Class VI UIC Area of Review and Corrective Action

This submission is for:

Project ID: R06-TX-0004

Project Name: bp Jasper Storage Site

Current Project Phase: Pre-Injection Prior to Construction

Overview

Simulator Used for AoR delineation modeling: Other

Other Simulator: CBI

Version Used: CBI

Simulator Description/Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Overview_Software--Highlights.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Overview_Software--Usage--Citations.pdf.pdf

Description of File Contents: The file Overview_Software Highlights.pdf has been uploaded. It describes the simulator software, as well as significant updates for the version utilized for modeling the AoR. Additionally, a list of citations that support the use of the modeling software has been provided for review.

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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Addl--AoR--Delineation--Info_Primacy.pdf

Description of Information Submitted: At the time of this submission, Texas does not have primacy for Class VI permitting.

Model Domain

Coordinate System: Other

Describe Coordinate System: The coordinate system is NAD27 / BLM 15N [EPSG:32065] and the units are US feet.

Horizontal Datum: NAD27

Vertical Datum: Mean Sea Level

Describe Vertical Datum: The vertical datum utilized is based on Mean Sea Level.

Mesh Type: Other

Describe Mesh Type: Rectilinear tartan corner point grid with variable grid cell geometry as the basis for finite difference calculations.

Domain Size in Global Units Specified Above

Domain Coordinates File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/DomainCoordTemplate_red.pdf

Grid Size

Number of Nodes in x: 272 y: 226 z: 46

Grid Spacing: Variable

Grid File Format: EarthVision ASCII File

Grid File Description: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Grid--File--Description_red.pdf

Grid Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Grid--Data--File.txt.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Image--Files--for--Model--Domain--Grid_red.pdf

Model Domain Comments: No comments at the time of this application submittal.

Processes Modeled by Simulator

Reservoir Conditions:

Supercritical CO_2 Conditions

Phases Modeled:

Aqueous Supercritical CO_2

Aqueous Phase:

Phase Compressibility: Compressible

Compressibility Value: -999 1/psi

Phase Composition: Compositional

Aqueous Phase Components:

CO2 Water

Supercritical CO2 Phase:

Phase Compressibility: Compressible

Phase Composition: Non-Compositional

Equation of State Description Including Reference: CBI

File with EOS Reference or Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/EoS--Reference_red.pdf

Multifluid Flow Processes:

Others: CBI

Thermal Conditions: Non-Isothermal

File Describing Thermal Conductivity Function including Parameters: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Thermal--Option.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Using--the--Thermal--Option.pdf.pdf

Heat Transport Processes:

Geochemistry Modeled: No

Geomechanical/Structural Deformations Modeled: No

Modeled Processes Comments: No comments at the time of this application submittal.

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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR_Porosity.zip.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Porosity--Description_red.pdf

Image Files for Porosity Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Grid--Porosity.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Porosity--Distribution.pdf.pdf

Permeability Distribution: Heterogeneous

Spatially Variable Permeability File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR_Perm.zip.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Permeability--Description_red.pdf

Image Files for Permeability Distributions: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Perm--Distribution.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Grid--Permeability.pdf.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Rock--Type--Description_red.pdf

Rock Type Distribution Data File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR_Rock--Type.zip.pdf

Image Files for Rock Type Distribution: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Regional--Core--Data.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Rock--Type--Distribution.pdf.pdf

Rock Type #1

Rock Compressibility: Bulk

Rock Compressibility Distribution: Single Value

Compressibility Value: -999 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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/RT1--Aqueous--Sat--vs--Cap--Press.csv.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/RT1--Aqueous--Rel--Perm.csv.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/RT1--Gas--Rel--Perm.csv.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: -999 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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/RT2--Aqueous--Sat--vs--Cap--Press.csv.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/RT2--Aqueous--Rel--Perm.csv.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/RT2--Gas--Rel--Perm.csv.pdf

Hysteresis other than non-wetting fluid trapping: No

Porosity and Permeability Reduction Due to Salt Precipitation

Rock Properties Comments: No comments at the time of this application submittal.

Boundary Conditions

Attach Boundary Conditions Description File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Boundary--Conditions--Description_red.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: No comments at the time of this application submittal.

Operational Information

Number of Injection Wells: -999

Number of Production/Withdrawal Wells: 0

Operational Information Comments: No comments at the time of this application submittal.

Model Output/Results

Provide file name and corresponding spatial location for each file: Filenames: Time Series Data Time Series Images

Time-Series File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Time--Series--Data.zip.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Time--Series--Images.pdf.pdf

Provide file name and corresponding variable and time stamp for each file: Filenames: CO2 Plume and AoR Snapshots Through Time Cross-Section CO2 Plume Snapshots Through Time

Snapshot File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/CO2--Plume--and--AoR--Snapshots--Through--Time.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Cross-Section--CO2--Plume--Snapshots--Through--Time.pdf.pdf

Provide file name and corresponding description of surface for each file: File Names: Flux_Data Flux_Sector_Grid_2 Water_Influx_NorthSouth AoR Flux Data Description_red

Surface Flux File: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Flux_Data.csv.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Flux_Sector_Grid_2.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Water_Influx_NorthSouth.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR--Flux--Data--Description_red.pdf

Model Output Comments: No comments at the time of this application submittal.

AoR Pressure Front Delineation

Lowermost USDW:

Name of Lowermost USDW: CBI

Water Density: -999 gm/cm^3 at Elevation: -999 ft

Location of Measurement for Density: -999

Temperature: -999 C at Elevation: -999 ft

Location of Measurement: -999

Pressure: -999 MPa at Elevation: -999 ft

Location of Measurement: -999

Salinity: -999 ppm at Elevation: -999 ft

Location of Measurement: CBI

Elevation of bottom of USDW: -999 ft

Injection Zone:

Name of Injection Zone: CBI

Water Density: -999 gm/cm^3 at Elevation: -999 ft

Location of Measurement: -999

Temperature: -999 C at Elevation: -999 ft

Location of Measurement: -999

Pressure: -999 MPa at Elevation: -999 ft

Location of Measurement: -999

Salinity: -999 ppm at Elevation: -999 ft

Location of Measurement: CBI

Elevation of top of Injection Zone: -999 ft

Method of Estimating Critical Pressure: Static Mass Balance

Assumptions: See Uploaded Document, "AoR Critical Pressure Description_red"

File Describing Critical Pressure Estimation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR--Pressure--Front--Delineation--Comments.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR--Critical--Pressure--Description_red.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Delineated--AoR--Pressure--Front--Shapefile.zip.pdf

AoR Pressure Front Delineation Comments: No comments at the time of this application submittal.

Corrective Action

File with Location of All Penetrations within AoR: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR--Legacy--Wells_All.csv.pdf

File with Location of Wells Requiring Corrective Action: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR--Legacy--Wells_Confining--Zone.csv.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/AoR--Legacy--Wells_Confining--Zone--Detail.csv.pdf

Supporting Documentation: https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Pressure--Determination.csv.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/USDW--Determinations.csv.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/USDW--Determination--Letters.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Confining--Zone--Artificial--Penetrations.pdf.pdf

Corrective Action Comments: No comments at the time of this application submittal.

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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/B_AoR--and--CA_red.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-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Att--1_Time--Series--Images.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Att--2_USDW--Evaluation--Report.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Att--3_USDW--Determination--Letters.pdf.pdf

https://gsdt.pnnl.gov/alfresco/service/velo/getFile/no_wiki/shared/Submissions/R06-TX-0004/Phase1-PreConstruction/AoRModeling-06-28-2023-0914/Att--4_Confining--Zone--Artificial--Penetrations.pdf.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: Jayraj Amin

For confirmation a read-only copy of your submission will be emailed to: Angela.Ludolph@bp.com