rev0_Jan2023.xlsx

Angle of Inclination in X Direction: 0.006471 Dips in the Direction of: decreasing x

Angle of Inclination in Y Direction: 0.011836 Dips in the Direction of: decreasing y

Grid Size

Number of Nodes in x: 57 y: 57 z: 1318

Grid Spacing: Variable

Grid File Format: Eclipse Keyword File

Grid File Description: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2--Grid--File--Description.pdf

Eclipse Keyword File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/3--Eclipse--Keyword--File.pdf

Faults Modeled: No

Caprock Modeled: Yes

Image File(s) for Model Domain Grid: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/4--Model--Domain--Grids.pdf

Model Domain Comments: Info provided inthe page of the portal is from the Petrel Static Model Build. Please note: theat the mesh in the dynamic model is upscaled in the X and Y deirection and is dicussed in Section 2.2 of the Technical Report. Please note: inclinations are from top of model, higher inclinations are at the base

Processes Modeled by Simulator

Reservoir Conditions:

Supercritical CO2 Conditions

Phases Modeled:

Aqueous Supercritical CO2

Aqueous Phase:

Phase Compressibility: Compressible

Compressibility Value: 0.000002 1/psi

Phase Composition: Non-Compositional

Supercritical CO2 Phase:

Phase Compressibility: Compressible

Phase Composition: Non-Compositional

Equation of State Description Including Reference: Peng-Robingson EOS

File with EOS Reference or Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--Peng---Robinson--EOS--1978.pdf

Multifluid Flow Processes:

Advection Buoyancy

Mixed Wettability Pore Compressibility Others: Dissolution of CO2, Brine and CO2 Compressibility, CO2-brine relative permeabilities, CO2-Brine Capillary Pressures

Thermal Conditions: Isothermal

Heat Transport Processes:

Geochemistry Modeled: No

Geomechanical/Structural Deformations Modeled: No

Modeled Processes Comments: Each reservoir is simulted independently. Each layer has an isothermal condition set.

Rock Properties and Constitutive Relationships

Porosity/Permeability Model

Single Porosity

Porosity Distribution: Heterogeneous

Porosity included in Eclipse Keyword File: No

Spatially Variable Porosity File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/Spatial--Variable--File_Porosity.zip

File Describing how Porosity was Determined and Assigned to Numerical Model: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2.--Porosity--Determination--Assignment.pdf

Image Files for Porosity Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/3.--Porosity--Image--Files.pdf

Permeability Distribution: Heterogeneous

Permeability included in Eclipse Keyword File: No

Spatially Variable Permeability File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/Spatial--Variable--File_Permeability.zip mD

File Describing how Permeability was Determined and Assigned to Numerical Model: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/5.--Porosity--Determination--Assignment.pdf

Image Files for Permeability Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/6.--Permeability--Image--Files.pdf

Number of Rock Types Modeled: 2

Description of Rock Type Selection and Assignment: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/7.--Rock--Type--Selection--and--Assignment.pdf

Rock Type Distribution Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/Rock--Type--Data--Distribution.zip

Image Files for Rock Type Distribution: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/9.--Rock--Type--Image--Files.pdf

Rock Type #1

Rock Compressibility: Pore

Rock Compressibility Distribution: Spatially Variable

Compressibility included in Eclipse Keyword File: Yes

Compressibility Variable Name in Eclipse Keyword File: ROCK

Constitutive Relationships

Aqueous Saturation vs. Capillary Pressure: Table

Tabular Format File for Aqueous Saturation vs Capillary Pressure: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.1--Capillary--Tables.zip

Aqueous Trapped Gas Modeled: Yes

Hysteresis other than non-wetting fluid trapping: No

Aqueous Relative Permeability: Table

Tabular Format File for Aqueous Relative Permeability: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.2--Aqueous--Rel--Perm--Tables.zip

Hysteresis other than non-wetting fluid trapping: No

Gas Relative Permeability: Table

Tabular Format File for Gas Relative Permeability: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.3--Gas--Rel--Perm--Tables.zip

Hysteresis other than non-wetting fluid trapping: No

Porosity and Permeability Reduction Due to Salt Precipitation

Rock Type #2

Rock Compressibility: Pore

Rock Compressibility Distribution: Spatially Variable

Compressibility included in Eclipse Keyword File: Yes

Compressibility Variable Name in Eclipse Keyword File: ROCK

Constitutive Relationships

Aqueous Saturation vs. Capillary Pressure: Table

Tabular Format File for Aqueous Saturation vs Capillary Pressure: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2.1--Capillary--Tables.zip

Aqueous Trapped Gas Modeled: Yes

Hysteresis other than non-wetting fluid trapping: No

Aqueous Relative Permeability: Table

Tabular Format File for Aqueous Relative Permeability: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2.2--Aqueous--Rel--Perm--Tables.zip

Hysteresis other than non-wetting fluid trapping: No

Gas Relative Permeability: Table

Tabular Format File for Gas Relative Permeability: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2.3--Gas--Rel--Perm--Tables.zip

Hysteresis other than non-wetting fluid trapping: No

Porosity and Permeability Reduction Due to Salt Precipitation

Rock Properties Comments: Rock Type 1 - Sand Rock Type 2 - Shale

Boundary Conditions

Attach Boundary Conditions Description File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--Boundary--Conditions.pdf

Initial Conditions

Initial Phases in Domain: Aqueous

Initial Aqueous Pressure: Spatially Variable

Spatially Variable Initial Aqueous Pressure File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--Spatial--Variable--intial--AQ--Pressures.pdf

Initial Temperature: Spatially Constant

Initial Temperature: 134 F

Initial Salinity: Spatially Constant

Initial Salinity: 170057 ppm

Initial Condition Comments: Please note; we have simulated 4 interval independent of each other. The selected fields above apply for each reservoir on its own. i.e. each interval is initialized with it's own Temperature and Salinity. More details are provided in Section 3.7 or the technical report. Values are represented in the techncial report Temperature - Lower Hosston : 134F and for Cotton Valley 144F Salinity - Lower Hosston : 170,057 ppm and for Cotton Valley 209,004 ppm

Operational Information

Number of Injection Wells: 4

Injection Well #1

Well Direction: Vertical

Location: X: 1788569.024 Longitude (DD) Y: 217408.996 Latitude (DD)

Wellbore Diameter: Constant

Wellbore Diameter: 0.625 ft

Well Screen Interval Provided as: Single Interval

Elevation of Top of Screened Interval: 4030 Elevation of Bottom of Screened Interval: 4322 ft

Mass Rate of Injection: 0.5 MMT/yr

Total Mass of Injection: 2.5 MMT

Fracture Gradient: 0.726 psi/ft

Maximum Injection Pressure: 2634 psi Elevation Corresponding to Pressure: 4322 ft

Description of How Fracture Gradient and Maximum Injection Pressure were Determined File:

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--Fracture--Gradient_Lower--Hosston.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2040 Stop Date: 12/31/2045

Injection Well #2

Well Direction: Vertical

Location: X: 1788569.024 Longitude (DD) Y: 217408.996 Latitude (DD)

Wellbore Diameter: Constant

Wellbore Diameter: 0.625 ft

Well Screen Interval Provided as: Single Interval

Elevation of Top of Screened Interval: 4853 Elevation of Bottom of Screened Interval: 5399 ft

Mass Rate of Injection: 0.5 MMT/yr

Total Mass of Injection: 2.5 MMT

Fracture Gradient: 0.753 psi/ft

Maximum Injection Pressure: 3288 psi Elevation Corresponding to Pressure: 5314 ft

Description of How Fracture Gradient and Maximum Injection Pressure were Determined File:

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2.--Fracture--Gradient_CV3.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2035 Stop Date: 12/31/2040

Injection Well #3

Well Direction: Vertical

Location: X: 1788569.024 Longitude (DD) Y: 217408.996 Latitude (DD)

Wellbore Diameter: Constant

Wellbore Diameter: 0.625 ft

Well Screen Interval Provided as: Single Interval

Elevation of Top of Screened Interval: 5400 Elevation of Bottom of Screened Interval: 5839 ft

Mass Rate of Injection: 0.5 MMT/yr

Total Mass of Injection: 2.5 MMT

Fracture Gradient: 0.769 psi/ft

Maximum Injection Pressure: 3737 psi Elevation Corresponding to Pressure: 5713 ft

Description of How Fracture Gradient and Maximum Injection Pressure were Determined File:

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/3.--Fracture--Gradient_CV2.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2030 Stop Date: 12/31/2035

Injection Well #4

Well Direction: Vertical

Location: X: 1788569.024 Longitude (DD) Y: 217408.996 Latitude (DD)

Wellbore Diameter: Constant

Wellbore Diameter: 0.625 ft

Well Screen Interval Provided as: Single Interval

Elevation of Top of Screened Interval: 5841 Elevation of Bottom of Screened Interval: 6200 ft

Mass Rate of Injection: 0.5 MMT/yr

Total Mass of Injection: 2.5 MMT

Fracture Gradient: 0.769 psi/ft

Maximum Injection Pressure: 4042 psi Elevation Corresponding to Pressure: 6112 ft

Description of How Fracture Gradient and Maximum Injection Pressure were Determined File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/4.--Fracture--Gradient_CV1.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2025 Stop Date: 12/31/2030

Number of Production/Withdrawal Wells: 0

Operational Information Comments: Please Note: only one well will be used at the Project Blue site in a "stacked reservoir" system design. Four total intervals will are modeled for a period of 5-years. Due to the limitations of the GSDT tool, we have selected 4 wells to account for the 4 intervals. The wells have been inputted with the same Location X and Y positions. Well inputs correspond the the below identifiation Injection Well No. 1 - Lower Hosston Injection Well No. 2 - Cotton Valley 3 Injection Well No. 3 - Cotton Valley 2 Injection Well No. 4 - Cotton Valley 1

Model Output/Results

Provide file name and corresponding spatial location for each file: Appendix 7 plume time series maps Appendix 8 pressure time series maps

Time-Series File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--Time--Series.pdf

Provide file name and corresponding variable and time stamp for each file: ASCII Files for properties. In order to read the Eclipse ASCII files, one will need to upload the dynamic model grid as a first step. End of Injection 2030 (CV1), 2035 (CV2), 2040 (CV3), 2045 (Lower Hosston) End of Observation: 2095 (all intvervals)

Snapshot File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/Snapshot--Files.zip

Provide file name and corresponding description of surface for each file: Not Applicable

Surface Flux File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/3.--Flux--Files.pdf

Sensitivity Analysis Description/Results: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/4.--Sensitivity.pdf

AoR Pressure Front Delineation

Lowermost USDW:

Name of Lowermost USDW: Wilcox Formation

Water Density: 0 gm/cm^3 at Elevation: 0 ft

Location of Measurement for Density: TBD - During Well Construction

Temperature: 0 F at Elevation: 0 ft

Location of Measurement: TBD - During Well Construction

Pressure: 0 psi at Elevation: 0 ft

Location of Measurement: TBD - During Well Construction

Salinity: 0 ppm at Elevation: 0 ft

Location of Measurement: TBD - During Well Construction

Elevation of bottom of USDW: 0 ft

Injection Zone:

Name of Injection Zone: TBD - During Well Construction

Water Density: 0 gm/cm^3 at Elevation: 0 ft

Location of Measurement: TBD - During Well Construction

Temperature: 0 F at Elevation: 0 ft

Location of Measurement: TBD - During Well Construction

Pressure: 0 psi at Elevation: 0 ft

Location of Measurement: TBD - During Well Construction

Salinity: 0 ppm at Elevation: 0 ft

Location of Measurement: TBD - During Well Construction

Elevation of top of Injection Zone: 0 m

Method of Estimating Critical Pressure: Other

File Describing Critical Pressure Estimation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--AoR--Determination.pdf

Estimated Critical Pressure: 0 psi

Delineated AoR:

Shapefile or KML File Showing Delineated AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/AOR_buffer_1mi_CV1_AOR_Zero_Bndry_n27spARS_ft_v2022_1222.zip

AoR Pressure Front Delineation Comments: A one mile buffer has been added the largest CV1 max plume extent.

Corrective Action

File with Location of All Penetrations within AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/APs--in--AOR.zip

File with Location of Wells Requiring Corrective Action: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/2.--Corrective--Action--Wells.pdf

Supporting Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/3.--Well--Records.pdf

Area of Review and Corrective Action Plan [40 CFR 146.82(a)(13) and 146.84(b) or applicable state requirements]

Are you making an Area of Review and Corrective Action Plan submission at this time?: Yes

Reason for Project Plan Submission: Permit application submission

Project Plan Upload

Attach the Area of Review and Corrective Action Plan: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/Mod--B-----AOR--CA--Plan.zip

Appendices and Supporting Materials Upload

Attach Any Supporting Documentation for the AoR and Corrective Action Plan: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-AR-0001/Phase1-PreConstruction/AoRModeling-02-15-2023-1713/1.--Addtional--Info--AOR--CA--Plan.pdf

Area of Review Reevaluation [40 CFR 146.84(e) or applicable state requirements]

Minimum fixed frequency of AoR reevaluation: 5 Years

Are you making an Area of Review reevaluation submission at this time?: No

Reevaluation Background

Reevaluation Materials

Please upload your amended AoR and Corrective Action Plan on the previous tab.

Complete Submission

Authorized submission made by: Rajiv Manhas

Comments regarding this submission: no comment

For confirmation a read-only copy of your submission will be emailed to: skonings@lapisenergy.com