Orchard Storage Company LLC

Underground Injection Control – Class VI Permit Application for

Orchard No. 1 to No. 7

Section 8 – Emergency Response and Remediation Plan

Gaines County, Texas

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SECTION 8 – EMERGENCY AND REMEDIAL RESPONSE PLAN

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8.1 Emergency and Remedial Response Plan Overview

This Emergency and Remedial Response Plan for the proposed Orchard No. 1 through No. 7 Class VI injection wells (Orchard Project) was prepared to meet the requirements of 16 Texas Administrative Code (TAC) **§5.206(h)** [Title 40, U.S. Code of Federal Regulations (40 CFR) **§146.94**]. This section is organized into six distinct parts. The parts address the issues of (1) potentially affected infrastructure and parties, (2) definitions of degrees of severity, (3) specific events and their response plans, (4) training, (5) communications plans and notification procedures, and (6) review and updates to this plan. These sections aim to ensure an expeditious, appropriate response to protect any Underground Sources of Drinking Water (USDWs) and maximize the protection of the environment, surrounding community, and company property. This plan will remain in place during the construction, operation, closure, and post-closure periods of the Orchard Project.

8.2 Resources/Infrastructure in the AOR

The Orchard Project is located in Gaines County, Texas, [redacted] The project area is primarily agricultural and therefore has minimal potential impacts to local infrastructure. One residence was identified within the area of review (AOR), as delineated in *Section 3 – Area of Review and Corrective Action Plan*, shown in Figure 8-1. Local public safety and medical resources (Table 8-1) may be activated to supplement any Orchard Storage Company LLC (Orchard Storage) response to an emergency or adverse event, if required to minimize the event's impact.

Table 8-1 – Local Public Safety and Medical Resources

Name	Location	Distance	Response Time*
[redacted]			

*This table is arranged in ascending order of response times.

Figure 8-1 shows the location of the Orchard Project AOR, with infrastructure identified. A large-scale version of this map is provided in *Appendix F*.

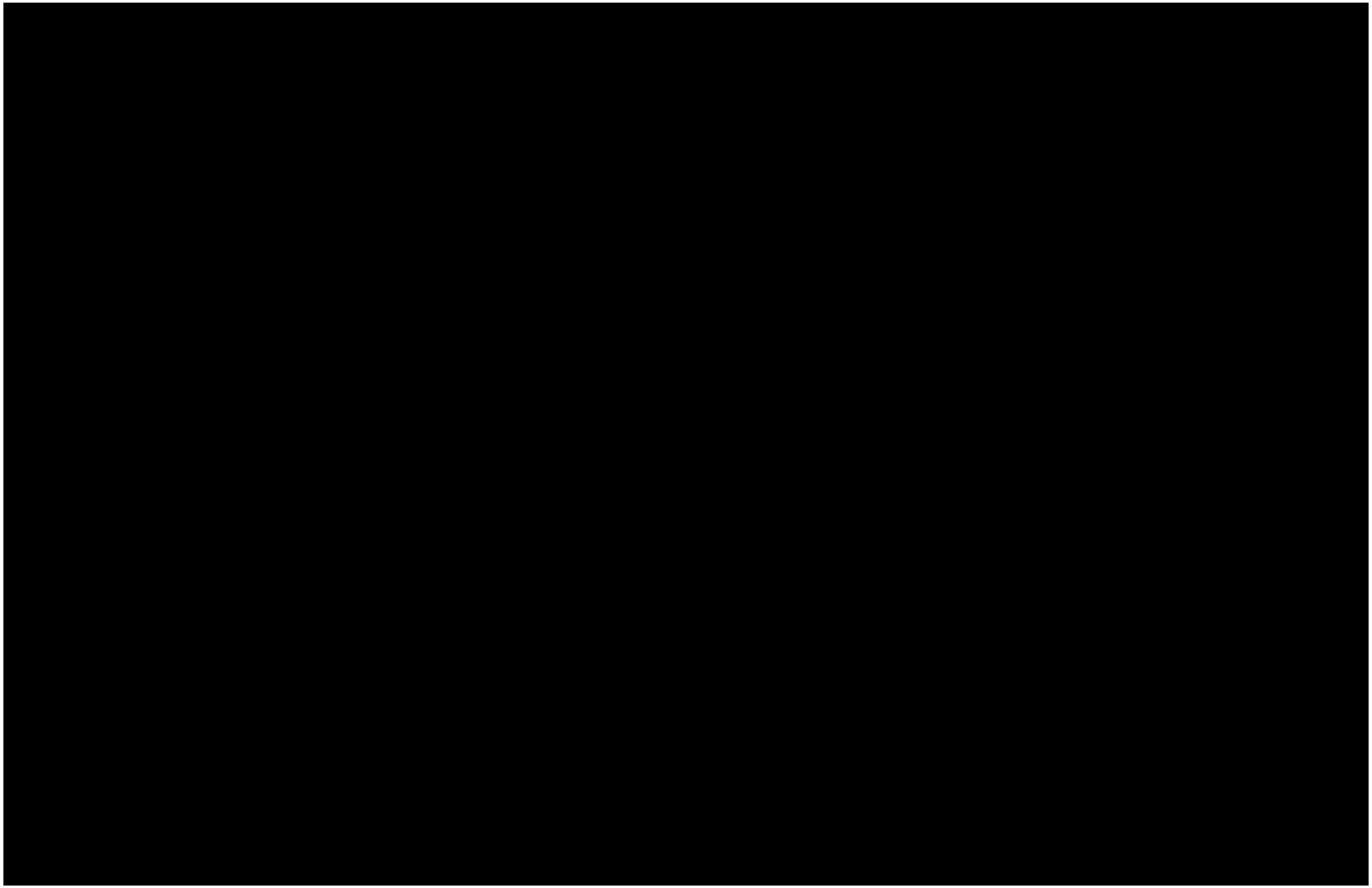

Figure 8-1 – Map of the Orchard Project AOR Showing Resources and Infrastructure

8.3 Degree of Risk for Emergency Events

Response actions will depend on the degree of severity of the event triggering an emergency response. Incident response will be managed via the Incident Command System (ICS) to organize, scale, and coordinate the response with third parties and communicate via a common emergency response language. Response teams will be assembled, organized, and scaled as necessary, depending on the severity of the event. At a minimum, response teams will be comprised of Orchard Project operations specialists and the Orchard Storage team. The teams will be expanded as needed to include specialty environmental-response resources, specialty well-intervention specialists, local first responders, and Gaines County officials. All responses will be coordinated and communicated as necessary with the relevant regulatory bodies.

A matrix of USDW-specific risks was developed to aid in identifying risk events and their relative probability of occurrence—summarized in Table 8-2. The methodology for determining the annual probability values and related financial assurance values is described in more detail in *Section 8.4.*

Table 8-2 – Risk Activity Table

Risk Event Type	Annual Probability	Number of Wells
Deep Oil-and-Gas Well Leak	[redacted]	
CO_2 Injection Well Leak		
Deep CO_2 Monitoring Well Leak		
Rapid Leakage Through Caprock		
Slow Leakage Through Caprock		
Release Through Existing Faults		
Release Through Induced Faults		
Leakage Through Caprock/Faults then Shallow Well		
Pipeline Release		

*This includes additional undocumented wells for conservatism in the analysis.

8.4 Emergency and Remedial Response Cost Estimates

This section summarizes the estimates of emergency and remedial response (ERR) costs for the Orchard Project. Such costs and the related methodology are at a *project* level, incorporating all of the project injection wells, the associated pore space occupancy plumes, and the critical pressure plume. These estimates are consistent with the Environmental Protection Agency's (EPA) Underground Injection Control (UIC) Program's Class VI regulatory requirements and are intended to inform the face value of the financial assurance necessary to satisfy ERR actions for the project.

Estimating possible ERR cost estimates for carbon capture and storage (CCS) necessitates understanding the interactions between the CCS stream, the geophysical environment in which it will be stored, and nearby populations. The long-term nature of the Orchard Project, the low probability of a release event, the variability in potential incident-conditions at the site, the size of the potentially impacted population, and the likely exposure pathways inform these estimates.

Monte Carlo analysis, risk-based, probabilistic modeling has been tailored to Orchard Project-specific risks and uncertainties, to (1) generate reasonable, upper-bound estimates of the ERR costs—and (2) provide a sensible, conservative, and objective basis for determining the face amount of the financial assurance instrument(s) necessary to support the Class VI permit.

The cost-estimation method applied to the Orchard Project is based on a peer-reviewed (Trabucchi et al., 2014) probabilistic approach—a model reflective of site-specific factors associated with the project. Specifically, the model's input parameters include the geologic location and specific chemical composition of the CO_2 stream, as well as site-specific conditions that exist within the established AOR. The analysis adopts several conservative input assumptions and incorporates probabilistic calculations that allow for multiple release incidents through operation and post-

injection site care. The annual probability values that were shown in Table 8-2 are derived from the FutureGen Project Environmental Impact Statement and associated database (DOE Office of NEPA Policy and Compliance, 2007). Furthermore, the cost estimates are based upon response actions that are generally accepted and commonly used to respond to contamination incidents that could impair the public's ability to safely access USDWs.

Based on a model run of 50,000 Monte Carlo trials and the addition of a [redacted] he upper-bound cost estimate to satisfy ERR is estimated to be [redacted] *in 2023 dollars*. This estimate specifically accounts for an array of possible risk events of potential concern as was identified in Table 8-2. Table 8-3 summarizes the statistical results of the Monte Carlo simulations. [redacted]

Table 8-3 – Monte Carlo Analysis Summary

Summary Statistic	Cost	Number of Events Occurring
Average	[redacted]	
Median		
Standard Deviation		
5th Percentile		
95th Percentile		
99th Percentile		
Minimum		
Maximum		

8.5 Infrastructure/Resource-Specific Events and Response Plans

This section outlines general response procedures to be followed during possible emergency events. The events included in this section may not necessarily present potential impacts to the USDW, but *are* events that require adequate response to assure safe and responsible operations. The responses are not intended to be exhaustive and will vary depending on the incident's specific requirements. Each situation will be evaluated based on the specific event, using best operating and engineering practices to prioritize life, safety, incident stabilization, containment, and repair or remediation. When an event has been detected, the response actions will address emergency and remedial measures related to the movement of the injectate or formation fluids that may cause an endangerment to the USDW and other events that threaten health, safety, or the environment.

If, at any time during Orchard Project operations, an employee or facility operator encounters a situation where the injected CO_2 stream may endanger the USDW, the following actions will be carried out:

1. Alert the Orchard Storage Superintendent.
2. Immediately cease injection.
3. Take all steps reasonably necessary to identify and characterize any release.
4. Notify the UIC Director within 24 hours.
5. Implement the Emergency and Remedial Response Plan approved by the UIC Director.

8.5.1 Water Quality Contamination

Water quality within the USDW could be adversely impacted by an event that results in brine, CO_2, or other contaminants leaking into the USDW.

Risk Level: Low

Prevention

As described in *Section 3 – Area of Review and Corrective Action Plan* and *Section 4 – Engineering Design and Operating Strategy*, Orchard Storage will apply best engineering and operating practices to prevent USDW contamination.

Detection

This may be detected through elevated concentrations of indicator parameters (e.g., chloride content) in groundwater samples or other evidence of fluid or CO_2 leakage into the USDW. In addition, the CO_2 plume will be monitored as outlined in *Section 5 – Testing and Monitoring Plan.*

Potential Response Actions

- Immediately notify the Orchard Storage Superintendent.
- Stop the injection.
- The Orchard Storage Superintendent will notify the UIC Director within 24 hours (16 TAC **§5.207(a)(2)(A)** [40 CFR **146.91(c)**].
- The Superintendent and team will make an initial assessment of the incident. A preliminary plan will be developed to stabilize, contain, and repair/remediate.
- Use a vertical seismic profile (VSP)—*if warranted*—to assess the location and degree of CO_2 movement, as described in *Section 5*.
- Restart the injection, if possible, at a reduced rate.
- Continue monitoring the USDW and plume to determine if migration continues.
- Treat the groundwater—*if the groundwater/USDW is impacted*—to remove CO_2, and provide an alternative water supply if necessary.
- Demonstrate mechanical integrity per the methods discussed in *Section 5*.
- Notify the UIC Director when the injection can be expected to resume.

8.5.2 CO_2 Release to the Surface

A CO_2 release at the surface can create a potential risk to health, safety, and the environment. This can be from major mechanical and integrity failures of the distribution and storage facilities, unidentified orphan wells, well-integrity issues, operating equipment over designed pressures, and geological complications.

Risk Level: Low

Prevention

- Proper operation and preventive maintenance of all surface facility equipment will be carried out.
- Due diligence will be exercised when collecting information from offset wells in the AOR.
- Continuous injection pressure, temperature and rate monitoring, annulus pressure tests, etc., will all be performed according to *Section 5*.
- Tubing and annular pressures will be monitored continuously and maintained below the maximum allowed values.
- The surface tree will be regularly maintained and tested for integrity.

Detection

The Supervisory Control and Data Acquisition (SCADA) system will detect any critical parameter excursion—and alarm and/or shut in as necessary.

Potential Response Actions

- Alert the Orchard Storage Superintendent.
- The Superintendent will notify the UIC Director within 24 hours (16 TAC **§5.207(a)(2)(A)** [40 CFR **146.91(c)**].
- The Superintendent and team will assess relevant facts to determine the severity of the event.
- For a Major or Serious Emergency (e.g., single large-volume CO_2 release):
    - Shut in the well or injection component as required.
    - Bleed injectant from the flowline and facilities, if applicable.
    - Limit access to the immediate area (i.e., authorized personnel only).
    - Communicate with the local emergency response, if applicable.
    - Monitor the well parameters to diagnose integrity loss and develop a remedial action plan.
    - Mobilize the necessary equipment—*if applicable*—to de-complete the well, to further diagnose and develop a remedial action plan.
    - Develop a remediation plan and communicate the same to the UIC Director and the Texas Railroad Commission (TRRC).
- For a Minor Emergency (e.g., low-level CO_2 release):

- Shut in the well, if necessary.
- Bleed injectant from the flowline and facilities, if applicable.
- Monitor the well parameters to diagnose integrity loss and develop a remedial action plan.
- Develop a remediation plan and communicate the same to the UIC Director and the TRRC.

8.5.3 Storage Rights Infringement

Storage rights infringement could occur if the CO_2 plume extends beyond the acquired pore-space lease area. Orchard Storage is acquiring pore space rights related to modeled plumes plus a substantial buffer to accommodate plume volumes.

Risk Level: Low

Prevention

- Active monitoring of injection parameters
- Periodic plume modeling and use of VSP imaging to monitor plume movement

Detection

- Downhole monitoring of injection pressures, temperatures, and conformance will inform flow-model adjustments that might result in plume movement that modeling has not predicted.
- VSP profiling to map plume movement would indicate that the plume has moved to an area where pore space rights are *not* in place.
- Pressure-transient analysis and interference testing between wells may provide insight into the plume location.

Potential Response Actions

- Verify the plume movement.
- Alert the Orchard Storage Superintendent.
- The Superintendent will notify the UIC Director within 24 hours (16 TAC **§5.207(a)(2)(A)** [40 CFR **146.91(c)**].
- The Superintendent and team will assess relevant facts to determine the severity of the event.
- Stop or reduce the injection, to minimize impact.
- Acquire more pore space to accommodate the plume.

8.5.4 Mineral Rights Infringement

Mineral rights infringement could occur if the plume extends into adjacent oil-and-gas mineral leases. The failure may be due to a confining-zone breach, natural seismic events, or plume growth

beyond modeled limits. The unexpected plume migration can have several effects, such as increasing pressure in hydrocarbon bearing zones and/or economically impacting nearby producing minerals.

Risk Level: Medium

Prevention

- Active monitoring of injection parameters
- Periodic plume modeling and use of VSP imaging to monitor plume movement

Detection

- VSP profiling to map plume movement would indicate that the plume has moved to an area where pore space rights are not in place.
- Adjacent hydrocarbon leases could report an unexpected increase in well pressure and production.
- Downhole monitoring of injection pressures, temperatures, and conformance will inform flow-model adjustments that might result in plume movement that modeling has not predicted.
- Pressure-transient analysis and interference testing between wells may provide insight into the plume location.

Potential Response Actions

- Alert the Orchard Storage Superintendent.
- The Superintendent will notify the UIC Director within 24 hours (16 TAC **§5.207(a)(2)(A)** [40 CFR **146.91(c)**].
- The Superintendent and team will assess relevant facts to determine the severity of the event.
- Stop or reduce the injection to minimize impact.
- Verify plume movement and location.
- Develop a mitigation or acquisition plan.

8.5.5 Entrained Contaminant (Non-CO_2) in Injection Stream

During injection operations, a change in composition or properties of the injected CO_2 stream could impact the metallurgy of the CO_2 injection system (flowlines, wellhead/tree, downhole tubulars). In addition, certain contaminants may initiate microbial activity downhole that would in turn create additional corrosion issues. This event is unlikely to occur as the CO_2 supply is [redacted]

Risk Level: Low

Prevention

Active, continuous monitoring of the incoming CO_2 stream will alert operators to any contamination of the CO_2 stream. The stream composition monitoring plus the active monitoring of asset integrity via corrosion coupons, as described in *Section 5 – Testing and Monitoring Plan*, will provide early leading indications of potential problems.

Detection

Constituent property deviations from the incoming CO_2 specification will be alarmed via the SCADA system. The Orchard Storage operations team can therefore assess the severity in near-real time and react accordingly.

Potential Response Actions

- Alert the Orchard Storage Superintendent.
- The Superintendent and team will assess relevant facts to determine the severity of the event.
- The Superintendent will notify the UIC Director within 24 hours (16 TAC **§5.207(a)(2)(A)** [40 CFR **146.91(c)**].
- Develop a mitigation plan that may include the use of corrosion chemicals or biocides as necessary.

8.5.6 Well Blowout

A well-control event could occur during the drilling phase of either the injection well or the monitoring wells. During that period of the well construction, an unexpected influx of formation fluid could enter the wellbore and cause a sudden release of fluids.

Risk Level: Low

Prevention and Detection

- Maintain appropriate mud weights as expected for the area, based on offset well data.
- Monitor the rate of drilling fluid returns vs. rates pumped, penetration rates, pump pressures, etc.

Potential Response Actions

- Stop drilling.
- Close the blowout preventer.
- Read and record the stabilized shut-in pressures.
- Kill the well by pumping down the wellbore fluid that is heavier than the current fluid until the well stops flowing.

- Notify the UIC Director within 24 hours.

Response Personnel: On-site drilling personnel and supervisors

Equipment: Drilling rig, mud logging equipment, blowout preventers with annular rams, and drilling fluid materials to increase mud weight adequately. Blowout preventers will be tested regularly to ensure operability.

8.5.7 Surface Spill

During drilling and completion or workover operations, an accidental release of drilling fluids, hydrocarbons, chemicals, etc., could occur.

Risk Level: Medium

Prevention and Detection

- Properly maintain blowout preventers to prevent accidental release of drilling fluids or hydrocarbons.
- Ensure adequate spill-prevention equipment is available on the drilling or workover rig.

Potential Response Actions

- Contain the spill using available equipment such as absorbents, booms, etc.
- Notify the appropriate regulatory authority and supervisory personnel.
- Immediately take samples around the point of entry.
- Initiate the spill prevention, control, and countermeasures plan for the facility.

Response Personnel: Drilling/workover crews or operations personnel

Equipment: Absorbents, containment equipment

8.5.8 Loss of Mechanical Integrity

Well-barrier components failing, causing fluid migration along the wellbore, could be due to a cement failure behind the casing, an improperly seated packer, or a tubing leak.

Risk Level: Low

Prevention and Detection

The appropriate wellbore design will be implemented in the construction phase, including proper cement and metallurgy of the casing and tubing. Pressure and rate monitoring, annulus pressure tests, mechanical integrity tests, etc., will all be performed per the Testing and Monitoring Plan

Potential Response Actions

- Stop the injection and notify the UIC Director within 24 hours.
- Close the wellhead valve.
- Monitor the well and annulus pressures.
- Determine the cause and severity of the failure, to determine if any of the CO_2 stream or formation fluids may have been released into any unauthorized zone.
- Pull and replace the tubing or the packer.
- Install a chemical sealant barrier and/or attempt a cement squeeze to block leaks.
- Demonstrate mechanical integrity per the methods discussed in *Section 5*.
- Notify the UIC Director when the injection can be expected to resume.

8.5.9 Accidents/Unplanned Events

Unforeseen events may occur during Orchard Project operations, such as surface infrastructure damage, pipeline leak, or weather-related events.

Risk Level: Low

Prevention

The site and equipment will be maintained regularly to prevent or minimize damage. The site will also be securely fenced to prevent unauthorized entry. Signage will be placed at the site entrance as required by the TRRC, with Orchard Storage and contact information. Operations will monitor the weather to be prepared for any adverse conditions that may occur. The SCADA and safety-shutdown systems will be maintained.

Detection

The SCADA system is designed to alert the operations team of any unexpected conditions within the injection operations. The safety shutdown system will be designed to shut down injection in the event of an emergency condition.

Potential Response Actions

- Alert the Orchard Storage Superintendent.
- The Superintendent will notify the UIC Director within 24 hours (16 TAC **§5.207(a)(2)(A)** [40 CFR **146.91(c)**].
- The Superintendent and team will assess relevant facts to determine the severity of the event.
- For a Major or Serious Emergency:
    - Shut in the well or injection component as required.
    - Bleed injectant from the flowline and facilities, if applicable.
    - Notify the appropriate regulatory authority and supervisory personnel.

- Limit access to the immediate area (i.e., authorized personnel only).
- Communicate with the local emergency response, if applicable.
- Monitor the well parameters to diagnose integrity loss and develop a remedial action plan.
- Mobilize the necessary equipment—*if applicable*—to de-complete the well, to further diagnose and develop a remedial action plan.
- Develop a remediation plan and communicate the same to the UIC Director and TRRC.

8.6 Training

Orchard Storage staff will attend, at a minimum, annual training associated with Health, Safety, and Environment (HSE). This training will include all the required Occupational Safety and Health Administration (OSHA) training (Hazardous Waste Operations and Emergency Response (HAZWOPER), etc). The staff will be trained in the ICS to ensure efficient response to incidents. In addition, the Orchard Storage staff will be provided technical training regarding the specific properties associated with CO_2 and standard operating procedures related to CO_2 storage.

Training will be reinforced by emergency drills that create scenarios to highlight specific incident responses. These drills will be as realistic as possible and may include local-county first responders. All training and emergency drills will be documented for verification.

Orchard Storage intends to implement an active outreach program with county first responders and the resident neighbors in the project storage area. Before starting CO_2 injection operations, Orchard Storage will provide a copy of this Emergency and Remedial Response Plan to local first responders and discuss potential response scenarios.

Per 16 TAC **§5.206 (h)(2)(C)**, Orchard Storage will provide training schedules, dates, and course outlines to the Commission annually and upon request.

8.7 Communications Plan and Emergency Notification Procedures

Orchard Storage intends to, as noted earlier, implement the ICS to respond to emergencies. The system, widely utilized by emergency response professionals, provides a common language and hierarchy to emergency response—a unified command—so that multiple agencies can effectively work together. The system can also be scaled to fit the incident.

A high-level structure for the ICS is as follows:

The chain-of-command members will be developed after the operating company has been formed and commercial agreements arranged. This section will then be updated to reflect the nomination of said members. As these positions are filled, relevant phone numbers including one for the local Orchard Storage office will be provided.

Emergency response contacts are provided in Table 8-4.

Table 8-4 – Emergency Services – CALL 911

Contact*	Phone #
[redacted]	
Environmental Services Contractor	TBD
UIC Program Director	TBD
EPA National Response Center	800-424-8802
TRRC Emergency Number	844-773-0305

*These numbers are listed in a relative daisy chain here only to suggest first and successive orders of response. Prioritization of calling turns on the event(s) necessitating the call(s) to any one or more of these all-important numbers.

As appropriate, Orchard Storage will communicate with the public regarding events that require an emergency response, including the impact of the event on drinking water or the severity of the event, actions taken or planned, etc.

Prior to commencing operations, Orchard Storage will develop Emergency Operating Procedures that will include the following:

- Procedures for requesting assistance and for follow-up action, to remove the public from an area of exposure
- Provisions for advance briefing of the public within the AOR on subjects such as the hazards and characteristics of CO_2
- The manner in which the public will be notified of an emergency and, in case of one, the steps to be taken
- Proposed actions—*if necessary*—designed to minimize and respond to risks associated with potential seismic events, including seismic monitoring

8.8 Emergency and Remedial Response Plan Review and Updates

This Emergency and Remedial Response Plan will be reviewed annually to ensure its applicability. Additionally, the plan will be reviewed after any AOR reevaluation and following any significant changes to the project that would necessitate such a review.

Any amendments to this plan must be approved by the UIC Director and incorporated into the permit. This plan will also be reviewed and submitted to the UIC Director within 1 year of an AOR evaluation—following any significant changes to the facility (e.g., addition of injection or monitoring wells), change in personnel, or when the UIC Director requires it.

8.9 References

DOE Office of NEPA Policy and Compliance. 2007. Final Risk Assessment Report for the FutureGen Project Environmental Impact Statement (revised April 2007).

Trabucchi, C., Donlan, M., Spirt, V., Friedman, S., and Esposito, R. 2014. Application of a Risk-Based Probabilistic Model (CCSvt model) to Value Potential Risks Arising from Carbon Capture and Storage. Energy Procedia 63.