CONSTRUCTION DETAILS
40 CFR 146.86(a)

One Earth CCS

Facility Information

Facility name: One Earth Sequestration, LLC
OES #1

Facility contact: Mark Ditsworth, VP of Technology and Special Projects
One Earth Sequestration, LLC, 202 N Jordan Drive, Gibson City
(217) 784-5321 ext. 215
mditsworth@oneearthenergy.com

Well location: McLean County, IL
40.845427°N, -88.480010°W (NAD 1983)

Injection Well Operating Conditions

Table 1 provides the injection well operating conditions anticipated for the One Earth Sequestration, LLC OES #1 well.

Table 1. *OES #1 Injection well operating conditions.*

Parameter	Value	Notes
Maximum proposed injection rate	4,255 MT/day	Assumes injection of 1.5 Mt/yr
Planned Injection Duration	20 Years	From Class VI narrative
Injection type	Continuous	Operational target is for continuous injection. However, intermittent injection may occur due to operational downtime.
Volume Flow Rate	934 – 1,019 gpm	Average - Maximum
Flow Velocity in Tubing	124 - 135 ft/min	Assuming 5-1/2” tubing ID of 4.839” at surface
Mass of Stream (mol fraction)	CO_2 – .9936 H_2O – 0.0002 O_2 – 1.30E-03 N_2 – 4.90E-03	FEED Study (2022)
CO_2 Stream Characteristics (lb/hr)	CO_2 – 118,465.8 H_2O – 10.3 O_2 – 112.6 N_2 – 371.2	FEED Study (2022)
CO_2 Stream Density	6.17 – 6.92 lb/gal	Average to maximum at surface
Sensitive, Confidential, or Privileged Information [redacted]		Regional data (see AoR and CA Plan)
		Regional data (see AoR and CA Plan)
		Determined using the fracture gradient multiplied by 0.9 (see AoR and CA Plan)
Maximum proposed annular pressure	4,289 psi	To maintain 100 psi differential pressure
Maximum pressure at wellhead	2,498	From Narrative
Minimum annulus pressure	100 psi	To maintain 100 psi differential pressure
Minimum differential pressure (directly above and across packer)	100 psi	For continuous mechanical integrity assurance
Sensitive, Confidential, or Privileged Information [redacted]		From OEE #1 well formation tops

Dry supercritical CO_2 is not corrosive, and corrosion will occur only when water is present (Russick et al., 1996; Zhang et al., 2011). Supercritical CO_2 is considered “dry” at water concentrations of 10 lbs./MMscf (211 ppmv). The design basis for the carbon capture and compression facility at One Earth Sequestration sets the typical treatment specification of 10 lb/MMscf (211 ppmv) (FEED) in the CO_2 delivered to the wellhead. Laboratory and modeling studies for the Mt. Simon Sandstone from the Illinois Basin suggest that there is minimal reactivity of the rock with brine and CO_2. This is discussed in the Narrative Section Geochemistry [40 CFR 146.82(a)(6)], Subsection Geochemical Reactions and Modeling. And in Section Site Suitability [40 CFR 146.83], Subsection Reservoir and Compatibility with the Injectate.

The Testing and Monitoring Plan provides for corrosion monitoring of injection well tubing using the coupon monitoring method and for measurement of water content in the injectate to evaluate potential corrosiveness of the injected CO_2. In addition, fluid samples from AZM and IZM wells will include field measurements of pH during each sampling event.

Formation Conditions

Table 2 presents the anticipated formation conditions for the OES #1 injection well.

Table 1. *Formation conditions for OES #1 well.*

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[redacted]

Open Hole Parameters

The open hole construction parameters for the OES #1 injection well are presented in Table 3. Mud weight will be designed to maintain overbalanced drilling. Two single shot surveys will be acquired during the surface section, then at least every 500 feet below the surface casing set depth to total depth. If wellbore deviation issues develop, additional surveys will be performed as necessary and drilling methods will be adapted as needed.

Table 2. *Well construction open hole details for the OES #1 well.*

Name	Depth Interval (feet)	Open Hole Diameter (inches)	Comment	Drilling Mud Type & Weight (lb/gal)[1]	Pressure Gradient (psi/ft)	Maximum Deviation and Dog Leg Severity[2]
Surface	Sensitive, Confidential, or Privileged Information [redacted]		To bedrock	Sensitive, Confidential, or Privileged Information [redacted]		
Intermediate			To primary seal			
Long			To bedrock			

Casing and Completion Tubing Specifications

The proposed casing and tubing completion string specifications are provided in Table 4. The wellbore schematic is presented in Figure 6.

Table 3. *Well casing and tubing specifications for the OES #1 well.*

Name	Depth Interval (feet)	Outside Diameter (inches)	Inside Diameter (inches)	Nominal Weight (lb/ft)	Material Grade (API)	Design Coupling/Joint Yield (klbf)	Thermal Conductivity @ 77 ° F (BTU/ft.hr.	Pipe Body Yield (klbf)	Collapse Strength	Burst Strength (psi)
Surface[1]	Sensitive, Confidential, or Privileged Information [redacted]									
Intermediate[2]										
Long[3] (carbon)										
Long[3] (chrome)										
Tubing[4]										

Sensitive, Confidential, or Privileged Information [redacted]

[redacted]

[redacted]

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[redacted]

Sensitive, Confidential, or Privileged Information

[redacted]

Sensitive, Confidential, or Privileged Information

[redacted]

Sensitive, Confidential, or Privileged Information

[redacted]

Sensitive, Confidential, or Privileged Information

[redacted]

Minimum Logging Specifications for Well Construction

Table 5 shows the minimum logging that will be conducted during well construction tasks. Additional logs may be run as needed for additional characterization and testing and monitoring.

Table 4. *Minimum logging planned related to well construction parameters.*

Name	Depth Interval (feet)	Open Hole Logs	Cased Hole Logs
Surface	Sensitive, Confidential, or Privileged Information [redacted]	Resistivity SP Caliper	Radial CBL/VDL or Ultrasonic Temperature
Intermediate	[redacted]	Resistivity SP Caliper	Radial CBL/VDL or Ultrasonic Temperature
Long	[redacted]	Resistivity SP Caliper Porosity Gamma Ray Fracture Finder	Radial CBL/VDL or Ultrasonic Temperature

Cement Specifications

The well will be fully cased and all strings cemented back to ground level as detailed in Table 6 and illustrated in Figure 6. The long string will include a CO_2-resistant EverCrete cementing system. CO_2 resistant cement will cover the entire open hole section from TD and be placed approximately 200 feet back into the 13 3/8” casing covering the Eau Claire sealing formation. The actual cement volume, displacement rates, and technique (i.e., single vs two-stage) will be determined refined using a cement design software with inputs from drilling operations (i.e., caliper logs, fracture logs, mud losses, etc.). A mud flush will be pumped ahead of all cement jobs to assist in mud removal. The injection well will have approximately 80 feet of cement above the casing shoe to prevent the injection fluid from contacting the Precambrian granite basement.

Table 5. *Well cement specifications for OES #1 well.*

Name	Depth Interval (feet)	Access.	Stage 1 Lead	Stage 1 Tail	Stage 2 Lead	Stage 2 Tail
Surface	Sensitive, Confidential, or Privileged Information [redacted]					
Intermed.	[redacted]					
Long	[redacted]					

Wellhead Design Parameters

The proposed wellhead schematic is presented in Figure 5. The wellhead includes a continuous automatic (shutoff) gate valve, along with access ports for downhole gauges and fiber optic monitoring.

A final design of the annulus pressure maintenance systems is not completed at this time. However, the annular pressure maintenance system will consist of the following components:

- Pressure Gauges - The pressure measurement of the annulus will be automated to alert the CO_2 operator of changes in pressure so manual or automated adjustments can be made to maintain the required positive differential pressure on the annulus. The positive differential may not be maintained during start-up, shutdown, and well maintenance periods.
- Brine Tank(s) and Tank Gauge - The annulus tank will contain an adequate amount of premixed packer fluid so that fluid use can be monitored using a tank gauge, and any fluid introduced into the annulus will be the same as already present.
- Pump or Accumulator – A pump or gas charged accumulator will be incorporated to maintain the pressures necessary on the annulus for the positive differential. It is anticipated that temperature, injection rate, and injection pressure fluctuations will require annular pressure changes to assure appropriate annular pressure.

References

E.M. Russick *et al.* Corrosive effects of supercritical carbon dioxide and cosolvents on metals, Journal of Supercritical Fluids (1996)

Trimeric Corporation et al., 2022. One Earth Energy CO_2 Capture Facility FEED Study and Class 4 Cost Estimate Final Report.

Zhang YC, Gao KW, Schmitt G. 2011. Water effect on steel corrosion under supercritical CO_2 conditions. In: Corrosion 2011. Paper No. 11378. Houston, TX, USA: NACE International, 2011a.

Sensitive, Confidential, or Privileged Information

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Figure 5. *Proposed OES #1 wellhead schematic.*

Sensitive, Confidential, or Privileged Information

[redacted]

Figure 6. *Wellbore and completions schematic for OES #1 well.*

CONSTRUCTION DETAILS
40 CFR 146.86(a)

One Earth CCS

Facility Information

Facility name:	One Earth Sequestration, LLC OES #2
Facility contact:	Mark Ditsworth, VP of Technology and Special Projects One Earth Sequestration, LLC, 202 N Jordan Drive, Gibson City (217) 784-5321 ext. 215 mditsworth@oneearthenergy.com
Well location:	McLean County, IL 40.500096°N, -88.474625°W (NAD 1983)

Injection Well Operating Conditions

Table 1 provides the injection well operating conditions anticipated for the OES #2 well.

Table 1. *OES #2 Injection well operating conditions.*

Parameter	Value	Notes
Maximum proposed injection rate	4,255 MT/day	Assumes injection of 1.5 Mt/yr
Planned Injection Duration	20 Years	From Class VI narrative
Injection type	Continuous	Operational target is for continuous injection. However, intermittent injection may occur due to operational downtime.
Volume Flow Rate	934 – 1,019 gpm	Average - Maximum
Flow Velocity in Tubing	124 - 135 ft/min	Assuming 5-1/2” tubing ID of 4.839” at surface
Mass of Stream (mol fraction)	CO_2 – .9936 H_2O – 0.0002 O_2 – 1.30E-03 N_2 – 4.90E-03	FEED Study (2022)
CO_2 Stream Characteristics (lb/hr)	CO_2 – 118,465.8 H_2O – 10.3 O_2 – 112.6 N_2 – 371.2	FEED Study (2022)
CO_2 Stream Density	6.17 – 6.92 lb/gal	Average to maximum at surface.
Sensitive, Confidential, or Privileged Information [redacted]	[redacted]	Regional data (see AoR and CA Plan)
[redacted]	[redacted]	Regional data (see AoR and CA Plan)
[redacted]	[redacted]	Determined using the fracture pressure multiplied by 0.9 (see AoR and CA Plan)
Maximum proposed annular pressure	4,289 psi	To maintain 100 psi differential pressure
Maximum pressure at wellhead	2,498 psi	From Narrative
Minimum annulus pressure	100 psi	To maintain 100 psi differential pressure.
Minimum differential pressure (directly above and across packer)	100 psi	For continuous mechanical integrity assurance.
Sensitive, Confidential, or Privileged Information [redacted]	[redacted]	From OEE #1 well formation tops.

Dry supercritical CO_2 is not corrosive, and corrosion will occur only when water is present (Russick et al., 1996; Zhang et al., 2011). Supercritical CO_2 is considered "dry" at water concentrations of 10 lbs./MMscf (211 ppmv). The design basis for the carbon capture and compression facility at One Earth Sequestration sets the typical treatment specification of 10 lb/MMscf (211 ppmv) (FEED) in the CO_2 delivered to the wellhead. Laboratory and modeling studies for the Mt. Simon Sandstone from the Illinois Basin suggest that there is minimal reactivity of the rock with brine and CO_2. This is discussed in the Narrative Section Geochemistry [40 CFR 146.82(a)(6)], Subsection Geochemical Reactions and Modeling. And in Section Site Suitability [40 CFR 146.83], Subsection Reservoir and Compatibility with the Injectate.

The Testing and Monitoring Plan provides for corrosion monitoring of injection well tubing using the coupon monitoring method and for measurement of water content in the injectate to evaluate potential corrosiveness of the injected CO_2. In addition, fluid samples from AZM and IZM wells will include field measurements of pH during each sampling event.

Formation Conditions

Table 2 presents the anticipated formation conditions for the OES #2 injection well.

Table 1*. Formation conditions for OES #2 well.*

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Open Hole Parameters

The open hole construction parameters for the OES #2 injection well are presented in Table 3. Mud weight will be designed to maintain overbalanced drilling. Two single shot surveys will be acquired during the surface section, then at least every 500 feet below the surface casing set depth to total depth. If wellbore deviation issues develop, additional surveys will be performed as necessary and drilling methods will be adapted as needed.

Table 2. *Well construction open hole details for the OES #2 well.*

Name	Depth Interval (feet)	Open Hole Diameter (inches)	Comment	Drilling Mud Type & Weight (lb/gal)[1]	Pressure Gradient (psi/ft)	Maximum Deviation and Dog Leg Severity[2]
Surface	Sensitive, Confidential, or Privileged Information [redacted]		To bedrock	Sensitive, Confidential, or Privileged Information [redacted]		
Intermediate	[redacted]	[redacted]	To primary seal	[redacted]	[redacted]	[redacted]
Long	[redacted]	[redacted]	To bedrock	[redacted]	[redacted]	[redacted]

Casing and Completion Tubing Specifications

The proposed casing and tubing completion string specifications are provided in Table 4. The wellbore schematic is presented in Figure 6.

Table 3. *Well casing and tubing specifications for the OES #2 well.*

Name	Depth Interval (feet)	Outside Diameter (inches)	Inside Diameter (inches)	Nominal Weight (lb/ft)	Material Grade (API)	Design Coupling/Joint Yield (klbf)	Thermal Conductivity @ 77 °F (BTU/ft.hr. °F)	Pipe Body Yield (klbf)	Collapse Strength	Burst Strength (psi)
Surface[1]	Sensitive, Confidential, or Privileged Information [redacted]									
Intermediate[2]										
Long[3] (carbon)										
Long[3] (chrome)										
Tubing[4]										

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Sensitive, Confidential, or Privileged Information

[redacted]

Sensitive, Confidential, or Privileged Information

[redacted]

Sensitive, Confidential, or Privileged Information

[redacted]

Minimum Logging Specifications for Well Construction

Table 5 shows the minimum logging that will be conducted during well construction tasks. Additional logs may be run as needed for additional characterization and testing and monitoring.

***Table 4**. Minimum logging planned related to well construction parameters.*

Name	Depth Interval (feet)	Open Hole Logs	Cased Hole Logs
Surface	Sensitive, Confidential, or Privileged Information [redacted]	Resistivity SP Caliper	Radial CBL/VDL or Ultrasonic Temperature
Intermediate	[redacted]	Resistivity SP Caliper	Radial CBL/VDL or Ultrasonic Temperature
Long	[redacted]	Resistivity SP Caliper Porosity Gamma Ray Fracture Finder	Radial CBL/VDL or Ultrasonic Temperature

Cement Specifications

The well will be fully cased and all strings cemented back to ground level as detailed in Table 6 and illustrated in Figure 6. The long string will include a CO_2-resistant EverCrete cementing system. CO_2 resistant cement will cover the entire open hole section from TD and be placed approximately 200 feet back into the 13 3/8" casing covering the Eau Claire sealing formation. The actual cement volume, displacement rates, and technique (i.e., single vs two-stage) will be determined refined using a cement design software with inputs from drilling operations (i.e., caliper logs, fracture logs, mud losses, etc.). A mud flush will be pumped ahead of all cement jobs to assist in mod removal. The injection well will have approximately 80 feet of cement above the casing shoe to prevent the injection fluid from contacting the Precambrian granite basement.

__Table 5__. Well cement specifications for OES #2 well.

Name	Depth Interval (feet)	Access.	Stage 1 Lead	Stage 1 Tail	Stage 2 Lead	Stage 2 Tail
Surface	Sensitive, Confidential, or Privileged Information [redacted]					
Intermed.	[redacted]					
Long	[redacted]					

Wellhead Design Parameters

The proposed wellhead schematic is presented in Figure 5. The wellhead includes a continuous automatic (shutoff) gate valve, along with access ports for downhole gauges and fiber optic monitoring.

A final design of the annulus pressure maintenance systems is not completed at this time. However, the annular pressure maintenance system will consist of the following components:

- Pressure Gauges - The pressure measurement of the annulus will be automated to alert the CO_2 operator of changes in pressure so manual or automated adjustments can be made to maintain the required positive differential pressure on the annulus. The positive differential may not be maintained during start-up, shutdown, and well maintenance periods.

- Brine Tank(s) and Tank Gauge - The annulus tank will contain an adequate amount of premixed packer fluid so that fluid use can be monitored using a tank gauge, and any fluid introduced into the annulus will be the same as already present.
- Pump or Accumulator – A pump or gas charged accumulator will be incorporated to maintain the pressures necessary on the annulus for the positive differential. It is anticipated that temperature, injection rate, and injection pressure fluctuations will require annular pressure changes to assure appropriate annular pressure.

References

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Trimeric Corporation et al., 2022. One Earth Energy CO_2 Capture Facility FEED Study and Class 4 Cost Estimate Final Report.

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Sensitive, Confidential, or Privileged Information

[redacted]

***Figure 5**. Proposed OES #2 wellhead schematic.*

Sensitive, Confidential, or Privileged Information

[redacted]

Figure 6. *Wellbore and completions schematic for OES #2 well.*

CONSTRUCTION DETAILS
40 CFR 146.86(a)

One Earth CCS

Facility Information

Facility name: One Earth Sequestration, LLC
OES #3

Facility contact: Mark Ditsworth, VP of Technology and Special Projects
One Earth Sequestration, LLC, 202 N Jordan Drive, Gibson City
(217) 784-5321 ext. 215
mditsworth@oneearthenergy.com

Well location: McLean County, IL
40.515829°N, -88.479947°W, (NAD 1983)

Injection Well Operating Conditions

Table 1 provides the injection well operating conditions anticipated for the OES #3 well.

Table 1. *OES #3 Injection well operating conditions.*

Parameter	Value	Notes
Maximum proposed injection rate	4,255 MT/day	Assumes injection of 1.5 Mt/yr
Planned Injection Duration	20 Years	From Class VI narrative
Injection type	Continuous	Operational target is for continuous injection. However, intermittent injection may occur due to operational downtime.
Volume Flow Rate	934 – 1,019 gpm	Average - Maximum
Flow Velocity in Tubing	124 - 135 ft/min	Assuming 5-1/2" tubing ID of 4.839" at surface
Mass of Stream (mol fraction)	CO_2 – .9936 H_2O – 0.0002 O_2 – 1.30E-03 N_2 – 4.90E-03	FEED Study (2022)
CO_2 Stream Characteristics (lb/hr)	CO_2 – 118,465.8 H_2O – 10.3 O_2 – 112.6 N_2 – 371.2	FEED Study (2022)
CO_2 Stream Density	6.17 – 6.92 lb/gal	Average to maximum at surface.
Sensitive, Confidential, or Privileged Information [redacted]	[redacted]	Regional data (see AoR and CA Plan)
[redacted]	[redacted]	Regional data (see AoR and CA Plan)
[redacted]	[redacted]	Determined using the fracture gradient multiplied by 0.9 (see AoR and CA Plan)
Maximum proposed annular pressure	4,289 psi	To maintain 100 psi differential pressure
Maximum pressure at wellhead	2,498	From narrative.
Minimum annulus pressure	100 psi	To maintain 100 psi differential pressure.
Minimum differential pressure (directly above and across packer)	100 psi	For continuous mechanical integrity assurance.
Sensitive, Confidential, or Privileged Information [redacted]	[redacted]	From OEE #1 well formation tops.

Dry supercritical CO_2 is not corrosive, and corrosion will occur only when water is present (Russick et al., 1996; Zhang et al., 2011). Supercritical CO_2 is considered "dry" at water concentrations of 10 lbs./MMscf (211 ppmv). The design basis for the carbon capture and compression facility at One Earth Sequestration sets the typical treatment specification of 10 lb/MMscf (211 ppmv) (FEED) in the CO_2 delivered to the wellhead. Laboratory and modeling studies for the Mt. Simon Sandstone from the Illinois Basin suggest that there is minimal reactivity of the rock with brine and CO_2. This is discussed in the Narrative Section Geochemistry [40 CFR 146.82(a)(6)], Subsection Geochemical Reactions and Modeling. And in Section Site Suitability [40 CFR 146.83], Subsection Reservoir and Compatibility with the Injectate.

The Testing and Monitoring Plan provides for corrosion monitoring of injection well tubing using the coupon monitoring method and for measurement of water content in the injectate to evaluate potential corrosiveness of the injected CO_2. In addition, fluid samples from AZM and IZM wells will include field measurements of pH during each sampling event.

Formation Conditions

Table 2 presents the anticipated formation conditions for the OES #3 injection well.

Table 1. *Formation conditions for OES #3 well.*

Sensitive, Confidential, or Privileged Information

[redacted]

Open Hole Parameters

The open hole construction parameters for the OES #3 injection well are presented in Table 3. Mud weight will be designed to maintain overbalanced drilling. Two single shot surveys will be acquired during the surface section, then at least every 500 feet below the surface casing set depth to total depth. If wellbore deviation issues develop, additional surveys will be performed as necessary and drilling methods will be adapted as needed.

Table 2. *Well construction open hole details for the OES #3 well.*

Name	Depth Interval (feet)	Open Hole Diameter (inches)	Comment	Drilling Mud Type & Weight (lb/gal)[1]	Pressure Gradient (psi/ft)	Maximum Deviation and Dog Leg Severity[2]
Surface	Sensitive, Confidential, or Privileged Information [redacted]		To bedrock	Sensitive, Confidential, or Privileged Information [redacted]		
Intermediate			To primary seal			
Long			To bedrock			

Casing and Completion Tubing Specifications

The proposed casing and tubing completion string specifications are provided in Table 4. The wellbore schematic is presented in Figure 6.

Table 3. *Well casing and tubing specifications for the OES #3 well.*

Name	Depth Interval (feet)	Outside Diameter (inches)	Inside Diameter (inches)	Nominal Weight (lb/ft)	Material Grade (API)	Design Coupling/Joint Yield (klbf)	Thermal Conductivity @ 77 ° F (BTU/ft.hr. °F)	Pipe Body Yield (klbf)	Collapse Strength	Burst Strength (psi)
Surface[1]	Sensitive, Confidential, or Privileged Information [redacted]									
Intermediate[2]										
Long[3] (carbon)										
Long[3] (chrome)										
Tubing[4]										

Sensitive, Confidential, or Privileged Information

[redacted]

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Sensitive, Confidential, or Privileged Information
[redacted]

[redacted]

Sensitive, Confidential, or Privileged Information

[redacted]

Figure 1. *20" Surface casing axial force design envelope.*

Sensitive, Confidential, or Privileged Information

[redacted]

Figure 2. *13-3/8" Intermediate casing axial force design envelope.*

Sensitive, Confidential, or Privileged Information

[redacted]

Figure 3. *9-5/8" Long string casing axial force design envelope.*

Sensitive, Confidential, or Privileged Information

[redacted]

Minimum Logging Specifications for Well Construction

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Name	Depth Interval (feet)	Open Hole Logs	Cased Hole Logs
Surface	Sensitive, Confidential, or Privileged Information [redacted]	Resistivity SP Caliper	Radial CBL/VDL or Ultrasonic Temperature
Intermediate	[redacted]	Resistivity SP Caliper	Radial CBL/VDL or Ultrasonic Temperature
Long	[redacted]	Resistivity SP Caliper Porosity Gamma Ray Fracture Finder	Radial CBL/VDL or Ultrasonic Temperature

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Table 5. *Well cement specifications for OES #3 well.*

Name	Depth Interval (feet)	Access.	Stage 1 Lead	Stage 1 Tail	Stage 2 Lead	Stage 2 Tail
Surface	Sensitive, Confidential, or Privileged Information [redacted]					
Intermed.						
Long						

Wellhead Design Parameters

The proposed wellhead schematic is presented in Figure 5. The wellhead includes a continuous automatic (shutoff) gate valve, along with access ports for downhole gauges and fiber optic monitoring.

A final design of the annulus pressure maintenance systems is not completed at this time. However, the annular pressure maintenance system will consist of the following components:

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Trimeric Corporation et al., 2022. One Earth Energy CO_2 Capture Facility FEED Study and Class 4 Cost Estimate Final Report.

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Sensitive, Confidential, or Privileged Information

[redacted]

Figure 5. *Proposed OES #3 wellhead schematic.*

Sensitive, Confidential, or Privileged Information

[redacted]

Figure 6. *Wellbore and completions schematic for OES #3 well.*