Class VI UIC Area of Review and Corrective Action

This submission is for:

Project ID: R06-LA-0019

Project Name: LA CCS

Current Project Phase: Pre-Injection Prior to Construction

Overview

Simulator Used for AoR delineation modeling: GEM

Version Used: 202021

Simulator Description/Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Introduction--to--GEM.pdf

Description of File Contents: The description of the GEM simulator from CMG.

Total Simulation Time From Start of Injection: 40907 days

Additional AoR Delineation Information: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Additional--AoR--Delineation--Information.pdf

Description of Information Submitted: The state of Louisiana does not have any additional requirements

Model Domain

Coordinate System: Geographic (Lat-Long)

Horizontal Datum: NAD27

Vertical Datum: Mean Sea Level

Describe Vertical Datum: Mean Sea Level

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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/DTM_AoRModeling_DomainCoordTemplate_11.10.2022_Redacted.xlsx

Angle of Inclination in X Direction: 0 Dips in the Direction of: increasing x

Angle of Inclination in Y Direction: 0 Dips in the Direction of: increasing y

Grid Size

Number of Nodes in x: 0 y: 0 z: 0

Grid Spacing: Variable

Grid File Format: ASCII file containing vertices and elements

Grid File Description: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Grid--File--Description--Note.pdf

Grid Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Grid--file--note.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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Image--File--for--model--domain.pdf

Model Domain Comments: Please see AoR and Corrective Action Plan, Section 2.1.3.1. uploaded to the CBI folder for more information on the model domain

Processes Modeled by Simulator

Reservoir Conditions:

Supercritical CO2 Conditions

Phases Modeled:

Aqueous Supercritical CO2

Aqueous Phase:

Phase Compressibility: Compressible

Compressibility Value: 0 1/Pa

Phase Composition: Compositional

Aqueous Phase Components:

CO_2 Water

Supercritical CO_2 Phase:

Phase Compressibility: Compressible

Phase Composition: Compositional

Supercritical CO_2 Phase Components:

CO_2

Equation of State Description Including Reference: Peng, D.Y. and Robinson, D.B., "A New Two-Constant Equation of State", Ind. Eng. Chem. Fundamen., Vol. 15, (1976), pp. 59-64. The development of a new two-constant equation of state in which the attractive pressure term of the semiempirical van der Waals equation has been modified is outlined. Examples of the use of the equation for predicting the vapor pressure and volumetric behavior of single-component systems, and the phase behavior and volumetric behavior of binary, ternary, and multicomponent systems are given. The proposed equation combines simplicity and accuracy. It performs as well as or better than the Soave-Redlich-Kwong equation in all cases tested and shows its greatest advantages in the prediction of liquid phase densities.

File with EOS Reference or Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/PR-2--Param.pdf

Multifluid Flow Processes:

Advection Dispersion Diffusion Buoyancy

Non-wetting Fluid Trapping Mixed Wettability Pore Compressibility

Thermal Conditions: Isothermal

Heat Transport Processes:

Geochemistry Modeled: No

Geomechanical/Structural Deformations Modeled: No

Modeled Processes Comments: Please see AoR and Corrective Action Plan Section 2.1.1. uploaded to the CBI folder for more information on the modeled processes.

Rock Properties and Constitutive Relationships

Porosity/Permeability Model

Single Porosity

Porosity Distribution: Heterogeneous

Spatially Variable Porosity File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Porosity--file--note.pdf

File Describing how Porosity was Determined and Assigned to Numerical Model: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Description--of--por--assignment.pdf

Image Files for Porosity Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Image--File--of--Porosity--Distributions--Note.pdf

Permeability Distribution: Heterogeneous

Spatially Variable Permeability File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Perm--File--Note.pdf 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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Description--of--perm--assignment.pdf

Image Files for Permeability Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Image--File--of--Perm--Distributions--Note.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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Description--of--Rock--Type--Selection--and--Assignment--Note.pdf

Rock Type Distribution Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Rock--Type--Distribution--Assignment--Note.pdf

Image Files for Rock Type Distribution: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Image--File--for--Rock--Type--Distribution--Assignment--Note.pdf

Rock Type #1

Rock Compressibility: Bulk

Rock Compressibility Distribution: Single Value

Compressibility Value: 0 1/psi

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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT1--Capillary--Pressure--Note.pdf

Aqueous Trapped Gas Modeled: Yes

Hysteresis other than non-wetting fluid trapping: Yes

File Providing Both Drainage and Imbibition Curves: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT1--Drainage--and--Imbibition--Curve--Note.pdf

Aqueous Relative Permeability: Table

Tabular Format File for Aqueous Relative Permeability: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT1--Rel--Perm--Table--Note.pdf

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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT1--GAS--Rel--Perm--Table--Note.pdf

Hysteresis other than non-wetting fluid trapping: No

Porosity and Permeability Reduction Due to Salt Precipitation

Rock Type #2

Rock Compressibility: Bulk

Rock Compressibility Distribution: Single Value

Compressibility Value: 0 1/psi

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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT2--Capillary--Pressure--Note.pdf

Aqueous Trapped Gas Modeled: Yes

Hysteresis other than non-wetting fluid trapping: Yes

File Providing Both Drainage and Imbibition Curves: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT2--Drainage--and--Imbibition--Curve--Note.pdf

Aqueous Relative Permeability: Table

Tabular Format File for Aqueous Relative Permeability: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT2--Rel--Perm--Table--Note.pdf

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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/RT2--GAS--Rel--Perm--Table--Note.pdf

Hysteresis other than non-wetting fluid trapping: No

Porosity and Permeability Reduction Due to Salt Precipitation

Rock Properties Comments: For more information on Rock Properties please see AoR and Corrective Action Plan Section 2.1.4. uploaded to the CBI folder.

Boundary Conditions

Attach Boundary Conditions Description File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Boundary--conditions--note.pdf

Initial Conditions

Initial Phases in Domain: Aqueous

Initial Aqueous Pressure: Varying with Depth, Temperature, and Salinity

Initial Aqueous Pressure: 0 psi at Reference Elevation: 0 ft

Initial Temperature: Varying with Depth

Initial Temperature: 0 F at Reference Elevation: 0 ft Gradient: 0 deg F/ft

Initial Salinity: Spatially Constant

Initial Salinity: 0 ppm

Initial Condition Comments: Please see Section 2.1.7. of the AoR and Corrective Action Plan uploaded to the CBI folder for more information.

Operational Information

Number of Injection Wells: 1

Injection Well #1

Well Direction: Vertical

Location: X: 0 Longitude (DD) Y: 0 Latitude (DD)

Wellbore Diameter: Constant

Wellbore Diameter: 0 in

Well Screen Interval Provided as: Single Interval

Elevation of Top of Screened Interval: 0 Elevation of Bottom of Screened Interval: 0 ft

Mass Rate of Injection: 0 MMT/yr

Total Mass of Injection: 0 MMT

Fracture Gradient: 0 psi/ft

Maximum Injection Pressure: 0 psi Elevation Corresponding to Pressure: 0 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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Fracture--Pressure--Note.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2026 Stop Date: xx/xx/xxxx

Number of Production/Withdrawal Wells: 0

Operational Information Comments: Please see section 2.1.8. in the AoR and Corrective Action Plan Uploaded to the CBI folder.

Model Output/Results

Provide file name and corresponding spatial location for each file: Please see Section 2.2 in the AoR and Corrective Action Plan uploaded to the CBI folder for time-series data at the monitoring well location.

Time-Series File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Time-series--Data--Note.pdf

Provide file name and corresponding variable and time stamp for each file: Please see Section 2.2 in the AoR and Corrective Action Plan uploaded to the CBI folder for snapshot data.

Snapshot File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Snapshot--Data--Note.pdf

Provide file name and corresponding description of surface for each file: Please see Section 2.2 in the AoR and Corrective Action Plan uploaded to the CBI folder for flux data.

Surface Flux File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Flux--Data--Note.pdf

Model Output Comments: Please see Section 2.2 in the AoR and Corrective Action Plan uploaded to the CBI folder for more information on the Model Outputs

AoR Pressure Front Delineation

Lowermost USDW:

Name of Lowermost USDW: XXX

Water Density: 0 kg/m^3 at Elevation: 0 ft

Location of Measurement for Density: Calculated

Temperature: 0 F at Elevation: 0 ft

Location of Measurement: Calculated

Pressure: 0 psi at Elevation: 0 ft

Location of Measurement: Calculated

Salinity: 0 ppm at Elevation: 0 ft

Location of Measurement: Calculated

Elevation of bottom of USDW: 0 ft

Injection Zone:

Name of Injection Zone: XXX

Water Density: 0 kg/m^3 at Elevation: 0 ft

Location of Measurement: Calculated

Temperature: 0 F at Elevation: 0 ft

Location of Measurement: Calculated

Pressure: 0 psi at Elevation: 0 ft

Location of Measurement: Calculated

Salinity: 0 ppm at Elevation: 0 ft

Location of Measurement: Calculated

Elevation of top of Injection Zone: 0 ft

Method of Estimating Critical Pressure: Static Mass Balance

Assumptions: calculated using Birkholzer et al (2011)

File Describing Critical Pressure Estimation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Birkholzer_Brine_Flow_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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/AoR--Shapefile--Note.pdf

AoR Pressure Front Delineation Comments: Please see Section 2.3 in the AoR and Corrective Action Plan uploaded to the CBI folder for more information on AoR pressure front delineation.

Corrective Action

File with Location of All Penetrations within AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Wells--in--AoR--note.pdf

File with Location of Wells Requiring Corrective Action: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Corrective--Action--Wells--in--AoR--note.pdf

Supporting Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/Well--Records--Note.pdf

Corrective Action Comments: Please see corresponding documents uploaded to the CBI folder for more information on wells requiring corrective action.

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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/2_LACCS_AoR--and--Corrective--Action--Plan_Redacted.pdf

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-LA-0019/Phase1-PreConstruction/AoRModeling-11-22-2022-1348/LACCS_Tabulation--of--Wells--in--AOR_InjWells_Redacted.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: Katherine Panczak

For confirmation a read-only copy of your submission will be emailed to: katherine.panczak@dtmidstream.com