Texas Commission on Environmental Quality

Waste Permits Division
Coal Combustion Residuals Groundwater Monitoring and Corrective Action
Draft Technical Guideline No. 32
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Topic: Coal Combustion Residuals (CCR) Groundwater Monitoring and Corrective Action

Contents

Introduction

Coal combustion residuals waste are generated from the combustion of coal in a boiler to produce steam for powering a turbine-generator to generate electricity. CCR waste are one of the largest waste streams generated in the United States, with roughly half used for "beneficial reuse" and half disposed in surface impoundments or landfills. CCR waste includes fly ash, bottom ash, boiler slag, and flue gas desulfurization materials, and are generated in a wet or dry condition. Some dry CCR waste may be mixed with water ("sluiced") to facilitate handling/transport of the CCR waste in the power generation facility.

CCR waste are classified by the Texas Commission on Environmental Quality (TCEQ) as a nonhazardous industrial solid waste. This classification is consistent with the EPA's determination of CCR waste as nonhazardous solid waste detailed in 40 Code of Federal Regulation (CFR) 257, Subpart D. The waste classification for CCR waste in Texas is conducted in accordance with TCEQ guidance RG-022 – Guidelines for the Classification and Coding of Industrial and Hazardous Waste.

Part 1 – Applicable Requirements

1.1 General

In accordance with 30 Texas Administrative Code (30 TAC) Chapter 352, Coal Combustion Residuals Waste Management, the TCEQ prepared this Technical Guideline No. 32 (TG-32) to assist electric utilities and independent power producers with the groundwater monitoring and corrective action used for the management and disposal of CCR waste in at landfill(s) and surface impoundment(s).

TG-32 does not include all applicable requirements. The detailed technical and administrative requirements for groundwater monitoring and corrective action are contained in 30 TAC Chapter 352, Subchapter H.

1.2 Purpose

30 TAC Chapter 352 establishes a CCR registration and management program to regulate CCR waste and requires the Owner/Operator to obtain a CCR registration and implement a groundwater detection/monitoring program.

The CCR rules under 30 TAC §352.901 primarily adopts by reference the groundwater monitoring and corrective actions included in 40 CFR §257.90 (Applicability), which gives the general requirements for establishing and implementing a groundwater monitoring program and corrective action for releases from a CCR unit. The commission adopts by reference 40 CFR §257.90 as amended through the August 5, 2016, issue of the *Federal Register* (81 FR 51802)

The criteria under 30 TAC Chapter 352, Subchapter H, are applicable to all CCR units, including existing CCR landfills, existing CCR surface impoundments, and new and lateral expansions of CCR units. All information and data required in adopted 30 TAC Chapter 352, Subchapter H, concerning the establishment of a groundwater monitoring system, a sampling and analysis program, and monitoring data obtained under 30 TAC Chapter 352, Subchapter H, since the effective date of the federal rules (October 19, 2015), must be included in the annual groundwater monitoring and corrective action report. The initial annual groundwater monitoring and corrective action report was required to be completed and placed in the facility's operating record by January 31, 2018. The Owner/Operator must comply with the recordkeeping, notification, and internet posting requirements of 30 TAC Chapter 352.

The CCR rules 30 under TAC §352.901(b) establish that, with the adoption of 30 TAC Chapter 352, 30 TAC Chapter 350 (Texas Risk Reduction Program) is not applicable to CCR units, as defined under 30 TAC §352.3 and as further described in 30 TAC §352.1.

The CCR rules under 30 TAC §352.902 establishes that the Groundwater Monitoring and Corrective Action Report, which will be prepared in accordance with 30 TAC §352.901, must be submitted to the executive director for review no later than 30 days after the report was placed in the facility's operating record. The report will contain at a minimum:

- A map, aerial image, or diagram showing the CCR unit(s) and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit(s);
- Narrative description of Facility and Unit Descriptions and groundwater monitoring system, monitoring well inspection;
- Hydrogeology (groundwater flow rate and direction) with potentiometric surface map;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a narrative description of why those actions were taken;
- In addition to all the monitoring data, a summary including the number of groundwater samples that were collected for analysis for each background and downgradient well, the dates the samples were collected, and whether the sample was required by the detection monitoring or assessment monitoring programs and laboratory reports;
- Statistical analysis and results;
- A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels); and other information required to be included in the annual report, as specified in 30 TAC §§352.971 and 352.981; and
- Summarize key actions completed, describe any problems encountered, discuss actions to resolve the problems, conclusions and recommendations, and project timelines and key activities for the upcoming year.

The commission determined that future groundwater monitoring and corrective action reports, after the initial report, should contain a summary of data generated since the initial report. The commission determined that this summary allows the executive director to properly evaluate the current site conditions as well as potential site trends.

1.3 Professional Certifications

In accordance with 30 TAC §352.4, all engineering plans, specifications, and related documents submitted to the TCEQ shall be prepared by, or under the supervision of, a qualified Texas licensed professional engineer (Texas P.E.), and shall be signed, sealed, and dated by the qualified Texas P.E., as required by the Texas Engineering Practice Act.

In accordance with 30 TAC §352.4, all geoscientific information submitted to the TCEQ shall be prepared by, or under the supervision of, a qualified Texas licensed professional geoscientist (Texas P.G.), and shall be signed, sealed, and dated by a qualified Texas P.G., as required by the Texas Geoscience Practice Act.

Part 2 – Groundwater Monitoring Systems

2.1 Groundwater Monitoring System Design

The Owner/Operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that accurately represents the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit. Provide the following:

- A map, aerial image, or diagram showing the CCR unit and all background (or upgradient) and downgradient monitoring wells, to include the well identification numbers, that are part of the groundwater monitoring program for the CCR unit. A minimum of one upgradient and three downgradient monitoring wells are required in accordance with 30 TAC §352.911/40 CFR §257.91;
- A map showing the groundwater elevations and groundwater flow direction;
- Information on any additional monitoring wells necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit; and
- The Owner/Operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.

Provide a determination of background quality. It may include sampling wells that are not hydraulically upgradient of the CCR management area where:

- Hydrogeologic conditions do not allow the Owner/Operator of the CCR unit to determine what wells are hydraulically upgradient; or
- Sampling at other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells.

A groundwater monitoring system for CCR units must be reviewed and approved by the executive director. The executive director may require additional monitoring wells to be installed to determine compliance with the requirements of 30 TAC §352.911(b).

2.2 Geologic Information

The number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of:

- Aquifer thickness;
- Groundwater flow rate;
- Groundwater flow direction including seasonal and temporal fluctuations in groundwater flow;
- Geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities; and
- Additional monitoring wells as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater are passing the waste boundary of the CCR unit.

2.3 Multiunit Groundwater Monitoring System

The multiunit groundwater monitoring system must be equally capable of detecting monitored constituents at the waste boundary of the CCR unit as the individual groundwater monitoring system for each CCR unit. Provide information on the following:

- Number, spacing, and orientation of each CCR unit;
- Hydrogeologic setting;
- Site history; and
- Engineering design of the CCR unit.

2.4 Contamination Prevention

Monitoring wells must be cased in a manner that maintains the integrity of the monitoring well borehole, in accordance with 30 TAC §352.911(d). This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (*i.e.,* the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater.

The Owner/Operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices.

The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

2.5 Groundwater Monitoring System Certification

A qualified Texas P.G. or qualified Texas P.E. must certify that the groundwater monitoring system design and construction meet the requirements of 30 TAC §352.911/40 CFR §257.91. If the groundwater monitoring system includes the minimum number of monitoring wells, the certification must document the basis supporting this determination, in accordance with 30 TAC §352.911/40 CFR §257.91(f).

2.6 Recordkeeping, Notification, and Internet Requirements

The Owner/Operator must comply with the recordkeeping, notification, and internet posting requirements of 30 TAC Chapter 352.

2.7 Changes to an Approved Groundwater Monitoring System

An Owner/Operator must request an amendment to the registration and the executive director must approve the request before changes to the groundwater monitoring system can be implemented.

2.8 Installation, Plugging, and Abandonment of Wells or Borings

Installation, plugging, and abandonment of wells or borings must be carried out in accordance with 16 TAC Chapter 76 (Licensing and Regulations of Water Well Drillers and Water Well Pump Installers).

Part 3 - Groundwater Sampling and Analysis

The groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide an accurate representation of groundwater quality at the background and downgradient wells required by 30 TAC §352.911/40 CFR §257.91. The Owner/Operator of the CCR unit must develop a sampling and analysis program in accordance with 30 TAC §352.931/40 CFR §257.93 that includes procedures and techniques for: sample collection; sample preservation and shipment; analytical procedures; chain of custody control; and quality assurance and quality control. The sampling and analysis methods chosen must be appropriate for groundwater sampling and accurately measure the prescribed constituents, and other monitoring parameters, in groundwater. The Owner/Operator must establish background groundwater quality in the upgradient wells that are part of the groundwater monitoring system. The number of samples collected for groundwater monitoring programs must be consistent with the statistical procedures chosen. A qualified Texas P.G. or qualified Texas P.E. must certify that the chosen statistical method is appropriate for evaluating the groundwater monitoring data. The Owner/Operator must comply with the recordkeeping, notification, and internet posting requirements of 30 TAC Chapter 352.

3.1 Procedures for Groundwater Sampling

3.1.1 Well Inspection

Procedures must be included that direct the sampler to inspect the integrity of each monitoring well before purging and sampling each well. At a minimum, the sampler should do all the following:

- Check casing, concrete pad, protective collar, and protective barriers for cracks, fissures, or damage (by equipment, animals, vandalism, or other cause);
- Check that the lid of the protective collar has a lock, that the lock is functional, and that the lid was locked when the sampler visited the well;
- Check that the well cap is present on the top of the well casing. If the well is flush-mounted (casing is in a ground-level vault and is not above ground level), check that the well cap and lid to the vault are both watertight. Any water present inside a flush-mounted well vault should be removed before removing the well cap;

- Note the proximity of the well to potential sources of contamination, including facility roads; and
- Avoid using organic sprays or other potential contaminants to remove any insects found on or in the casing, or organic lubricants on well components including hinges and locks.

3.1.2 Water-Level Measurements

The depth-measuring equipment should be calibrated regularly and documented. Before purging a well, the sampler must do all the following:

- Measure the depth to water every event and measure the depth to the bottom of the well at least every two years;
  - Take all depth measurements from a permanent, clearly marked and identifiable reference point, or datum. The datum is typically a point marked with permanent marker at the top of the well casing and must be documented on the Monitor Well Data Sheet for each well;
  - Record depths to the nearest hundredth of a foot;
- Decontaminate the water level indicator probe before use in each well;
- Include in the field log any indication of organic compounds that have formed a liquid separate from the groundwater; and
- Calculate the elevation of the water level with respect to mean sea level and report to the nearest hundredth of a foot after water-level measurements are taken.

3.2 Well Purging

Specify which method(s) of purging will be used and the reasons for selecting the method(s). No single purge method may be appropriate for all the monitoring wells at a facility. Variables including well diameter, depth to water, pH, and total dissolved solids content should be considered when determining which purge method(s) to use.

For wells that have significant levels of total dissolved solids, low-flow purging may be an appropriate method.

Some technologies, for example passive samplers, do not require the well to be purged prior to sampling.

Provide sufficient details about the chosen purge methods so that samplers can implement methods correctly and consistently.

In the following subsections of this document, several common purge methods are described, with guidelines for their implementation.

3.2.1 Low-Flow Purging

A widely used method of well purging is low-flow purging, which involves removal of well water in a manner that minimizes drawdown, turbidity, and disturbances to the aquifer. The goal is to ensure the collection of representative groundwater samples. This guidance is generally based on the United States Environmental Protection Agency (EPA) publication *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures* (April 1996).

The following procedures should be implemented during low-flow purging:

- Place the pump intake in the middle of the screened interval to avoid mixing formation water with sediments in the well bottom or overlying stagnant water within the well casing. We suggest the use of dedicated purging and sampling devices. If non-dedicated equipment is used, it must be decontaminated between wells to prevent cross-contamination;

- Limit low-flow purging to wells that exhibit no continuous drawdown under sustained pumping;
- Measure and record water levels before pumping; and
- Initiate purging and adjust flow to a rate that results in a minimal (<0.1 meter [<0.33 feet]) well drawdown. This goal may be difficult to achieve and may require adjustment based on site-specific conditions. If the minimal drawdown exceeds 0.1 meter, but remains stable, continue purging.

Purge rates for low-flow purging are typically in the range of 0.1 to 0.5 liters per minute. A higher purge rate may be acceptable but must be determined at each well location. Purge rates should ideally be equivalent to the well recharge rate at the pump intake. Pumping rates that result in minimal drawdown in one well at a facility could be too high for another well at the same facility.

Water level should be monitored in each well and purge rate adjusted to minimize drawdown. Also, water levels and purge rates should be recorded every three to five minutes during purging, and upon completion of sampling. Determine the optimum pumping rate for each well and record this information for future reference.

The minimum well-purge volume should be at least two pump and tubing volumes.

Water quality indicator parameters should be continuously monitored during purging, preferably with a flow-through cell. Stabilization of parameters including pH, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), temperature, and turbidity should be used to determine when stagnant casing water has been purged and formation water is available for sampling. A minimum subset should include pH, specific conductance, and either turbidity or DO. Measurements should be recorded every three to five minutes. Temperature and pH are not helpful in distinguishing between formation water and stagnant casing water but are still important for data interpretation. Stabilization is considered achieved when all the parameters are within the following ranges for three successive readings:

- ±0.1 units for pH;
- ±3% for specific conductance;
- ±10 millivolts for ORP; and
- ±10% for turbidity and DO.

3.2.1 Purging with a Non-Low-Flow Pump

If you cannot meet the criteria for low-flow purging, then purging with electric, or air-operated pumps at higher speeds is acceptable.

Specify the type of pump that will be used, based on what will be most effective. Pumps and tubing should be limited to those made of stainless steel, Teflon®, or other resistant materials.

You should use positive-pressure displacement bladder pumps or other types of pumps that are designed to prevent air from contacting the water and to minimize aeration in the well, to help prevent the loss of volatile constituents that are being monitored.

The following procedures should be implemented when purging by a non-low-flow method:

- Make sure that each well has a clean, dedicated pump and tubing installed to minimize cross-contamination between wells.
  If separate pumping equipment is not dedicated to each well, the non-dedicated sampling equipment must be decontaminated between wells. The final rinse in the decontamination process should be done with laboratory reagent-grade water. If

commercial distilled water is used instead for the final rinse, a sample of the water should be analyzed for volatile organic compounds (VOCs) at each event, to ensure that any VOCs in the commercial distilled water are known and can be factored into the evaluation of the analytical results.

- Calculate the volume of water in each well using the following equation:

  V = 0.041 d2h

  where:

  V = volume of water, in gallons;

  D = diameter of well casing, in inches;

  H = length of water column (total well depth minus depth to water, measured during preliminary work stage of sampling event), in feet; and

  0.041 = conversion factor = well-casing diameter squared ÷ 4 x π (well cross-sectional area, in inches) x 144 square inches per square foot x 7.4805 gallons per cubic foot.

- After the preliminary work has been done and a well is ready to be purged, assemble the pump, hoses, and safety chain or rope, and lower the pump into the well. To avoid stirring up accumulated sediments at the bottom of the well, set the pump level at least three to five feet from the bottom of the well, if possible; however, also make sure that the pump is deep enough in the water column so that it does not run dry, which could damage it.
- Make connections between the pump and the control box, if you are using an air-lift or bladder pump.
- Attach a flow meter to the outlet hose to measure the volume of water purged. Alternatively, a graduated bucket or container with marks can be used to measure volumes.
- Next, attach the power supply if required, and begin purging the well. The well should be purged at a rate low enough to prevent groundwater that is recharging the well from cascading down the sides of the well, if possible.
- If the pumping rate exceeds the well recharge rate and the water discharge rate from the pump decreases or stops, lower the pump deeper into the water column in the well or reduce the pumping rate to decrease well drawdown, and then continue pumping. If you are using an air-lift or bladder pump, be sure to adjust the flow rate to prevent violent jolting of the hose as the sample is drawn in.
- Continue purging until the desired volume has been purged, unless the well goes dry before the purging process is completed.

3.2.1.1 Purging with a Bailer

If pumping is not an option, you can use bailers to purge the well. Bailers should have a bottom-emptying device that allows the bailer to be emptied slowly with minimum aeration of the sample. When purging with a bailer, you should also take extra care to avoid introducing contaminants to the water in the well. You should use disposable gloves, a new pair for each well, to avoid cross-contamination.

Because of the ease of stirring up accumulated sediments at the bottom of the well, purging should be done in ways that will minimize turbidity. Bailers should be lowered gently, not dropped, to a foot or two above the bottom of the screen, allowed to sit for several seconds, and then pulled slowly and steadily up to the surface. As was indicated regarding purging with a pump, purging and recovery should continue until at least three casing volumes have been removed or the well goes dry. The well should then be allowed to recover.

3.2 No-Purge Technique

If a well is to be sampled using a passive method, purging may not be necessary. Passive groundwater sampling involves deploying a sampling device, appropriate for the constituents being monitored, in a well and leaving it there for a predetermined period before retrieving it to collect the sample.

3.2.1 Storage and Disposal of Purge Water and Excess Sample Water

Specify how purge water and excess sample water will be managed and disposed.

3.2.4.1 Storing Purge Water and Excess Sample Water

You should store purge water and excess sample water in a properly labeled drum or container until the analytical results have been received and a proper disposal method has been selected. All the disposable sampling equipment (ex. tubing or bailers) and supplies (ex. gloves) should be containerized separately from the purge water.

3.2.4.2 Disposing of Uncontaminated Water

If the analytical results indicate that constituents are at or below background concentrations, purge water and excess sample water may be applied to the unsaturated soil on-site or discharged to surface water, if an authorization is not required.

3.2.4.3 Disposing of Contaminated Water

If constituents are above background concentrations, the water is considered contaminated. Specify which methods will be used for disposing of groundwater that is contaminated or for which analyses have not yet been received. The following methods are allowed:

- Transport off-site or discharge to an authorized wastewater treatment facility, or liquid waste processing facility, if the water quality is acceptable to the receiving facility.
- If test results indicate levels of contaminants that cause the water to be classified as hazardous, the water must be properly transported and disposed of at a hazardous-waste facility.

3.2.5 Records and Documentation of Well Purging

All the data collected should be recorded in a field log before and during purging. This data should include all of the following:

- Sampler's name;
- Date and time;
- Outdoor temperature and weather conditions;
- Initial depth to water, measured well depth, and calculated height and volume of the water column;
- Desired well volume to purge (for example, three casing volumes);
- Purge-discharge rate, if known, and purge duration (elapsed time);
- Volume of water purged from a well;
- Low-flow parameter readings, if a low-flow method is used;

- Well inspection results; and
- Any other pertinent information.

3.3 Sample Collection

3.3.1 General Considerations

Physical or chemical changes can occur in groundwater samples if inappropriate or inadequate sampling devices, collection procedures, preservatives, temperature controls, or shipping methods are used.

3.3.1.1 Timing and Sequence of Sampling

The elapsed time between purging and sample collection should be as short as possible, to avoid temporal variations in water levels and water chemistry. Preferably, sampling should be done within 24 hours of purging.

You should measure the water level in each well again before sampling to determine whether there is enough water for sampling, especially if the well went dry during purging. Where possible, you should allow the water level in a well to recover to 90% of the level that existed prior to purging, before collecting a sample. To allow wells that purged dry to recover sufficiently to sample, or suspended sediments to settle, you may have to wait several hours or several days between purging and sampling.

Allow up to seven days recovery time after purging a well before determining that the well is dry or has not recharged sufficiently to sample. If after seven days a slowly recharging well has not recovered sufficiently for a complete set of samples, you should collect a partial set of samples, until no more samples for the set can be collected.

If contamination is known to be present in one or more wells at a CCR unit, you should begin the sampling at the well that is known to be the least contaminated and end with the most contaminated well. Where no contamination is known, the order should generally be from the well with the highest water-level elevation to the one with the lowest elevation (that is, from upgradient to downgradient) for wells screened in the same water-bearing unit.

3.3.1.2 Cleaning and Decontaminating Field Equipment

If you use non-dedicated sampling devices, you should clean and decontaminate them using appropriate procedures before sampling each well. Do not reuse sample bottles, bailer rope, rubber hoses, or disposable gloves. If a bailer is used, we recommend a bottom-emptying device, because it allows the bailer to be emptied slowly from the bottom, reducing turbulence and aeration, which could alter sample chemistry.

3.3.1.3 Calibrating Field Equipment

Field equipment, including devices for measuring water levels and water quality indicator parameters, must be calibrated in accordance with the manufacturer’s instructions prior to sampling.

3.3.1.4 Water Quality Indicator Parameters

Before sample collection begins, you should again measure and record water quality indicator parameters—including pH, specific conductance, dissolved oxygen, oxidation-reduction potential, temperature, and turbidity—in addition to the measurements you made during purging.

3.3.1.5 Sample Filtering

Filtering of samples in the field is not allowed.

3.3.2 Sample-Collection Methods

Include both the preferred and alternative sampling methods that might be used at a facility. Low-flow sampling is the recommended sampling method because it controls turbidity and delivers higher-quality samples. However, non-low-flow pumps, bailers, and passive (no-purge) samplers are also acceptable methods.

When using pumps for sampling, the pumping rate in a well should be the same or less than the purging rate in that well and should be sufficiently low to minimize sample aeration.

Information about passive samplers is available in the publication *Protocol for Use of Five Passive Samplers to Sample for a Variety of Contaminants in Groundwater* (February 2007), a publication of the Interstate Technology Regulatory Council (ITRC).

3.3.3 Sample Volumes and Sampling Containers

The volume of samples and types of sample containers needed depends on the constituents to be analyzed. EPA recommendations include:

- For volatile organic compounds (VOCs), use two 40 ml glass vials (or lab-specified alternate quantity or size) with special caps with Teflon® septa, pre-preserved by the lab. The septum must be correctly placed, with the Teflon® side toward the sample (shiny side away from the sample);
- For semivolatile organic compounds (SVOCs), use a one-liter glass container;
- For metals, use laboratory-provided polyethylene or glass containers that already contain the necessary preservatives; and
- For other inorganic constituents, use laboratory-provided polyethylene or glass containers (preservatives generally are not used, except for samples to be analyzed for ammonia).

3.3.4 Sample-Collection Procedure

3.3.4.1 Cleanliness

To prevent contamination, keep clean equipment on top of plastic sheeting and not in direct contact with the ground. You should check the area around the sampling point for possible sources of air contamination, particularly when sampling for VOCs. Note any potential impacts in the field log.

You should collect all water samples as close to the wellhead as practical. Do not allow the sampling device to touch the sampling container but hold the two as close to each other as possible, to reduce aeration.

Generally, you should discard the first portion of water taken from a well during sampling. This is done to help eliminate any non-representative water that may be present at the top of the water column.

Water removed during sampling and not utilized must be handled in the same way as purge water.

3.3.4.2 Filling Sample Containers

Fill sample containers in the following order, according to volatilization sensitivity (from most to least volatile): VOCs, SVOCs, Metals, Other Inorganic Constituents.

When filling containers for VOC samples, allow the water stream to flow down the inner wall of the vial to minimize formation of air bubbles. Overflow the containers slightly so that the vial has a positive meniscus. Screw the caps on carefully to avoid leaving any air space in the vials. If an air bubble forms in the bottle, do not open the bottle to remove it, but collect an additional, separate sample.

If you use bailers for sampling, discard the first part of the sample to remove any sludge or suspended solids, then fill both VOC vials from a single bailer to minimize differences in the samples.

3.3.4.3 Labeling Sample Containers

You must label all sample containers for identification purposes. The labels must include information regarding the sample number (with the well number as part of the sample number), site identification, analysis to be performed, preservatives used, date and time of sample collection, and name of sampler. You should write the information on the label with permanent ink and, if necessary, cover the label with transparent tape to protect the written data.

3.3.5 Quality Control Samples

We recommend that you use trip blanks, field blanks, equipment blanks, and field duplicate samples for quality control (QC), as they can help determine whether samples have been contaminated from other sources. Typical collecting frequencies are as follows:

Typical Collecting Frequencies for Blanks

Type of Blank	***Collection Frequency***
Trip Blanks	One for each sampling event
Field Blanks	One per day, or one for every 10 wells sampled, whichever is greater
Equipment Blanks	One per day or sampling event
Field Duplicates	One for every 20 wells sampled, with at least one per sampling event

The various types of QC samples are described below.

Trip Blanks. A trip blank is a laboratory-prepared sample of reagent-grade or distilled water provided with a set of sample jars that is transported to and from the site in the same manner as the sample containers. The purpose of the trip blank is to determine if any of the sample bottles or collected samples have been contaminated before or during sampling, or if sample shipment, handling, and storage have had an impact on the integrity of the sample.

Field Blanks. A field blank is prepared in the field by pouring laboratory reagent-grade or distilled water into clean sample containers opened in the field, then returned with the samples to the laboratory for analysis. It is used to check for incorrect sampling procedures or airborne contaminants at the sample-collection point. It is appropriate to collect the field blanks when sampling downgradient wells. If a well is contaminated, a field blank collected close to the contaminated well, in addition to the regular field blank, may help determine if there are other contaminant sources in the area of the well.

Equipment Blanks. An equipment blank is a sample of laboratory reagent-grade or distilled water run through the well-sampling equipment in the same manner as the actual groundwater sample, to determine the effectiveness of the procedures for equipment decontamination.

Field Duplicates. Analysis of field duplicate samples provides a check on the precision of the laboratory techniques. Field duplicates are two samples taken at the same time from the same well, and from the same bailer, if bailers are used. Field duplicates are labeled differently so that the laboratory is unaware that the samples are duplicates.

You should label duplicate samples as you would regular samples, but with a sample name for example "Dup-1," "Dup-2," and so on, and with the sample time omitted, so there is no way for the laboratory to know which well the duplicate sample is from. The information about which well the duplicate is from should be written in the field logbook.

3.3.6 Chain-of-Custody Documentation

A suitable chain-of-custody (COC) document must accompany the samples at every step from field to laboratory and must be signed by each party (except commercial transporters) handling the samples, from the sampler to the laboratory representative. Usually laboratories provide their blank COC forms with the empty sample-bottle shipment. Proper COC procedures are essential to ensure sample integrity and to provide legally and technically defensible data.

The person collecting the sample starts the COC procedure and fills in all the required information on the COC document, for example sample name, collection date and time, and requested analyses. Individuals relinquishing and receiving the samples should sign, date, and note the time of transfer on the COC document. A completed COC document should be placed inside a sealed plastic bag to prevent the ice or water in the cooler from damaging it. Mailed packages should have tracking numbers to allow for locating shipments.

3.3.7 Sample Storage and Transport

All samples should be kept cold, ideally at 4° C ± 2°, and transported to the laboratory as soon as possible, preferably within 48 hours of sampling. You should wrap the samples, put them in resealable plastic bags, and place them in a hard-sided ice chest or other insulated container packed with sufficient ice or refreezable materials to keep them at the ideal temperature. You should not use dry ice to chill the samples because the samples could freeze and break their containers.

If the samples are to be shipped, they should be kept chilled with ice that is double-bagged in resealable plastic bags while sampling is occurring. Then, just before shipping, the sampler should pour out the excess melt water, and add more ice, if necessary. Coolers can also be kept cold with frozen packages of refreezable materials for example "blue ice." The samples, blanks, and COC documents need to be well packed in the insulated cooler, with as little extra air space as possible, utilizing ice bags, foam, or bubble wrap to add padding, then thoroughly sealed with shipping tape. Flimsy, expanded-foam or soft-sided ice chests are not suitable for shipping.

3.3.8 Documentation of Sampling

All information related to a sampling event must be recorded in a bound, permanent field logbook or equivalent. All the entries in the logbook should be legible and made in black, permanent ink. Entry errors should be crossed out with a single line, dated, and initialed by the person making the corrections. An essential practice is to record sufficient information so that the sampling situation can be reconstructed without relying on the sampler's memory. Location, date, time, weather conditions, name and identity of sampling personnel, all field measurements including numerical values and units, comments about the integrity of the well, and so on should be recorded. Because the field logbook may be the only acceptable record for legal purposes, it should be protected and kept in a safe place.

3.4 Groundwater Analysis

3.4.1 Laboratory Accreditation

General provisions as well as accreditation and certification requirements for environmental testing laboratories are specified in 30 TAC Chapter 25. All environmental testing laboratories must be accredited in accordance with 30 TAC Chapter 25 (except as provided in 30 TAC §25.6), if the laboratory provides analytical data that is used for a TCEQ decision relating to a (1) permit, (2) authorization, (3) compliance action, (4) enforcement action, (5) corrective action, (6) characterization of an environmental process or condition, or (7) assessment of an environmental process or condition.

3.4.2 Groundwater Sampling and Analysis Requirements

A groundwater monitoring program must include consistent sampling and analysis procedures that are designed to ensure results that provide an accurate representation of groundwater quality at the background and point-of-compliance wells.

3.4.3 Constituents Required for Detection Monitoring

The Owner/Operator must sample and analyze for the constituents listed in Appendix III to 30 TAC §352.1421, in all groundwater monitoring wells.

3.4.4 Test Methods

Groundwater samples must be analyzed using analytical methods that accurately measure hazardous constituents and other monitoring parameters in groundwater samples. The following two publications identify and describe analytical methods that are acceptable for groundwater monitoring: Test Methods for Evaluating Solid Waste (a publication of the EPA; also known as SW-846; as revised), and Standard Methods for the Examination of Water and Wastewater (a joint publication of the American Public Health Association, the American Water Works Association, and the Water Environment Federation; as revised). Any alternative inorganic constituents chosen for detection monitoring can be analyzed by the methods described in either of these two references.

3.4.5 Acceptance Limits for Quality Control Samples

Quality control samples are used to determine precision (how repeatable a measurement is) and bias (how close the result is to the actual value). Each analysis has associated acceptance limits. Quality control results that are outside acceptance limits for a constituent and method should be flagged by the laboratory, with an explanation of any problems encountered by the laboratory, including any corrective actions attempted to resolve the analytical problems. Groundwater sample results associated with quality control results that are outside acceptance limits may still be used but should be flagged. You, the Owner/Operator of a facility, must review all data and ensure that the laboratory has performed all required quality assurance and quality control activities, and documented any problems and corrective actions associated with an analysis. The laboratory must maintain all records in accordance with the requirements of the National Environmental Laboratory Accreditation Conference (NELAC).

3.4.6 Practical Quantitation Limit

The practical quantitation limit (PQL) is the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

For each constituent listed in 30 TAC §352.1421 Appendix III or in 30 TAC §352.1431 Appendix IV, or for each groundwater parameter that has a groundwater protection standard (GWPS), the laboratory will demonstrate that the method and procedure used in the analysis can attain a PQL at or below the GWPS.

Table 1: Appendix III to Part 257—Constituents for Detection Monitoring

Common name[1]
Boron
Calcium
Chloride
Fluoride
pH
Sulfate
Total Dissolved Solids (TDS)

Table 2: Appendix IV to Part 257—Constituents for Assessment Monitoring

Common name[1]
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Fluoride
Lead
Lithium
Mercury
Molybdenum
Selenium
Thallium
Radium 226 and 228 combined

[1]Common names are those widely used in government regulations, scientific publications, and commerce; synonyms exist for many chemicals.

Laboratory quality control samples will meet the precision and accuracy data-quality objectives that are listed in the table below.

Table 3. Measurement-Quality Objectives

Chemical of Concern	*Precision (% RSD)*	*Accuracy (% recovery)*
Metals	10	70–130
Volatiles	20	50–150
Semivolatiles	30	50–150

The laboratory will report non-detected results as less than the value of the PQL.

When the limits for precision and accuracy listed in Table 1 cannot be met, the Owner/Operator will submit information to support a recommendation for using alternative precision and accuracy limits.

3.4.7 Laboratory Case Narrative

All analytical data submitted under the requirements of this permit will be examined by the Owner/Operator to ensure that the data-quality objectives are considered and met prior to submittal for the commission's review. The Owner/Operator will determine if the results for a sample are accurate and complete. The quality control results, supporting data, and data review by the laboratory must be included when the Owner/Operator reviews the data. The Owner/Operator will report any anomalies that were identified in the laboratory case-narrative summary.

The Owner/Operator will ensure that the laboratory documents and reports all problems and anomalies associated with the analysis. If analysis of the data indicates that the data fails to meet quality control goals, the Owner/Operator will determine if the data is usable. If the Owner/Operator determines that the analytical data may be used, all problems and corrective action that the laboratory identified during the analysis will be included in the report submitted to the TCEQ.

A Laboratory Case Narrative (LCN) for all problems and anomalies observed will be submitted by the Owner/Operator. The LCN will provide the following information:

- The exact number of samples, constituents analyzed, and sample matrices;
- The name of the laboratory performing analyses. If more than one laboratory is used, all laboratories will be identified in the case narrative;
- Explanation of each failed precision and accuracy measurement determined to be outside of the laboratory or method control limits;
- Explanation if the failed precision and accuracy measurements cause a positive or negative bias on the results;
- Identification and explanation of problems associated with the sample results, along with the limitations on data usability;
- When appropriate and when requested, a statement on the estimated uncertainty of analytical results of the samples;
- A statement of compliance or noncompliance with data-quality objectives. Holding-time exceedances and matrix interferences must be identified. Dilutions must be identified,

and if dilutions are necessary, they must be done to the smallest dilution possible to effectively minimize matrix interferences and bring the sample into control for analysis; and

- Identification of all applicable quality assurance and quality control samples that will require special attention by the reviewer.

3.4.8 Other Information

In addition to the LCN, a laboratory report will include the following:

- A table identifying the field-sample name with the sample identification in the laboratory report;
- Chain of Custody forms;
- For each sample, a report (certificate of analysis) of the constituents analyzed, the analytical methods, and the laboratory PQLs;
- A release statement provided by the laboratory, with the following wording: "I am responsible for the release of this laboratory data package. This data package has been reviewed by the laboratory and is complete and technically compliant with the requirements of the methods used, except where noted by the laboratory in the attached exception reports. By my signature below, I affirm to the best of my knowledge that all problems or anomalies that were observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory in the Laboratory Review Checklist, and no information or data have been knowingly withheld that would affect the quality of the data."

  If an in-house laboratory is used, the laboratory release statement must also include the following: "This laboratory is an in-house laboratory controlled by the person responding to the rule. The official signing the cover page of the rule-required report in which these data are used is responsible for releasing this data package and is by signature affirming that the above release statement is true"; and
- A Laboratory Review Checklist (LRC). For every "exception report"—a response of "No," "NA," or "NR"—on the checklist, the Owner/Operator will ensure that the laboratory provides a detailed description of the exception in the summary of the LCN.

3.5 Statistical Evaluation of Monitoring Data

3.5.1 Regulatory Requirements

Statistical evaluation of analytical results from groundwater samples is required to determine if the CCR unit has affected groundwater quality. Statistical procedures provide an objective way for characterizing analytical results and making decisions, including establishing background groundwater quality, determining if changes in groundwater quality are significant, and determining if constituents of concern are above or below GWPS and whether corrective action is needed.

Any statistical method used to evaluate data must be appropriate for the distribution of tested constituents. It may not be possible to specify statistical methods until at least a few background samples have been taken. Therefore, you should identify the methods that might be used, and explain how it will be decided which methods to use once the data has been collected.

3.5.2 Establishing and Updating Background

The background data for a facility should reflect groundwater quality that has not been affected by leakage from the CCR unit. These conditions could range from an uncontaminated aquifer to a historically contaminated site.

3.5.2.1 Assumptions for Statistical Tests

3.5.2.1.1 Statistical Independence

Allowing as much time as possible to pass between sampling events is the best way to achieve statistical independence. But you must draw a balance between collecting a sufficient number of samples from a given well over a specified time period and ensuring that the samples are statistically independent. The time between samples will depend on the hydrogeological conditions and groundwater flow velocity.

3.5.2.1.2 Normality of Data and Selecting Parametric or Nonparametric Methods

Most statistical methods used for the evaluation of groundwater monitoring results are based on the assumption that the population from which the data are taken is normally distributed. These methods also apply to data from a population that has been transformed by mathematical manipulations into a normal distribution. In that case, the data are treated statistically after the appropriate transformation.

If the data are not normally distributed, either raw or transformed, then nonparametric statistical methods that do not require or assume normality can be used.

3.5.2.1.3 Outliers

Unusual values in a data set are considered outliers. Outliers in sample results can be due to several factors, including measurement errors, laboratory errors, clerical errors, and contaminated samples. Statistical calculations are required to determine if a sample result is a statistical outlier. The EPA document *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (March 2009) (Unified Guidance) recommends generally not to remove outliers unless some basis for a likely error can be identified. However, the Unified Guidance also recommends removing extreme values (unusual-looking, high-magnitude measurements) in background data sets even if the reason for the extreme values is not known. Removal of statistically identified outliers should be based on technical information or knowledge that can support that decision.

3.5.2.1.4 Trends

An assumption about background is that background samples come from a background population with a stable mean and variance that does not vary significantly through time. Data that show a trend of increasing or decreasing concentrations may violate this assumption. The proper handling of trends in background depends on the cause of the trend. For newly installed monitoring wells, it may be necessary to discard initially collected observations and wait for the aquifer or well construction materials to stabilize.

3.5.2.5 Non-Detects

Samples with values below the laboratory quantitation limit or other reporting limit (RL) are called “non-detects.” The actual concentration of a constituent reported as non-detect may be anywhere between zero and the reporting limit.

When using parametric statistical tests, the Unified Guidance recommends that one-half of the RL be used in place of non-detects for calculations.

If the proportion of non-detects exceeds certain thresholds, nonparametric tests should be used.

When all data are non-detect, a nonparametric prediction limit should be used, with the RL as the limit. If a constituent has never been detected in groundwater at a site, or has not been detected recently, it may be evaluated using the “double-quantification rule” (DQR, described later in this document).

3.5.3 Site-Wide False Positive Rates and Statistical Power

False positives are results that are from the background population but exceed the background statistical limit. Statistical power refers to the ability of a test to identify real increases above background.

The Unified Guidance recommends two statistical performance criteria that are fundamental to good design of a detection monitoring program:

- Application of an annual cumulative Site-Wide False Positive Rate (SWFPR) design target, suggested at 10% per year (5% for each of two semiannual sampling events); and
- Use of EPA power curves to gauge the cumulative annual ability of any individual test to detect contaminated groundwater when it exists.

The SWFPR is a function of the number of constituents, number of wells, number of annual evaluations, and the type of verification resampling program. The greater the number of constituents, the greater the likelihood of false positives. It is recommended that constituents not historically detected in background not be included in SWFPR computations.

The Unified Guidance recommends a power (the y axis of the power diagram) of at least 55% to 60% when concentration levels are three standard deviations (SD, the x axis of the power diagram) above the background mean, and at least 80% to 85% at 4 SD.

3.5.4 Statistical Tests

Prediction limits, control charts, and confidence intervals are statistical tools that are commonly used. Prediction limits and control charts are used for evaluating detection monitoring results. Confidence intervals are used to evaluate results during assessment monitoring and corrective action.

An alternative method—the “double quantification rule”—is available for evaluating results for constituents that have never been detected or that have not been detected in a long time.

Verification resampling will almost always be needed to maintain adequate statistical power and minimize the overall false-positive rate for detection monitoring programs. Therefore, it is important to outline a resampling strategy prior to beginning detection monitoring.

3.5.4.1 Prediction Limits

Prediction limits provide an estimate of an interval that will include values of future measurements based on previous measurements, with a given level of confidence. The previous measurements may be background data for either a group of wells (interwell comparison) or a single well (intrawell comparison). For parametric prediction limits, background data should be either normal or normalized by using a transformation (e.g., the natural logarithm) and should not exhibit trends and should not include statistical outliers. All possible outliers should be examined to determine whether a cause is known. If a transformation is used, the resulting limit should be back- transformed to the original units. When normality cannot be justified, a nonparametric limit should be computed. The largest or second-largest value in a background data set is usually selected as a non-parametric limit.

3.5.4.2 Control Charts

Combined Shewhart-CUSUM control charts are an alternative test to prediction limits in detection monitoring. This control chart assesses two statistics at one time: the Shewhart portion works somewhat like a prediction limit and compares each new measurement against a control limit, whereas the CUSUM portion tracks the cumulative sum of how much each measurement exceeds a threshold level. In practice, both the control limit and CUSUM limit can be set to the same value. A statistical exceedance is declared if either the new measurement or the CUSUM exceeds the limit.

To use the Shewhart-CUSUM control chart for analysis, the original or transformed data must be:

- normally distributed;
- independent;
- generally above detection limits; and
- represent groundwater quality not affected by a CCR unit.

3.5.4.3 Trend Tests

The Unified Guidance suggests trend tests as an alternative to prediction limits when the data are not amenable to prediction limits. Also, a trend test can be used for historically contaminated wells, where uncontaminated data cannot be collected.

For most constituents, a trend test will have one of three outcomes:

- a statistically significant decreasing trend, which indicates that water quality may be improving;
- an insignificant trend, which indicates that water quality is staying the same; or
- a statistically significant increasing trend, which indicates that water quality may be getting worse.

3.5.4.4 Double Quantification Rule (DQR)

The Unified Guidance recommends using the Double Quantification rule (DQR) for constituents not historically detected. Constituents that have not been detected in the background samples are not subject to formal statistics and should not be included in Site-Wide False Positive Rate (SWFPR) computations. If a constituent has been detected for two consecutive semiannual sampling events, it should be treated as a statistically significant increase (SSI) and added to SWFPR computations.

3.5.4.5 Verification Resampling

In a detection monitoring program that incorporates verification resampling, an SSI is not declared unless the resample or resamples also exceed the background limit. The exceedance detected in the initial sample may be referred to as an “initial exceedance.”

Verification resampling should be conducted to verify or disconfirm an initial exceedance. If a constituent in an original sample from a well exceeds its statistical limit, then one or more resamples are collected from that well and evaluated.

A statistical test utilizing resampling is not complete until all necessary resamples have been evaluated.

Prediction limits are well suited for retesting. Typical retesting strategies are to allow for one resample for constituents evaluated using a parametric method with eight background measurements, or two resamples for constituents evaluated using a nonparametric method with eight background measurements. If the retesting strategy involves one resample, the initial exceedance is disconfirmed if the constituent concentration in the resample does not exceed the prediction limit (pass one of one resample). If the retesting strategy involves two resamples, the initial exceedance is disconfirmed if the constituent concentration in the first or second resample does not exceed the prediction limit (pass one of two resamples); if the first resample passes, the second resample does not need to be taken.

A resampling strategy ordinarily should not be changed from event to event; however, it can be periodically reevaluated and changed as necessary during a background update, which would include new sample results since the previous background evaluation and may include new wells or changes to the list of constituents monitored.

3.5.4.6 Confidence Intervals for Assessment Monitoring and Corrective Action Monitoring

The Unified Guidance recommends the use of confidence intervals for evaluating results during assessment monitoring and corrective action monitoring. A confidence interval should be constructed using at least four measurements. For a site conducting semiannual monitoring, the four samples would include the sample from the current event and the samples from the three preceding semiannual events (spanning a period of one and a half years).

During assessment monitoring, the lower confidence limit (LCL) for each constituent is compared against its GWPS to determine if a constituent is present at a statistically significant level above its GWPS. If an LCL exceeds a GWPS, corrective action is triggered, unless it is demonstrated that the statistically significant level resulted from error in sampling, analysis, statistical evaluation, or from natural variation in groundwater quality.

During corrective action monitoring, the upper confidence limit (UCL) for each constituent is compared against its GWPS to determine if a constituent remains at a statistically significant level above its GWPS. A remedy under corrective action is considered complete when the UCLs for all assessment constituents have not exceeded GWPSs for a period of three consecutive years.

3.6 Establishing Background Levels

Background refers to the data set representing groundwater quality that has not been affected by leakage from a CCR unit. A minimum of eight background samples are needed, from each background and point-of-compliance well, to establish limits for any statistical test. Generally, the background sample size should be as large as feasible.

A facility may establish background limits for the constituents listed in Appendix III and Appendix IV of 40 CFR Part 257, adopted by reference in 30 TAC §§352.1421 and 352.1431 respectively, for a well using data collected earlier from that well, and then compare detection monitoring results from that well to the earlier background (*intrawell* comparison), provided that the earlier data from the well represent background groundwater quality not affected by the CCR unit. If background values are not available from a well or if the well is already affected by the CCR unit, then detection monitoring results from the well will need to be compared to background from upgradient wells (in the absence of spatial variation) or other wells that are not affected (*interwell* comparison). After the facility completes background monitoring, it must evaluate the background data to ensure that the data are representative of background groundwater quality.

Existing CCR units were required to have collected and analyzed samples for the constituents listed in Appendix III and Appendix IV no later than October 17, 2017. New units are required to have sampled for background within the first six months after receiving waste in the CCR unit.

Part 4 – Detection Monitoring

4.1 Detection Monitoring

After the completion of background monitoring, the Owner/Operator must sample all monitoring wells on a semiannual basis for the constituents listed in Appendix III adopted by reference in 30 TAC §352.1421, unless another sampling schedule is approved by the TCEQ. The goal of detection monitoring is to identify changes in groundwater chemistry that may indicate a release from the CCR unit.

Changes in groundwater chemistry are identified by statistically comparing the detection monitoring result for each constituent in each well to the established background statistical limit for that constituent. No later than 60 days after each sampling event, the facility must determine if there has been an initial exceedance over the background limit for any tested constituent. If an initial exceedance is determined at the point of compliance, the facility must notify the TCEQ and any local pollution agency with jurisdiction that has requested to be notified, in writing within 14 days. The term “initial exceedance” refers to a monitoring result that exceeds a statistical limit but has not yet been verified by resampling.

4.1.1 Verification Resampling

If an initial exceedance over a background limit is determined, the Owner/Operator may conduct verification resampling and submit the results within 60 days of the initial exceedance determination. The verification resampling results will confirm or disprove the initial exceedance. If an initial exceedance is verified, an SSI is declared, and assessment monitoring is triggered unless an “alternative source demonstration” is submitted and approved. If a verification resample does not confirm an exceedance, routine detection monitoring may continue.

4.1.2 Alternative Source Demonstration

If a statistically significant increase over a background limit of any tested constituent at any monitoring well has occurred and the Owner/Operator has reasonable cause to think that a source other than a CCR unit caused the contamination or that the statistically significant increase resulted from error in sampling, analysis, or statistical evaluation, or from natural variation in groundwater quality, then the Owner/Operator may submit a report providing documentation to this effect. The report is commonly referred to as an “alternative source demonstration" (ASD), but may be a demonstration of an error or of natural variation, instead of a source other than the CCR unit.

An Owner/Operator pursuing an ASD must first notify the executive director of the TCEQ (and any local pollution agency with jurisdiction that has requested to be notified) in writing, within 14 days of determining an SSI over a background limit, that Owner/Operator intends to make the demonstration. The ASD must be submitted within 90 days of determining an SSI.

The Owner/Operator must initiate assessment monitoring within 90 days of detecting an SSI, if no ASD is sought, or within 90 days of the executive director denying the ASD. An ASD must be approved by the executive director for the Owner/Operator to return to detection monitoring.

Part 5 – Assessment Monitoring

Assessment monitoring is required if a facility determines there has been an SSI over a background limit for one or more of the constituents listed in Appendix III adopted by reference in 30 TAC §352.1421.

The CCR rules under 30 TAC §352.951 requires that within 90 days of triggering an assessment monitoring program, and annually thereafter, the Owner/Operator sample and analyze the groundwater for all Appendix IV constituents adopted by reference in 30 TAC §352.1431. The Owner/Operator must resample all wells and conduct analyses for all Appendix III parameters adopted by reference in 30 TAC §352.1421, and the Appendix IV constituents adopted by reference in 30 TAC §352.1431 detected during the initial assessment monitoring sampling, within 90 days of obtaining the initial results, and on at least a semiannual basis thereafter. The Owner/Operator must establish groundwater protection standards for all detected Appendix IV constituents adopted by reference in 30 TAC §352.1431 within 90 days of obtaining the initial results.

The GWPS for a constituent shall be the higher of either the maximum contaminant level established under 40 CFR §141.62 (Maximum contaminant levels for inorganic contaminants) and 40 CFR §141.66 (Maximum contaminant levels for radionuclides) or the background concentration.

If the concentration of any Appendix IV constituent is above its respective background limit, but below its GWPS, the facility must continue assessment monitoring. If the concentrations of all Appendix IV constituents are shown to be at or below background values for two consecutive sampling events, the Owner/Operator may return the well to detection monitoring status, after notifying the executive director and receiving approval.

If any Appendix IV constituents were detected at statistically significant levels above the GWPS, the facility must notify the executive director and appropriate local government officials within 14 days of the determination. The Owner/Operator may conduct an ASD as described in Section 4.1.2, but the Owner/Operator must initiate assessment of corrective measures within 90 days of finding any constituent listed in Appendix IV at a statistically significant level.

The Owner/Operator will also need to characterize the nature and extent of the release and any relevant site conditions that may affect the remedy ultimately selected. The characterization must be sufficient to support a complete and accurate assessment of the corrective measures necessary to effectively clean up all releases from the CCR unit pursuant to 40 CFR §257.96. Characterization of the release includes the following minimum measures:

- Install additional monitoring wells necessary to define the contaminant plume(s);
- Collect data on the nature and estimated quantity of material released including specific information on the constituents listed in Appendix IV of this part and the levels at which they are present in the material released;
- Install at least one additional monitoring well at the facility boundary in the direction of contaminant migration and sample this well; and
- Sample all wells to characterize the nature and extent of the release.

Notify all persons who own the land or reside on the land that directly overlies any part of the plume of contamination if contaminants have migrated off-site if indicated by sampling of wells of this section. The Owner/Operator has completed the notifications when they are placed in the facility's operating record as required by 40 CFR §257.105(h)(8).

Within 90 days of finding that any of the constituents listed in Appendix IV have been detected at a statistically significant level exceeding the GWPS, the Owner/Operator must initiate assessment of corrective measures as required by 40 CFR §257.96.

Part 6 - Corrective Measures

6.1 Assessment of Corrective Measures

Within 90 days of finding that any of the constituent listed in Appendix IV adopted by reference in 30 TAC §352.1431 has been detected at a statistically significant level above a GWPS, or immediately upon detection of a release from a CCR unit, the Owner/Operator must initiate an assessment of corrective measures to prevent further releases, remediate any releases, and restore affected areas to original conditions.

The Owner/Operator of the CCR unit must continue to monitor groundwater in accordance with the assessment monitoring program while the assessment of corrective measures is conducted.

The assessment of corrective measures must analyze the performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination; the time required to begin and complete the remedy; the institutional requirements, including state or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s), the effectiveness of potential corrective measures, including performance, reliability, ease of implementation, and potential impacts.

Within 30 days of completing the assessment of corrective measures required by this section, and before remedy implementation, the Owner/Operator shall submit an application for amendment to the registration in accordance with 30 TAC §352.131 (relating to Amendments). The application must include, at a minimum:

- The concentration of all Appendix III constituents listed in 30 TAC §352.1421 with a statistically significant increase over the background value at each monitoring well;
- The concentration of any constituent listed in Appendix IV in 30 TAC §352.1431 detected in the groundwater at each monitoring well;
- The established GWPS for each detected Appendix IV constituent listed in 30 TAC §352.1431;
- A schedule for submitting Corrective Action Effectiveness Reports; and
- A signed affidavit certifying that all persons who own land or reside on land that directly overlays the plume of contamination have been notified as required by 30 TAC §352.951.

If a public meeting was not held prior to the application submission referenced above, the executive director will hold a public meeting to satisfy the requirement of 40 CFR §257.96(e). As a result, the executive director's initial decision on the final remedy will be available for public comment during the public meeting in addition to the application, including the corrective measures assessment. The Owner/Operator that held a public meeting satisfying the requirement of 40 CFR §257.96(e) prior to application submission are not required by 30 TAC §352.961(c) to hold another public meeting; however, other public meeting criteria in 30 TAC §352.451 may require a public meeting during application review.

The Owner/Operator of the CCR unit must comply with the recordkeeping requirements of 30 TAC Chapter 352, Subchapter K.

6.2 Selection of Remedy

Based on the results of the corrective measures assessment, the Owner/Operator must, as soon as feasible, select a remedy, that, at a minimum, is protective of human health and the environment, attain the GWPS, control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in Appendix IV into the environment, remove from the environment as much of the contaminated material that was released from the CCR unit as is feasible, taking into account factors including avoiding inappropriate disturbance of sensitive ecosystems, and comply with standards for management of waste as specified in 30 TAC §352.981/40 CFR §257.98(d). The final remedy selection shall be achieved through issuance of the registration amendment as specified 30 TAC §352.981(b).

6.2.1 Remedy

In selecting a remedy, the Owner/Operator must consider the following evaluation factors: the long- and short-term effectiveness and protectiveness of the potential remedy(ies), along with the degree of certainty that the remedy will prove successful based on consideration of the following:

- Magnitude of reduction of existing risks;
- Magnitude of residual risks in terms of likelihood of further releases due to CCR remaining following implementation of a remedy;
- The type and degree of long-term management required, including monitoring, operation, and maintenance;
- Short-term risks that might be posed to the community or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal of contaminant;
- Time until full protection is achieved;
- Potential for exposure of humans and environmental receptors to remaining waste, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment;
- Long-term reliability of the engineering and institutional controls; and
- Potential need for replacement of the remedy.

6.2.2 Effectiveness

The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:

- The extent to which containment practices will reduce further releases;
- The extent to which treatment technologies may be used;
- The ease or difficulty of implementing a potential remedy(ies) based on consideration of the following types of factors:
    - Degree of difficulty associated with constructing the technology;
    - Expected operational reliability of the technologies;
    - Need to coordinate with and obtain necessary approvals and permits from other agencies;
    - Availability of necessary equipment and specialists; and

- Available capacity and location of needed treatment, storage, and disposal services.

6.2.3 Schedule

The Owner/Operator must specify as part of the selected remedy a schedule(s) for implementing and completing remedial activities. Such a schedule must require the completion of remedial activities within a reasonable period of time. The Owner/Operator of the CCR unit must consider the following factors in determining the schedule of remedial activities:

- Extent and nature of contamination, as determined by the characterization required under 40 CFR §257.95(g);
- Reasonable probabilities of remedial technologies in achieving compliance with the groundwater protection standards established under 40 CFR §257.95(h) and other objectives of the remedy;
- Availability of treatment or disposal capacity for CCR managed during implementation of the remedy; and
- Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy.

6.2.4 Aquifer Characterization

Resource value of the aquifer including:

- Current and future uses;
- Proximity and withdrawal rate of users;
- Groundwater quantity and quality;
- The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to CCR constituents;
- The hydrogeologic characteristic of the facility and surrounding land; and
- The availability of alternative water supplies; and
- Other relevant factors.

6.2.5 Completion

The selection of remedy will be considered complete when the registration amendment required under 30 TAC §352.961, including the approved corrective action program, is issued. The Owner/Operator of the CCR unit must comply with the recordkeeping, notification, and internet requirements of 30 TAC Chapter 352.

6.3 Implementation of the Corrective Action Program

Within 90 days of selecting a remedy the Owner/Operator must initiate remedial activities based on the schedule established during the selection of remedy process:

- Establish and implement a corrective action groundwater monitoring program that:
  - Meets the requirements of an assessment monitoring program;
  - Documents the effectiveness of the corrective action remedy; and
  - Demonstrates compliance with the GWPS.

- Implement the corrective action remedy selected under 30 TAC §352.971;
- Take any interim measures necessary to reduce the contaminants leaching from the CCR unit, and/or potential exposures to human or ecological receptors. Interim measures must, to the greatest extent feasible, be consistent with the objectives of and contribute to the performance of any remedy that may be required pursuant to 30 TAC §352.971. The following factors must be considered by an Owner/Operator in determining whether interim measures are necessary:
    - Time required to develop and implement a final remedy;
    - Actual or potential exposure of nearby populations or environmental receptors to any of the constituents listed in Appendix IV;
    - Actual or potential contamination of drinking water supplies or sensitive ecosystems;
    - Further degradation of the groundwater that may occur if remedial action is not initiated expeditiously;
    - Weather conditions that may cause any of the constituents listed in Appendix IV to migrate or be released;
    - Potential for exposure to any of the constituents listed in Appendix IV as a result of an accident or failure of a container or handling system; and
    - Other situations that may pose threats to human health and the environment.
- If at any time it is determined that compliance with the requirements of 30 TAC §352.971 is not being achieved through the remedy selected, the Owner/Operator must implement other methods or techniques that could feasibly achieve compliance with the requirements;
- Remedies selected pursuant to 30 TAC §352.971 shall be considered complete when:
    - The Owner/Operator of the CCR unit demonstrates compliance with the GWPS established under 30 TAC §352.951 has been achieved at all points within the plume of contamination that lie beyond the groundwater monitoring well system established under 30 TAC §352.961;
    - Compliance with the GWPS established under 30 TAC §352.951 has been achieved by demonstrating that concentrations of constituents listed in Appendix IV have not exceeded the GWPS for a period of three consecutive years using the statistical procedures and performance standards in 30 TAC §352.981; and
    - All remedial activities have been completed.
- Demonstration of these requirements must be signed and sealed by a qualified Texas P.G. or by a qualified Texas P.E; and
- Must meet the recordkeeping, notification, and internet requirements specified in 30 TAC Chapter 352.

6.4 Corrective Action Effectiveness Report (CAER)

Provide a CAER, in accordance with 30 TAC §352.991, with the following information:

- A summary of the corrective actions taken since the last reporting period;
- A comparison of:
    - The groundwater protection standards;
    - The initial concentration of Appendix IV constituents from 30 TAC §352.1431 and

    - The current (i.e., at the time of CAER submittal) concentrations of Appendix IV constituents from 30 TAC §352.1431;
- An estimate of the percentage of the corrective actions which have been completed;
- An estimate, in years, of the additional time necessary to complete the corrective actions; and
- A determination whether sufficient progress is being made to achieve the selected remedy within a reasonable timeframe, given the circumstances of an impacted property.

Applicable Regulations

30 TAC Chapter 352

40 CFR §257.90 Applicability.
§257.91 Groundwater monitoring systems.
§257.93 Groundwater sampling and analysis requirements.
§257.94 Detection monitoring program.
§257.95 Assessment monitoring program.
§257.96 Assessment of corrective measures.
§257.97 Selection of remedy.
§257.98 Implementation of the corrective action program.

Sources

RG-074 Guidelines for Preparing a Groundwater Sampling and Analysis Plan

Appendix III to Part 257—Constituents for Detection Monitoring

Appendix IV to Part 257—Constituents for Assessment Monitoring

<www.ecfr.gov/cgi-bin/text-idx?SID=05193918af99df2d383e227c394880e8&mc=true&node=pt40.27.257&rgn=div5#ap40.27.257_1107.iii>