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CP4-ES-2100 FRev. 2	TITLE: Groundwater Level Measurement	Page 1 of 18

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REVISION/CHANGE LOG

Revision/Change Letter	Description of Changes	Pages Affected	Date of Revision/Change
FR0	Initial FRNP release	All	10/20/17
FR1	Revision	All	12/21/17
FR1A	Added the word Sampler as the performer under Prerequisites	4	1/2/19
FR2	General procedure revision including addition of Colloidal Borescope System in section 6.5 and 6.6. Flowed down JHA.	All	2/26/2020

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1.0 PURPOSE AND SCOPE

1.1 Purpose

This procedure provides instructions for the installation and use of the Electronic Water Level Indicator, Pressure Transducer and Data Logger System, and the Colloidal Borescope System used to conduct water level measurements, measure well depth, and determine velocity and direction for groundwater in open boreholes, cased wells, or piezometers.

1.2 Scope

This procedure applies to Paducah Gaseous Diffusion Plant (PGDP) Deactivation & Remediation (D&R) Contractor Personnel and Subcontractors involved in obtaining required groundwater level measurements, well depth, and groundwater velocity and particle flow trajectory data at the PGDP.

2.0 REFERENCES

2.1 Use References

- CP3-WM-1037, *Generation and Temporary Storage of Waste Materials*
- CP4-ES-2700, *Logbooks and Data Forms*
- CP4-ES-2702, *Decontamination of Sampling Equipment and Devices*
- Aquavision Colloidal Borescope Users Guide
- Ryobi Propane Fueled Generator Operators Manual
- Transducer Operating Manual provided by Manufacturer

2.2 Source References

- CP2-HS-2000, *Worker Safety and Health Program for the Paducah Gaseous Diffusion Plant, Paducah Kentucky*
- CP2-SM-1000, *Activity Level Work Planning and Control Program for the Paducah Gaseous Diffusion Plant, Paducah Kentucky*
- Data Logger Operating Manual provided by Manufacturer
- JHA-10903, *Monitoring Well Sampling and Water Level Data Collection*

3.0 COMMITMENTS

None

4.0 PRECAUTIONS AND LIMITATIONS

4.1 Precautions

4.1.1 A minimum of two people shall be present and within visual range of each other at all times during any measurement.

4.1.2 Personnel shall exercise caution when unlocking and opening wells known or suspected to be under pressure, or contain insect nests according to the task specific Work Control Package (WCP).

4.1.3 A portable or stationary eyewash station shall be present and capable of providing 15 minutes of continuous flow if working with hazardous chemicals.

4.1.4 Leather or cut resistant gloves shall be worn when handling materials that may cause cuts or abrasions.

4.1.5 Personnel shall inspect vault doors to determine pinch points that need to be guarded or eliminated and shall ensure well vault doors are secured with a safety latch prior to entering the vault.

4.1.6 Communication equipment shall be available at all times.

4.1.7 Personnel shall contact Waste Management for proper management and/or storage of waste and ensure hazardous and non-hazardous waste is segregated.

4.1.8 Personnel shall be aware of the potential for chemical hazards in the area and shall evacuate the area and notify supervision if he or she suspects chemical exposure, such as: strange smell, vapor cloud, burning or itching sensation, spill of unknown liquid, broken lines or damage to equipment that may contain hazardous chemicals.

4.1.9 Personnel shall be familiar with the hazards associated with exposure to Volatile Organic Compounds (VOCs), specifically, trichloroethylene (TCE) and vinyl chloride (VCL).

4.1.10 Personnel shall wear chemical resistant gloves when handling TCE contaminated equipment, liquid, or soil.

4.1.11 Industrial Hygiene (IH) shall periodically collect VOC samples during ground water level measurement activities.

4.1.12 A sustained instrument response at or above the action limit Breathing Zone (BZ) shall require a work pause with Personnel leaving the area and notification to the IH Program Manager and Industrial Safety (IS)/IH Supervisor.

4.1.13 Respiratory protection shall be required when direct read BZ monitoring detects exposure levels greater than the action limits or data shows exposure levels at or above action limits.

4.2 Limitations

4.2.1 Instruments and equipment shall be decontaminated and ready for use and shall be protected from sources of contamination (for example, wrapped in aluminum foil, sealed in plastic or other storage containers, placed on plastic sheeting in staging area) during transport to the location and during field activities.

4.2.2 Project specific information shall be documented in a logbook at the start of a sampling event and at the time of sample collection but no later than before leaving the sample site. All data that is entered into Project Environmental Measurements System (PEMS) is documented on applicable data forms.

4.2.3 During borescope operations for azimuth and velocity surveys at a discrete depth, the borescope must be placed a minimum 2 to 8 hours prior to beginning the survey to allow the ambient hydraulic conditions and the surrounding porous media to re-establish and allow any turbidity effects from setting the borescope to subside.

4.2.4 Colloidal Borescope System operational checks shall be performed prior to each deployment.

4.2.5 The breakthrough time of Supreno EC Microflex Nitrile gloves is 2 hours for TCE. Personnel shall **NOT** use Supreno EC Microflex Nitrile gloves more than 2 hours after contact with TCE contaminated liquid or soil.

4.2.6 The breakthrough time of Showa 730 gloves is 4 hours for TCE. Personnel shall **NOT** use Showa 730 gloves for more than 4 hours after contact with TCE contaminated liquid or soil.

4.2.7 The following Occupational Exposure Limits (OEL) for TCE shall apply:

- 8 hour Time Weighted Average (TWA) = 10 ppm
- 10 hour TWA= 7 ppm
- Action Limit = 5 ppm
- Short Term Exposure Limit (STEL) = 25 ppm

5.0 PREREQUISITES

5.1 Contact Radiological Control (RADCON) when entering a contamination area to determine if a Radiological Work Permit (RWP) is required **and** determine required surveys and monitoring requirements for the RWP.

5.2 **If** required, **then** read **and** sign off on the RWP.

5.3 **If** using a Propane Fueled Generator, **then** ensure the Ryobi Propane Fueled Generator Operators Manual is read and understood prior to deploying equipment in the field with portable power.

5.4 **If** using the Colloidal Borescope, **then** ensure the Aquavision Colloidal Borescope Users Guide is read and understood prior to operating the Colloidal Borescope System.

5.5 Ensure the following:

- Instruments and equipment are decontaminated and ready for use according to CP4-ES-2702, *Decontamination of Sampling Equipment and Devices*.
- Equipment has current calibration records.

6.0 INSTRUCTIONS

6.1 General Requirements

<u>Sampler</u>

6.1.1 **If** pertinent field observations are made during work activities, **then** record observations and measurements according to CP4-ES-2700, *Logbooks and Data Forms*.

6.1.2 Review task specific WCP for the following:

- Reference to any photos, maps and figures that indicate or show proposed water level measurement well locations
- Methods to be used
- Required notifications and permits needed prior to starting water level measurement event.

6.1.3 Record the location where water level measurements will be taken on the appropriate PEMS generated data form.

NOTES:

The use of caution is required to prevent equipment from contacting potentially contaminated surfaces.

Plastic sheeting may be used to stage equipment and materials around the open borehole, well, or piezometer to protect equipment from cross contamination.

6.1.4 **If** field decontamination is required by the task specific WCP, **then** set up temporary decontamination area.

6.1.5 Document any construction, sampling, development or redevelopment within the 24 hours preceding a water measurement on the well, open borehole, and/or piezometer.

6.1.6 Repeat measurements two times to ensure a quality water level measurement.

6.1.7 **If** floating product is known to be present or encountered, **then** measure using an oil/water contact sensor probe.

NOTE:

Cascading water within a borehole can cause false readings with some types of water level measurement devices.

6.1.8 **If** historic water level measurements exist from the same well or piezometer, **then** review measurements to be able to recognize measurement error.

6.1.9 Record any deviations from method or factors that may affect measurements (for example, active recharge due to a precipitation event, saturated zone being stressed due to nearby pumping, drastic atmospheric pressure changes, etc.).

6.2 Electronic Water Level Indicator

<u>Sampler</u>

6.2.1 Obtain an electronic water level indicator to manually measure water levels.

6.2.2 Prior to mobilizing to the field, ensure the following:

A. Batteries are new or fully charged on electronic water-level indicator.

B. Alarm functions correctly.

C. Cable is free from damage.

6.2.3 Ensure electronic water-level indicator is decontaminated prior to use.

NOTE:

Personnel performing sampling activities are periodically required to check the accuracy of the decontaminated water-level indicator against a surveyor's tape or other measurement device to verify marks on the cable.

6.2.4 Ensure electronic water level indicator has been checked for accuracy.

6.2.5 Record the following information for the borehole, well, or piezometer:

- Location
- Date
- Time
- Other pertinent information

6.2.6 Prior to water level measurement, inspect the surface condition of the wellhead, pad, and guard posts (if present) **and** note any adverse conditions.

NOTE:

The reference point is a permanent mark or a "V" notch filed into the top of the well casing and is located on the north side of the top of casing.

6.2.7 Locate the reference point (measurement point).

6.2.8 **If** a reference point is **NOT** present, **then** perform the following:

A. Establish a reference by filing a "V" notch on the north side of the well casing with a file, being careful cuttings do **NOT** fall into the well, **or** mark with a suitable marking instrument.

B. Notify the Environmental Monitoring Manager and Supervisor (or Designee) **and** note actions taken.

6.2.9 Record all readings from the reference point.

6.2.10 Document the reference point used.

6.2.11 Perform the following:

A. Slowly lower the electronic water level indicator probe (or oil/water interface probe) into the open borehole, well, or piezometer, trying not to scrape the sides of the well casing or borehole wall with the cord or the probe until alarm sounds **and/or** the indicator light illuminates.

B. Slowly raise probe until the alarm no longer sounds **and/or** the indicator light no longer stays illuminated.

C. Slowly lower the probe **and** stop probe once alarm sounds **and/or** the indicator light stays illuminated.

6.2.12 Hold cord to reference point, **and** mark cord with thumb where it contacts the reference point.

6.2.13 Use a measuring device to determine distance from last marked increment on the cable to the thumb marked point on the cable **or** read the depth directly from the imprinted cable.

NOTE:
Measurements should be repeated until readings remain constant.

6.2.14 Repeat Step **6.2.11B** through **6.2.13** a minimum of two times to check for accuracy.

6.2.15 Record measurement to the nearest 0.01 ft.

6.3 Pressure Transducer and Data Logger (Separate or Self-Contained)

Sampler

6.3.1 Use a pressure transducer and data logger (or self-contained data logger and pressure or level sensor) to continuously measure water level.

6.3.2 Review the manufacturer's operating manuals and installation instructions to ensure proper operation of the electronic data logger and pressure transducer or self-contained data logger and pressure or level sensor.

6.3.3 Prior to mobilizing to the field, ensure the following:

A. Batteries are new or fully charged.

B. Cable is free from damage.

6.3.4 Record the serial number for the transducer or self-contained data logger and pressure or level sensor on CP4-ES-2100-F01, *Pressure Transducer Deployment Form.*

NOTE:

Most pressure transducers are pre-calibrated by the manufacturer. Pressure transducers are manufactured to measure pressure over a specific range of submergence. Measurements will **NOT** be accurate outside the manufacturer's specified range.

It is recommended that the manufacturer's specifications be consulted concerning maintenance and chemical compatibility of the pressure transducer to be used to ensure compatibility with expected contaminants. Expected contaminants and concentrations of those contaminants may be found in the task specific WCP.

6.3.5 Ensure cable and transducer or self-contained data logger and pressure or level sensor are decontaminated prior to use.

6.3.6 Record the following on CP4-ES-2100-F01:

- Well, open borehole, or piezometer identification number
- Date
- Time
- Any other pertinent information

CAUTION:

Over pressuring by submersing to a depth outside the rated range, or by hitting the water surface too fast, as the transducer is lowered into the well may damage the transducer. Pressure transducers shall **NOT** be submerged beyond their rated depth or lowered at too rapid of a rate.

6.3.7 Set the transducer's depth, reference elevation, scale factor, and test number in the data logger according to the procedure(s) in the manufacturer's operating manual **and** record on CP4-ES-2100-F01, *Pressure Transducer Deployment Form,* or in logbook.

6.3.8 Prior to placing pressure transducer or self-contained data logger and pressure or level sensor, inspect the surface condition of the wellhead, pad and guard posts (if present) and record conditions in accordance with CP4-ES-2700, *Logbooks and Data Forms*.

6.3.9 Take an initial manual water level measurement from the well to be monitored by using an electronic water level indicator using the steps outlined in Section **6.2,** *Electronic Water Level Indicator.*

6.3.10 Pad sharp edges of the well casing to protect the cables.

6.3.11 Slowly lower the unit **and** secure at the desired depth following manufacturer's instructions.

6.3.12 Begin continuous water level measuring task by referring to task specific WCP for direction on data needs **and** follow manufacture's instruction(s) to set up the data logger for collecting data.

6.3.13 Ensure data is saved, using manufacturer's instruction(s), prior to shutting down and leaving the well location.

6.3.14 Retrieve data following the manufacturer's instruction(s).

6.3.15 Upon completion of the test, restore the area around the test well by removing all materials and equipment used to measure continuous water level measurements.

6.3.16 Close **and** lock the well cap.

6.4 Total Well Depth Measurement Techniques

Sampler

NOTE:

The depth to water must be determined prior to sounding a well.

Sounding the well to determine the total depth may be required by the task specific WCP.

6.4.1 **If** sounding the well is required, **then** determine the total depth by lowering a weighted measuring tape or a water level indicator probe to the bottom of the well.

6.4.2 **If** a measuring tape with a weighted end is used for sounding a well, **then** ensure weight is stainless steel or an inert material.

6.4.3 Record well depth measurement.

6.5 Assembly and Operational Check of the Colloidal Borescope System

Sampler

NOTE:

Failure to follow the direction provided in the Ryobi Propane Fueled Generator Operators Manual may result in electrical static disturbance during data collection.

WARNING:

Failure to follow the direction provided in the Aquavision Colloidal Borescope User's Guide could result in poor and/or inaccurate data collection, damage to the Borescope and associated equipment, or injury.

Performer

6.5.1 Ensure the Camera Control Unit (CCU) on/off switch is turned OFF.

6.5.2 Connect the CCU power adapter to a 120V Alternating Current (AC) supply.

6.5.3 Ensure the following when plugging the connector into the probe:

A. Sealing surfaces are clean.

B. Threads are lightly lubricated with silicon grease or other seal lubricant.

6.5.4 Connect the cable between the borescope probe and the CCU.

6.5.5 Locate the Universal Serial Bus (USB) cable provided with the system **and** connect the USB port from the CCU into a USB port on the laptop.

6.5.6 Locate the factory supplied VCE Express video card (54 mm wide) **and** connect the Video Out from the CCU to the Express Card Slot on the laptop.

6.5.7 Open AquaLITE software on laptop **and** navigate to (File –Compass-View/Configure Compass).

6.5.8 Turn the CCU on/off switch to ON.

6.5.9 **When** the green compass circle shows a red needle, **then** rotate the probe around the vertical axis to verify that the needle moves in a relative fashion.

6.5.10 Confirm cardinal orientation, North = 0°.

6.5.11 **When** confirmed, **then** press (OK) to accept **and** exit the Compass Configuration.

6.5.12 Set up a new project in AquaLITE (File > New).

6.5.13 Enter test well information as described in the Aquavision Colloidal Borescope Users Guide.

6.5.14 **If** the AquaLITE video screen is white and the colloidal borescope back light is on, **then** enable "Preview" status **and** observe the video screen shift color.

6.5.15 Place a small object (pencil tip, piece of paper, finger, etc.) midway between the backlight head and the camera **and** observe the magnified, silhouetted image on the monitor.

6.6 Installation and Deployment of the Colloidal Borescope System

Sampler

NOTE:
All measurements must be taken from a consistent Reference Point that is clearly marked and documented.

6.6.1 Record location (such as borehole, well, or piezometer), date, time, and Reference Point on CP4-ES-2100-F02, *Colloidal Borescope Test Deployment Form* and CP4-ES-2100-F03, *Colloidal Borescope Vertical Profiling Data Form* as appropriate.

- Water Level (WL)
- Top of Screen (TOS)
- Bottom of Screen (BOS)
- Total Depth (TD)
- Borescope Focal Point Depth

6.6.2 Ensure that the Colloidal Borescope System is decontaminated prior to use.

6.6.3 **If** cable has visible damage, **then** do **NOT** use cable.

NOTE:
Care shall be taken to lower Borescope slowly into the well to minimize the disturbance of the formation.

6.6.4 Connect borescope probe to the deployment end of the communication cable reel, **and** begin system deployment.

6.6.5 Slowly lower Borescope into test well **and** secure at the desired depth.

6.6.6 Consult the Aquavision Colloidal Borescope Users Guide to set the Borescopes location, depth, azimuth, and all other configuration settings in the AquaLITE software program **and** commence with test.

6.6.7 Upon completion of test, save **and** export data according to Aquavision Colloidal Borescope Users Guide, Section 2.

6.6.8 Document summary test data.

6.6.9 Restore area around the test well by removing all materials and equipment used to conduct Colloidal Borescope data collection.

6.6.10 Close **and** lock the well cap.

7.0 ACCEPTANCE CRITERIA

None

8.0 POST PERFORMANCE WORK ACTIVITIES

8.1.1 Contact the transportation specialist prior to transporting radiologically contaminated equipment, tools or supplies.

8.1.2 Decontaminate any non-disposable water level measurement equipment, tools, or supplies in accordance with CP4-ES-2702.

8.1.3 Collect **and** label any waste generated by the decontamination process.

8.1.4 Dispose of non-fissile waste or material generated during this work activity according to CP3-WM-1037, *Generation and Temporary Storage of Waste Materials*.

9.0 RECORDS

9.1 Records Generated

The following records may be generated by this procedure:

- Annual Water Level Data Form
- Quarterly Water Level Data Form
- CP4-ES-2100-F01, *Pressure Transducer Deployment Form*
- CP4-ES-2100-F02, *Colloidal Borescope Test Deployment Form*
- CP4-ES-2100-F03, *Colloidal Borescope Vertical Profiling Form*

Forms are to be completed in accordance with CP3-OP-0024, *Forms Control.*

9.2 Records Disposition

The records are to be maintained in accordance with CP3-RD-0010, *Records Management Process.*

Appendix A – Acronyms/Definitions

ACRONYMS

AC – Alternating Current

BOS – Bottom of Screen

BZ – Breathing Zone

CCU – Camera Control Unit

D&R – Deactivation and Remediation

IH – Industrial Hygiene

IS – Industrial Safety

JHA – Job Hazard Analysis

OEL – Occupational Exposure Limits

PEMS – Project Environmental Measurements System

PGDP – Paducah Gaseous Diffusion Plant

RADCON – Radiological Control

RWP – Radiological Work Permit

STEL – Short Term Exposure Limits

TD – Total Depth

TCE – Trichloroethylene

TOS – Top of Screen

TWA – Time Weighted Average

USB – Universal Serial Bus

VOC – Volatile Organic Compound

VCL – Vinyl Chloride

WL – Water Level

WCP – Work Control Package

Appendix A – Acronyms/Definitions (cont)

DEFINITIONS

Azimuth –The Borescope probe's magnetic heading in the well. The software will use this information to provide trajectory data relative to true North, regardless of probe orientation.

Electronic Data Logger – An electronic device that can be programmed to receive electrical impulses, which are stored as data. Pressure transducers are designed to be used with automatic data-logging instruments and send a current to the data logger. The current is proportional to the pressure and can be converted to meaningful units by the data logger.

Pressure Transducer - An electronic probe connected to a wire cable that is lowered into the water column of a well to measure pressure. The pressure measured is the total pressure, which includes both the hydrostatic pressure of the fluid column above the transducer and the atmospheric pressure at the fluid surface. Changes in hydrostatic pressure are proportional to changes in the height of the water column or water level.

CP4-ES-2100-F01 – Pressure Transducer Deployment Form

Project ID:	Location:	Date:
Start Date/Time:	Stop Date/Time:	Datum:

Reference Level Setting:	Reference Level Measurement (ft):
Data Point Interval:	Parameters Recording:
Placement Depth:	Log Name:
Pressure Transducer Serial Number:	Associated Borescope Serial Number:

Technicians:

Comments:

Completed By:

Printed Name	Signature	Date

Verified By:

Printed Name	Signature	Date

CP4-ES-2100-F02 – Colloidal Borescope Test Deployment Form

Project ID:	Location:	Date:

Point Datum: TIC	WL	TOS	BOS	TD

Borescope Length:	Cable Zero Point:
Well Completion Stickup:	Borescope Depth Setting:
Deployment Date/Time:	Retrieval Date/Time:
Technicians:	
Scope Serial Number:	Associated Data Logger Serial Number:
Tracking Configuration Settings	
Capture Delay:	Particle Sensitivity:
Minimum Particle Size (NM):	Max Velocity (UM/SEC):
Minimum Matches:	Data Point Frequency:
Image Size: Ensure Image Size Remains @ 2500W x 2000H	
Comments	

Completed By:

Printed Name	Signature	Date

Verified By:

Printed Name	Signature	Date

CP4-ES-2100-F03 – Colloidal Borescope Vertical Profiling Form

Project ID: CB Vertical Profiling Project	Location:	Date:	
Arrival Time:	Departure Time:	Well Diameter:	
Point Datum: TIC	WL:	TOS:	BOS:
TD:	Borescope Length: 1.75 ft	Cable Zero Point:	
Well Completion Stickup:	Preferential Zone Selection/Depth::		
Technicians:			

Test ID	VP-1	VP-2	VP-3	VP-4	Option-1	Option-2
Start Time						
Stop Time						
Depth (TIC)						
Avg Direction						
Avg Velocity (UM/SEC)						
Capture Delay (MS)						
Particle Sensitivity						
Min Particle Size (NM)						
Max Velocity (UM/SEC)						
Min Matches						
Data Pt Frequency						

Image Size: Ensure Image Size Remains @ 2500W x 2000H

Observation VP-1:

Observation VP-2:

Observation VP-3:

Observation VP-4:

Observation Option-1:

Observation Option-2:

Comments:

Completed By:

Printed Name | Signature | Date

Verified By:

Printed Name | Signature | Date