Class VI UIC Area of Review and Corrective Action

This submission is for:

Project ID: R06-LA-0005

Project Name: Authentic ReductionsVCCS1-Wilcox

Current Project Phase: Pre-Injection Prior to Construction

Overview

Simulator Used for AoR delineation modeling: Other

Other Simulator: Reveal

Version Used: 12.5

Simulator Description/Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/1--Simulator--Description--Overview--Tab.pdf

Description of File Contents: This file references the Simulator description in the AoR and Corrective Action Plan

Total Simulation Time From Start of Injection: -999 days

Additional AoR Delineation Information: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/2--AOR--Delineation--Overview--Tab.pdf

Description of Information Submitted: This file references the AoR Delineation discussion in the AoR and Corrective Action Plan

Model Domain

Coordinate System: Geographic (Lat-Long)

Horizontal Datum: NAD27

Vertical Datum: Mean Sea Level

Describe Vertical Datum: MSL

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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/3--Model--Domain--Coordinates--File.pdf

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

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

Grid Size

Number of Nodes in x: -999 y: -999 z: -999

Grid Spacing: Constant

Grid Spacing in x: -999 y: -999 z: -999

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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/4--Grid--File--Description--Model--Domain--Tab.pdf

Grid Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/5--Grid--Data--File--Model--Domain--Tab.pdf

Faults Modeled: No

Caprock Modeled: No

Image File(s) for Model Domain Grid: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/6--Model--Domain--Image--Files--Model--Domain--Tab.pdf

Model Domain Comments: This document references section and related figures that describe the model domain grid.

Processes Modeled by Simulator

Reservoir Conditions:

Supercritical CO2 Conditions

Phases Modeled:

Aqueous Supercritical CO2

Aqueous Phase:

Phase Compressibility: Compressible

Compressibility Value: -999 1/Pa

Phase Composition: Non-Compositional

Supercritical CO2 Phase:

Phase Compressibility: Compressible

Phase Composition: Non-Compositional

Equation of State Description Including Reference: D.B. Robinson and D.Y. Peng. The Characterization of the Heptanes and Heavier Fractions for the GPA Peng-Robinson Programs. Research report (Gas Processors Association). Gas Processors Association, 1978

File with EOS Reference or Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/7--EOS--Reference--Processes--Modeled--Tab.pdf

Multifluid Flow Processes:

Advection Buoyancy

Thermal Conditions: Non-Isothermal

File Describing Thermal Conductivity Function including Parameters: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/8--Thermal--Conductivity--Processes--Modeled--Tab.pdf

Heat Transport Processes:

Advection

Geochemistry Modeled: No

Geomechanical/Structural Deformations Modeled: No

Modeled Processes Comments: There are no comments at this time.

Rock Properties and Constitutive Relationships

Porosity/Permeability Model

Single Porosity Dual Porosity

Porosity Distribution: Heterogeneous

Spatially Variable Porosity File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/9--Porosity--Spatial--Variability--Rock--Properties--Tab.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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/10--Porosity--Properties.pdf

Image Files for Porosity Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/11--Porosity--Image--Files--Rock--Properties--Tab.pdf

Permeability Distribution: Heterogeneous

Spatially Variable Permeability File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/12--Permeability--Spatial--Variability--Rock--Properties--Tab.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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/13--Permeabilty--Determination--Rock--Properties--Tab.pdf

Image Files for Permeability Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/14--Permeabilty--Image--Files--Rock--Properties--Tab.pdf

Number of Rock Types Modeled: 1

Description of Rock Type Selection and Assignment: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/15--Rock--Types--Rock--Properties--Tab.docx

Rock Type Distribution Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/16--Rock--Type--Distribution--Rock--Properties--Tab.pdf

Image Files for Rock Type Distribution: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/17--Rock--Type--Images--Rock--Properties--Tab.pdf

Rock Type #1

Rock Compressibility: Bulk

Rock Compressibility Distribution: Single Value

Compressibility Value: -999 1/Pa

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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/18--Sand--Saturation--Cap--Prsr--Rock--Properties--Tab.pdf

Aqueous Trapped Gas Modeled: No

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-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/19--Sand--Aqueous--Rel--Perm--Rock--Properties--Tab.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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/20--Sand--Gas--Rel--Perm--Rock--Properties--Tab.pdf

Hysteresis other than non-wetting fluid trapping: No

Porosity and Permeability Reduction Due to Salt Precipitation

Rock Properties Comments: There are no comments at this time.

Boundary Conditions

Attach Boundary Conditions Description File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/24--Boundary--Conditions--Boundary--Conditions--Tab.pdf

Initial Conditions

Initial Phases in Domain: Aqueous

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

Initial Aqueous Pressure: -999 MPa at Reference Elevation: -999 m

Initial Temperature: Varying with Depth

Initial Temperature: -999 C at Reference Elevation: -999 m Gradient: -999 deg C/m

Initial Salinity: Spatially Constant

Initial Salinity: -999 mg/L

Initial Condition Comments: There are no comments at this time.

Operational Information

Number of Injection Wells: 1

Injection Well #1

Well Direction: Vertical

Location: X: -999 Longitude (DD) Y: -999 Latitude (DD)

Wellbore Diameter: Constant

Wellbore Diameter: -999 in

Well Screen Interval Provided as: Single Interval

Elevation of Top of Screened Interval: -999 Elevation of Bottom of Screened Interval: -999 m

Mass Rate of Injection: -999 MMT/yr

Total Mass of Injection: -999 MMT

Actual Injection Temperature: -999 C

Modeled Injection Temperature: -999 C

Fracture Gradient: -999 psi/ft

Maximum Injection Pressure: -999 Pa Elevation Corresponding to Pressure: -999 m

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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/25--Frac--Gradient--and--Max--Inj--Prsr--Dtm--Ops--Info--Tab.pdf

Composition of Injectate: Pure CO_2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: -999 Stop Date: -999

Number of Production/Withdrawal Wells: 0

Operational Information Comments: There are no comments at this time.

Model Output/Results

Provide file name and corresponding spatial location for each file: Time series images are included in Appendix 5 of the AoR and Corrective Action Plan. Each figure is labeled according to its time period during and post injection.

Time-Series File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/26--Time--Series--File--Model--Output--Tab.pdf

Provide file name and corresponding variable and time stamp for each file: Snapshots of images are included in Appendix 4 of the AoR and Corrective Action Plan. Each figure is labeled according to its time period during and post injection.

Snapshot File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/27--Snapshot--File--Model--Output--Tab.pdf

Provide file name and corresponding description of surface for each file: Surface Flux files/images were not generated as part of this modeling effort.

Surface Flux File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/28--Surface--Flux--File--Model--Output--Tab.pdf

Sensitivity Analysis Description/Results: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/29--Sensitivity--Analysis--Model--Output--Tab.pdf

Model Output Comments: A sensitivity analysis was not performed for this iteration.

AoR Pressure Front Delineation

Lowermost USDW:

Name of Lowermost USDW: -999

Water Density: -999 kg/m^3 at Elevation: -999 m

Location of Measurement for Density: -999

Temperature: -999 C at Elevation: -999 m

Location of Measurement: -999

Pressure: -999 MPa at Elevation: -999 m

Location of Measurement: -999

Salinity: -999 mg/L at Elevation: -999 m

Location of Measurement: -999

Elevation of bottom of USDW: -999 m

Injection Zone:

Name of Injection Zone: -999

Water Density: -999 kg/m^3 at Elevation: -999 m

Location of Measurement: -999

Temperature: -999 C at Elevation: -999 m

Location of Measurement: -999

Pressure: -999 MPa at Elevation: -999 m

Location of Measurement: -999

Salinity: -999 mg/L at Elevation: -999 m

Location of Measurement: -999

Elevation of top of Injection Zone: -999 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-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/30--Critical--Pressure--Est--AoR--and--PF--Delineation--Tab.pdf

Estimated Critical Pressure: -999 MPa

Delineated AoR:

Shapefile or KML File Showing Delineated AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/31--AoR--Shapefile--AoR--and--PF--Delineation--Tab.pdf

AoR Pressure Front Delineation Comments: There are no comments at this time.

Corrective Action

File with Location of All Penetrations within AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/32--Penetrations--Shapefile--Corrective--Action--Tab.pdf

File with Location of Wells Requiring Corrective Action: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/33--zCA--Wells--Shapefile--Corrective--Action--Tab.pdf

Supporting Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/34--Supporting--Documentation--Corrective--Action--Tab.pdf

Corrective Action Comments: There are no comments at this time

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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/Module--B-----AOR--CAP--Plan-----CPS--Final_Redacted2.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-0005/Phase1-PreConstruction/AoRModeling-06-24-2022-1922/35--Appendicies--AoR--and--CA--PLan--Tab.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: Krishnan Raghunathan

For confirmation a read-only copy of your submission will be emailed to: kraghunathan@AR-CO2.com