DIVISION OF ENVIRONMENT
QUALITY MANAGEMENT PLAN

PART III:

UNDERGROUND INJECTION CONTROL (UIC) PROGRAM
QUALITY ASSURANCE MANAGEMENT PLAN

Revision 9
12/12/11

Kansas Department of Health and Environment
Division of Environment
Bureau of Water
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

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SIGNATURES/APPROVALS

UIC Program Manager

(Signature, UIC Program Manager)

3-20-2012
(Date)

Geology Programs Section:

(Signature, Section Chief)

3-20-12
(Date)

BOW QA Manager

(Signature, BOW QA Manager)

3/26/12
(Date)

Bureau of Water:

(Signature, Interim Bureau Director)

3/20/12
(Date)

DOE QA Representative:

(Signature, DOE QA Representative)

3-27-12
(Date)

Division of Environment:

(Signature, Division Director)

3-26-2012
(Date)

1 INTRODUCTION

1.1 Historical Background and Overview of the UIC Program

Industrial wastes have been disposed into deep geological formation in Kansas since the 1950s and salt solution mining operations have been conducted in Kansas since the late 1800s. After several incidents nation wide where contamination was attributed to the use of injection wells, it was realized injection activities could contaminate groundwater if not conducted under strict controls. This prompted Congress to develop the Underground Injection Control (UIC) Program as a part of the Safe Drinking Water Act of 1974.

KDHE's Geology Section of the Bureau of Water (BOW) administers the state/federal UIC Program on behalf of the U.S. Environmental Protection Agency in Kansas. Underground injection is the technology of placing fluids underground, in porous formations of rocks, through wells or other similar conveyance systems. Kansas was delegated the authority to administer the Federal UIC Program on behalf of EPA in Kansas for Class I, III, IV and V wells. This delegation of authority became effective December 2, 1983. Prior to that time there was minimal regulation of industrial waste disposal wells but KDHE regulations for salt solution mining wells has been in place since 1979. The UIC Program for all classes of wells on Indian Lands in Kansas is administered by EPA. The UIC Program defines an injection well as any bored, drilled, or driven shaft or dug hole, where the depth is greater than the largest surface dimension or an improved sinkhole or a subsurface fluid distribution system, that is used to discharge fluids underground. This definition covers a wide variety of injection practices that range from technically sophisticated and highly monitored wells which direct fluids by gravity into isolated formations almost one mile beneath the earth's surface, to the far more numerous on-site drainage systems, such as septic systems, cesspools, and stormwater wells, that discharge fluids a few feet below the ground surface. While treatment technologies for these wastes exist, it would be very costly to treat and release to surface waters the vast quantities of these industrial wastes produced each year. When injection wells are properly sited, constructed, tested, monitored and operated, underground injection is an effective and environmentally safe method to dispose of waste. The Safe Drinking Water Act (SDWA) established the Underground Injection Control (UIC) Program to provide the safeguards so that injection wells do not endanger current and future underground sources of drinking water (USDW). The most accessible fresh water is stored in shallow geologic formation, called aquifers and is the most vulnerable to contamination. These aquifers feed our lakes, provide recharge for our streams and rivers, and serve as resources for a large portion of the state's population by providing water for public water supply systems. The EPA groups underground injection into five classes for regulatory control purposes. Each class includes wells with similar functions, construction and operating features so that technical requirements can be applied consistently to the class. Class I includes the emplacement of hazardous and non-hazardous fluids (industrial and municipal wastes) into isolated formations beneath the lowermost drinking water aquifer (USDW). Class I wells are the most strictly regulated and are further regulated under the Resource, Conservation, and Recovery Act if they inject hazardous waste.

Class II injection wells include injection of brines and other fluids associated with oil and gas production. Class II wells are regulated by the Kansas Corporation Commission. Class III encompasses injection and recovery of fluids associated with solution mining of minerals. Salt is the only mineral solutioned mined in Kansas using Class III wells. Class IV address injection of hazardous or radioactive waste into or above a USDW and is prohibited unless authorized under other statutes for groundwater remediation. Class V includes all underground injection activities not included in classes I through IV. Generally Class V wells inject non-hazardous fluids into or above a USDW and are typically shallow, on-site disposal systems, such as floor and sink drains which discharge directly or indirectly to the groundwater through dry wells, leach fields, and similar types of drainage wells. Injection practices or wells which are not covered by the UIC program include other residential waste disposal systems that inject only sanitary waste and commercial waste disposal systems that serve fewer than 20 persons that inject only sanitary waste. Injection wells have the potential to inject contaminants that may cause our underground sources of drinking water to become contaminated. The UIC Program prevents this contamination by setting minimum requirements. The goals of the state/federal UIC Program are to prevent contamination by keeping injected fluids within the well and the intended injection zone, or in the case of injection of fluids directly or indirectly into a USDW, to require that injected fluids not cause a public water system to violate drinking water standards or otherwise adversely affect public health. These minimum requirements affect the siting of an injection well, and the construction, operation, maintenance, monitoring, testing, and finally the closure of the well. All injection wells require authorization under general rules or specific permits. Federal UIC Program regulations can be found in 40 CFR Part 144, 40 CFR Part 145, 40 CFR Part 146, 40 CFR Part 147, and 40 CFR Part 148. State program requirements are promulgated as regulations and may be found in K.A.R. 28-43-1 et seq., and K.A.R. 28-46-1 et seq. Article 43 of the regulations addresses construction, operation, monitoring, and abandonment of salt solution mining wells. Article 46 addresses underground injection control regulations.

1.2 Quality Assurance/Control Objectives

Quality assurance (QA) and quality control (QC) activities conducted within KDHE's underground injection control program are intended to ensure that all monitoring and analytical data are scientifically valid, defensible and of known and acceptable precision and accuracy. The remainder of this document describes the procedural QA/QC criteria developed to meet these objectives. Standard Operating Procedures (SOPs) and equipment are described in the appendices of this program management plan.

2 QUALITY ASSURANCE/CONTROL ORGANIZATION

2.1 Administrative Organization

The organizational framework for the Underground Injection Control Program in the Bureau of Water is depicted in figure 2.1-1 below.

Figure 2.1-1

http://kdhenet/human_resources/org_chart/ENVIR/BOW/BOW_Geology.pdf

2.2 Staff Responsibilities

The following paragraphs summarize the primary functions and responsibilities of the Geology Section and the Underground Injection Control Unit.

Geology Section - This section consists of three units: the Underground Injection Control Unit, Underground Storage Unit, and Water Well Unit.

The Underground Injection Control Unit is responsible for generally permitting and monitoring underground injection wells, excluding Class II wells. In regard to UIC Program

activities, the Underground Injection Control Unit administers the Class I, Class III, Class IV, and Class V program activities. Permitting activities typically involve detailed hydrogeologic reviews, reviews of alternative treatment and disposal methods, plans for the handling and disposal of drilling fluids and waste, evaluations regarding the compatibility of injection well components in regard to the types of wastes or extracted minerals they will come into contact with, detailed evaluations regarding compatibility of the waste with the injection zone fluids and materials, construction procedures proposed to protect groundwater aquifers, the planning and review of geophysical logs, financial assurance mechanisms for closure of the well, instrumentation and methods for monitoring mechanical integrity and operation of the wells, hydrogeologic sampling of formations and formation fluids encountered, and proposed plugging methodologies. The Underground Injection Control Unit also provides compliance monitoring oversight by both reviewing monitoring reports submitted by UIC facilities and conducting inspections of these facilities. Compliance and enforcement actions are also initiated as required. Technical assistance is provided to permittees and consulting firms providing construction or geophysical testing services to the UIC operators. The Underground Injection Control Unit also develops permits which address operational conditions and limitations under which operators of UIC injection wells are to conduct injection practices. The Underground Injection Control Unit staff is located in the central office and provides almost 100 percent of all field activities conducted in regard to UIC Program activities. Because of the nature of the wastes involved, the depths to which the wells are constructed, and the need for specialized equipment for conducting mechanical integrity tests, geophysical logging, the collection of geological core samples, and the sampling of formation fluids, KDHE staff is involved in little, if any, analytical sampling. The majority of activities conducted by the UIC program staff involve witnessing construction and plugging practices, geophysical logging, testing and reviewing data generated by the UIC facilities regarding day-to-day operation of the injection wells and any groundwater monitoring well systems employed at a facility. Provided in the appendices to this QAMP, are numerous standard operating procedures that are offered as guides to UIC operators or consultants in developing various construction, plugging or sampling plans as a part of UIC program activities. Since KDHE does not actively conduct these tests, these standard operating procedures are provided in the appendices as reference material as they are provided to permittees and consulting firms for consideration in developing their various plans which are required to be submitted, reviewed by KDHE, and approved prior to their being implemented.

3 QUALITY CONTROL CRITERIA AND PROCEDURES

3.1 Monitoring Site Selection Criteria

The selection of field monitoring sites is based on several factors including type and purpose of sample, representativeness, ability to document or relocate the sampling site, prevention of sample contamination, accessibility, and safety. Selection criteria vary depending upon the type of medium being sampled, as described in the following paragraphs.

3.1.1 Monitoring Site Selection Criteria - Underground Injection Control

Samples for compliance monitoring (grab or composite) must be collected at the point described in the UIC permit. Sample collection, preservation and handling procedures are spelled out in detail in Appendix B, I., F. in Part III of the QA/QC document.

Safety concerns related to sampling include strong acids and bases, toxic materials, toxic atmospheres, slippery floors, mechanical and electrical hazards, vehicle traffic, heavy equipment operation, and confined spaces, to name a few.

Construction, plugging, and mechanical integrity testing requirements, criteria, pass/fail criteria, witnessing procedures and reporting forms are provided in KDHE's "State Of Kansas Underground Injection Control Program Description - June 1995".

Safety hazards related to UIC witnessing procedures include strong acids and bases, toxic materials, toxic atmospheres, slippery floors, mechanical, electrical and fire hazards, vehicle traffic, heavy equipment operation, and confined spaces, to name a few.

3.2 Sampling Procedures and Sample Custody

3.2.1 UIC Samples

As indicated previously, little if any direct sampling and analysis is conducted by KDHE staff in administering the UIC Program. One exception could possibly be sample collection of groundwater from observation wells located at Class III operations. Typically because the sampling of the Class III operations requires analysis for chlorides, KDHE would primarily have the facility collect samples which KDHE may split with facility for conducting chloride analysis. Sample procedures could also conceivably involve investigations in an attempt to determine if waste not authorized by the UIC permit or hazardous wastes are being injected in violation of UIC and RCRA regulations. Any investigative work conducted in this regard would utilize sampling protocols developed by the Bureau of Waste Management in regard to RCRA sampling or wastewater sampling procedures outlined in SOP #WPCP-002.

3.2.2 Sampling Procedures and Sample Custody

Regulated entities required to sample wastes being injected as a condition of their UIC permit shall abide by the procedures set forth in their permit. Samples to be analyzed in an onsite laboratory shall be collected in an appropriate sample container, and transported immediately to the laboratory where chain of custody will be transferred to the laboratory analyst or other designated employee. Collection, preservation, storage, and analysis shall be in accordance with 40 CFR 136 and/or Appendix B, (SOP # WPCP-002). The sample collector shall log the date, time, name, and the exact location of the sample collection as per K.A.R. 28-16-63.

The sample shall be analyzed using laboratory techniques approved by EPA and the State of Kansas. The analyst shall record the dates the analyses were performed, who performed the analyses, analytical techniques/methods used, and the results of such analyses. The permittee shall maintain the records for a period of three years.

Samples to be transported to an offsite laboratory shall be preserved and iced as per 40 CFR 136.3, Table II. Custody may be retained by the sample collector and transferred to the laboratory, transferred to a transporter, or the sample may be mailed directly to the laboratory, providing holding times will not be exceeded. Ultimately, the sample chain of custody will be transferred to the laboratory in accordance with the laboratory QA/QC protocols.

3.3 Analytical Procedures

Analytical procedures to be discussed in this section are generally field laboratory tests, either performed in the field with portable test kits and reagents or in a wastewater laboratory. The analytical procedures can be grouped as titrations, gravimetric, potentiometric or colorimetric analyses. GS-UIC Program staff typically do not conduct any field laboratory tests. Samples for compliance monitoring and evidentiary samples (except for those field tests which must be done on-site) shall be collected and transported to the KDHE laboratory or an approved commercial laboratory.

Staff are expected to utilize their best professional judgement when confronted with an “out-of-control situation”. They are to report the situation to their supervisor and explain what actions they took to address the situation.

3.4 Internal Procedures for Assessing Data Precision, Accuracy, Representativeness and Comparability

3.4.1 In-house Audits

During system audits, staff responsible for field operations are required to demonstrate consistent technique regarding sample collection, sample preparation, and chain-of-custody. The section chief is responsible for maintaining a log of audit results and for summarizing these results in annual QA reports to the Division QA director (see section 3.8, below).

3.4.2 Procedural Blanks, Duplicate Measurements and Spiked Samples

The possibility of sample contamination during sample preparation, storage and analysis is assessed through the use of procedural blanks, prepared with ASTM Type I-quality water and subjected to the same treatment as the rest of the samples collected as a result of the investigation or project. Under this protocol blanks are utilized in the following manner:

(a) Should the blank concentration exceed the sample concentration, a corrected concentration normally is not included in the data file; however, should the sample concentration be less than the minimum detection limit (MDL) of the analytical method, the concentration is recorded as such regardless of the blank concentration.

(b) Should the blank concentration be less than the MDL, the sample concentration is recorded without modification.

In the event a blank level exceeds the MDL, the level is not deducted from the reported sample concentration; rather, a sequence of corrective action procedures is initiated in accordance with section 3.6.

The possibility of sample contamination from sample containers is assessed through the analysis of container blanks. Five percent of the sample collection containers are selected at random, partially filled with ASTM Type I-quality water, sealed, and stored for a 48-hour interval. The resulting container blank is analyzed to determine levels of impurities leached from the container walls. If detectable concentrations of impurities are observed, a sequence of corrective action procedures is initiated.

In the case of a special monitoring program, one of the sampling sites in the network shall be equipped with two composite samplers, located side-by-side to facilitate the collection of duplicate samples. The alternative is to collect two grab samples at a selected station each time. Data generated by the duplicate sampling effort are used to assess the chemical variability of the sampling and analysis activities. In the case of a special investigation or fishkill, a duplicate sample shall be collected at one of the sampling points. These data provide a basis for quantifying the statistical uncertainty inherent in sample collection.

For UIC samples, it is important that the magnitude and variability of contamination be reduced as much as possible. For metals analyses, for instance, a blank level greater than one-half the respective sample concentration initiates corrective action. This action may include decontamination of containers used for collection and storage of the samples and related equipment. Should contamination problems persist the section chief performs an unscheduled system audit of field performance audit. If necessary the section chief works with the Kansas Health and Environmental Laboratory (KHEL) to identify any contributing sources of contamination. The scope and magnitude of any sample contamination problem, as well as all corrective action implemented to resolve the problem, are documented in the annual QA reports to the Division QA director (see section 3.8, below).

At the discretion of the Section Chief, the Bureau Director, or the Bureau QA Director, blind reference samples, spiked with known concentrations of one or more parameters, may be submitted to KHEL and used as a general indicator of the overall accuracy of the data reported by the laboratory.

3.4.3 Safety Procedures

Safety procedures for handling field sampling and laboratory equipment must be followed carefully. Safety hazards include handling strong acids, strong bases, and toxic reagents. Materials to be sampled also present safety concerns, particularly sewage with its potential for infection.

3.5 External Procedures for assessing Data Precision, Accuracy, Representativeness and Comparability

3.5.1 Onsite Audits

Bureau of Water monitoring programs may, at the discretion of the Director of the Bureau of Water, be required to participate in periodic QA/QC audits conducted by an independent third party. Audit findings, and corrective actions implemented in response to such findings, shall be reported to the Bureau Director and Bureau QA Director and addressed in detail within the annual program evaluation.

3.5.2 Interlaboratory Sample Comparison Programs

Whenever possible, samples shall be split between the permittee or other entity and KDHE and the samples sent to the respective laboratories. Comparison between laboratory results shall be reviewed by the program manager or unit chief and passed on to the section chief for inclusion in the annual QA report. Consistent finding of disparities greater than 10% shall be cause for implementation of corrective action procedures.

3.6 Corrective Action Procedures

3.6.1 Sample Contamination

The discovery of sample contamination as outlined in section 3.4.2 will lead to corrective action procedures should the contamination exceed the MDL. Possible sources of contamination could include impure sample preservative, the wrong preservative, improper handling, or improper storage, the Section Chief or Program Manager will investigate and take the necessary steps for correction. The steps taken will be recorded for inclusion in the annual QA report.

3.6.2 Staff Performance Problems

Should a member of the project or field staff have difficulty with a given work procedure (e.g. as determined during an internal performance audit) an effort is made by the Section Chief to identify the scope and seriousness of the problem, identify any data affected by the problem, and recommend an appropriate course of corrective action. All effected data are either deleted from the file or flagged within the file, at the discretion of the Section Chief. Possible corrective actions include further in-house or external training for the employee, a reassignment of work duties, or modification of the work procedure.

3.7 Data Management

Completed sample analysis reports from KHEL are delivered by inside mail to the Chief of the Technical Services Section, then routed to the appropriate project staff or program manager for data reduction and validation. The data are checked for conspicuous oversights or dubious results. Should problems be noted in the data reports, corrective action procedures are initiated in accordance with section 3.6.

Each analysis report is electronically filed at the laboratory; hard copies are filed in the appropriate BOW file after they are reviewed by staff. Copies of UIC monitoring reports are kept on file for a minimum of three years.

3.8 Quality Assurance Reporting Procedures

The Section Chief is responsible for informing the Bureau Director or Bureau QA Director of project QA/QC status and of any QA/QC needs within the wastewater pollution control program. They are also responsible for maintaining adequate communication with KHEL with regard to program QA/QC concerns.

In addition to these routine communication requirements, the Section Chief prepares an annual program QA/QC status report which is routed through the Bureau Director to the Division QA Director. This report contains the following types of information:

(a) status of QA project plan;

(b) description of data accuracy, precision, completeness, representativeness and comparability;

(c) discussion of significant QA/QC problems, corrective actions, progress, needs, plans and recommendations;

(d) results of internal and any external system or performance audits;

(e) summary of QA/QC-related training performed since the last QA/QC status report; and

(f) any other pertinent information specifically requested by the bureau director or the Division QA Director.

APPENDIX A

INVENTORY OF PROGRAM FIELD AND LABORATORY EQUIPMENT

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INVENTORY OF PROGRAM FIELD AND LABORATORY EQUIPMENT

I. UIC SAMPLES

A. Safety and Sampling Equipment

1. KDHE laboratory sample collection bottles for metals, nutrients, volatile organics (43 ml and 200 ml), bacteriological, organics and pesticides, inorganics cubetainers, dissolved oxygen bottles (Winkler method)
2. Cooler
3. Hard Hat
4. Safety Goggles
5. Leather Boots
6. Protective Coveralls

B. Testing Equipment

GS UIC Program staff do not utilize field testing equipment.

APPENDIX B

STANDARD OPERATING PROCEDURE

SAMPLE COLLECTION, PRESERVATION AND HANDLING

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I. SAMPLING

A. Samples for the Underground Injection Control Program shall be collected in the following manner:

1. Contact the representative of the company owning the injection well for a staff member to accompany KDHE sample collector. Offer to "split" the sample, one portion going to the company's laboratory for analysis and the other going to the KDHE laboratory.

2. The type of samples needed should be determined beforehand so that the correct containers, preservatives, coolers or ice chests, safety equipment, and sampling equipment are on hand.

3. Locate a sampling tap which will yield a sample representative of the flow normally received by the UIC well. Ideally the well should be receiving wastewater at the time of sample collection so that unrepresentative material in the pipe is not sampled. Turn the tap on so that a gentle stream is being discharged.

4. Fill the sample containers one by one by allowing water to run by gravity into the container(s).

5. Samples for inorganic analysis should be collected in collapsible, one liter polyethylene containers (cubetainers). Samples for pesticides, base neutrals or acid extractables should be collected in one gallon brown glass containers provided by KHEL. Samples for VOC analysis should be collected in 41 ml glass vials provided by the laboratory. Fill the vial overfull so that surface tension causes the water to "heap up". Put the plastic septum on, shiny side down, so that no air bubbles are trapped and screw the cap on. Invert the container and flick it with a fingernail to make sure that no bubbles are trapped in the container. If so, repeat the sampling procedure.

6. Put all the filled sample containers in an ice chest for transfer to the laboratory.

7. Implement the chain-of-custody documentation.

APPENDIX C

STANDARD OPERATING PROCEDURE

MANAGEMENT AND REPORTING OF DATA

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I. DATA CUSTODY

The purpose of this standard operating procedure (SOP) is to establish uniform policies and procedures for maintaining an accurate written record of a sample from the time it is collected through its introduction as evidence into litigation proceedings and to insure that a sample has not been tampered with or altered throughout the process.

A. The sample by definition is in custody if:

1. It is in actual physical possession of the sample collector.

2. It is in view of the sample collector after being in the collector's physical possession

3. It is locked up after being in the sample collector's physical possession.

4. It is placed in a designated secure area.

B. FIELD PROCEDURES

1. Chain -of- Custody procedures will be followed for all tests deemed to be of importance for compliance with statutes and regulations and for those which could become evidence in litigation. Samples for plant process control, field screening analyses, or other samples collected for a technical or information purposes will not need to follow chain of custody procedures. In general, those samples submitted to the KDHE laboratory will be subject to chain of custody procedures.

2. In order to insure adequate control and documentation of collected samples, the number of personnel handling the samples should be minimized.

3. A unique number shall be assigned to each sample for identification purposes. If a sample consists of several bottles for analysis of different parameters from the same sample, the same sample number is used for each portion of the original sample.

4. If the samples are to be shipped to other laboratories for analysis a sample label is attached to each sample container at the time of collection.

5. Record all field measurements and other pertinent data on the field sheet.

6. Custody of the sample is initiated at the time of sample collection by insuring that the sample is in the sample collector's physical possession or view at all times, or is stored in a locked place where there could be no reasonable possibility of tampering. The sample collector is responsible for the collected samples until they are received by the laboratory or have been appropriately shipped to the lab. The chain of custody record is initiated at the time of sample collection and a copy accompanies the samples. The chain of custody record is at the bottom of the KDHE laboratory sheet. Signatures and dates on the sample custody sheet shall be signed in indelible ink. The sample shall make sure the name, date, time, exact location, sample identifiers and parameters for analysis are listed before signing off. The person assuming custody shall sign and date the custody section of the sheet in the sample collector's presence. An exception is samples delivered after hours; these must be placed in the designated sample storage area of the KDHE laboratory by the individual having custody.

II. DATA MANAGEMENT

Data received from the laboratory shall be forwarded to the Chief of the Technical Services Section, Bureau of Water, or a designated project manager. The data will be examined and any unusually high values or values considered to be unreasonable will be noted and brought to the attention of the laboratory and the appropriate section or unit chief. High values for a given contaminant or parameter may indicate a real problem, but occasionally occur as a result of a decimal error, a missed dilution at a permittee laboratory, sample collection at the wrong location or other error. Such errors should be corroborated and noted and initialed on the data reporting sheet prior to passing the information along or filing.

Significant figures must be checked to ascertain that no unusual degree of accuracy is implied by the result. For instance, BOD values expressed to thousandth of a milligram per liter. Report results shall be checked for comparison with the degree of accuracy expressed as the permit limits.

The laboratory results shall then be forwarded to the appropriate section or project manager. The copy distribution list shall be reviewed to make sure the information is distributed to all who need it. A copy is routed to the appropriate file and/or electronic data base.

The GS-UIC staff does not utilize ancillary data obtained from third parties.

Semi-annual/Annual reports are provided to EPA as a condition of the federal grant received to administer the UIC Program.

APPENDIX D

STANDARD OPERATING PROCEDURE

EVALUATION OF DATA QUALITY

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QUALITY CONTROL AND STATISTICAL EVALUATION OF DATA

Accuracy is a measure of how closely the analytical result or the average of a set of analytical tests approaches the true value of a parameter. Two types of error affect accuracy: systematic error and random error. An example of systematic error would be inaccuracy in a piece of laboratory equipment, for example a laboratory balance that consistently under-weighs. Random error is error from a variety of sources which cannot be totally controlled. Errors in the use of pipettes, graduated cylinders, or other laboratory equipment are examples. Random error is controlled by averaging a series of replicate analyses of a sample.

Precision measures how closely a series of replicate measurements approaches the average. It is a measure of how well results can be reproduced. A laboratory may have a high degree of precision on a given test but be inaccurate. It is necessary to control both precision and accuracy to achieve a consistency of data quality.
A number of methods are available for evaluating both accuracy and precision. However these measures do not account for errors in sampling and handling that occur prior to laboratory analysis.

A. Wastewater Laboratories

Wastewater laboratories and commercial laboratories providing effluent quality data to the Bureau for compliance purposes shall be certified by the Kansas Department of Health and Environment and shall follow the Laboratory Certification Section guidelines for data evaluation and quality.

B. Contract laboratories analyzing samples for a Bureau project must conform to the following general guidelines for data quality and evaluation:

1. At least 10% of a given number of samples should be for quality control purposes. At least one blank, one spike sample and one set of duplicates shall be analyzed with each sample set.

2. For accuracy determinations spiked samples shall be used. The use of spikes is preferable to the use of analysis of known standards as the spikes more nearly approach the true range of values encountered in analyzing the samples. The procedure involves the addition of a known quantity of standard to a known volume of unknown sample. Replicate analyses of both the known and the unknown sample are run and the results are compared to generate a percent recovery. Ideally, the result should be 100% but results between 90% and 110% are acceptable. The procedure for calculating percent recovery is as follows:

a. Determine the unknown sample concentration by averaging the results of replicate analyses.

b. Calculate the theoretical concentration of the spiked sample. (See Wastewater Sampling for Process and Quality Control, Water Environment Federation, 1979, p64.

c. Determine the spiked sample concentration by averaging the results of the duplicate analyses.

d. Divide the spiked sample concentration by the theoretical concentration. Multiply the result by 100. The result is the percent recovery.

3. For measurement of precision it is necessary to measure a series of replicate samples. The degree of precision required shall be determined at the outset of the project and incorporated onto the project QA/QC Plan. The determination of precision shall be through the use of average deviation, variance and standard deviation.

C. UIC Samples

As indicated previously, KDHE staff seldom conduct sampling at UIC facilities. The following data control procedures would apply in these cases if sampling were conducted:

1. Whenever possible these industries will be targeted for split samples. One portion of the sample will go to the industry's lab or the commercial lab used by the industry and one portion will go to the KDHE laboratory for comparison.

2. Sample values in any parameter differing by more than 10% will be cause for an extensive evaluation of the facility or commercial lab quality control procedures.

APPENDIX E

UIC STANDARD OPERATING PROCEDURES

APPENDIX E

The following SOPs can be found at the Geology Section UIC Web site: http://kdheks.gov/uic/

Section