Class VI UIC Area of Review and Corrective Action

This submission is for:

Project ID: R06-LA-0002

Project Name: Project Minerva

Current Project Phase: Pre-Injection Prior to Construction

Overview

Simulator Used for AoR delineation modeling: Other

Other Simulator: REVEAL

Version Used: IPM V12.0 Reveal V9.5

Simulator Description/Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--1.pdf

Description of File Contents: Complete user manual for Reveal V9.5

Total Simulation Time From Start of Injection: 230 yrs

Additional AoR Delineation Information: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--2.pdf

Model Domain

Coordinate System: State Plane

Horizontal Datum: NAD27

Coordinate System Units: ft

Vertical Datum: Reference Elevation

Describe Vertical Datum: NAVD 88

Zone: Louisiana South

FIPSZONE: 1702 ADSZONE: 4051

Mesh Type: Hexahedral Curvilinear

Domain Size in Global Units Specified Above

Domain Coordinates File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--37.pdf

Grid Size

Number of Nodes in x: 239 y: 131 z: 52

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-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--3.pdf

Eclipse Keyword File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--4.pdf

Faults Modeled: Yes

Fault Coordinates File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--5.pdf

Caprock Modeled: Yes

Image File(s) for Model Domain Grid: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--6.pdf

Processes Modeled by Simulator

Reservoir Conditions:

Supercritical CO2 Conditions

Phases Modeled:

Aqueous Supercritical CO2

Aqueous Phase:

Phase Compressibility: Compressible

Compressibility Value: -999 1/psi

Phase Composition: Compositional

Aqueous Phase Components:

CO2 Water Salt

Supercritical CO2 Phase:

Phase Compressibility: Compressible

Phase Composition: Compositional

Supercritical CO2 Phase Components:

CO2 Methane

Equation of State Description Including Reference: Please see CBI submission

File with EOS Reference or Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--7.pdf

Multifluid Flow Processes:

Advection Buoyancy

Non-wetting Fluid Trapping Pore Compressibility

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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--8.pdf

Heat Transport Processes:

Advection Conduction

Geochemistry Modeled: Yes

File Describing Geochemistry Modeling: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--9.pdf

Geomechanical/Structural Deformations Modeled: Yes

File Describing Geomechanical/Structural Modeling: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--10.pdf

Rock Properties and Constitutive Relationships

Porosity/Permeability Model

Single Porosity

Porosity Distribution: Heterogeneous

Porosity included in Eclipse Keyword File: Yes

Porosity Variable Name in Eclipse Keyword File: PORO

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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--11.pdf

Image Files for Porosity Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--12.pdf

Permeability Distribution: Heterogeneous

Permeability included in Eclipse Keyword File: Yes

Permeability Variable Name in Eclipse Keyword File: PERMX, PERMY, PERMZ

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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--13.pdf

Image Files for Permeability Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--14.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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--15.pdf

Rock Type Distribution Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--16.pdf

Image Files for Rock Type Distribution: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--17.pdf

Rock Type #1

Rock Compressibility: Pore

Rock Compressibility Distribution: Single Value

Compressibility Value: -999 1/psi

Compressibility included in Eclipse Keyword File: No

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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--18.pdf

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-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--19.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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--20.pdf

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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--21.pdf

Porosity and Permeability Reduction Due to Salt Precipitation

Rock Type #2

Rock Compressibility: Pore

Rock Compressibility Distribution: Single Value

Compressibility Value: -999 1/Pa

Compressibility included in Eclipse Keyword File: No

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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/EPA--AoR--CBI--60.pdf

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-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/EPA--AoR--CBI--61.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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/EPA--AoR--CBI--62.pdf

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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/EPA--AoR--CBI--63.pdf

Porosity and Permeability Reduction Due to Salt Precipitation

Boundary Conditions

Attach Boundary Conditions Description File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--22.pdf

Initial Conditions

Initial Phases in Domain: Aqueous

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

Initial Aqueous Pressure: -999 psi at Reference Elevation: -999 ft

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 ppm

Operational Information

Number of Injection Wells: 4

Injection Well #1

Well Direction: Vertical

Location: X: -999 UTM Y: -999 UTM

Wellbore Diameter: Constant

Wellbore Diameter: 8.5 in

Well Screen Interval Provided as: Single Interval

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

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 psi Elevation Corresponding to Pressure: -999 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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--23.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2020 Stop Date: 01/01/2050

Injection Well #2

Well Direction: Vertical

Location: X: -999 UTM Y: -999 UTM

Wellbore Diameter: Constant

Wellbore Diameter: 8.5 in

Well Screen Interval Provided as: Single Interval

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

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 psi Elevation Corresponding to Pressure: -999 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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--24.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2020 Stop Date: 01/01/2050

Injection Well #3

Well Direction: Vertical

Location: X: -999 UTM Y: -999 UTM

Wellbore Diameter: Constant

Wellbore Diameter: 8.5 in

Well Screen Interval Provided as: Single Interval

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

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 psi Elevation Corresponding to Pressure: -999 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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--25.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2020 Stop Date: 01/01/2050

Injection Well #4

Well Direction: Vertical

Location: X: -999 UTM Y: -999 UTM

Wellbore Diameter: Constant

Wellbore Diameter: 8.5 in

Well Screen Interval Provided as: Single Interval

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

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 psi Elevation Corresponding to Pressure: -999 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-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--26.pdf

Composition of Injectate: Pure CO2

Injection Schedule Provided as: Single Injection Period

Injection Start Date: 01/01/2020 Stop Date: 01/01/2050

Number of Production/Withdrawal Wells: 0

Model Output/Results

Provide file name and corresponding spatial location for each file: Please see CBI submission

Time-Series File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--27.pdf

Provide file name and corresponding variable and time stamp for each file: Please see CBI submission

Snapshot File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--28.pdf

Provide file name and corresponding description of surface for each file: Please see CBI submission

Surface Flux File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--29.pdf

Sensitivity Analysis Description/Results: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/EPA--AoR--CBI--v3.pdf

AoR Pressure Front Delineation

Lowermost USDW:

Name of Lowermost USDW: PLIOCENE

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

Location of Measurement for Density: -999

Temperature: -999 C at Elevation: -999 ft

Location of Measurement: -999

Pressure: -999 psi at Elevation: -999 m

Location of Measurement: -999

Salinity: -999 ppm at Elevation: -999 m

Location of Measurement: -999

Elevation of bottom of USDW: -999 ft

Injection Zone:

Name of Injection Zone: Frio Formation

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 psi at Elevation: -999 m

Location of Measurement: -999

Salinity: -999 ppm at Elevation: -999 m

Location of Measurement: -999

Elevation of top of Injection Zone: -999 ft

Method of Estimating Critical Pressure: Dynamic Modeling

Describe Model Used: -999

File Describing Critical Pressure Estimation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--31.pdf

Estimated Critical Pressure: -999 psi

Delineated AoR:

Shapefile or KML File Showing Delineated AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--32.pdf

Corrective Action

File with Location of All Penetrations within AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--33.pdf

File with Location of Wells Requiring Corrective Action: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--34.pdf

Supporting Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--35.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-LA-0002/Phase1-PreConstruction/AoRModeling-07-11-2022-1834/GCS--AoR--CBI--36.pdf

Appendices and Supporting Materials Upload

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: Benjamin Heard

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