

CES Project Preliminary Risk Register

Risk Level	
Black	Extreme: Stop the task/processes. Significant Action Plan required.
Red	High: Significant Action Plan required.
Yellow	Medium: Action Plan required.
Green	Low: Minimal/No Action Plan may be warranted but not required.
Blue	Insignificant: Safe to proceed. Action Plan not required.

Identification										Qualitative Analysis										Risk Response																		
Risk Number	Date Identified	Identified By	Project Phase	Description of Risk	Risk Trigger(s)	Risk Type	Risk Category	Likelihood	Severity	Risk Matrix					Strategy	Strategy Action Plan/Response Plan	Category	Assigned to	Avoidance Measures	Response Personnel	Equipment	Status	Risk Number															
										Likelihood					Severity																							
										Very Low	Low	Medium	High	Very High																								
1a		Schlumberger	Drilling/Injection	Over-pressurized fluid (blowout)	1. Fluid influx encountered during well construction or operation that results in the loss of primary and/or secondary well barriers due to operational error or equipment failure.	Drilling/Equipment	HS	Very Low	Catastrophic	Likelihood					Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator		Open	1a											
										Severity					Very Low	Low	Medium	High	Very High	Mitigation	Cease operations due to loss of hydrostatic fluids.	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Project Mgr.			Open										
										Light	Very Low	Low	Medium	High	Very High	Mitigation	Install well control procedures (see well plan).	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Project Mgr.	Pressure Control Equipment	Open															
										Medium	Very Low	Low	Medium	High	Very High	Mitigation	Close flow valve (blowout preventer) if considered appropriate not to damage well and USDW.	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Project Mgr.		Open															
										Major	Very Low	Low	Medium	High	Very High	Mitigation	Regain pressure control by restoring fluid levels in the wellbore with appropriate density fluid, restriction of flow through choke or both.	Major/Serious/Minor	Well Eng.	Monitoring	Well Eng., Project Mgr.	Pumping Equipment, Rig	Open															
										Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Alert local fire and police and UIC Program Director immediately.	Major/Serious	Well Eng.	Monitoring	Well Eng., Project Mgr.		Open															
										Multi-Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Determine cause of event and initiate remediation procedures.	Minor	Well Eng.	Monitoring	Well Eng., Project Mgr.	Pumping Equipment, Rig	Open															
										Very Low	Low	Medium	High	Very High	Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Well Eng.	Monitoring	Well Eng., Project Mgr.		Open																
										2a		Schlumberger	Injecting/Monitoring	Injection or monitoring (verification) well integrity failure	1. Wellhead pressure exceeds the specified shutdown pressure specified in the permit.	Equipment	HS	Low	Light	Likelihood					Very Low	Low		Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator		Open	2a
																				Severity					Very Low	Low		Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Major/Serious, Minor	Well Eng., Project Mgr.	Monitoring	Well Eng., Project Mgr.		
Light	Very Low	Low	Medium	High	Very High	Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.											Monitoring	Project Mgr.		Open															
Medium	Very Low	Low	Medium	High	Very High	Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator											Monitoring	Site Operator		Open															
Major	Very Low	Low	Medium	High	Very High	Mitigation	Shut in well (close flow valve). After verifying pressures will not damage well or USDW.	Major/Serious	Site Operator											Monitoring	Site Operator	Wellbore	Open															
Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Eng.											Monitoring	Well Eng.	Wellbore logs, workover rig	Open															
Multi-Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator											Monitoring	Site Operator		Open															
Very Low	Low	Medium	High	Very High	Mitigation	Establish test sensors to determine they are functioning properly. If sensors are determined faulty or in need of maintenance commence repair/replacement operations. (in consultation with the UIC Program Director restart injector).	Minor	Site Operator	Maintenance											Site Operator		Open																
Very Low	Low	Medium	High	Very High	Mitigation	Vert fluids, if needed to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Major/Serious	Site Operator	Monitoring											Site Operator		Open																
Very Low	Low	Medium	High	Very High	Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Project Mgr.	Monitoring											Project Mgr.		Open																
Very Low	Low	Medium	High	Very High	Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Eng./Site Operator	Monitoring	Well Eng.	Wellbore logs	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	If there has been a loss of mechanical integrity, initiate shutdown plan. Provided there is sufficient mechanical integrity to contain pressure. May need to allow Packer fluid into reservoir and keep well full with fluid in mechanical integrity permits.	Minor	Well Eng./Site Operator	Monitoring	Well Eng.	Workover rig to pull tubing if required	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Repeat automatic shutdown devices.	Minor	Site Operator	Monitoring	Site Operator		Open																										
Very Low	Low	Medium	High	Very High	Mitigation	If a shut off is triggered by mechanical or electrical malfunctions without endangering a USDW, repair faulty components. electrical malfunctions without endangering a USDW, repair faulty components. Verify with analog gauges.	Minor	Well Eng., Project Mgr.	Monitoring/Maintenance	Well Eng., Project Mgr.		Open																										
2b		Schlumberger	Injecting/Monitoring	Injection or monitoring (verification) well integrity failure	1. Annulus pressure indicates a loss of external or internal well containment.	Equipment	HS	Low	Serious	Likelihood					Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator		Open	2b											
										Severity					Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.			Open										
										Light	Very Low	Low	Medium	High	Very High	Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.		Open															
										Medium	Very Low	Low	Medium	High	Very High	Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator		Open															
										Major	Very Low	Low	Medium	High	Very High	Mitigation	Shut in well (close flow valve). After verifying pressures will not damage well or USDW. Allow packer fluid into reservoir to stop CO2 flow and keep well full with proper density fluid if required.	Major/Serious	Site Operator	Monitoring	Site Operator	Wellbore, Workover rig to pull tubing if required	Open															
										Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Vert fluids, if needed, to maintain reasonable wellbore and surface facilities pressures.	Major/Serious	Site Operator	Monitoring	Site Operator		Open															
										Multi-Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator		Open															
										Very Low	Low	Medium	High	Very High	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer	Monitoring	Well Engineer	Wellbore logs, workover rig	Open																
										Very Low	Low	Medium	High	Very High	Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr.	Monitoring	Well Engineer		Open																
										Very Low	Low	Medium	High	Very High	Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer	Wellbore logs	Open																
Very Low	Low	Medium	High	Very High	Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs.	Minor	Well Engineer	Monitoring	Well Engineer	Workover rig to set plugs if required	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Vert fluids f from wellhead in order to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Minor	Site Operator	Monitoring	Site Operator		Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Repeat automatic shutdown devices.	Minor	Site Operator	Monitoring	Site Operator		Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer	Wellbore logs, workover rig	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	If a shut off is triggered by mechanical or electrical malfunctions without endangering a USDW, repair faulty components. electrical malfunctions without endangering a USDW, repair faulty components. Verify with analog gauges.	Minor	Site Operator	Monitoring/Maintenance	Site Operator		Open																										
2c		Schlumberger	Injecting/Monitoring	Injection or monitoring (verification) well integrity failure	1. Mechanical integrity test results identify a loss of mechanical integrity.	Equipment	HS	Very Low	Catastrophic	Likelihood					Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator		Open	2c											
										Severity					Very Low	Low	Medium	High	Very High	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.			Open										
										Light	Very Low	Low	Medium	High	Very High	Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious, Minor	Project Mgr.	Monitoring	Project Mgr.		Open															
										Medium	Very Low	Low	Medium	High	Very High	Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator		Open															
										Major	Very Low	Low	Medium	High	Very High	Mitigation	Shut in well (close flow valve). After verifying pressures will not damage well or USDW. Need to verify test method to shut in well so that the mechanical integrity issues are not a factor such as allowing packer fluid to flow to reservoir and keep well full of fluid.	Major/Serious	Site Operator	Monitoring	Site Operator	Wellbore logs, workover rig	Open															
										Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Vert fluids, if needed, to maintain reasonable wellbore and surface facilities pressures.	Major/Serious	Site Operator	Monitoring	Site Operator		Open															
										Multi-Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator		Open															
										Very Low	Low	Medium	High	Very High	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer	Monitoring	Well Engineer	Workover rig	Open																
										Very Low	Low	Medium	High	Very High	Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr.	Monitoring	Well Engineer		Open																
										Very Low	Low	Medium	High	Very High	Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer	Wellbore logs	Open																
Very Low	Low	Medium	High	Very High	Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs.	Minor	Well Engineer	Monitoring	Well Engineer	Workover rig to set plugs if required	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Repeat automatic shutdown devices.	Minor	Site Operator	Monitoring	Site Operator		Open																										
Very Low	Low	Medium	High	Very High	Mitigation	If there is damage to the wellhead, repair the damage and conduct a survey to ensure wellhead leakage has ceased.	Minor	Well Engineer	Monitoring	Well Engineer		Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Confirm well integrity prior to restarting injection (upon approval of the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer	Wellbore logs	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Review downhole, wellhead, and annulus pressure data.	Major/Serious	Well Engineer	Monitoring	Well Engineer		Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Isolate the nearby area, if needed, establish a safe distance and perimeter using a hard-hat air-quality monitor.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Hard-hat air quality monitor	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	Perform a well log/MIT to detect CO2 movement outside of the casing.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Well log/MIT	Open																										
Very Low	Low	Medium	High	Very High	Mitigation	If a shut off is triggered by mechanical or electrical malfunctions without endangering a USDW, repair faulty components. electrical malfunctions without endangering a USDW, repair faulty components. Verify with analog gauges.	Minor	Site Operator	Monitoring/Maintenance	Site Operator		Open																										

CES Project Preliminary Risk Register

Risk Level	
Black	Extreme: Stop the task/processes. Significant Action Plan required.
Red	High: Significant Action Plan required.
Yellow	Medium: Action Plan required.
Green	Low: Minimal regulatory Action Plan may still be required but not required.
Blue	Insignificant: Safe to proceed. Action Plan not required.

Risk Number	Date Identified	Identified By	Project Phase	Identification				Qualitative Analysis										Risk Response						Risk Number																																																																																																																																																																																																																																																																																																												
				Description of Risk	Risk Trigger(s)	Risk Type	Risk Category	Likelihood	Severity	Risk Matrix					Strategy	Strategy Action Plan/Response Plan			Category	Assigned to	Avoidance Measures	Response Personnel	Equipment		Status																																																																																																																																																																																																																																																																																																											
										Very Low	Low	Medium	High	Very High		Very Low	Low	Medium								High	Very High																																																																																																																																																																																																																																																																																																									
3a		Schlumberger	Injecting/Monitoring	Injection well monitoring equipment failure (e.g. shut-off valve or pressure gauge, etc.)	1. The failure of monitoring equipment for wellhead pressure, temperature and/or annulus pressure may indicate a problem with the injection well that could endanger USDWs.	Equipment	HS	Medium	Light	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator	Open	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Project Mgr	Monitoring	Project Mgr	Open	Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.9(i).	Major/Serious, Minor	Project Mgr	Monitoring	Project Mgr	Open	Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator	Open	Mitigation	Shut in well (close flow valve). Allow packer fluid into reservoir to stop CO2 flow and keep well full with proper density fluid if required.	Major/Serious	Site Operator	Monitoring	Site Operator	Wellline, Workover rig to pull tubing if required	Open	Mitigation	Vent fluids from wellhead in order to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Major/Serious	Site Operator	Monitoring	Site Operator	Open	Mitigation	Vent fluids, if needed, to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Major/Serious	Site Operator	Monitoring	Site Operator	Open	Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator	Open	Mitigation	Verify pressures and temperatures with analog gauges.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Wellline logs, workover rig	Open	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr	Monitoring	Well Engineer, Project Mgr	Open	Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr	Monitoring	Well Engineer, Project Mgr	Open	Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer	Wellline logs	Open	Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs.	Minor	Well Engineer	Monitoring	Well Engineer	Workover rig to set plugs if required	Open	Mitigation	Shut in well (close flow valve). Allow packer fluid into reservoir to stop CO2 flow and keep well full.	Minor	Well Engineer	Monitoring	Well Engineer	Workover rig to pull tubing if required	Open	Mitigation	Vent fluids from wellhead in order to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing.	Minor	Well Engineer	Monitoring	Well Engineer	Open	Mitigation	Reset automatic shutdown devices.	Minor	Well Engineer	Monitoring	Well Engineer	Open	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer	Wellline logs, workover rig	Open	Mitigation	If there is damage to the wellhead, repair the damage and conduct a survey to ensure wellhead leakage has ceased.	Minor	Well Engineer	Monitoring	Well Engineer	Workover rig	Open	Mitigation	Confirm well integrity prior to restarting injection (upon approval of the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer	Wellline logs	Open	Mitigation	Review downhole, wellhead, and annulus pressure data.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Open	Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air quality monitor.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Hand-held air quality monitor	Open	Mitigation	Perform a well logMIT to detect CO2 movement outside of the casing.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Well logMIT	Open																																																																																																																																																				
																																																																																																																																																																																	3b		Schlumberger	Injecting/Monitoring	Injection well monitoring equipment failure (e.g. shut-off valve or pressure gauge, etc.)	1. Equipment failures (sensor, computer, cabling, etc) and damage to wellhead (run over by heavy equipment).	Equipment	HS	Very Low	Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator	Open	Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Project Mgr	Monitoring	Project Mgr	Open	Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.9(i).	Major/Serious, Minor	Project Mgr	Monitoring	Project Mgr	Open	Mitigation	Initiate immediate shutdown plan.	Major/Serious	Site Operator	Monitoring	Site Operator	Open	Mitigation	Shut in well (close flow valve). Allow packer fluid into reservoir to stop CO2 flow and keep well full with proper density fluid.	Major/Serious	Site Operator	Monitoring	Site Operator	Workover rig to pull tubing if required	Open	Mitigation	Vent fluids from wellhead in order to maintain acceptable pressures as surface and downhole as not to damage the wellhead or casing, if possible.	Major/Serious	Site Operator	Monitoring	Site Operator	Open	Mitigation	Communicate with CES personnel and local authorities to initiate evacuation plans, as necessary.	Major/Serious	Site Operator	Monitoring	Site Operator	Open	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious	Well Engineer	Monitoring	Well Engineer	Open	Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious	Well Engineer, Project Mgr	Monitoring	Well Engineer, Project Mgr	Open	Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Well Engineer	Monitoring	Well Engineer	Wellline logs	Open	Mitigation	If there has been a loss of mechanical integrity, prepare well for longer term shutdown to get repairs accomplished. May include plugs.	Minor	Well Engineer	Monitoring	Well Engineer	Workover rig to set plugs if required	Open	Mitigation	Reset automatic shutdown devices.	Minor	Well Engineer	Monitoring	Well Engineer	Open	Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure. Identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer	Wellline logs, workover rig	Open	Mitigation	If there is damage to the wellhead, repair the damage and conduct a survey to ensure wellhead leakage has ceased.	Minor	Well Engineer	Monitoring	Well Engineer	Workover rig	Open	Mitigation	Confirm well integrity prior to restarting injection (upon approval of the UIC Program Director).	Minor	Well Engineer	Monitoring	Well Engineer	Wellline logs	Open	Mitigation	Review downhole, wellhead, and annulus pressure data.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Wellline logs	Open	Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air quality monitor.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Hand-held air quality monitor	Open	Mitigation	Perform a well logMIT to detect CO2 movement outside of the casing.	Major/Serious	Well Engineer	Monitoring	Well Engineer	Well logMIT	Open

CES Project Preliminary Risk Register

Risk Level	
Black	Extreme: Stop the leak/processes. Significant Action Plan required.
Red	High: Significant Action Plan required.
Yellow	Medium: Action Plan required.
Green	Low: Minimal regulatory Action Plan may still be required but not required.
Blue	Insignificant: Safe to proceed. Action Plan not required.

Identification										Qualitative Analysis										Risk Response				
Risk Number	Date Identified	Identified By	Project Phase	Description of Risk	Risk Trigger(s)	Risk Type	Risk Category	Likelihood	Severity	Risk Matrix					Strategy	Strategy Action Plan/Response Plan	Category	Assigned to	Avoidance Measures	Response Personnel	Equipment	Status	Risk Number	
										Likelihood					Severity									
										Very Low	Low	Medium	High	Very High	Very Low	Low	Medium	High	Very High					
4a		Schlumberger	Throughout	Fluid (e.g. brine) leakage to a USDW	1. Any evidence of fluid movement out of the injection zone (i.e., not necessarily to a USDW) to address unanticipated events associated with faults or other pathways; any potential USDW endangerment/acceptable changes in water quality, and CO2 leakage to the land surface.	Leakage	Environmental	Very Low	Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Signage	Site Operator	Open				
										Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Project Mgr.	Open									
										Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious/Minor	Site Operator	Monitoring	Project Mgr.	Open								
										Mitigation	Install shutdown plan.	Major/Serious/Minor	Site Operator	Monitoring	Site Operator	Open								
										Mitigation	If the presence of indicator parameters is confirmed, develop (in consultation with the UIC Program Director) a case-specific work plan to:	Site Operator	Monitoring	Project Mgr.	Open									
										Mitigation	Install additional groundwater monitoring points near the affected groundwater wells to delineate the extent of impact, and	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Remediate unacceptable impacts to the affected USDW.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Arrange for an alternate potable water supply if the USDW was being utilized and has been caused to exceed drinking water standards.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Proceed with efforts to remediate USDW to mitigate any unsafe conditions (e.g., install system to intercept/collect brine or CO2; pump and treat to assist CO2-laden water).	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Continue groundwater remediation and monitoring on a frequent basis (frequency to be determined by Clean Energy Systems and the UIC Program Director) until unacceptable adverse USDW impact has been fully addressed.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
Mitigation	Address a well integrity issue, including taking specific steps to identify the location of the failure/leak, effect repairs, and demonstrate MI.	Major/Serious/Minor	Well Eng., Project Mgr.	Monitoring	Well Eng., Project Mgr.	Open																		
Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air-quality monitor.	Major/Serious/Minor	Site Operator	Monitoring	All monitoring	Hand-held air quality monitor	Open																	
4b		Schlumberger	Throughout	Fluid (e.g. CO2) leakage to a USDW	1. Any evidence of CO2 movement out of the injection zone (i.e., not necessarily to a USDW) to address unanticipated events associated with faults or other pathways; any potential USDW endangerment/acceptable changes in water quality, and CO2 leakage to the land surface.	Leakage	Environmental	Very Low	Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Signage	Site Operator	Open				
										Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Project Mgr.	Open									
										Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious/Minor	Site Operator	Monitoring	Project Mgr.	Open								
										Mitigation	Install shutdown plan.	Major/Serious/Minor	Site Operator	Monitoring	Site Operator	Open								
										Mitigation	If the presence of indicator parameters is confirmed, develop (in consultation with the UIC Program Director) a case-specific work plan to:	Site Operator	Monitoring	Project Mgr.	Open									
										Mitigation	Install additional groundwater monitoring points near the affected groundwater wells to delineate the extent of impact, and	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Remediate unacceptable impacts to the affected USDW.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Arrange for an alternate potable water supply if the USDW was being utilized and has been caused to exceed drinking water standards.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Proceed with efforts to remediate USDW to mitigate any unsafe conditions (e.g., install system to intercept/collect brine or CO2; pump and treat to assist CO2-laden water).	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	Continue groundwater remediation and monitoring on a frequent basis (frequency to be determined by Clean Energy Systems and the UIC Program Director) until unacceptable adverse USDW impact has been fully addressed.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
Mitigation	Address a well integrity issue, including taking specific steps to identify the location of the failure/leak, effect repairs, and demonstrate MI.	Major/Serious/Minor	Well Eng., Project Mgr.	Monitoring	Well Eng., Project Mgr.	Open																		
Mitigation	Isolate the nearby area, if needed; establish a safe distance and perimeter using a hand-held air-quality monitor.	Major/Serious/Minor	Site Operator	Fence	Air monitoring	Hand-held air quality monitor	Open																	
5a		Schlumberger	Throughout	A natural disaster (e.g., earthquake, tornado, lightning strike)	1. Well problems (integrity loss, leakage, or malfunction) may arise as a result of a natural disaster affecting the normal operation of the injection well. An earthquake may disturb surface and/or subsurface facilities, and weather-related disasters (e.g., tornado or lightning strike) may affect surface facilities.	Natural	Environmental	Low	Catastrophic	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Signage	Site Operator	Open				
										Mitigation	Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Site Operator	Open									
										Mitigation	Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.91(c).	Major/Serious/Minor	Site Operator	Monitoring	Site Operator	Open								
										Mitigation	Install immediate shutdown plan.	Major/Serious/Minor	Site Operator	Preventative Operation	Site Operator	Open								
										Mitigation	Shut in well (close flow valves).	Major/Serious/Minor	Site Operator	Preventative Operation	Site Operator	Open								
										Mitigation	Vent CO2 from surface facilities if appropriate.	Major/Serious/Minor	Site Operator	Preventative Operation	Site Operator	Open								
										Mitigation	Communicate with CES personnel and local authorities to institute evacuation plans, if necessary.	Major/Serious/Minor	Site Operator	Monitoring		Open								
										Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Major/Serious/Minor		Monitoring		Open								
										Mitigation	Determine if any leaks to ground water or surface water occurred.	Major/Serious/Minor	GW Consultant	Monitoring	GW Consultant	Open								
										Mitigation	If contamination is detected, identify and implement appropriate remedial actions (in consultation with the UIC Program Director).	Major/Serious/Minor	GW Consultant	Remedial Action	GW Consultant	Open								
Mitigation	Conduct assessment to determine whether there has been a loss of mechanical integrity.	Minor	Site Operator	Monitoring	Site Operator	Open																		
Mitigation	If there has been a loss of mechanical integrity, initiate shutdown plan.	Minor	Site Operator	Remedial Action	Site Operator	Open																		
Mitigation	If there has not been a loss of mechanical integrity, initiate gradual shutdown.	Minor	Site Operator	Remedial Action	Site Operator	Open																		
Mitigation	Monitor well pressure, temperature, and annulus pressure to verify integrity loss and determine the cause and extent of failure; identify and implement appropriate remedial actions to repair damage to the well (in consultation with the UIC Program Director).	Minor	Site Operator	Monitoring	Site Operator	Open																		

CES Project Preliminary Risk Register

Risk Level	
Black	Extreme: Stop the task/processes. Significant Action Plan required.
Red	High: Significant Action Plan required.
Yellow	Medium: Action Plan required.
Orange	Low: Potential regulatory Action Plan may not be required but not required.
Blue	Insignificant: Safe to proceed. Action Plan not required.

Identification							Qualitative Analysis					Risk Response								
ID	Company	Activity	Event	Consequence	Environment	Severity	Likelihood					Mitigation	Severity	Mitigation	Responsible Party	Frequency	Status			
							Very Low	Low	Medium	High	Very High									
6a	Schlumberger	Throughout or injection	Induced or natural seismic event	1. Injection operation inducing a seismic event equal to or less than M1.5.	Seismic	Environmental	Medium	Light	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator	Open	
															Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Site Operator	Open	
															Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.9(i)(1).	Site Operator	Monitoring	Site Operator	Open	
															Continue normal operation within permitted levels.	Minor	Site Operator	Site Operator	Open	
															Document the event for reporting to EPA in semiannual reports.	Minor	Site Operator	Site Operator/Microseismic Provider	Microseismic monitoring	Open
															Continue normal operation within permitted levels.	Minor	Site Operator	Site Operator	Open	
6b	Schlumberger	Throughout or injection	Induced or natural seismic event	1. Five (5) or more seismic events within a 30-day period having a magnitude greater than M1.2 but less than or equal to M2.0.	Seismic	Environmental	Medium	Light	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator	Open	
															Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Site Operator	Open	
															Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.9(i)(1).	Major/Seismic, Minor	Site Operator	Site Operator	Open	
															Continue normal operation within permitted levels.	Minor	Site Operator	Site Operator	Open	
															Initiate gradual shutdown of the well if it is determined to be appropriate.	Minor	Site Operator	Site Operator	Open	
															Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.	Minor	Microseismic provider	Site Operator	Microseismic monitoring, fall-off test	Open
6c	Schlumberger	Throughout or injection	Induced or natural seismic event	1. Seismic event greater than M1.5 and local observation or felt report.	Seismic	Environmental	Medium	Major	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator	Open	
															Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Site Operator	Open	
															Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.9(i)(1).	Major/Seismic, Minor	Site Operator	Site Operator	Open	
															Continue normal operation within permitted levels.	Minor	Site Operator	Site Operator	Open	
															Initiate gradual shutdown of the well if it is determined to be appropriate.	Minor	Site Operator	Site Operator	Open	
															Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.	Minor	Microseismic provider	Site Operator	Microseismic monitoring, fall-off test	Open
6d	Schlumberger	Throughout or injection	Induced or natural seismic event	1. Seismic event greater than M2.0 and local observation or report.	Seismic	Environmental	Low	Major	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator	Open	
															Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Site Operator	Open	
															Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.9(i)(1).	Major/Seismic, Minor	Site Operator	Site Operator	Open	
															Continue normal operation within permitted levels.	Minor	Site Operator	Site Operator	Open	
															Initiate gradual shutdown of the well if it is determined to be appropriate.	Minor	Site Operator	Site Operator	Open	
															Review seismic and operational data to determine location and magnitude of seismic event. If the event falls within or near the extents of the plume, use the microseismic, geomechanics and facies data to estimate potential impact to USDWs. Perform a pressure fall-off test to determine if the storage complex has been compromised by the seismic event.	Minor	Microseismic provider	Site Operator	Microseismic monitoring, fall-off test	Open
6e	Schlumberger	Throughout or injection	Induced or natural seismic event	1. Seismic event greater than M2.0 and local observation or report, and/or report and confirmation of damage.	Seismic	Environmental	Low	Major	Very Low	Low	Medium	High	Very High	Mitigation	Limit access to wellhead to authorized personnel only.	Site Operator	Storage	Site Operator	Open	
															Determine the severity of the event, based on the information available, within 24 hours of notification.	Site Operator	Monitoring	Site Operator	Open	
															Notify the UIC Program Director within 24 hours of the emergency event, per 40 CFR 146.9(i)(1).	Major/Seismic, Minor	Site Operator	Site Operator	Open	
															Continue normal operation within permitted levels.	Minor	Site Operator	Site Operator	Open	
															Initiate immediate shutdown plan.	Minor	Site Operator	Site Operator	Open	
															Communicate with facility personnel and local authorities to initiate evacuation plans, as necessary.	Minor	Site Operator	Site Operator	Open	