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Groundwater Quality Monitoring Well Installation for WAG 1

J. A. Mortimore
M. L. Ebers

[redacted]

OPERATED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

ORNL/RAP-47

OPERATIONS DIVISION

GROUNDWATER QUALITY MONITORING WELL INSTALLATION IN WAG 1 OAK RIDGE NATIONAL LABORATORY OAK RIDGE, TENNESSEE

J. A. Mortimore

in conjunction with

The EDGe Group, Inc.
725 Pellissippi Parkway
Knoxville, TN 37933-0879

Environmental Restoration Facilities Upgrade Program
ACTIVITY NO. KG 02 00 00 0; ONLKG02

Prepared by the
OAK RIDGE NATIONAL LABORATORY
Oak Ridge, Tennessee 37831
operated by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
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1. INTRODUCTION

The purpose of this report is to document the drilling and installation of the groundwater quality monitoring (GQM) wells in waste area grouping (WAG) 1. Installation of groundwater quality monitoring wells was required at Oak Ridge National Laboratory (ORNL) for regulatory compliance. Data obtained from these wells will be used to characterize and assess the WAGs in accordance with applicable Department of Energy (DOE), state, and Environmental Protection Agency regulatory requirements. The wells in WAG 1, the second group of GQM wells to be installed at ORNL, were drilled and developed between April 1987 and April 1988.

2. THE WAG CONCEPT

At ORNL, the solid waste management units (SWMUs) include solid waste storage areas (SWSAs), pipelines, spill sites, buildings, ponds, and experimental test sites that are considered to be potential sources of contamination. The SWMUs are further grouped into WAGs, whose boundaries are defined by watersheds that contain contaminants derived from similar assemblages of operating facilities and SWMUs. Basically, the wells are located on or near these boundaries to determine whether there is a continuing release of contaminants from the WAG.

3. DESCRIPTION OF WAG 1

WAG 1 includes operating research and development facilities located within the main security fence at ORNL plus certain areas outside the fence. These outside areas include SWSA 1 and portions of First Street, First Creek, and White Oak Creek north of Lagoon Road (see Fig. 1).

4. INSTALLATION METHODS

Four types of groundwater quality monitoring wells were installed in WAG 1, each of which had its own drilling and completion characteristics. The four well types are discussed in detail below. The specifications for drilling were provided in Release Specific Technical Directions for Regulatory Compliance Monitoring Wells, Phase I (Ref. 1).

Type A Well

The type A well boring was drilled to total depth with 7-in.-diam solid stem augers. Upon completion, the boring was bailed with a steel bailer to remove drill cuttings. The well was completed with 2-in.-diam stainless steel screen, casing, and silt trap. Stainless steel centralizers were positioned at the base and top of the screen and

every 20 ft along the casing. A sandpack was poured into the annular space from total depth to 1 ft above the screen. Pelleted bentonite was poured into the annular space to create a 2-ft seal above the sandpack. The tops of the sandpack and bentonite seal were measured with a stainless steel weighted tape. The annular space above the bentonite seal was then grouted through a tremie pipe to the surface.

Type B Well

The first step in drilling a type B well was to auger a 14-in.-diam boring from the surface to approximately 1 ft into solid rock. Bentonite pellets were poured into the boring and charged with water to prevent grout from entering the interior of the casing. A 10-in.-diam string of steel casing was installed in the boring, and the annulus was grouted to the surface. The boring was then deepened with an 8-in.-diam tricone air rotary bit to total depth, and the well was completed with 4-in.-diam stainless steel screen and casing. A sandpack, bentonite seal, and grout were installed in the annular space using the same procedures as those for the type A well.

Type C Well

A 14-in.-diam boring was augered and 10-in.-diam steel casing set in the same manner as in type B wells. The boring was deepened with an 8-in.-diam tricone air rotary bit to a predetermined depth. Open-ended 4-in.-diam stainless steel casing was set from the drilled depth to the surface. Bentonite pellets were poured around the base of the casing within the annulus and charged with water, if necessary, to form a seal to prevent grout from entering the interior of the casing. The annulus was then grouted to the surface with a tremie pipe. Below the casing, an open hole interval was drilled with a 3 7/8-in.-diam tricone air rotary bit. This section of the boring was left open to serve as the sample interval.

Type D Well

The first step in drilling a type D well was to auger a 12-in.-diam boring from the surface to approximately 1 ft into solid rock. An 8-in.-diam string of steel casing was installed in the boring with a bentonite seal as explained for type B above. The annulus was then grouted to the surface. The boring was deepened with a 6-in.-diam tricone air rotary bit to total depth, and the well was then completed with 2-in.-diam stainless steel screen and casing. A sandpack, bentonite seal, and grout were installed in the annular space using the same procedures as those for the type A well.

5. ENVIRONMENTAL REQUIREMENTS DURING DRILLING

All well drilling at WAG 1 was conducted according to the draft document, Interim Health, Safety, and Environmental Protection Procedures for Well-Drilling Operations (Ref. 2). Among the procedures set forth by this document was a system for rating proposed well

locations according to the expectation of encountering contamination. This rating determined whether a well could be drilled by contract personnel and what level of health physics and industrial hygiene coverage would be used during drilling. This document served in the interim until the final document, Health, Safety, and Environmental Protection Procedures for Excavating Operations (Ref. 3), came into effect in March 1988.

To comply with the drilling procedures, the drillers and hydrogeologists who would be working near the well attended a training program. The training conveyed to the worker a basic understanding of radioactivity and other types of contamination and the hazards that could be encountered at ORNL. The workers were informed of the proper procedures to follow in the event of an on-site emergency.

Special procedures were required during drilling. The ground surface at all drill sites was covered with polyethylene sheeting to avoid contact between the tools and the surrounding ground surface and to protect the environment in the event of a hydraulic fluid release. Containment was required for all drill cuttings produced. During augering, a metal pan was used to contain cuttings until proper disposition was determined by the health physicist. During air rotary drilling, cuttings were diverted from the borehole to a special containment box designed by Martin Marietta Energy Systems, Inc. The box is a 500-gal trailer-mounted tank with demister elements and high-efficiency particulate air filters at the air exhaust. Tank contents were checked by the health physicist to determine proper disposition.

Reference 3 also required that four other documents be produced before drilling could begin. These are the Action Description Memorandum, Safety Assessment, Quality Assurance Assessment/Plan, and Project Waste Management Plan (Refs. 4-7).

6. FIELD SUPPORT

The groundwater quality monitoring wells in WAG 1 were installed by the construction contractor, A. L. Clark Drilling Company, Inc., whose contract began in January 1987. The drilling contract was administered by the Engineering organization at ORNL through Energy Systems Procurement. The management organization chart for the project can be found in the Task Management Plan for Groundwater Quality Monitoring Well Installation (Ref. 8).

The hydrogeologic support and installation record-keeping were supplied through a contract with Engineering, Design & Geosciences Group, Inc. (EDGe), formerly MCI Consulting Engineers. Inc. An EDGe representative was present during all activities that affected the quality of the wells and advised the Company on well construction.

Health physics and industrial hygiene support was supplied by ORNL personnel or their subcontractors.

Construction engineering support was supplied by Energy Systems personnel. Drawings, excavation permits, well placement in the field, and as-built surveying and calculations were done by the Energy Systems Civil and Architectural Department or by their subcontractor, Adams-Craft-Herz-Walker Engineering Company. The as-built survey data are summarized in a table in Figure 1.

7. DRILLING RECORDS

A complete data package has been compiled for each of the 25 groundwater quality monitoring wells drilled in WAG 1. These data packages can be found listed in numerical order in Appendix A. Each well data package consists of 12 forms, which are listed below in the order that they appear in the data package. All original records are retained in the ORNL Remedial Action Program Records Control Data Base (Ref. 9).

1. Monitor Well Narrative
2. Pre-Drilling Checklist For Monitoring Wells
3. Decontamination Checklist Drilling Equipment
4. Well Log
5. Well Installation/Completion Form
6. Monitoring Well Materials Certification
7. Post-Well Completion Checklist
8. Monitoring Well Development Form
9. Monitoring Well Development Progress
10. Hydraulic Conductivity Calculations
11. Nonconformance Report (if necessary)
12. Chain of Custody Forms

8. SAMPLING DURING INSTALLATION

Samples of soil, rock, and drilling water were taken by the EDGe hydrogeologist during well installation and submitted to the ORNL Analytical Chemistry Division for chemical analysis. Soil and rock samples were taken from the unsaturated and saturated zones. Samples of drilling water were collected from the water pump discharge on the drill rig when drilling with air rotary. All samples were transferred using chain of custody forms, which are included in the data packages. The sampling procedures are described in detail in Ref. 8. Samples were collected from only one well of each well pair. Soil sample collection was inadvertently omitted from wells 809, 812, and 828.

Analyses were performed on the soil, rock, and water samples to determine moisture content and concentrations of 31 chemical elements, total organic carbon, and radionuclides. Results from these analyses can be found in the Remedial Action Program Data Base (Ref. 9). Examples of data that can be obtained are included in Appendix B.

9. SPECIAL NOTES ON INSTALLATION AND DEVELOPMENT

The following special events took place during the drilling of the groundwater quality monitoring wells in WAG 1.

- Detection of Odors: During the development of wells 807, 808, 809, 819, and 826, a "sewage-like" odor was detected by the developers. Industrial hygiene personnel tested all five wells for fecal coliform and none was detected. Hydrogen sulfide concentrations were below 1 ppm as measured with a real-time monitor. Samples were taken by the ORNL Environmental Compliance and Monitoring Department. It was determined that there were elevated levels of chlorine and sulfates, but there were no health concerns for on-site personnel.

The following activities took place after the Geoguard pumps were installed in the groundwater quality monitoring wells in WAG 1.

- Hydraulic Conductivity Tests: The Geoguard pumps were removed from each well during testing of the well for hydraulic conductivity by an EDGe hydrogeologist.

- Water Level Measurements: Water levels were measured in all the groundwater quality monitoring wells in WAG 1 by EDGe employees at least once prior to well development and again before hydraulic conductivity testing.

When the Geoguard pumps were removed from the wells during these activities, they were handled with sterile gloves and placed on clean polyethylene. All instruments placed in the wells underwent the cleaning and decontamination procedures outlined in the drilling specifications (Ref. 1).

All wells were developed by pumping with a Geoguard airlift pump using oilless compressors. The two-stage Geoguard pumps were converted to dedicated bladder pumps for sampling after development was complete. A Teflon surge block was installed below the pump and agitated by hand during well development in most wells. The Teflon surge block was removed when the pump was converted. In addition to hand surging, most wells were periodically surged with a workover rig and a stainless steel surge block.

Twenty-two of the 25 wells in WAG 1 were pumped until the water removed was at or near 5 Jackson turbidity units, as measured by a Hach turbidity test kit. The procedure for measuring turbidity is included in Ref. 8. The three remaining wells (817, 823, and 824) were developed for 3 to 4 weeks before pumping was terminated. It was determined that, because of low well yields, the time required to fully develop the wells was prohibitive.

REFERENCES

1. Release Specific Technical Directions for Regulatory Compliance Monitoring Wells, Phase I, K-4147, Oak Ridge National Laboratory, April 1987, pp. 2-4.

2. D. C. Parzyck, Interim Health, Safety, and Environmental Protection Procedures for Well-Drilling Operations, ORNL/M-116, Oak Ridge National Laboratory, March 19, 1986, Draft.

3. Environmental Compliance and Health Protection Division, Health, Safety, and Environmental Protection Procedures for Excavating Operations, ORNL/M-116/R1, Oak Ridge National Laboratory, March 3, 1988.

4. Action Description Memorandum, Regulatory Compliance Monitoring Wells, 39 KG 02, C. K. Valentine, April 9, 1986.

5. Safety Assessment, Regulatory Compliance Monitoring Wells, Phase I, ORNL/ENG/SA-1250, AY 29, 1986.

6. Project Quality Assurance/Assessment Plan, Regulatory Compliance Monitoring Wells, Phase I, X-PQAA-4147-0.

7. Project Waste Management Plan, Regulatory Compliance Monitoring Wells, Phase I, K-4171, Draft.

8. J. A. Mortimore, Task Management Plan for Groundwater Quality Monitoring Well Installation, Draft, Oak Ridge National Laboratory, February 1988.

9. P. T. Owen and L. D. Voorhees, Description of the Records Control Database Developed for the ORNL Remedial Action Program, ORNL/RAP/LTR-88/14, Oak Ridge National Laboratory, January 29, 1988.

10. L. D. Voorhees, L. A. Hook, M. J. Gentry, R. A. McCord, M. A. Faulkner, K. A. Newman, and P. T. Owen, Data Base Management Activities for the Remedial Action Program at ORNL: Calendar Year 1987, ORNL/TM-10694, Oak Ridge National Laboratory, 1988.

Appendix A - Data packages

Appendix B - Examples of Analytical Data Available

INTERNAL DISTRIBUTION

1. J. S. Baldwin
2-3. L. D. Bates
4. T. W. Burwinkle
5. K. W. Cook
6. E. C. Davis
7. D. D. Huff
8-10. L. D. Hyde
11. R. H. Ketelle
12. J. R. Lawson
13. L. E. McNeese
14. G. K. Moore
15. J. A. Mortimore
16. C. E. Nix
17-23. P. T. Owen
24. T. P. Perry
25. D. K. Solomon
26. S. H. Stow
27. L. E. Stratton
28-29. J. R. Trabalka
30-31. L. D. Voorhees
32. Central Research Library
33. Document Reference Section
34. LRD-RC
35. ORNL Patent Office

EXTERNAL DISTRIBUTION

36. M. L. Ebers, EDGe Group, Inc., 725 Pellissippi Pkwy, Knoxville, Tennessee 37933-0879.

37. R. D. Glenn, Bechtel National, Inc., P. O. Box 350, Oak Ridge, Tennessee 37831-0350.

38. Office of Assistant Manager for Energy Research and Development, U. S. Department of Energy, Oak Ridge Operations, P. O. Box 2001, Oak Ridge, Tennessee 37831-8610.

39-40. Office of Scientific and Technical Information, P. O. Box 62, Oak Ridge, Tennessee 37831.

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1.0 General Information

1.1 Well Location

Monitoring well number 806 is located in the Main Plant area of ORNL. It is 100 feet east of the intersection of Melton Valley Drive and First Street. The location is shown on ORNL drawing number C3E 20004 A075. Survey coordinates for this well are N 20,082.90, E 29,657.29 (X-10 grid) or latitude 35° 55' 11.9" and longitude 84° 19' 01.9". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 806 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Joe Clark. Drilling commenced on 5/11/87 and was finished on 5/12/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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A drill rig and equipment were mobilized to the staked drilling location and set up over plastic sheeting. Continuous split spoon samples were taken from ground surface to a depth of 8.0 feet. The hole was then reamed to a diameter of 6.5 inches using solid stem augers. This boring was advanced in rock to a total depth of 16.0 feet. The cuttings produced during drilling were removed from the borehole by bailing. Stainless steel screen and casing were installed followed by a sand pack and bentonite seal.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0806S01 was collected in the split spoon interval from 1.6 feet to 1.8 feet on 5/11/87 and soil sample 0806S02 was collected in the split spoon interval from 6.9 feet to 7.1 feet on 5/11/87. Analytical results for these samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 1.3 feet to 1.6 feet. The sample was measured, weighed and a bulk density of 1.8 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.5 to 15.7 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.5 to 15.5 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.5 feet to 2.5 feet above ground surface. A sandpack was then poured into the annular space from 4.5 to 15.5 feet, with a 2 foot bentonite pellet seal poured into the annular space above the sandpack from 2.5 to 4.5 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 806 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 898.5 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/8/88 at a depth of 12.7 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 806 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 3.99×10^{-4} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

2.6 Nonconformance Report

A nonconformance report has been filed for this well due to the presence of grout inside the 2 inch stainless steel casing. A copy of this report is attached.

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WELL No. 806

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/11/87	JG
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/11/87	JG
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	JG
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/11/87	JG
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/11/87	JG
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/11/87	JG
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/11/87	JG

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE John W. Anderson 5/11/87

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WELL No. 806

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE 5/11/87
John W. Anderson

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WELL No. 806

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Joe Clark
DRILL: Gus Pech

DATE: START: 5/11/87
FINISH: 5/12/87
LOGGED BY: John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split spoon, Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 8.0'
DEPTH DRILLED IN ROCK: 8.0'
TOTAL DEPTH OF WELL: 16.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5		100%	Topsoil, dark brown, with organic material,
				moist
0.5	2.0	0806S01	100%	Silty clay, dark gray with limestone
		@1.6-1.8'		fragments, moist
				Bulk Density = 1.8 grams/cm³
2.0	6.0		100%	Silty clay with minor limestone fragments,
				brownish gray, dry
6.0	8.0	0806S02	100%	Silty clay with limestone fragments, brownish
		@6.9-7.1'		gray, wet
8.0	8.5		50%	Limestone with minor silty clay nodules, wet
	8.5			Split spoon refusal
8.5	15.0			Limestone, light gray, hard, wet
15.0	15.3			Void
15.3	16.0			Limestone, dark gray, hard
	16.0			TOTAL DEPTH

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WELL No. 806

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Joe Clark

LOCATION Main Plant
ORNL GRID COORDINATES
N 20082.90
E 29657.29
ELEV. GROUND 774.94
ELEV. TOP STAINLESS STEEL CASING 777.46
DRILLING DATES:
STARTED: 5/11/87
FINISHED: 5/12/87

EQUIPMENT ☒ 6 INCH AUGER 16.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	8.0	FEET OF 2 IN. S.S. CASING
3.0	12.0	SACKS OF SAND
50	17	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

Cavities, Spillage and Irregular Auger Boring Diameter

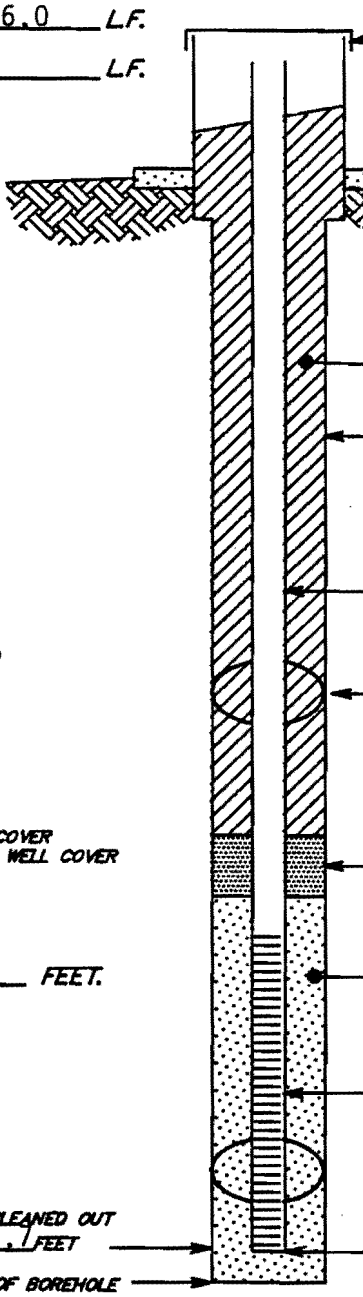
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.7 FEET.

CENTRALIZERS AT 3.0 FEET.
15.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 806

DATE: 5/11/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/11/87	02
BENTONITE		5/11/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/11/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/11/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	5/11/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/11/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/8/88	02
GROUT		5/11/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE 5/11/87
John W. Anderson

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 806

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/12/87	
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/12/87	
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/7/88	jmm
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/12/87	

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/7/88
John M. McLoughlin

5/12/87
John W. Anderson

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WELL No. 806

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/2/88 TIME:

DEVELOPMENT ENDING DATE: 3/7/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe, Inc.

ONE WELL VOLUME: (GALLONS) 9.0 gallons

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 898.5 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 1.1 Feet from Surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/8/88 AT 12.7 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/8/88
John M. McLoughlin

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WELL NO. 806
LOCATION: Main Plant
DATE: 2/25/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 9 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/25/88	27.2	Muddy				
3/1/88	5.0	Muddy				
3/2/88	197.5	Muddy				
3/3/88	279.2	Cloudy				
3/4/88	281.0	Cloudy				
3/7/88	108.6	Clear	5 JTU's	898.5	99.83	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	898.5	99.83	

COMMENTS NOTE: pH Averaged 7.4

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0806 DATE OF TEST: 4/5/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 14.47 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 6.53 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 14

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.1977
.2033

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WELL No. 806

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	6.820	.290
20.00	6.730	.200
30.00	6.690	.160
40.00	6.640	.110
50.00	6.630	.100
60.00	6.620	.090
75.00	6.610	.080
90.00	6.600	.070
105.00	6.590	.060
120.00	6.580	.050
150.00	6.570	.040
180.00	6.560	.030
240.00	6.550	.020
300.00	6.540	.010

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.31E-05 FT/SEC = 3.99E-04 CM/SEC

TRANSMISSIVITY = 1.31E-04 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.74E-05 FT/SEC = 5.31E-04 CM/SEC

TRANSMISSIVITY = 1.74E-04 FT**2/SEC

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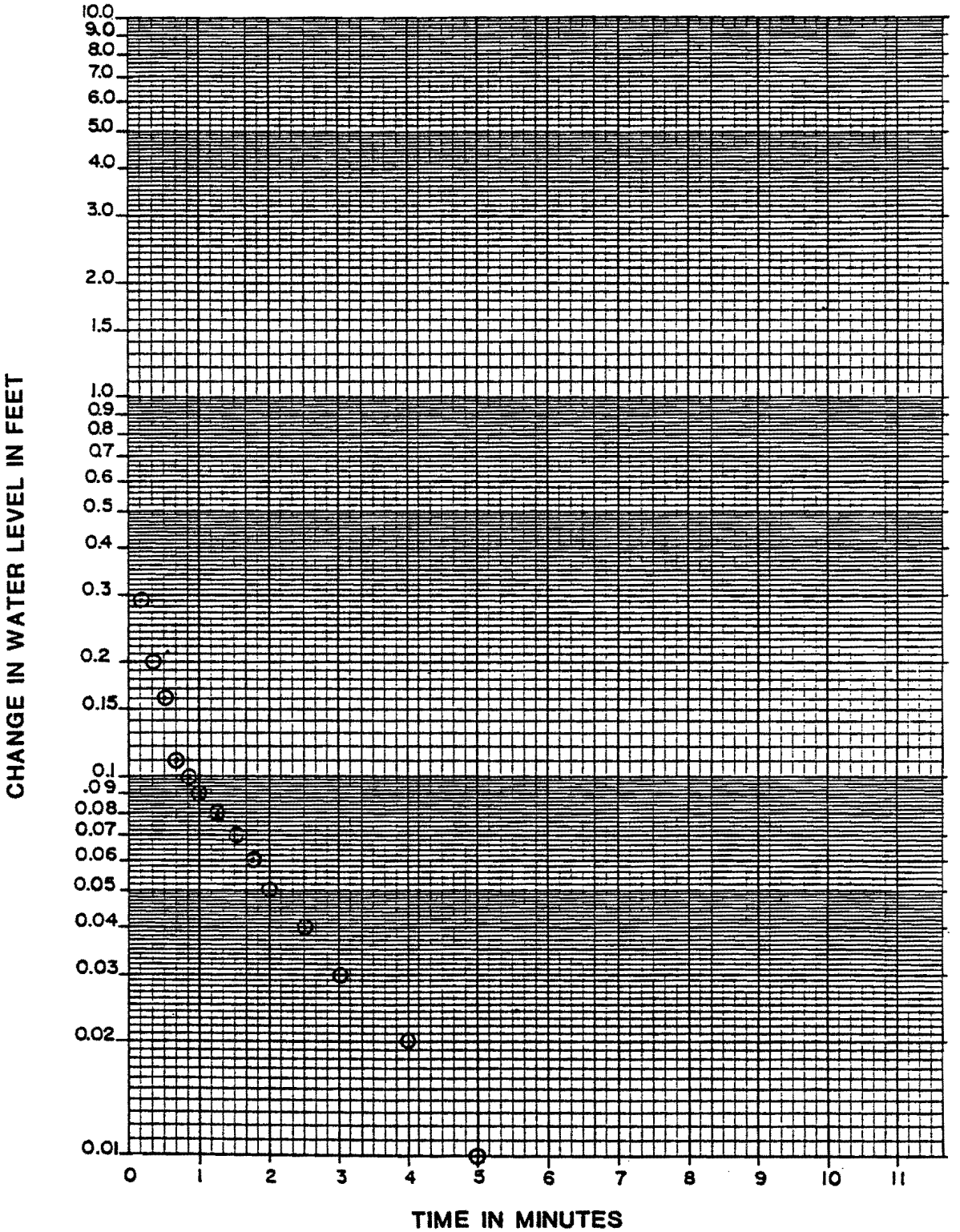
WELL No. 806

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0806 S01 ~~0806 S1~~

WELL NO.: 0806

LOCATION: 1.6 - 1.8'

TYPE: Soil

SAMPLER: John Anderson (SIGNATURE)

DATE: 5/11/87

TIME: 1:42 PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
John Anderson	5/18/87	7:48	MCI	[illegible]	5/18/87	7:48	MCI
[illegible]	6/2/87	9:00	MCI	[illegible]	6/2/87	9:00	ORNL CPA

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0806S02 ~~0806S2~~

WELL NO.: 0806

LOCATION: 6.9-7.1'

TYPE: Soil

SAMPLER: John Anderson (SIGNATURE)

DATE: 5/11/87

TIME: 2:01 PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
John Anderson	5/18/87	7:48	MCI	[illegible]	5/18/87	7:48	MCI
[illegible]	6/2/87	9:00	MCI	[illegible]	6/2/87	9:00	ORNL CPA

REMARKS:

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 806
AREA: Main Plant

NONCONFORMANCE REPORT

ISSUE DATE: 1/25/88 DATE OF NONCONFORMANCE: May 1987

DESCRIPTION OF NONCONFORMANCE:

An unknown quantity of grout was accidentally poured inside the 2 inch stainless steel casing while filling the annular space between the stainless steel casing and the outer 8 5/8 inch protective casing in May, 1987.

Grout was observed on the inside of the 2 inch stainless steel casing while checking the water level on 1/22/88 by Bryn Howze and Michael L. Ebers.

POSSIBLE DETRIMENTAL EFFECTS TO WELL QUALITY:

The grout could affect the pH of the ground water in this hole.

COMMENTS:

OBSERVER OF NONCONFORMANCE: Michael L. Ebers	DATE: 1/22/88
REPORTED BY: Michael L. Ebers	DATE: 1/25/88
DISTRIBUTION PROJECT MANAGER: Jill Mortimore	DATE SUBMITTED: 1/25/88
CONSTRUCTION ENGINEER: Steve L. Laman	DATE SUBMITTED: 1/25/88

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1.0 General Information

1.1 Well Location

Monitoring well number 807 is located southwest of the Main Plant area. It is 100 feet south of Building 2643. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 20,909.27, E 30,008.52 (X-10 grid) or latitude 35° 55' 20.6" and longitude 84° 19' 04.0". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 807 was drilled by A.L. Clark Drilling Services, Inc. A Schramm Rotadrill air rotary rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, II with the assistance of Joe Clark. Drilling commenced on 5/5/87 and was finished on 5/6/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/5/87 Rig moved on location and set up. Split spoon sampled from 0.0' to 9.0'. Drilled from 0.0' to 10.8' with 6 3/4" auger.

5/6/87 Drilled from 10.8' to 16.0' with 6 3/4" auger. Bailed hole and ran in 2" stainless steel screen, casing, sand and bentonite.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologists Michael L. Ebers and John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0807S01 was collected in the split spoon interval from 1.2 feet to 1.4 feet on 5/5/87 and soil sample 0807S02 was collected in the split spoon interval from 6.0 feet to 6.3 feet on 5/5/87. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 0.4 feet to 0.9 feet. The sample was measured, weighed and a bulk density of 2.0 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 14.5 to 14.8 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 4.3 to 14.5 feet. A two-inch diameter stainless steel casing was installed above the screen from 4.3 feet to 2.8 feet above ground surface. A sandpack was then poured into the annular space from 3.0 to 14.8 feet, with a 1.8 foot bentonite pellet seal poured into the annular space above the sandpack from 1.2 to 3.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 807 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 669.7 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/24/88 at a depth of 11.7 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 807 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 4.82×10^{-4} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 807

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/5/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/5/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	5/6/87	MLE
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/6/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/5/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/5/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/5/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/6/87

Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 807

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/5/87

Michael L. Ebers

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WELL No. 807

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, II
HELPER: Richard Pickel
DRILL: Schramm Rotadrill

DATE: START: 5/5/87
FINISH: 5/6/87
LOGGED BY: Michael L. Ebers & John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split Spoon and Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan, plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 9.0'
DEPTH DRILLED IN ROCK: 7.3'
TOTAL DEPTH OF WELL: 16.3'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0	0.2	0807S01	100%	Topsoil, medium brown with organic material
		@1.2-1.4'		
0.2	2.0		100%	Clay, orange brown, moist to dry with angular
				limestone fragments and chert nodules
2.0	4.0		0	No recovery
4.0	4.8		100%	Clay, brown mottled with gray with limestone
				fragments, firm
4.8	9.0	0807S02	100%	Clay, very soft, gray, moist to wet, limestone
		@6.0-6.3'		fragments from 8.7' to 9.0'
	9.0			Split spoon refusal
				Bulk Density = 2.0 grams/cm³
9.0	16.3			Limestone, fine grained, olive gray, hard
	16.3			TOTAL DEPTH

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WELL No. 807

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson, Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Joe Clark

EQUIPMENT ☒ 6 3/4 INCH AUGER 16.3 L.F.
☐ _____ INCH AUGER _____ L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 20,909.27
E 30,008.52
ELEV. GROUND 774.53
ELEV. TOP STAINLESS STEEL CASING 777.36

DRILLING DATES:
STARTED: 5/5/87
FINISHED: 5/6/87

MATERIALS USED

EST. VOL.	USED VOL.	
	10.2	FEET OF 2 IN. S.S. SCREEN
	7.1	FEET OF 2 IN. S.S. CASING
2.6	3.8	SACKS OF SAND
25	25	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, Spillage, Irregular
Auger Boring Diameter

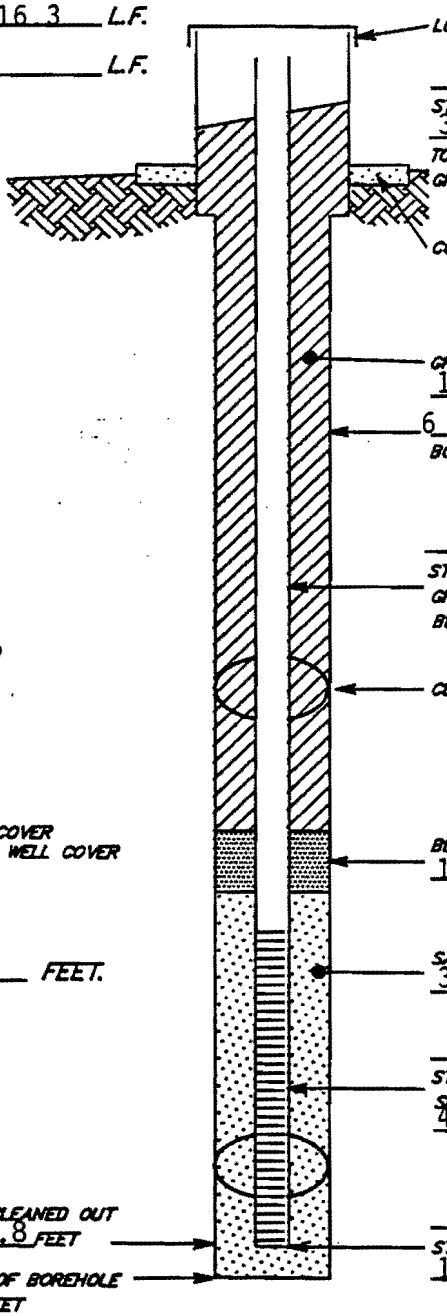
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 11.7 FEET.

CENTRALIZERS AT 4.3 FEET.
14.8 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 807

DATE: 5/6/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/6/87	02
BENTONITE		5/6/87	01
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ■ NO)	5/6/87	03
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ■ NO)	5/6/87	03 & 04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	5/6/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ☐ YES ■ NO)	5/6/87	03
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/24/88	02
GROUT		5/7/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/6/87
Michael L. Ebers

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 807

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/6/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/6/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/24/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/6/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/24/88
John M. McLoughlin

Michael L. Ebers 5/6/87
Michael L. Ebers

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 807

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 2/23/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/24/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 9.0 gallons

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 669.7 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: R. C. Williams, MMES

ODOR OF WATER: Strong Organic Odor

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 2.2 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/24/88 AT 11.7 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/24/88
John M. McLoughlin

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 807
LOCATION: Main Plant
DATE: 2/23/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 9.0 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/23/88	135					
2/24/88	171					
2/25/88	99					
3/22/88	90.2					
3/23/88	34.0					
3/24/88	140.5	Clear	5 JTU's	669.7	74.41	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	669.7	74.4	

COMMENTS Average pH = 7.7

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WELL No. 807

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0807 DATE OF TEST: 4/4/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 12.34 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 6.61 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 16

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WELL No. 807

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	7.240	.630
20.00	7.100	.490
30.00	7.030	.420
40.00	6.970	.360
50.00	6.930	.320
60.00	6.880	.270
75.00	6.830	.220
90.00	6.790	.180
105.00	6.750	.140
120.00	6.740	.130
150.00	6.700	.090
180.00	6.670	.060
240.00	6.630	.020
300.00	6.630	.020
360.00	6.620	.010
420.00	6.620	.010

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.58E-05 FT/SEC = 4.82E-04 CM/SEC

TRANSMISSIVITY = 1.58E-04 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 2.12E-05 FT/SEC = 6.45E-04 CM/SEC

TRANSMISSIVITY = 2.12E-04 FT**2/SEC

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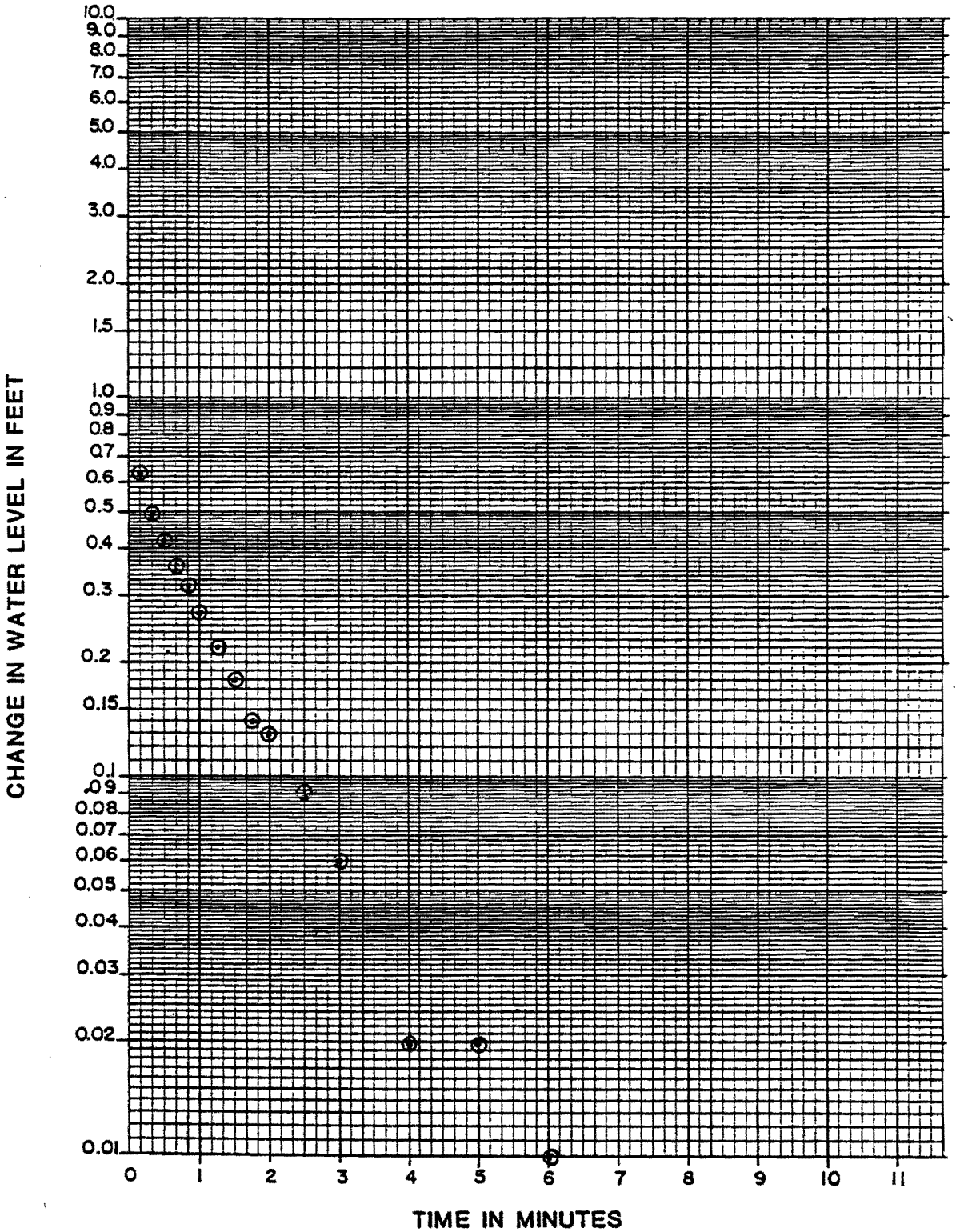
WELL No. 807

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0807501 ~~0807-51~~

WELL NO.: 0807-51

LOCATION: Main Plant - South Side @ 1.2'-1.4'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 5/5/87

TIME: 3:57 PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/5/87	4:40	MCI	[signature]	5/5/87	4:40	MCI
[signature]	5/26/87	11:40	"	[signature]	5/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0807502 ~~0807S2~~

WELL NO.: 0807-S2

LOCATION: Main Plant - South Side @ 6.0-6.3

TYPE: Soil

SAMPLER: (SIGNATURE)

DATE: 5/5/87

TIME: 4:11 PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
	5/5/87	4:40	MCI		5/5/87	4:40	MCI
	5/26/87	11:40	"		5/26/87	11:40	ORNL

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 808 is located south of the Main Plant. It is situated approximately 280 feet east of First Street and adjacent to a roadway which connects First Street and the coal refuse pond. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 20,910.18, E 30,018.64 (X-10 grid) or latitude 35° 55' 20.7" and longitude 84° 19' 03.9". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 808 was drilled by A.L. Clark Drilling Services, Inc. A Driltech air rotary drill rig was used to drill this boring for monitor well installation under the operation of Steve Clark with the assistance of Steve Kirk. Drilling commenced on 4/29/87 and was finished on 5/4/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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4/29/87 Rig moved on site and set up; advanced boring from ground surface to a depth of 10.75' with a 14" diameter auger. Installed 10 3/4" inch diameter surface casing and grouted casing in place.

4/30/87 Containment box and diverter readied for air rotary drilling. Advanced borehole using an 8 1/2" diameter tri-cone roller bit from 10.8' to a depth of 35.0'.

5/1/87 Four inch diameter stainless steel casing placed from the surface to 35.0' and grouted into place. One bag of sand placed inside of stainless steel casing in an attempt to prevent introduction of grout into borehole.

5/4/87 A 3 7/8" diameter borehole was advanced through the 4" stainless steel casing to a total depth of 55.0'. Borehole was blown with air to clean hole of water and cuttings. Series of water level readings were taken with a final reading of 36.5' below ground surface.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologists Charles W. Stanley, Richard E. Flohr and Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel

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silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

A drill water sample was collected from the water pump on the drill rig on 5/4/87. A chain of custody form for this sample is included in this data package. Analytical results for the water sample described above can be obtained from the Remedial Action Program data base at ORNL.

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2.4 Installation and Development

2.4.1 Installation

This was an open hole or type C well, without a stainless steel screen. A fourteen-inch diameter boring was augered from ground surface to bedrock (10.75 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a depth of 35.0 feet. A four-inch diameter stainless steel casing was installed and tremie grouted from the bottom of the eight-inch diameter boring at 35.0 feet and extending 2.24 feet above ground surface. The air rotary method was then used to drill a 3 7/8 inch diameter boring (open hole interval) from the bottom of the four-inch diameter stainless steel casing at 35.0 feet to a total depth of 55.0 feet. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 808 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 97 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was

5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/2/88 at a depth of 50.9 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 808 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 3.09×10^{-6} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 808

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	4/29/87	CWS
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	4/29/87	CWS
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	4/29/87	CWS
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	4/29/87	CWS
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	4/29/87	CWS
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	4/29/87	CWS

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE CWS 4/29/87
Charles W. Stanley

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 808

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE [signature] 4/29/87
Charles W. Stanley

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 808

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: Steve Clark
HELPER: Steve Kirk
DRILL: Driltech

DATE: START: 4/29/87
FINISH: 5/4/87
LOGGED BY: R.E. Flohr, M.L. Ebers & C.W. Stanley
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Auger, tri-cone air rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan, plastic, containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 9.4'
DEPTH DRILLED IN ROCK: 45.6'
TOTAL DEPTH OF WELL: 55.0'

DRILLING FLUID SAMPLES:
TYPE: Drill water DATE: 5/4/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	3.0			Topsoil, medium brown with shale fragments
3.0	9.4			Clay, medium gray with roots, rock fragments,
				moist, wet at 7.0', mixed with brown soil
				and clay
9.4	10.75			Rock, hard, calcareous shale, wet, with clay
	10.75			Stopped 14" auger drilling
10.75	16.0			Limestone, shaly, brownish gray and greenish
				gray, fine grained
16.0	35.0			Limestone, light olive gray, fine grained,
				massive, locally glauconitic, few 1/32"
				fractures filled with white calcite
35.0	55.0			Limestone, light olive gray, fine grained
	55.0			TOTAL DEPTH

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WELL No. 808

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Charles W. Stanley
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- ☒ 14 INCH AUGER 10.75 L.F.
- ☐ ____ INCH AUGER ____ L.F.
- ☒ 8 INCH ROTARY 24.25 L.F.
- ☐ 3 7/8 INCH ROTARY 20.0 L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 20,910.18
E 30,018.64
ELEV. GROUND 774.50
ELEV. TOP STAINLESS STEEL CASING 776.74

DRILLING DATES:
STARTED: 5/1/87
FINISHED: 5/4/87

MATERIALS USED

EST. VOL.	USED VOL.	
	N/A	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	14.2	FT. OF 10 IN. SURFACE CASING
3.3	7.0	SACKS OF CEMENT (SURFACE CASING)
	14.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	42.0	GALLONS OF WATER (SURFACE CASING)
	37.2	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
7.8	10.0	SACKS OF CEMENT (S.S. CASING)
	20.0	POUNDS OF POWDERED BENTONITE (S.S. CASING)
	60.0	GALLONS OF WATER (S.S. CASING)
	N/A	POUNDS OF BENTONITE PELLETS (STAINLESS STEEL CASING SEAL)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, Spillage and Irregular Auger Boring Diameter

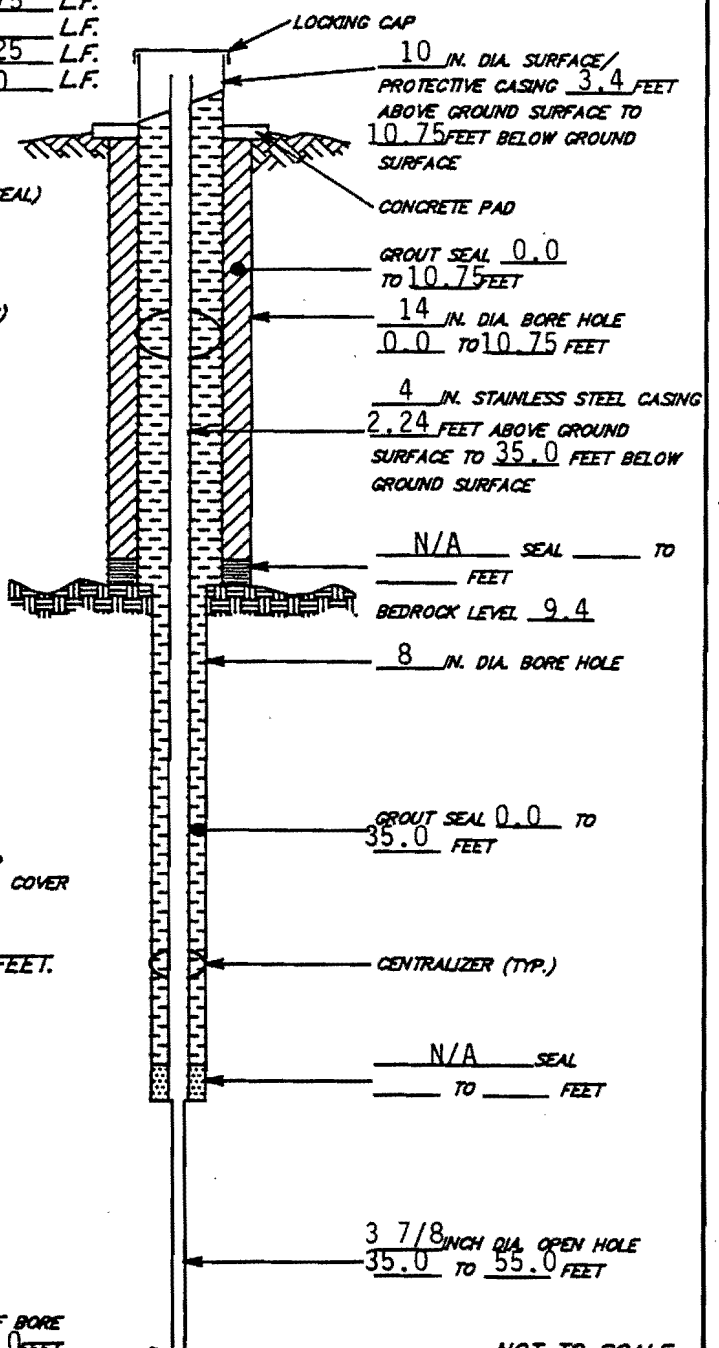
SURFACE CASING TREMIE GROUTED YES ☒ NO ☐
STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

MONITORING WELL PUMP BASE SET AT 50.9 FEET.

CENTRALIZERS AT 5.0 FEET.
20.0 FEET.
33.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE C WELL

NOT TO SCALE

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WELL No. 808

DATE: 5/1/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/1/87	02
BENTONITE		N/A	--
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ☐ NO)	N/A	--
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/1/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	5/1/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/1/87	01
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/2/88	02
GROUT		5/5/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE [signature] 5/5/87
Charles W. Stanley

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WELL No. 808

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/4/87	REF
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/4/87	REF
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/2/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/4/87	REF

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/2/88
John M. McLoughlin

Richard E. Flohr 5/4/87
Richard E. Flohr

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 808

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump with Air Compressor

DEVELOPMENT BEGAN DATE: 2/24/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/2/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 35.5

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 97.0 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: R. H. Ketelle, MMES

ODOR OF WATER: Strong Organic Odor

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 3.1 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/2/88 AT 50.9 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/2/88
John M. McLoughlin

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 808
LOCATION: Main Plant
DATE: 2/24/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 35.5 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/24/88	71.4	Sl. Cloudy		71.4		
3/2/88	25.6	Clear	5	97.0	2.73	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	97.0	2.73	

COMMENTS

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0808 DATE OF TEST: 4/5/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 20.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 52.78 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 20.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.70 FEET
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 25

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)

1.9373
1.9381

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WELL No. 808

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
50.00	3.650	1.950
60.00	3.650	1.950
75.00	3.640	1.940
90.00	3.640	1.940
105.00	3.640	1.940
120.00	3.640	1.940
150.00	3.640	1.940
180.00	3.630	1.930
240.00	3.620	1.920
300.00	3.610	1.910
360.00	3.610	1.910
420.00	3.610	1.910
480.00	3.600	1.900
540.00	3.580	1.880
600.00	3.580	1.880
720.00	3.590	1.890
840.00	3.590	1.890
960.00	3.580	1.880
1080.00	3.580	1.880
1200.00	3.570	1.870
1320.00	3.560	1.860
1440.00	3.560	1.860
1560.00	3.560	1.860
1680.00	3.560	1.860
1800.00	3.550	1.850

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.01E-07 FT/SEC = 3.09E-06 CM/SEC

TRANSMISSIVITY = 2.03E-06 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.01E-07 FT/SEC = 3.09E-06 CM/SEC

TRANSMISSIVITY = 2.03E-06 FT**2/SEC

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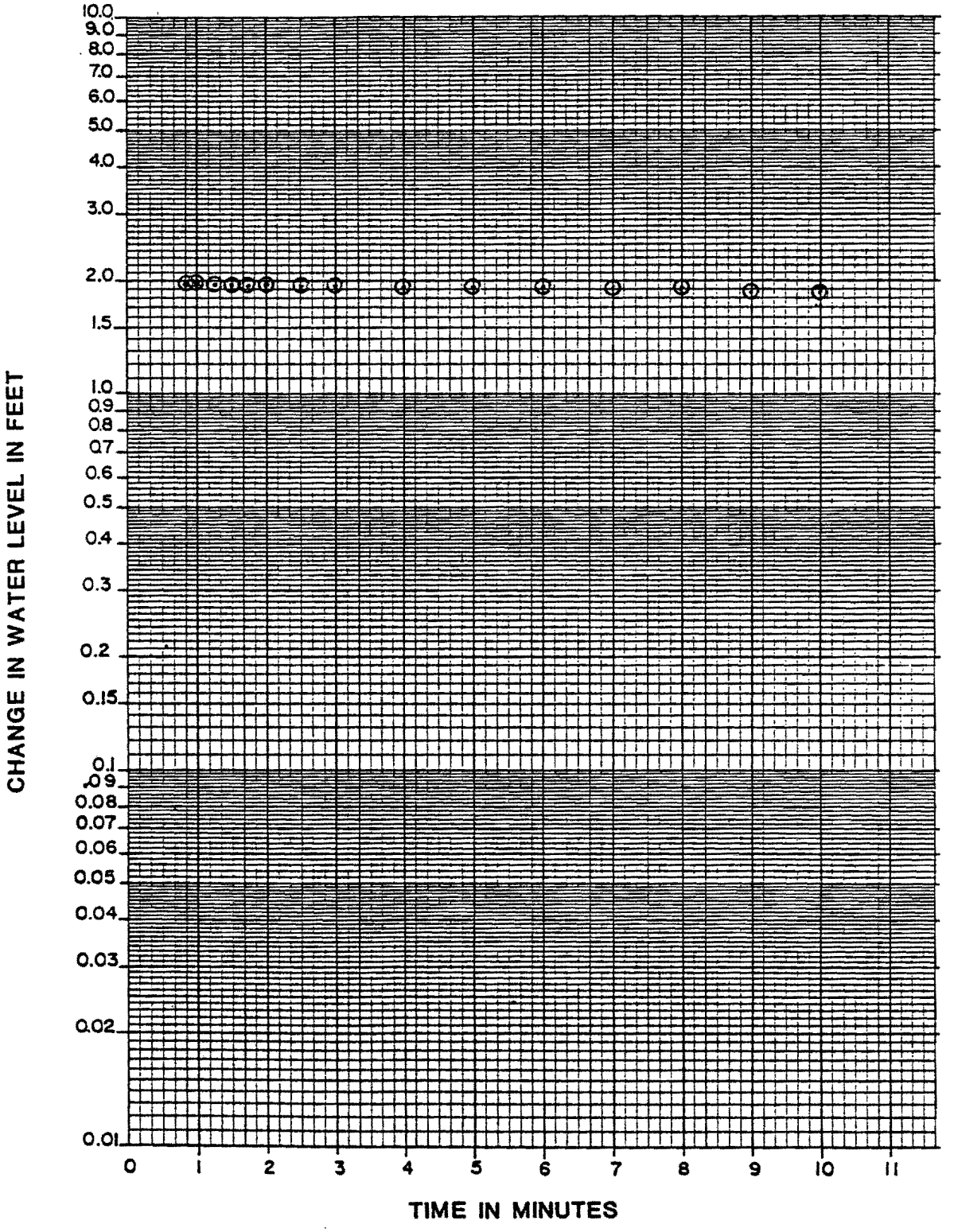
WELL No. 808

HYDRAULIC CONDUCTIVITY CALCULATIONS



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NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0808 W-01

WELL NO.: @ 808

LOCATION: from water hydrant at New Hydrofracture

TYPE: Drill Water

SAMPLER: Richard Flohr (SIGNATURE)

DATE: 5/4/87

TIME: 1:30 pm

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
Richard Flohr	5/4/87	3:40 pm	MCI	[illegible]	5/4/87 ~~15:4~~ BCG	15:40	ORNL

REMARKS:

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1.0 General Information

1.1 Well Location

Monitoring well number 809 is located in the Main Plant area. It is approximately 60 feet west of First Street and 425 feet south of White Oak Avenue at the edge of an existing parking lot. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,142.87, E 29,652.46 (X-10 grid) or latitude 35° 55' 20.6" and longitude 84° 19' 09.1". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 809 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced and finished on 4/29/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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4/29/87 Split spoon samples were taken from the ground surface to a depth of 7.9 feet where the sampler refused to advance to a greater depth. The boring was advanced to a total depth of 16.0 feet with a 6 3/4 inch diameter auger. Boring was cleaned of cuttings with a bailer. A 2 inch stainless steel screen and casing was placed to a depth of 15.6 feet, a sandpack placed circumventing the screen and a bentonite seal placed above the sandpack in order to seal the screen interval.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Richard E. Flohr. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

No samples were collected during drilling.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.3 to 15.6 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.0 to 15.3 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.0 feet to 1.8 feet above ground surface. A sandpack was then poured into the annular space from 3.5 to 15.6 feet, with a 2.0 foot bentonite pellet seal poured into the annular space above the sandpack from 1.5 to 3.5 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

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2.4.2 Well Development

Well number 809 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 196.0 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/22/88 at a depth of 12.7 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 809 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout

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attached) value of 2.49 x 10^{-4} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 809

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	4/29/87	REF
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	4/29/87	REF
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	4/29/87	REF
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	N/A	
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	4/29/87	REF
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	4/29/87	REF
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	4/29/87	REF

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Richard E. Flohr 4/29/87
Richard E. Flohr

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WELL No. 809

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Richard E. Flohr 4/29/87

Richard E. Flohr

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WELL No. 809

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech

DATE: START: 4/29/87
FINISH: 4/29/87
LOGGED BY: Richard E. Flohr
HEALTH PHYSICST: Carl Stooksbury

TYPE DRILLING: Split spoon, Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 7.9'
DEPTH DRILLED IN ROCK: 8.1'
TOTAL DEPTH OF WELL: 16.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.7		60%	Gravel and topsoil
0.7	0.9		60%	Coal particles
0.9	2.0		60%	Clay, silty, brown with rounded rock fragments
2.0	4.0		0%	No recovery
4.0	6.0		15%	Clay, silty to very silty, dark grayish brown
				with few organics, wet
6.0	8.2		40%	Clay, silty, dark grayish brown to shale,
				bluish at 7.9'
8.2				Split spoon refusal
8.2	8.7			Rock, hard
8.7	10.0			Soft with some rock fragments (filled cavity)
10.0	15.0			Hard, slow drilling
15.0	16.0			Soft with some hard rock cobbles
	16.0			TOTAL DEPTH

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WELL No. 809

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Richard E. Flohr
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Richard Pickel

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,142.87
E 29,652.46
ELEV. GROUND 776.74
ELEV. TOP STAINLESS STEEL CASING 778.58

DRILLING DATES:
STARTED: 4/19/87
FINISHED: 4/19/87

EQUIPMENT ☒ 6 3/4 INCH AUGER 16.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.3	FEET OF 2 IN. S.S. SCREEN
	6.8	FEET OF 2 IN. S.S. CASING
2.5	2.8	SACKS OF SAND
33.0	30.0	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, Spillage, Irregular Auger Boring Diameter

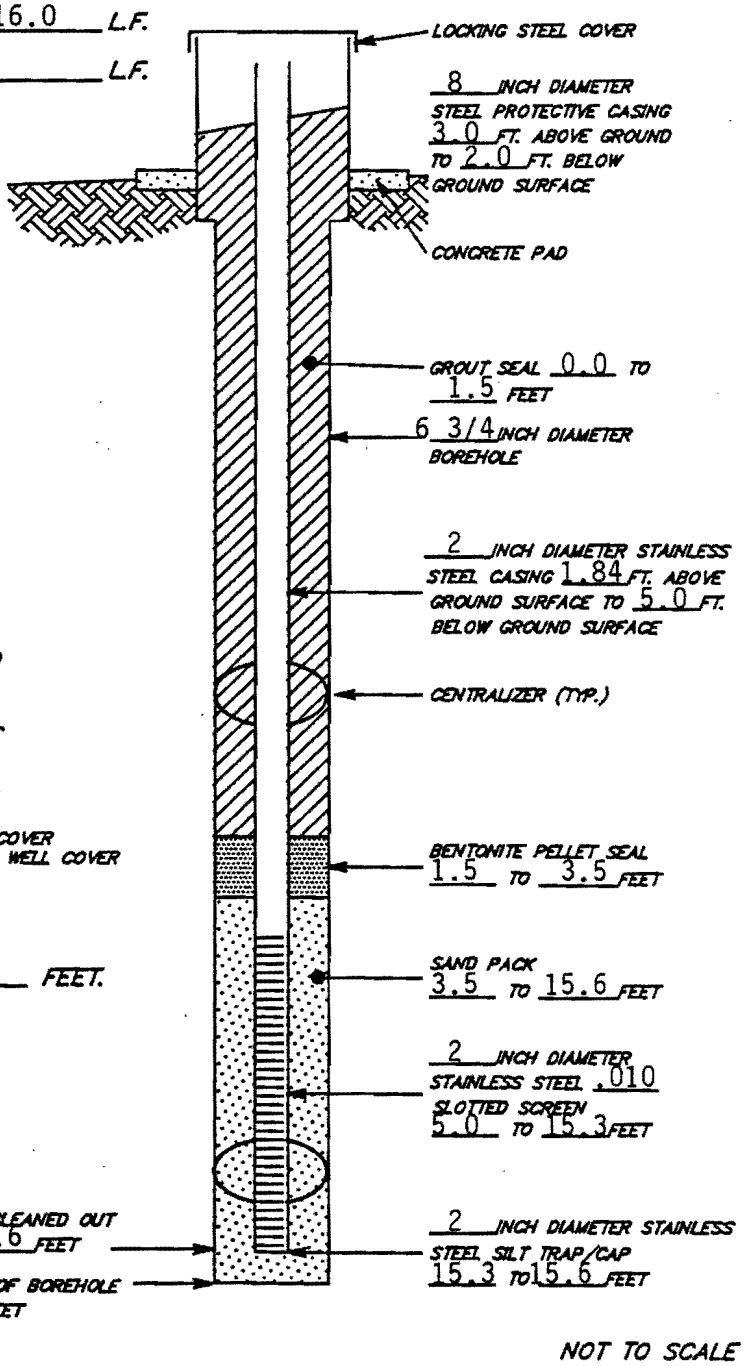
WELL COVER USED ☒ LOCKING STEEL COVER ☐ FLUSH MOUNTED WELL COVER ☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.7 FEET.

CENTRALIZERS AT 6.0 FEET.
15.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 809

DATE: 4/29/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		4/29/87	02
BENTONITE		4/29/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ■ NO)	4/29/87	02
STAINLESS STEEL CASING	(PREPACKAGED ☐ YES ■ NO)	4/29/87	02
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	4/29/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ☐ YES ■ NO)	4/29/87	01
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/22/88	02
GROUT		4/30/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Richard E. Flohr 4/29/87
Richard E. Flohr

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WELL No. 809

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	4/29/87	REF
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	4/29/87	REF
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/22/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	4/29/87	REF

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/22/88
John M. McLoughlin

Richard E. Flohr 4/29/87
Richard E. Flohr

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WELL No. 809

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 2/22/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/22/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 9.3

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 196.0 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: Organic Odor

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 2.5 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/22/88 AT 12.7 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/22/88
John M. McLoughlin

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 809
LOCATION: Main Plant
DATE: 2/22/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 9.3 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/22/88	63					
2/23/88	72					
3/22/88	61		5 JTU's	196	21.07	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	196	21.07	

COMMENTS

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WELL No. 809

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0809 DATE OF TEST: 4/7/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 13.53 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 2.35 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 15

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.9945
1.0266

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WELL No. 809

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
60.00	3.190	.840
75.00	3.060	.710
90.00	2.950	.600
105.00	2.870	.520
120.00	2.800	.450
150.00	2.690	.340
180.00	2.620	.270
240.00	2.520	.170
300.00	2.460	.110
360.00	2.430	.080
420.00	2.410	.060
480.00	2.390	.040
540.00	2.380	.030
600.00	2.370	.020
720.00	2.360	.010

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 8.17E-06 FT/SEC = 2.49E-04 CM/SEC

TRANSMISSIVITY = 8.17E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.09E-05 FT/SEC = 3.32E-04 CM/SEC

TRANSMISSIVITY = 1.09E-04 FT**2/SEC

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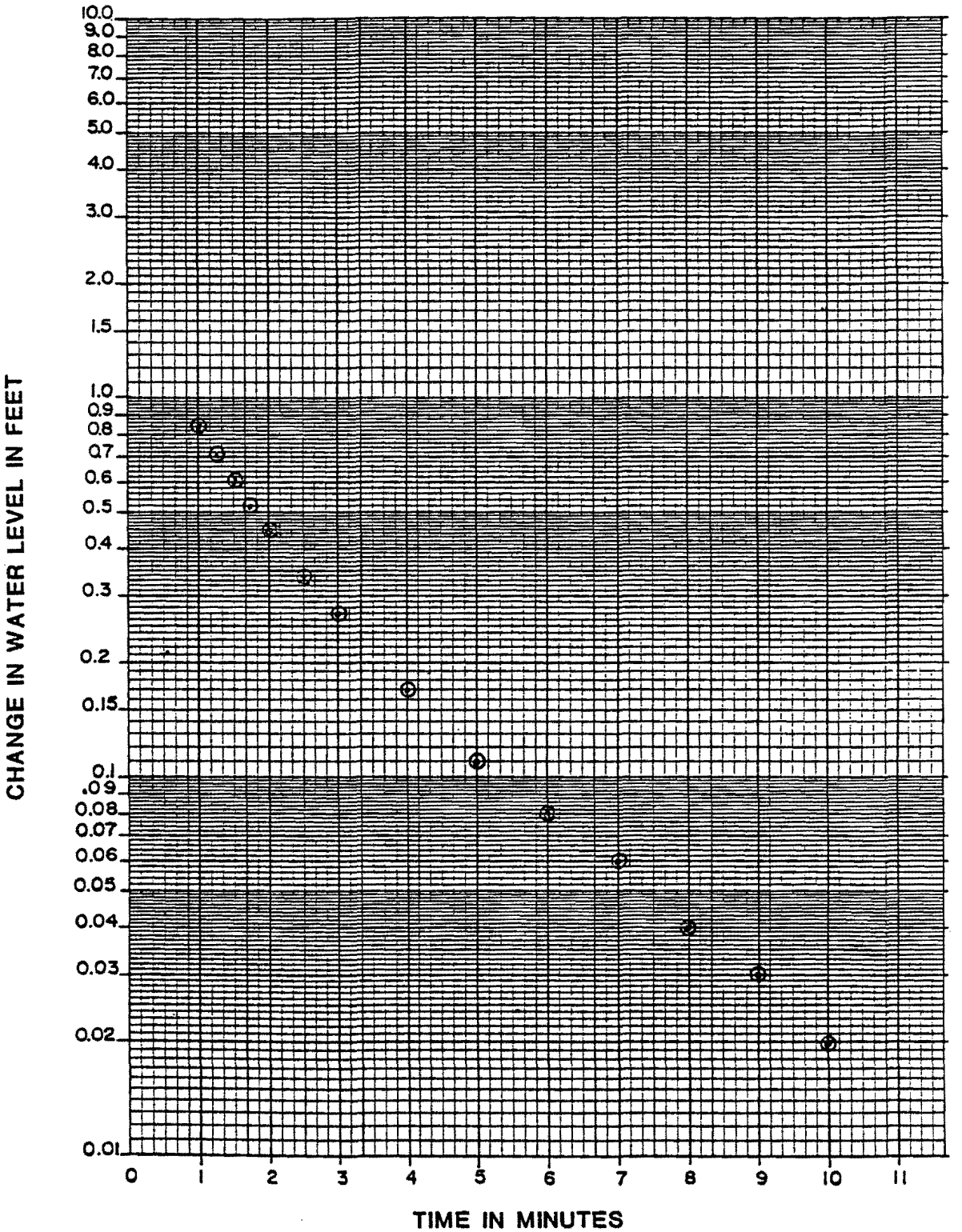
WELL No. 809

HYDRAULIC CONDUCTIVITY CALCULATIONS



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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 810 is located in the Main Plant area. It is in the parking lot 300 feet east of the Environmental Sciences Building #1505. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,879.28, E 29,539.20 (X-10 grid) or latitude 35° 55' 26.0" and longitude 84° 19' 15.3". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 810 was drilled by A.L. Clark Drilling Services, Inc. A Schramm Rotadrill rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, II with the assistance of A. L. Clark, III. Drilling commenced on 5/1/87 and was finished on 5/6/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

5/1/87 The rig was moved to the well site and set up. Split spoon samples were taken from 1.0 feet to 8.0 feet. The boring was augered from 0 feet to 9.5 feet.

5/4/87 The boring was augered from 9.5 feet to 16.6 feet total depth. The boring was bailed dry and then left to recharge overnight.

5/5/87 The boring was bailed and 2 inch stainless steel screen casing, sand and bentonite were installed.

5/6/87 The annular space was grouted from the top of the bentonite seal to the surface.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

One soil sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. A chain of custody form for this sample is included with this data package. This soil sample, 810S01, was collected in the split spoon interval from 5.2 feet to 5.35 feet on 5/1/87.

A bulk density soil sample was collected from the split spoon sample interval from 6.0 feet to 6.3 feet. The sample was measured, weighed and a bulk density of 1.88 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.3 to 15.6 feet. Above the silt trap a

two-inch diameter stainless steel screen was installed from 5.3 to 15.3 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.3 feet to 1.5 feet above ground surface. A sandpack was then poured into the annular space from 4.7 to 15.6 feet, with a 2.2 foot bentonite pellet seal poured into the annular space above the sandpack from 2.5 to 4.7 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 810 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 63 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 2/25/88 at a depth of 12.8 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

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2.5 Hydraulic Conductivity Testing

Well number 810 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 4.97×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 810

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/1/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/1/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/1/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/1/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/1/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/1/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/1/87

Michael L. Ebers

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 810

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE [signature] 5/1/87
Michael L. Ebers

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WELL No. 810

ORNL MONITORING WELL LOG

LOCATION: Main Plant-Bldg. 1000 Parking Lot
DRILLER: A. L. Clark, II
HELPER: A. L. Clark, III
DRILL: Schramm Rotadrill

DATE: START: 5/1/87
FINISH: 5/5/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split spoon, Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: one
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 7.0'
DEPTH DRILLED IN ROCK: 9.0'
TOTAL DEPTH OF WELL: 16.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	1.0			Asphalt and limestone gravels, augered through
1.0	1.9		70%	Clay, light brown with abundant 1/4" to 1/2"
				chert fragments, dry, crumbly, fill
1.9	3.0		80%	Clay, olive gray with abundant chert fragments
				up to 1", dry and crumbly
3.0	5.0		35%	Clay, olive gray with chert
5.0	8.0	810S01 @	100%	Clay, mottled, olive gray and medium brown,
		5.2-5.35'		with chert fragments to 1", plastic, slightly
				moist
	8.0			Split spoon refusal
8.0	16.0			Limestone, olive gray to dark greenish gray,
				fine grained, massive and locally shaly, hard
				augering
	16.0			TOTAL DEPTH

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WELL No. 810

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A.L. Clark Drilling Services

DRILLER: A. L. Clark, II HELPER: A. L. Clark, III

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,879.28
E 29,539.20
ELEV. GROUND 790.19
ELEV. TOP STAINLESS STEEL CASING 791.69

DRILLING DATES:
STARTED: 5/1/87
FINISHED: 5/5/87

EQUIPMENT ☒ 6 3/4 INCH AUGER 16.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	6.8	FEET OF 2 IN. S.S. CASING
2.4	3.0	SACKS OF SAND
31.0	40.0	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Fractures and Cavities

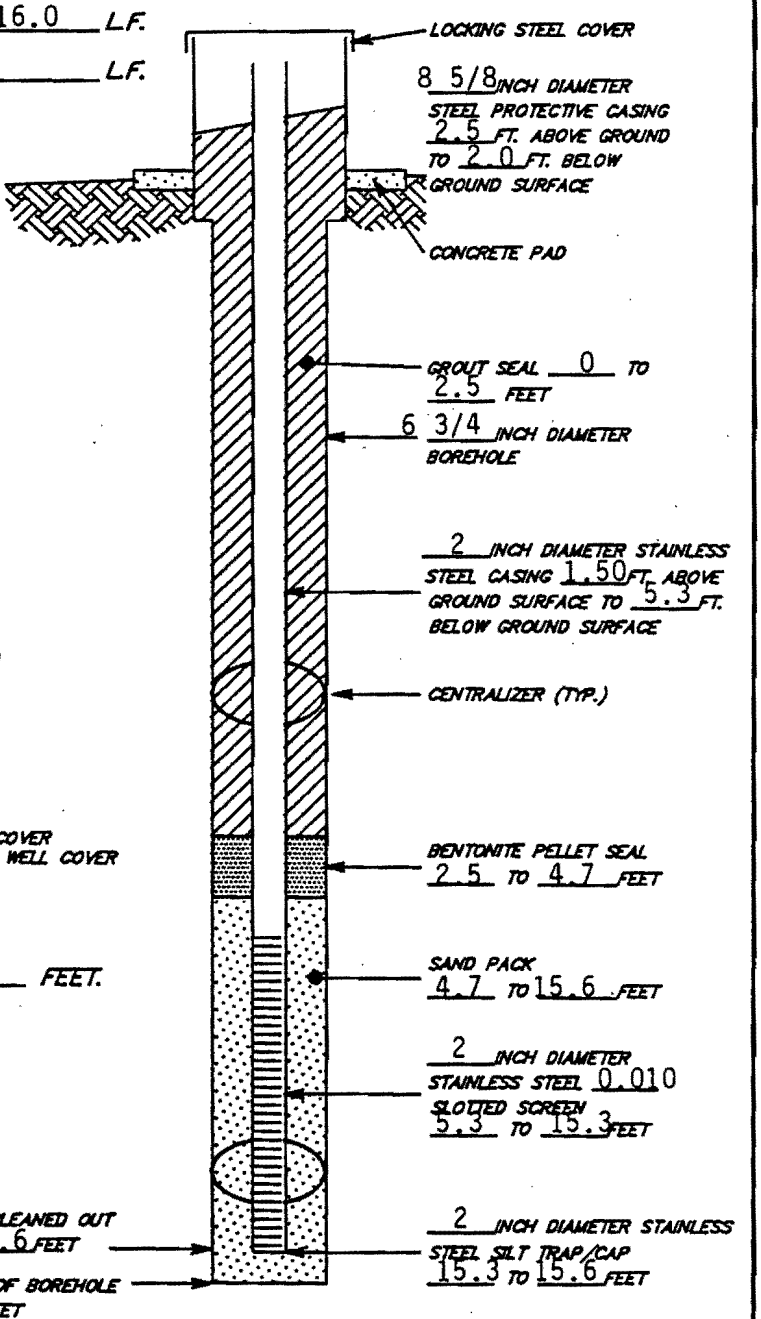
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.8 FEET.

CENTRALIZERS AT 5.6 FEET.
15.6 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 810

DATE: 5/5/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/5/87	02
BENTONITE		5/5/87	01
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/5/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/5/87	03 & 04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	5/5/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ☐ YES ■ NO)	5/5/87	02
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2/25/88	02
GROUT		5/6/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/5/87
Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 810

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/5/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/5/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2/25/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/5/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 2/25/88
John M. McLoughlin

Michael L. Ebers 5/1/87
Michael L. Ebers

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725 Pellissippi Parkway
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WELL No. 810

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 2/19/88 TIME:

DEVELOPMENT ENDING DATE: 2/25/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 9

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 63 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Richard H. Ketelle, MMES

ODOR OF WATER:

WATER DISCHARGED TO:

- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 11.3 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 2/25/88 AT 12.8 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 2/25/88
John M. McLoughlin

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WELL No. 810

DATE: 2/19/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 9

	1 WELL VOLUMES	2 WELL VOLUMES	3 WELL VOLUMES	4 WELL VOLUMES	5 WELL VOLUMES	PERCENT VARIATION
TURBIDITY	318	312	300	309	066	
CONDUCTIVITY	.64	.64	.62	.64	.46	
TEMPERATURE	--	--	--	--	--	
pH	7.9	7.8	7.9	7.9	7.9	
DATE	2/19	2/19	2/22	2/23	2/23	
TIME						
WATER LEVEL IN BARREL						
GALLONS IN BARREL						

	6 WELL VOLUMES	7 WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	PERCENT VARIATION
TURBIDITY	057	5 JTU's				
CONDUCTIVITY	.45					
TEMPERATURE	--					
pH	7.9					
DATE	2/24					
TIME						
WATER LEVEL IN BARREL						
GALLONS IN BARREL						

TOTAL 63 Gallons

	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	PERCENT VARIATION
TURBIDITY						
CONDUCTIVITY						
TEMPERATURE						
pH						
DATE						
TIME						
WATER LEVEL IN BARREL						
GALLONS IN BARREL						

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0810 DATE OF TEST: 4/7/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 12.99 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 4.83 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 30

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
1.5269
1.5340

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WELL No. 810

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
30.00	6.600	1.770
40.00	6.550	1.720
50.00	6.480	1.650
60.00	6.410	1.580
75.00	6.340	1.510
90.00	6.270	1.440
105.00	6.180	1.350
120.00	6.130	1.300
150.00	6.020	1.190
180.00	5.950	1.120
240.00	5.850	1.020
300.00	5.770	.940
360.00	5.690	.860
420.00	5.620	.790
480.00	5.560	.730
540.00	5.490	.660
600.00	5.450	.620
720.00	5.350	.520
840.00	5.290	.460
960.00	5.210	.380
1080.00	5.170	.340
1200.00	5.120	.290
1320.00	5.080	.250
1440.00	5.040	.210
1560.00	5.020	.190
1680.00	5.000	.170
1800.00	4.970	.140
1920.00	4.950	.120
2040.00	4.930	.100
2160.00	4.920	.090

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WELL No. 810

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.63E-06 FT/SEC = 4.97E-05 CM/SEC

TRANSMISSIVITY = 1.63E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 2.18E-06 FT/SEC = 6.64E-05 CM/SEC

TRANSMISSIVITY = 2.18E-05 FT**2/SEC

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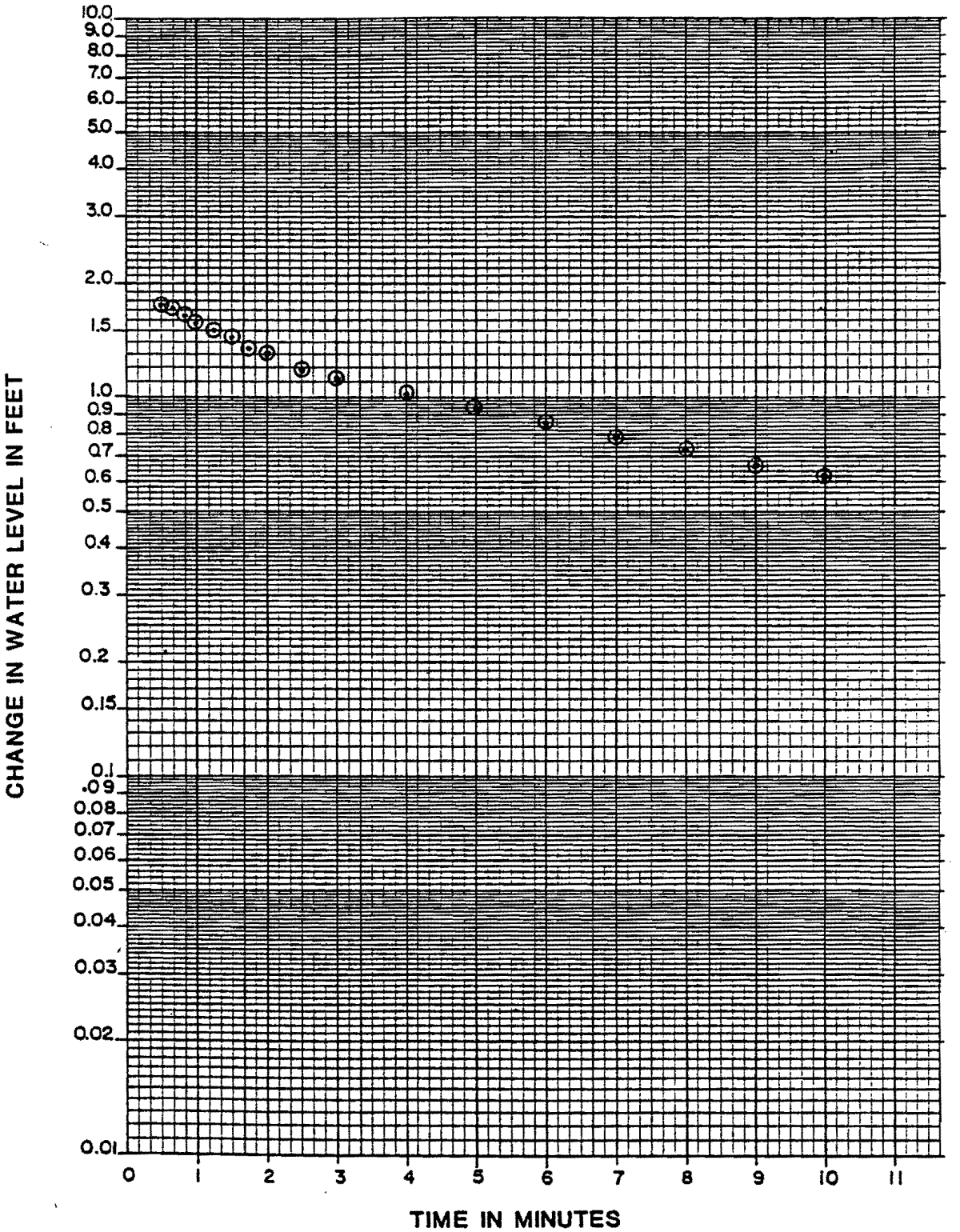
WELL No. 810

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 810501

WELL NO.: 810

LOCATION: MAIN PLANT BLDG 1000 PARKING LOT @ 5.2' TO 5.35'

TYPE: SOIL

SAMPLER: [signature] (SIGNATURE)

DATE: 5/1/87

TIME: 10:30AM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/26/87 ~~5/26/87~~	11:40AM	MCI	[signature]	5/26/87 11:40 →		ORNL

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 811 is located in the Main Plant area. It is between First Street and First Creek, approximately 120 feet west of Building 2500. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,002.68, E 29,652.35 (X-10 grid) or latitude 35° 55' 27.7" and longitude 84° 19' 15.0". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 811 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech and a Driltech rig were used to drill this boring for monitor well installation under the operation of A. L. Clark, III/Steve Clark with the assistance of Richard Pickel/Steve Kirk. Drilling commenced on 5/5/87 and was finished on 5/13/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/5/87 The Gus Pech drill rig was moved to the well site and set up.

5/6/87 The boring was split spooned from 0.0' to 5.8' and then augered from the surface to 17.6 feet.

5/7/87 The boring was augered from 17.6' to 28.0'.

5/8/87 The boring was augered from 28.0' to 31.0' then reamed from the surface to 4.5 feet with a 14" auger. Five and one half feet of 8 inch surface casing was grouted in.

5/11/87 The Gus Pech was moved off the location and the Driltech set up. The boring was deepened with a 6 1/4 inch tri-cone air rotary from 31.0 feet to 67.0 feet.

5/12/87 The boring had 50 feet of water overnight. Stainless steel screen, casing, sandpack and bentonite seal were installed.

5/13/87 The annular space was grouted to the surface.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologists Michael L. Ebers and Richard E. Flohr. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical

Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

One soil sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. A chain of custody form for this sample is included with this data package. This soil sample, 0811S01, was collected in the split spoon interval from 0.5 feet to 0.8 feet on 5/6/87.

2.4 Installation and Development

2.4.1 Installation

This was a type D well. A fourteen-inch diameter boring was augered

from ground surface to bedrock (5.0 feet). An eight-inch diameter string of decontaminated steel surface casing was installed and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill a six-inch diameter boring to a total depth of 66.7 feet. A two-inch diameter stainless steel silt trap was installed from 66.5 to 66.7 feet. Above the silt trap, a two-inch diameter stainless steel screen was installed from 46.5 feet to 66.5 feet. A two-inch diameter stainless steel casing was installed above the screen at 46.5 feet and extended 2.4 feet above ground surface. A sandpack was then poured into the annular space from 44.0 to 66.7 feet, with a 2.0 foot bentonite seal poured into the annular space above the sandpack from 42.0 to 44.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 811 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 150 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 2/24/88 at a depth of 61.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 811 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 4.83×10^{-6} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 811

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/6/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/6/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/12/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/6/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/6/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/6/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/12/87
Michael L. Ebers

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WELL No. 811

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/6/87
Michael L. Ebers

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WELL No. 811

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech & Driltech

DATE: START: 5/6/87
FINISH: 5/12/87
LOGGED BY: Michael L. Ebers & Richard E. Flohr
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split Spoon, Augers & Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: one
TYPE: soil
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 5.8'
DEPTH DRILLED IN ROCK: 60.9'
TOTAL DEPTH OF WELL: 66.7'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	2.0	0811S01	45%	Topsoil, clayey and silty, dark brown with
		@0.5-0.8'		organics and rock fragments @ 0.8' (fill)
2.0	4.0		15%	Clay, light brown, with considerable rock
				fragments
4.0	5.8		35%	Limestone, gray to dark gray, moist at 5.1',
				rock fragments from 5.1' to 5.8'
5.8	22.5			Limestone, gray, hard
22.5	23.5			Limestone, shaly
23.5	66.7			Limestone, medium gray, hard, 2 inch break
				at 41'
	66.7			TOTAL DEPTH

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WELL No. 811

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Richard E. Flohr / Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services, Inc.
DRILLER: Steve Clark, A. L. Clark, III
HELPER: Steve Kirk, Richard Pickel

LOCATION: Main Plant
ORNL GRID COORDINATES
N 22,002.68
E 29,652.35
ELEV. GROUND 791.00
ELEV. TOP STAINLESS STEEL CASING 793.42

DRILLING DATES:
STARTED: 5/6/87
FINISHED: 5/12/87

DRILLING METHOD:
- [x] 6 1/4 INCH AUGER 26.0 L.F.
- [x] 14 INCH AUGER 5.0 L.F.
- [x] 6 1/4 INCH ROTARY 35.7 L.F.
- [ ] ____ INCH ROTARY ____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	N/A	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	5.0	FT. OF 8 IN. SURFACE CASING
2.5	4.0	SACKS OF CEMENT (SURFACE CASING)
	8.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	20.0	GALLONS OF WATER (SURFACE CASING)
	48.9	FT. OF ____ IN. DIA. STAINLESS STEEL CASING
	20.0	FT. OF 2 IN. DIA. STAINLESS STEEL SCREEN
4.1	4.2	SACKS OF SAND
40.0	50.0	POUNDS OF BENTONITE PELLETS
6.7	8.0	SACKS OF CEMENT (WELL CASING)
	16.0	POUNDS OF POWDERED BENTONITE (WELL CASING)
	56.0	GALLONS OF WATER (WELL CASING)
	3.2	FT. OF 8 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES: Cavities and Spillage

SURFACE CASING TREMIE GROUTED YES [x] NO [ ]

STAINLESS STEEL CASING TREMIE GROUTED YES [x] NO [ ]

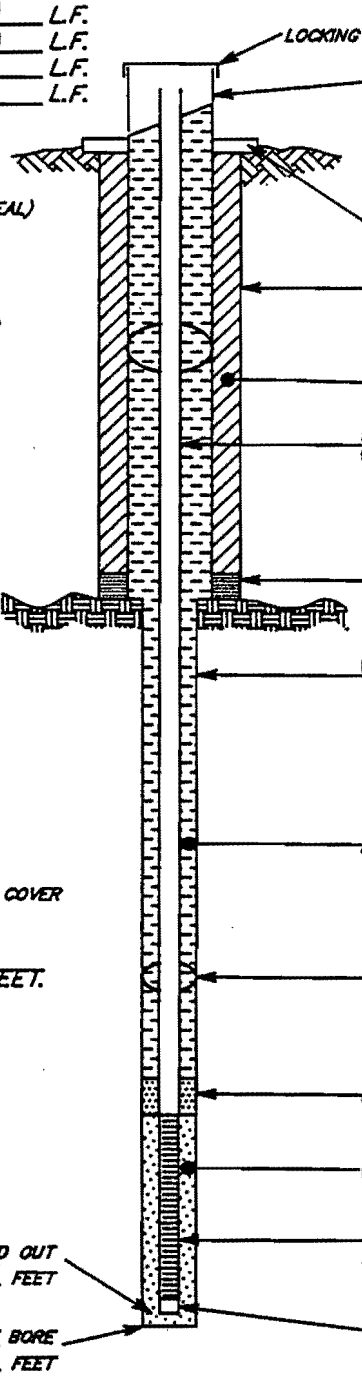
WELL COVER USED
- [x] LOCKING STEEL COVER
- [ ] FLUSH MOUNTED WELL COVER
- [ ] OTHER

SILT TRAP USED YES [x] NO [ ]

MONITORING WELL PUMP BASE SET AT 61.2 FEET.

CENTRALIZERS AT 5 FEET.
16 FEET.
36 FEET.
56 Feet.
66 Feet.

NOTE: ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE D WELL

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WELL No. 811

DATE: 5/12/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/12/87	02
BENTONITE		5/12/87	01
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/12/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/12/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	5/12/87	02
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/12/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	2/24/88	02
GROUT		5/13/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/13/87
Michael L. Ebers

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WELL No. 811

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/12/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/12/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	2/24/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/12/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 2/24/88
John M. McLoughlin

Michael L. Ebers 5/12/87
Michael L. Ebers

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WELL No. 811

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 2/18/88 TIME:

DEVELOPMENT ENDING DATE: 2/24/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 25

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 150 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Richard H. Ketelle, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 1.0 Foot from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 2/24/88 AT 61.2 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 2/24/88
John M. McLoughlin

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WELL No. 811

DATE: 2/18/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 25 '

	1 WELL VOLUMES	2 WELL VOLUMES	3 WELL VOLUMES	4 WELL VOLUMES	5 WELL VOLUMES	PERCENT VARIATION
TURBIDITY	302	650	0.96	0.20	0.10	
CONDUCTIVITY	1.4	0.2	1.01	1.02	0.95	
TEMPERATURE	--	--	--	--	--	
pH	9.0	9.1	9.1	9.1	9.2	
DATE	2/18	2/19	2/22	2/22	2/23	
TIME						
WATER LEVEL IN BARREL						
GALLONS IN BARREL						

	6 WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	PERCENT VARIATION
TURBIDITY	5 JTU's					
CONDUCTIVITY						
TEMPERATURE						
pH						
DATE Wed.	2/24/87					
TIME						
WATER LEVEL IN BARREL						
GALLONS IN BARREL						

TOTAL 150 Gallons

	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	___ WELL VOLUMES	PERCENT VARIATION
TURBIDITY						
CONDUCTIVITY						
TEMPERATURE						
pH						
DATE						
TIME						
WATER LEVEL IN BARREL						
GALLONS IN BARREL						

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0811 DATE OF TEST: 4/8/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 20.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 65.92 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 20.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 2.83 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 31

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
2.3575
2.3602

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WELL No. 811

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
20.00	5.230	2.400
30.00	5.220	2.390
40.00	5.210	2.380
50.00	5.200	2.370
60.00	5.180	2.350
75.00	5.170	2.340
90.00	5.170	2.340
105.00	5.160	2.330
120.00	5.150	2.320
150.00	5.130	2.300
180.00	5.110	2.280
240.00	5.080	2.250
300.00	5.040	2.210
360.00	5.010	2.180
420.00	4.990	2.160
480.00	4.960	2.130
540.00	4.930	2.100
600.00	4.910	2.080
720.00	4.860	2.030
840.00	4.810	1.980
960.00	4.770	1.940
1080.00	4.730	1.900
1200.00	4.690	1.860
1320.00	4.660	1.830
1440.00	4.620	1.790
1560.00	4.590	1.760
1680.00	4.560	1.730
1800.00	4.530	1.700
1920.00	4.510	1.680
2040.00	4.480	1.650
2160.00	4.450	1.620

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WELL No. 811

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.59E-07 FT/SEC = 4.83E-06 CM/SEC

TRANSMISSIVITY = 3.17E-06 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.97E-07 FT/SEC = 6.01E-06 CM/SEC

TRANSMISSIVITY = 3.94E-06 FT**2/SEC

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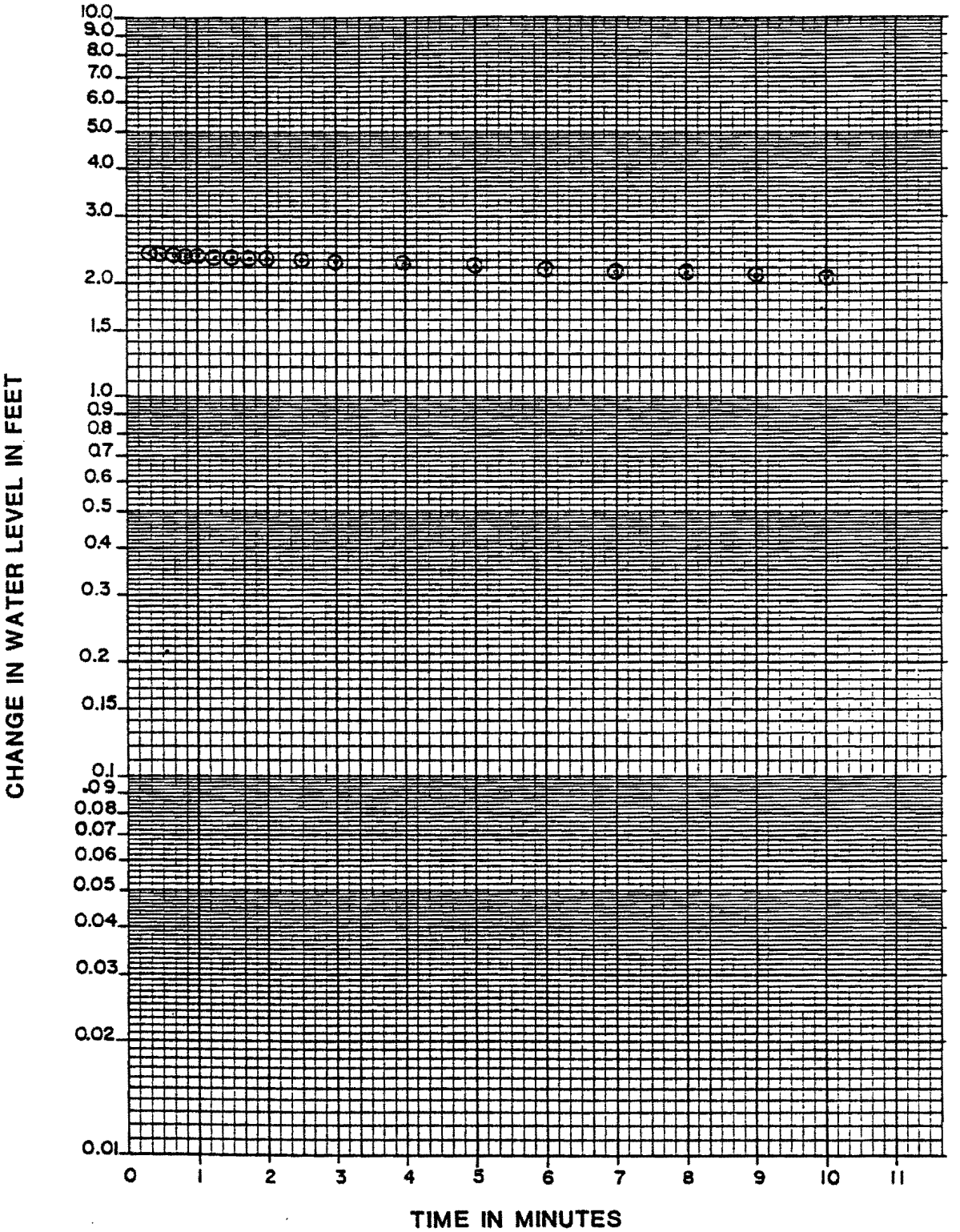
WELL No. 811

HYDRAULIC CONDUCTIVITY CALCULATIONS



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NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0811 S01

WELL NO.: 0811

LOCATION: Depth 0.5'-0.8'

TYPE: Soil

SAMPLER: Richard Fobin (SIGNATURE)

DATE: 5/6/87

TIME: 8:20 AM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
Richard Fobin	5/7/87	1:09 pm	MCI	[illegible]	5/7/87	13:14	ORNL CPA

REMARKS:

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 812 is located in the Main Plant area. It is 70 feet northwest of Building 2069. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,350.38, E 29,931.44 (X-10 grid) or latitude 35° 55' 32.1" and longitude 84° 19' 14.5". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 812 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced and finished on 5/14/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/14/87 The drill rig and equipment were mobilized to the staked drilling location and set up on plastic sheeting. Continuous split spoon samples were taken from ground surface to a depth of 2.5 feet at which point rock was encountered. The split spoon boring was then reamed to 6.5 inches using solid stem augers. The boring was then advanced in rock to a total depth of 16.0 feet. The cuttings produced during drilling were removed by bailing. Stainless steel screen, casing, sandpack and bentonite seal were installed.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

There were no samples collected during drilling.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.2 to 15.5 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.2 to 15.2 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.2 feet to 2.7 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 15.5 feet, with a 2.0 foot bentonite pellet seal poured into the annular space above the sandpack from 2.0 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

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2.4.2 Well Development

Well number 812 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 730.6 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/14/88 at a depth of 12.5 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 812 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout

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attached) value of 3.78×10^{-3} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 812

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. EXCAVATION PERMIT OBTAINED.	5/14/87	[illegible]
2. ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/14/87	[illegible]
3a. SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	[illegible]
3b. PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/14/87	[illegible]
4. WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/14/87	[illegible]
5. CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/14/87	[illegible]
6. POLYETHYLENE COVER IN PLACE OVER HOLE.	5/14/87	[illegible]

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE [signature] 5/14/87
John W. Anderson

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WELL No. 812

ORNL MONITORING WELL LOG

PAGE 1 OF 1

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech

DATE: START: 5/14/87
FINISH: 5/14/87
LOGGED BY: John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Augers
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 2.5'
DEPTH DRILLED IN ROCK: 13.5'
TOTAL DEPTH OF WELL: 16.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5			Topsoil, medium brown with organic material,
				spoon refusal @ 0.5'
0.5	2.5			Limestone gravel with medium brown topsoil
2.5	3.5			Calcareous cemented clay with limestone
				fragments, light green, hard
3.5	5.5			Limestone gravel, fine, dry
5.5	11.5			Shaly limestone, dry, hard
11.5	12.0			Soft, wet, free water
12.0	16.0			Shaly limestone - hard
	16.0			TOTAL DEPTH

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WELL No. 812

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Richard Pickel

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,350.38
E 29,931.44
ELEV. GROUND 803.19
ELEV. TOP STAINLESS STEEL CASING 805.88

DRILLING DATES:
STARTED: 5/14/87
FINISHED: 5/14/87

EQUIPMENT ☒ 6 INCH AUGER 16.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	7.9	FEET OF 2 IN. S.S. CASING
3.0	3.5	SACKS OF SAND
25.0	25.0	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage and Cavities

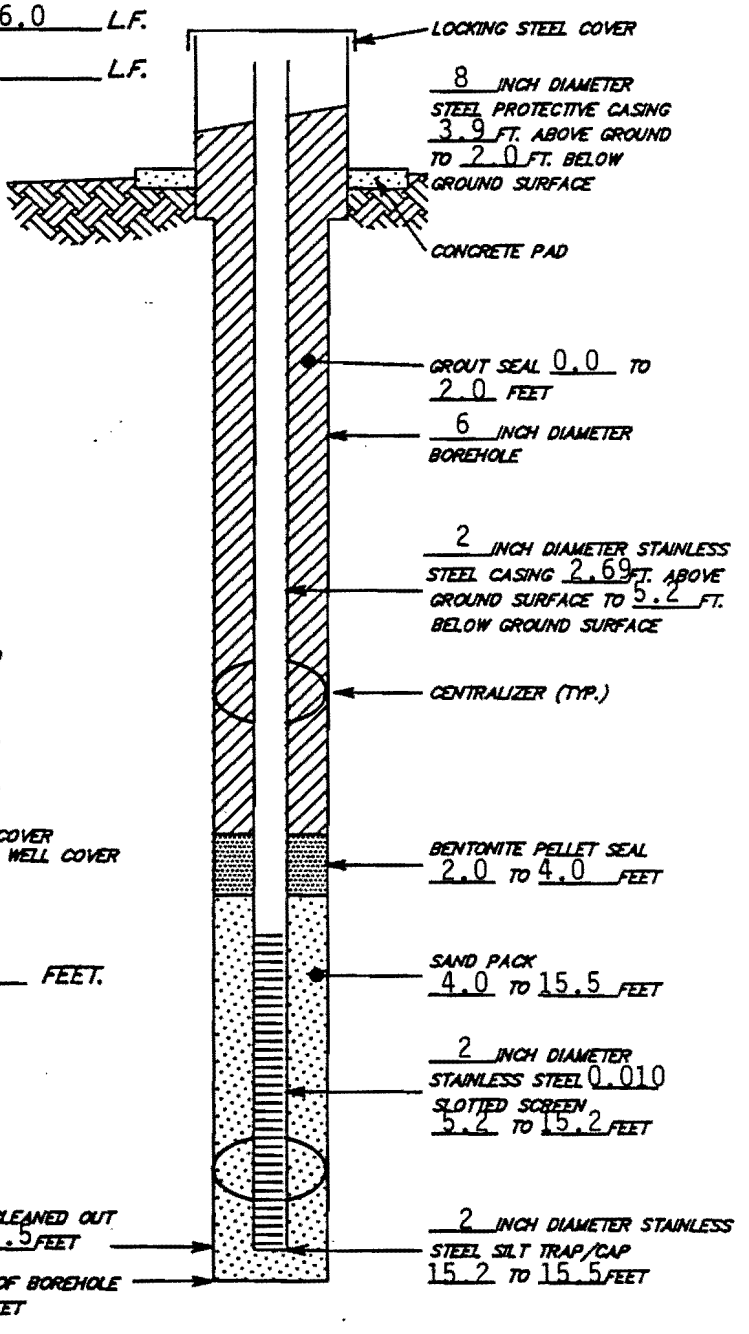
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.5 FEET.

CENTRALIZERS AT 5.0 FEET.
14.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 812

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE: 5/14/87
John W. Anderson

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WELL No. 812

DATE: 5/14/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/14/87	04
BENTONITE		5/14/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/14/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/14/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	5/14/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/14/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/14/88	02
GROUT		5/15/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE John W. Anderson 5/14/87

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WELL No. 812

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/14/87	[illegible]
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/14/87	[illegible]
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/14/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/14/87	[illegible]

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/14/88
John M. McLoughlin

[illegible] 5/14/87
John W. Anderson

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WELL No. 812

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/9/88 TIME:

DEVELOPMENT ENDING DATE: 3/14/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 8.9

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 730.6 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 3.3 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/14/88 AT 12.5 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/14/88
John M. McLoughlin

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WELL NO. 812
LOCATION: Main Plant
DATE: 3/9/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 8.9 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/9/88	112.4					
3/10/88	168.6					
3/11/88	337.2					
3/14/88	112.4	Clear	5 JTU's	730.6	82.09	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	730.6	82.09	

COMMENTS Average pH = 7.6

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WELL No. 812

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0812 DATE OF TEST: 4/13/86

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 11.83 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 3.57 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 12

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
7.3640
7.0979

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WELL No. 812

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
5.00	6.860	3.290
10.00	7.570	4.000
15.00	5.700	2.130
20.00	4.590	1.020
25.00	3.990	.420
30.00	3.740	.170
35.00	3.680	.110
40.00	3.650	.080
45.00	3.630	.060
50.00	3.620	.050
55.00	3.600	.030
60.00	3.580	.010

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.24E-04 FT/SEC = 3.78E-03 CM/SEC

TRANSMISSIVITY = 1.24E-03 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.66E-04 FT/SEC = 5.07E-03 CM/SEC

TRANSMISSIVITY = 1.66E-03 FT**2/SEC

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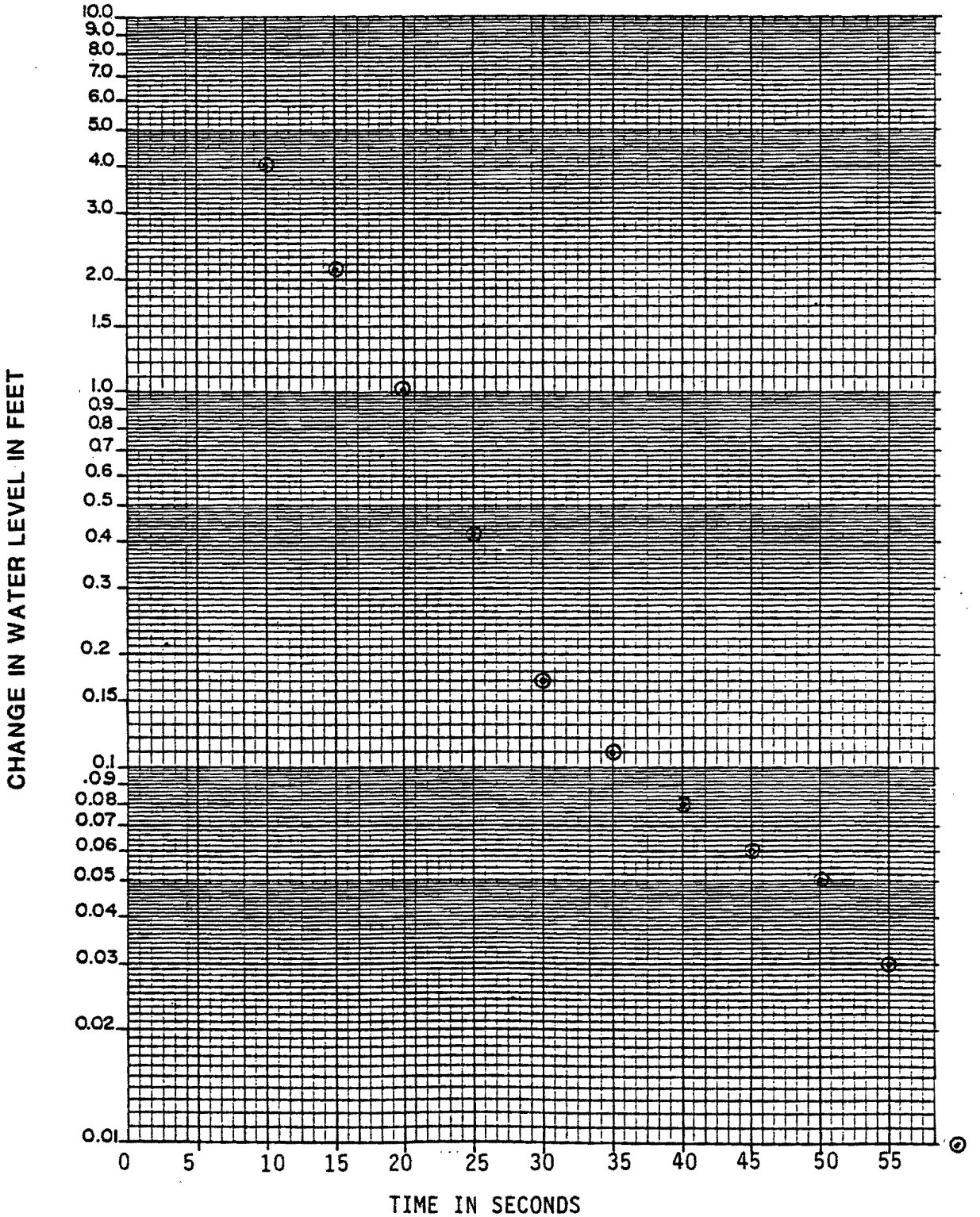
WELL No. 812

HYDRAULIC CONDUCTIVITY CALCULATIONS



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1.0 General Information

1.1 Well Location

Monitoring well number 813 is located in the Main Plant area. It is 40 feet north of Building 2026. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,615.0, E 30,261.86 (X-10 grid) or latitude 35° 55' 36.1" and longitude 84° 19' 13.0". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 813 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech and a Driltech rig were used to drill this boring for monitor well installation under the operation of A. L. Clark, III/Steve Clark with the assistance of Richard Pickel/Steve Kirk. Drilling commenced on 5/26/87 and was finished on 6/1/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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A Gus Pech drill was mobilized to the staked area and set up. Split spoon samples were taken from ground surface to a depth of 20.5 feet, at which point the Chickamauga limestone was encountered. When the originally planned total depth of 30 feet was reached, the boring was found to be dry. At this time, it was decided to make this a "C" type well. A 14-inch boring was advanced to bedrock (21 feet) and surface casing installed. After the surface casing had set up an 8-inch tri-cone bit with the air rotary method was used to advance the boring to 43 feet. Four inch stainless steel casing was installed and grouted into the boring. Drilling then progressed to 63 feet with a 2.0 inch diameter bit. After blowing the boring dry, it was found to have a good rate of recharge.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs.

2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0813S01 was collected in the split spoon interval from 1.2 to 1.4 feet on 5/26/87 and soil sample 0813S02 was collected in the split spoon interval from 6.2 to 6.4 feet on 5/26/87. Analytical results for these two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 9.5 feet to 10.0 feet. The sample was measured, weighed and a bulk density of 2.2 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was an open hole or type C well, without a stainless steel screen. A fourteen-inch diameter boring was augered from ground surface to bedrock (21.6 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a depth of 43.0 feet. A four-inch diameter stainless steel casing was installed and tremie grouted from the bottom of the eight-inch diameter boring at 43.0 feet and extending 0.8 feet above ground surface. The air rotary method was then used to drill a 3 7/8 inch diameter boring (open hole interval) from the bottom of the four-inch diameter stainless steel casing at 43.0 feet to a total depth of 63.0 feet. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 813 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 337.2 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was

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5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/14/88 at a depth of 58.9 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 813 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 5.82×10^{-4} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 813

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/26/87	[illegible]
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/26/87	[illegible]
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	[illegible]
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/26/87	[illegible]
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/26/87	[illegible]
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/26/87	[illegible]
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/26/87	[illegible]

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE [signature] 5/26/87
John W. Anderson

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WELL No. 813

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE 5/26/87

John W. Anderson

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WELL No. 813

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, III/Steve Clark
HELPER: Richard Pickel/Steve Kirk
DRILL: Gus Pech to 21' & Driltech to 63'

DATE: START: 5/26/87
FINISH: 6/1/87
LOGGED BY: John W. Anderson
HEALTH PHYSICST: N/A

TYPE DRILLING: Split Spoon, Auger & Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 20.5'
DEPTH DRILLED IN ROCK: 42.5'
TOTAL DEPTH OF WELL: 63.0'

DRILLING FLUID SAMPLES:
TYPE: Water DATE: 5/27/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5		40%	Topsoil with organic material, dark brown,
				damp
0.5	6.0	0813S01	60%	Clay, silty with chert and limestone
		@1.2-1.4'		fragments, medium brown, damp
6.0	8.0	0813S02	100%	Clay, silty, with chert fragments, orange
		@6.2-6.4'		brown, wet
8.0	10.0		100%	Clay, silty, crumbly, some limestone and
				chert, orange brown, wet
				Bulk Density @ 9.5'-10.0' = 2.2 grams/cm³
10.0	18.0		100%	Clay, silty with chert fragments, mottled
				orange brown and light brown, crumbly, damp
18.0	20.5		100%	Clay, silty with chert and shale fragments,
				plastic, orange brown, damp
	20.5			Auger and split spoon refusal
20.5	22.2			Limestone, light gray
22.2	23.4			Soft
23.4	26.1			Limestone, very hard
26.1	29.0			Void, clay filled, very soft
29.0	30.0			Limestone, hard

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WELL No. 813

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
30.0	39.5			Void, open*
39.5	59.8			Limestone, hard
59.8	60.4			Soft
60.4	63.0			Hard
	63.0			TOTAL DEPTH
				* No detailed lithologic description available for the interval from 30.0' to 63.0' due to the use of a containment box.

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WELL No. 813

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, II HELPER: Richard Pickel

DRILLING METHOD:
- ☒ 14 INCH AUGER 21.6 L.F.
- ☒ 6.5 INCH AUGER 39.5 L.F.
- ☒ 8.0 INCH ROTARY 43.0 L.F.
- ☐ INCH ROTARY 20.0 L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,615.0
E 30,261.86
ELEV. GROUND 848.86
ELEV. TOP STAINLESS STEEL CASING 849.71

DRILLING DATES:
STARTED: 5/26/87
FINISHED: 6/1/87

MATERIALS USED

EST. VOL.	USED VOL.	
	50	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	22.9	FT. OF 10 IN. SURFACE CASING
8	8	SACKS OF CEMENT (SURFACE CASING)
	16	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	48	GALLONS OF WATER (SURFACE CASING)
	43.8	FT. OF 4.0 IN. DIA. STAINLESS STEEL CASING
20	87	SACKS OF CEMENT (S.S. CASING)
	174	POUNDS OF POWDERED BENTONITE (S.S. CASING)
	522	GALLONS OF WATER (S.S. CASING)
	25	POUNDS OF BENTONITE PELLETS (STAINLESS STEEL CASING SEAL)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavernous

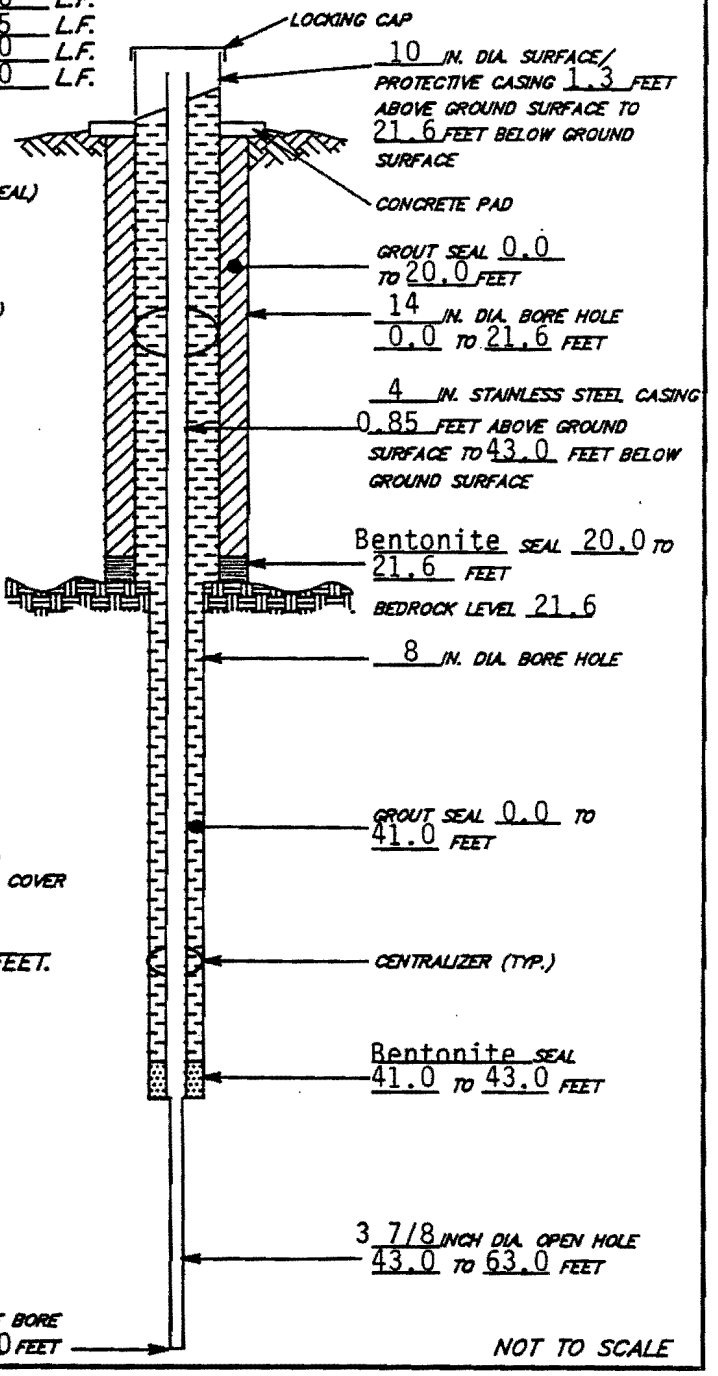
SURFACE CASING TREMIE GROUTED YES ☒ NO ☐
STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

MONITORING WELL PUMP BASE SET AT 58.9 FEET.

CENTRALIZERS AT 4.0 FEET.
22.0 FEET.
42.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE C WELL

NOT TO SCALE

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WELL No. 813

DATE: 6/1/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		N/A	N/A
BENTONITE		6/1/87	06
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ☐ NO)	N/A	N/A
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	6/1/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	6/1/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	6/1/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/14/88	02
GROUT		6/1/87	06
WELL COVERS		6/1/87	01
SURFACE CASING		5/27/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE John W. Anderson 6/1/87

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WELL No. 813

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/1/87	
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/1/87	
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/11/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/1/87	

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE: John Michael McLoughlin 3/11/88
John M. McLoughlin

6/1/87
John W. Anderson

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WELL No. 813

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/10/88 TIME:

DEVELOPMENT ENDING DATE: 3/11/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 8.9

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 337.2 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 48.4 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/14/88 AT 58.9 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/14/88
John M. McLoughlin

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WELL NO. 813
LOCATION: Main Plant
DATE: 3/11/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 8.9 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/10/88	168.6					
3/11/88	168.6	Clear	5 JTU's	337.2	37.89	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	337.2	37.89	

COMMENTS Average pH = 7.3

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0813 DATE OF TEST: 4/13/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 3.88 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 20.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 13.28 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 13.28 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 4.68 FEET
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 24

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
2.7441
2.9992
3.2683
3.5192
3.7542
3.8938

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WELL No. 813

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	7.390	2.710
20.00	8.430	3.750
30.00	8.330	3.650
40.00	8.140	3.460
50.00	8.020	3.340
60.00	7.690	3.010
75.00	7.300	2.620
90.00	7.000	2.320
105.00	6.730	2.050
120.00	6.470	1.790
150.00	6.060	1.380
180.00	5.770	1.090
240.00	5.430	.750
300.00	5.200	.520
360.00	5.050	.370
420.00	4.950	.270
480.00	4.870	.190
540.00	4.820	.140
600.00	4.790	.110
720.00	4.750	.070
840.00	4.740	.060
960.00	4.730	.050
1080.00	4.730	.050
1200.00	4.730	.050

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.91E-05 FT/SEC = 5.82E-04 CM/SEC

TRANSMISSIVITY = 2.53E-04 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.91E-05 FT/SEC = 5.82E-04 CM/SEC

TRANSMISSIVITY = 2.53E-04 FT**2/SEC

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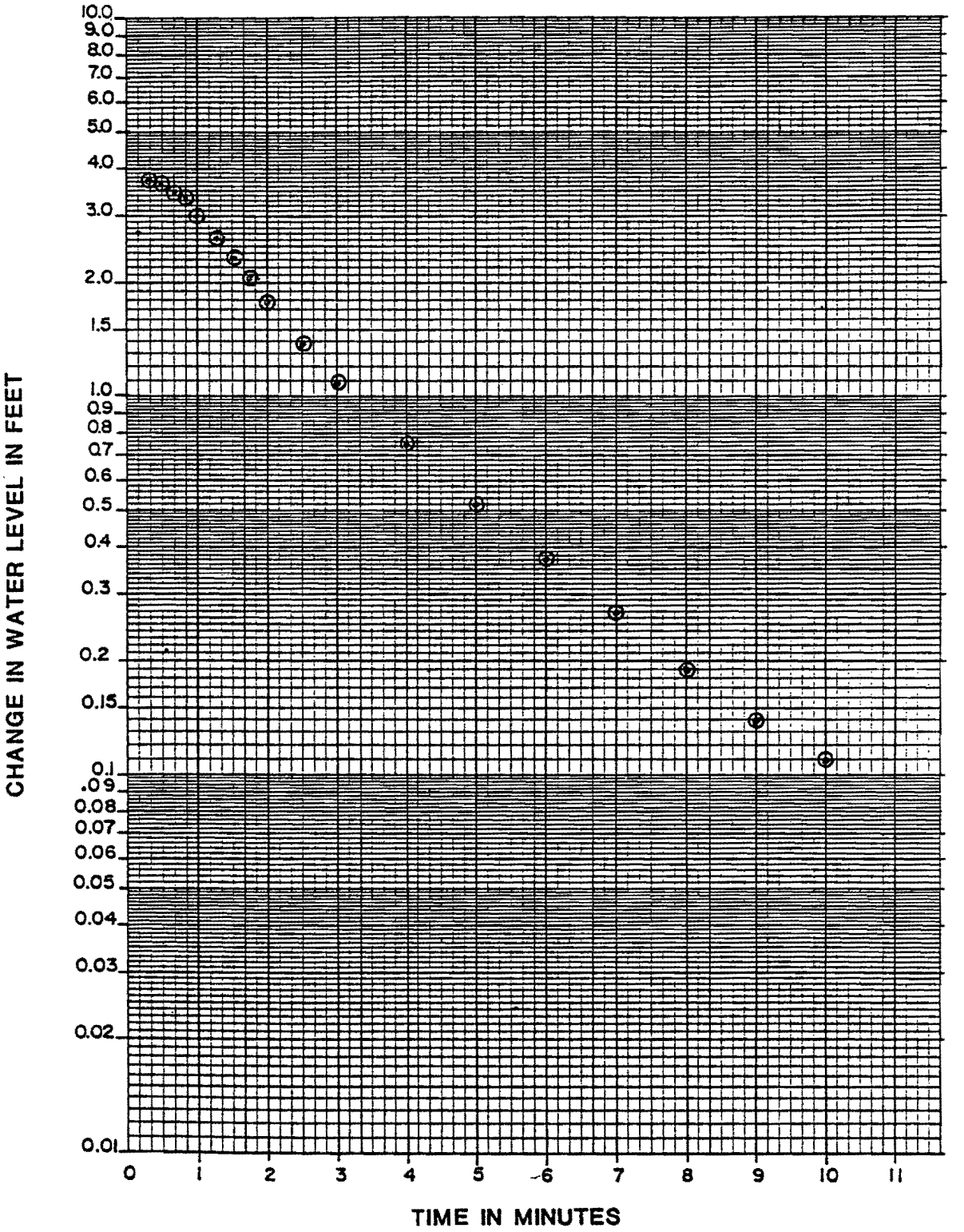
WELL No. 813

HYDRAULIC CONDUCTIVITY CALCULATIONS



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NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0813501

WELL NO.: 0813

LOCATION: 1.2' - 1.4'

TYPE: Soil

SAMPLER: John Chuchman (SIGNATURE)

DATE: 5/26/87

TIME: 9:40

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
John Chuchman	6/2/87	7:30	MCI	[illegible]	6/2/87	7:30	MCI
[illegible]	6/2/87	9:00	MCI	[illegible]	6/2/87	09:00	ORNL CPA

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0813 502

WELL NO.: 0213

SAMPLER: (SIGNATURE)

LOCATION: 6.2' - 6.4'

TYPE: Soil

DATE: 5/26/87

TIME: 10:10

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
	6/2/87	7:30	MCI		6/2/87	7:30	MCI
	6/2/87	9:00	MCI		6/2/87	0900	ORNL CPA

REMARKS:

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1.0 General Information

1.1 Well Location

Monitoring well number 814 is located in the Main Plant area. It is 30 feet north of Building 3013. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,831.84, E 30,999.25 (X-10 grid) or latitude 35° 55' 41.9" and longitude 84° 19' 07.0". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 814 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech and a Driltech drilling rig were used to drill this boring for monitor well installation under the operation of A. L. Clark, III/Steve Clark with the assistance of Joe Clark/Steve Kirk. Drilling commenced on 6/5/87 and was finished on 6/18/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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6/5/87 The Gus Pech was mobilized to the staked location and set up on plastic. The boring was drilled from 0.0' to 5.0' with a 14" auger.

6/8/87 Set 4.5' of 10 3/4" surface casing and grouted with 2 sacks cement.

6/9/87 The Gus Pech was moved off the hole and a Driltech mobilized to the location.

6/10/87 Drilled from 4.5' to 80.0' with 6 1/4" air rotary tri-cone using the containment box.

6/11/87 Had 23 feet of water in hole. Started to install 4" casing and screen. Hit obstruction at 65'. Removed 4" casing and screen and drilled out obstruction. Reinstalled 4" screen and casing, sandpack and bentonite seal.

6/12/87 Partially grouted annulus with 16 sacks of cement (hydraulic pump shaft broke).

6/18/87 Finished grouting annular space with 8 sacks of cement.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures

outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

One soil sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. A chain of custody form for this sample is included with this data package. Soil sample 0814S01 was collected in the split spoon interval from 2.3 to 2.5 feet on 6/5/87. A drill water sample was collected from the water pump on the drill rig on 6/11/87. Analytical results for the two samples described above can be obtained from the Remedial Action Program data base at ORNL.

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A bulk density soil sample was collected from the split spoon sample interval from 0.8 to 1.2 feet. The sample was measured, weighed and a bulk density of 1.9 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A fourteen-inch diameter boring was augered from ground surface to bedrock (4.5 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a total depth of 79.0 feet. A four-inch diameter stainless steel silt trap was installed from 78.7 to 79.0 feet. Above the silt trap, a four-inch diameter stainless steel screen was installed from 48.7 feet to 78.7 feet. A four-inch diameter stainless steel casing was installed from the top of the screen at 48.7 feet and extending 1.3 feet above ground surface. A sandpack was then poured into the annular space from 46.0 to 79.0 feet, with a 3 foot bentonite seal poured into the annular space above the sandpack from 43.0 to 46.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 814 was developed to remove drill cuttings, silt, and

other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 298 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/10/88 at a depth of 75.0 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 814 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously removing a known quantity of water from the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 3.53×10^{-3} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 814

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/5/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/5/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	6/11/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/5/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/5/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/5/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/11/87

Michael L. Ebers

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WELL No. 814

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/5/87

Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 814

ORNL MONITORING WELL LOG

LOCATION: Main Plant Near Bldg. 3013
DRILLER: A. L. Clark, III, Steve Clark
HELPER: Joe Clark, Steve Kirk
DRILL: Gus Pech, Driltech

DATE: START: 6/5/87
FINISH: 6/11/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Sherrie Chadwick

TYPE DRILLING: Split Spoon, Auger & Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: one
TYPE: soil
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 4.5'
DEPTH DRILLED IN ROCK: 75.5'
TOTAL DEPTH OF WELL: 80.0'

DRILLING FLUID SAMPLES:
TYPE: Drill Water DATE: 6/11/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.3		100%	Topsoil, roots and grass, dark brown
0.3	2.8	0814S01	100%	Clay, light brown, medium stiff, slightly
		@2.3-2.5'		damp with 30% chert fragments from 1/16" to
				1", subangular
				Bulk Density @ 0.8' to 1.2' = 1.9 grams/cm³
2.8	2.9		100%	Limestone, light olive gray, fine grained,
				locally weathered
	2.9			Split spoon refusal
2.9	4.5			Clay, light brown, medium stiff, slightly
				damp with chert fragments
	4.5			Auger refusal
4.5	19.5			Limestone, shaly, fairly soft*
19.5	21.0			Limestone, fairly hard
21.0	21.5			Limestone, shaly, soft
21.5	31.0			Limestone, fairly hard
31.0	32.0			Limestone, shaly, soft
32.0	42.0			Limestone, hard
42.0	42.8			Limestone, shaly, hard
42.8	53.0			Limestone, medium hard

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WELL No. 814

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
53.0	53.2			Soft
53.2	60.0			Limestone, medium hard
60.0	72.0			Limestone, hard
72.0	72.5			Soft
72.5	79.0			Limestone, hard
	79.0			TOTAL DEPTH
				* No detailed lithologic description available
				for the interval from 4.5' to 79.0' due to
				the use of a containment box.

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WELL No. 814

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- ☒ 14 INCH AUGER 4.5 L.F.
- ☐ INCH AUGER L.F.
- ☒ 8 INCH ROTARY 74.5 L.F.
- ☐ INCH ROTARY L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,831.84
E 30,999.24
ELEV. GROUND 877.00
ELEV. TOP STAINLESS STEEL CASING 878.32

DRILLING DATES:
STARTED: 6/5/87
FINISHED: 6/11/87

MATERIALS USED

EST. VOL.	USED VOL.	
	25	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	4.5	FT. OF 10 IN. SURFACE CASING
1.4	2.0	SACKS OF CEMENT (SURFACE CASING)
	4.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	14	GALLONS OF WATER (SURFACE CASING)
	50.0	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
	30	FT. OF 4 IN. DIA. STAINLESS STEEL SCREEN
10	12.5	SACKS OF SAND
40	50	POUNDS OF BENTONITE PELLETS
9.5	24	SACKS OF CEMENT (WELL CASING)
	48	POUNDS OF POWDERED BENTONITE (WELL CASING)
	168	GALLONS OF WATER (WELL CASING)
	2.2	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, Spillage, Irregular Auger Boring

SURFACE CASING TREMIE GROUTED YES ☒ NO ☐ Diameter

STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

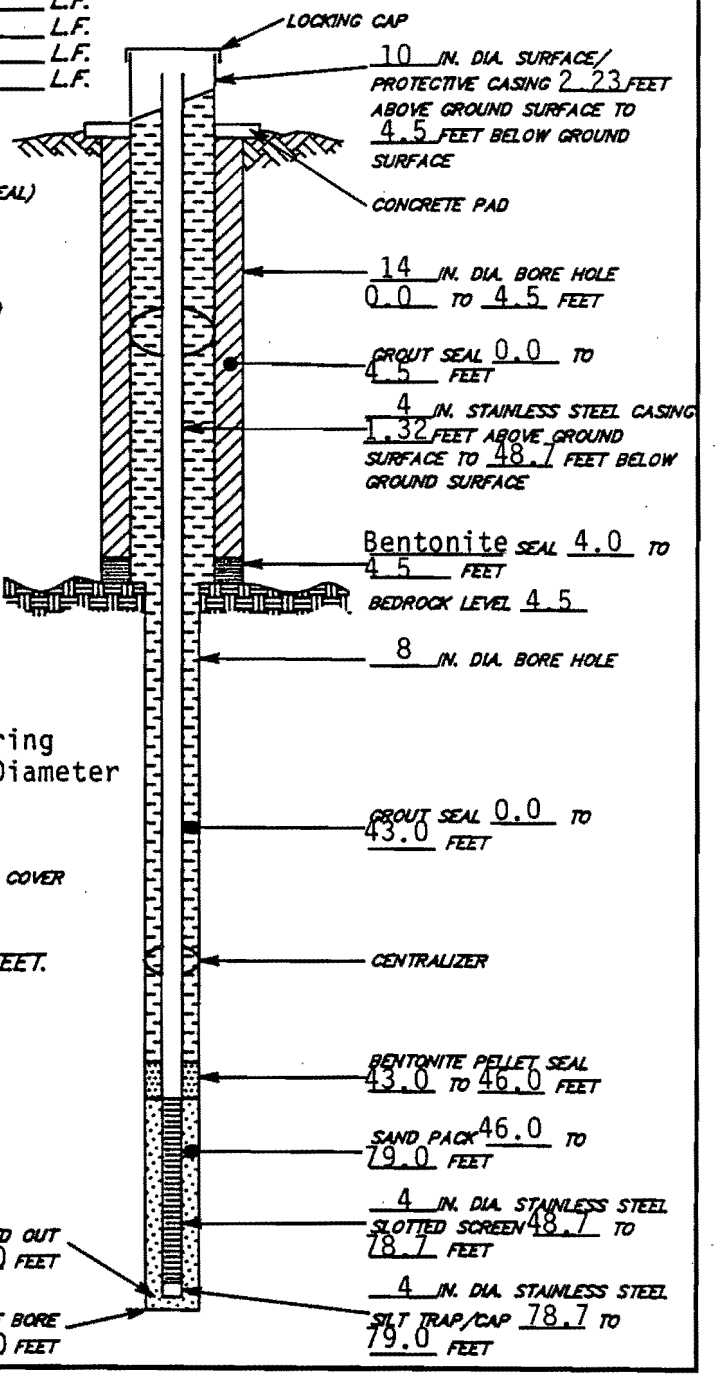
WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 75.0 FEET.

CENTRALIZERS AT 3 FEET.
20 FEET.
40 FEET.
60 Feet.
79 Feet.

NOTE: ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE B WELL

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WELL No. 814

DATE: 6/11/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		6/11/87	02
BENTONITE		6/8/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	6/11/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	6/11/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	6/11/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	6/11/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/10/88	02
GROUT		6/8/87 6/12/87	07 07
WELL COVERS		6/87	01
SURFACE CASING		6/8/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/11/87
Michael L. Ebers

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WELL No. 814

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/11/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/11/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/10/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/11/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/10/88
John M. McLoughlin

Michael L. Ebers 6/11/87
Michael L. Ebers

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WELL No. 814

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/8/88 TIME:

DEVELOPMENT ENDING DATE: 3/9/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 39.0

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 298.0 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- [x] CLEAR
- [ ] SLIGHTLY CLOUDY
- [ ] MOD. TURBID
- [ ] MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Steve L. Laman, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- [ ] GROUND SURFACE
- [ ] STORM SEWERS
- [x] DRUMS
- [ ] TANK TRUCK
- [ ] STORAGE TANKS
- [ ] OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 54.9 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/10/88 AT 75.0 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/10/88
John M. McLoughlin

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WELL NO. 814
LOCATION: Main Plant
DATE: 3/8/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 39 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/8/88	112.4	Sl. Cloudy				
3/9/88	185.6	Clear	5 JTU's	298.0	7.64	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	298.0	7.64	

COMMENTS Average pH = 7.2

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0814 DATE OF TEST: 4/14/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.25 INCHES
DIAMETER OF DRILLED HOLE = 8.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 30.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 18.30 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 30.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 8.22 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 15

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WELL No. 814

HYDRAULIC CONDUCTIVITY CALCULATIONS

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.3491
.4143
.4835
.6245
.6812
.7387
.7888
.8835
.9168

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	7.340	.880
20.00	7.750	.470
30.00	7.900	.320
40.00	7.980	.240
50.00	8.040	.180
60.00	8.060	.160
75.00	8.110	.110
90.00	8.150	.070
105.00	8.150	.070
120.00	8.170	.050
150.00	8.190	.030
180.00	8.200	.020
240.00	8.200	.020
300.00	8.210	.010
360.00	8.210	.010

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WELL No. 814

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.16E-04 FT/SEC = 3.53E-03 CM/SEC

TRANSMISSIVITY = 3.48E-03 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 8.50E-05 FT/SEC = 2.59E-03 CM/SEC

TRANSMISSIVITY = 2.55E-03 FT**2/SEC

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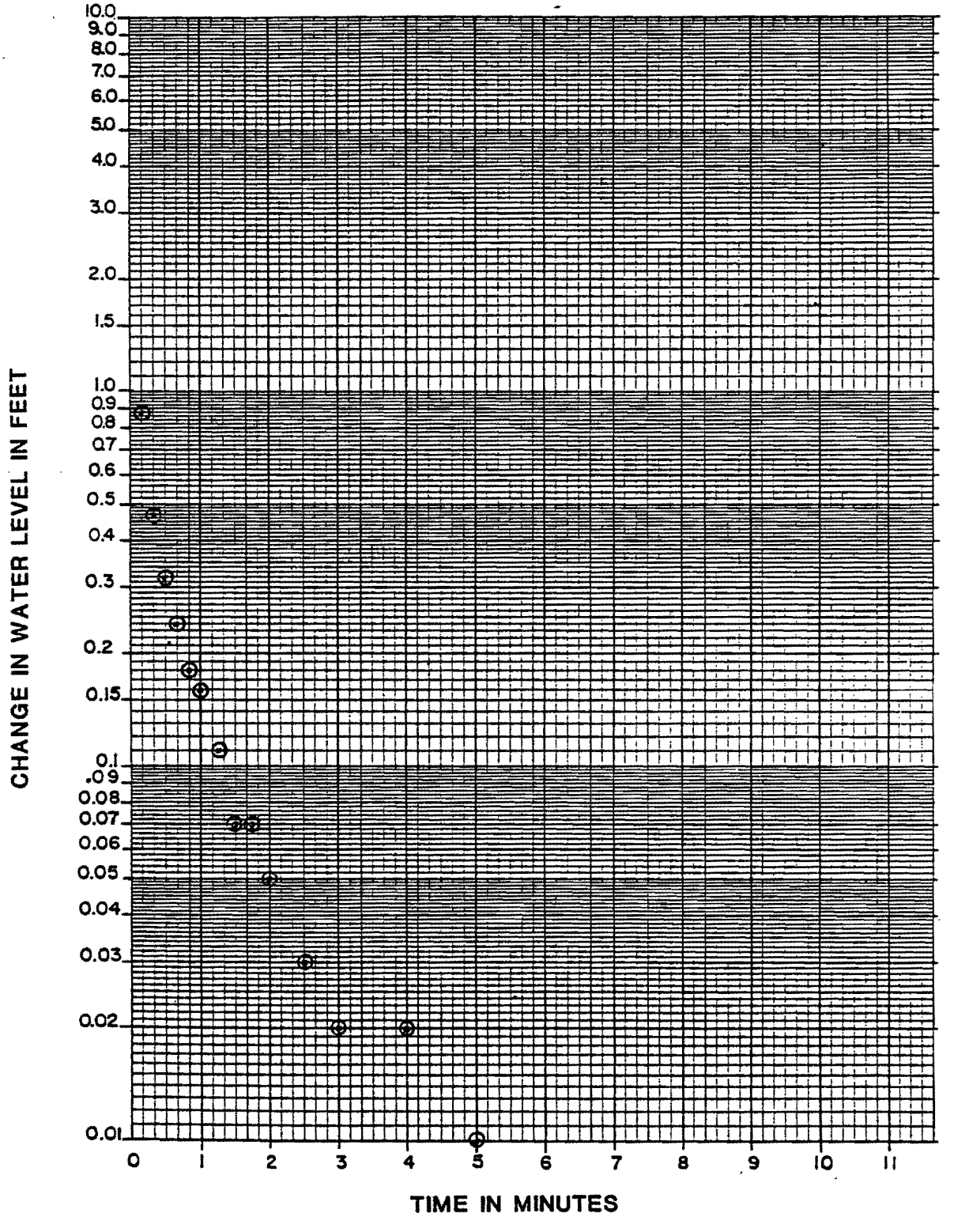
WELL No. 814

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0814 S01

WELL NO.: 0814

LOCATION: Main Plant @ 2.3-2.5'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 6/5/87

TIME: 12:30 P.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	6/22/87	9:30AM	MCI	[signature]	6/22/87	9:30	

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0814 W01

WELL NO.: 0814

LOCATION: Main Plant @80'

TYPE: Drill Water

SAMPLER: [signature] (SIGNATURE)

DATE: 6/11/87

TIME: 7:30 A.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	6/22/87	9:30AM	MCI	Nancy Owen	6/22/87	9:30 am	

REMARKS:

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1.0 General Information

1.1 Well Location

Monitoring well number 815 is located in the Main Plant area. It is 80 feet west of Building 3103. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 23,143.96, E 31,746.29 (X-10 grid) or latitude 35° 55' 48.6" and longitude 84° 19' 01.5". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 815 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced on 5/19/87 and was finished on 5/20/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/19/87 & 5/20/87 The drill rig and equipment were mobilized to the staked location and set up on plastic sheeting. Continuous split spoon samples were taken from the ground surface to a depth of 10.0 feet. The split spoon boring was then reamed to a diameter of 6.5 inches using solid stem augers. The boring was then advanced to a total depth of 26.0 feet. This well was originally planned to be 15 feet in depth, but due to a lack of water, it was increased to 26.0 feet. The cuttings produced during drilling were removed by bailing. Two inch stainless steel casing, screen, sandpack and bentonite were installed.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0815S01 was collected in the split spoon interval from 1.0 feet to 1.3 feet on 5/19/87 and soil sample 0815S02 was collected in the split spoon interval from 6.2 feet to 6.4 feet on 5/19/87.

A bulk density soil sample was collected from the split spoon sample interval from 1.3 feet to 1.7 feet. The sample was measured, weighed and a bulk density of 2.0 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 25.7 to 26.0 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 15.7 to 25.7 feet. A two-inch diameter stainless steel casing was installed above the screen from 15.7 feet to 2.2 feet above ground surface. A sandpack was then poured into the annular space from 14.0 to 26.0 feet, with a 2.0 foot bentonite pellet seal poured into the annular space above the sandpack from 12.0 to 14.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 815 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 428.9 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/21/88 at a depth of 23.0 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 815 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 8.19×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 815

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/19/87	[illegible]
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/19/87	[illegible]
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	[illegible]
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/19/87	[illegible]
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/19/87	[illegible]
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/19/87	[illegible]
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/19/87	[illegible]

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE [signature] 5/19/87
John W. Anderson

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WELL No. 815

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE 5/18/87
John W. Anderson

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 815

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech

DATE: START: 5/19/87
FINISH: 5/20/87
LOGGED BY: John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split spoons, Augers
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger, pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 10.0'
DEPTH DRILLED IN ROCK: 16.0'
TOTAL DEPTH OF WELL: 26.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.3		100%	Topsoil, dark brown, with organic material
0.3	2.0	0815S01	100%	Clay, silty, reddish-brown with limestone
		@1.0-1.3'		fragments, damp
				Bulk Density = 2.0 grams/cm³
2.0	4.0		30%	Clay, silty, reddish-brown with limestone
				fragments, damp
4.0	6.0		100%	Clay, greenish gray, silty, with minor fine
				limestone fragments, moist
6.0	8.0	0815S02	20%	Clay, greenish gray, silty with minor fine
		@6.2-6.4'		limestone fragments, moist
8.0	9.4		100%	Clay, greenish gray, silty with limestone
				fragments, wet
9.4	10.0			Clay, shaly, brownish-red with limestone
				fragments, wet
	10.0			Split spoon refusal
10.0	15.1			Siltstone, reddish-brown, hard, damp
15.1	16.0			Shale, reddish-brown, crumbly, damp
16.0	26.0			Siltstone, reddish-brown, crumbly, wet
	26.0			TOTAL DEPTH

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WELL No. 815

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services, Inc.

DRILLER: A. L. Clark, III HELPER: Richard Pickel

LOCATION Main Plant
ORNL GRID COORDINATES
N 23,143.96
E 31,746.29
ELEV. GROUND 823.99
ELEV. TOP STAINLESS STEEL CASING 826.20

DRILLING DATES:
STARTED: 5/19/87
FINISHED: 5/20/87

EQUIPMENT ☒ 6 INCH AUGER 26.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	17.9	FEET OF 2 IN. S.S. CASING
3.0	3.0	SACKS OF SAND
33.0	33.0	POUNDS OF BENTONITE PELLETS
5.0	5.0	SACKS OF CEMENT
	10.0	POUNDS OF POWDERED BENTONITE
	30.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

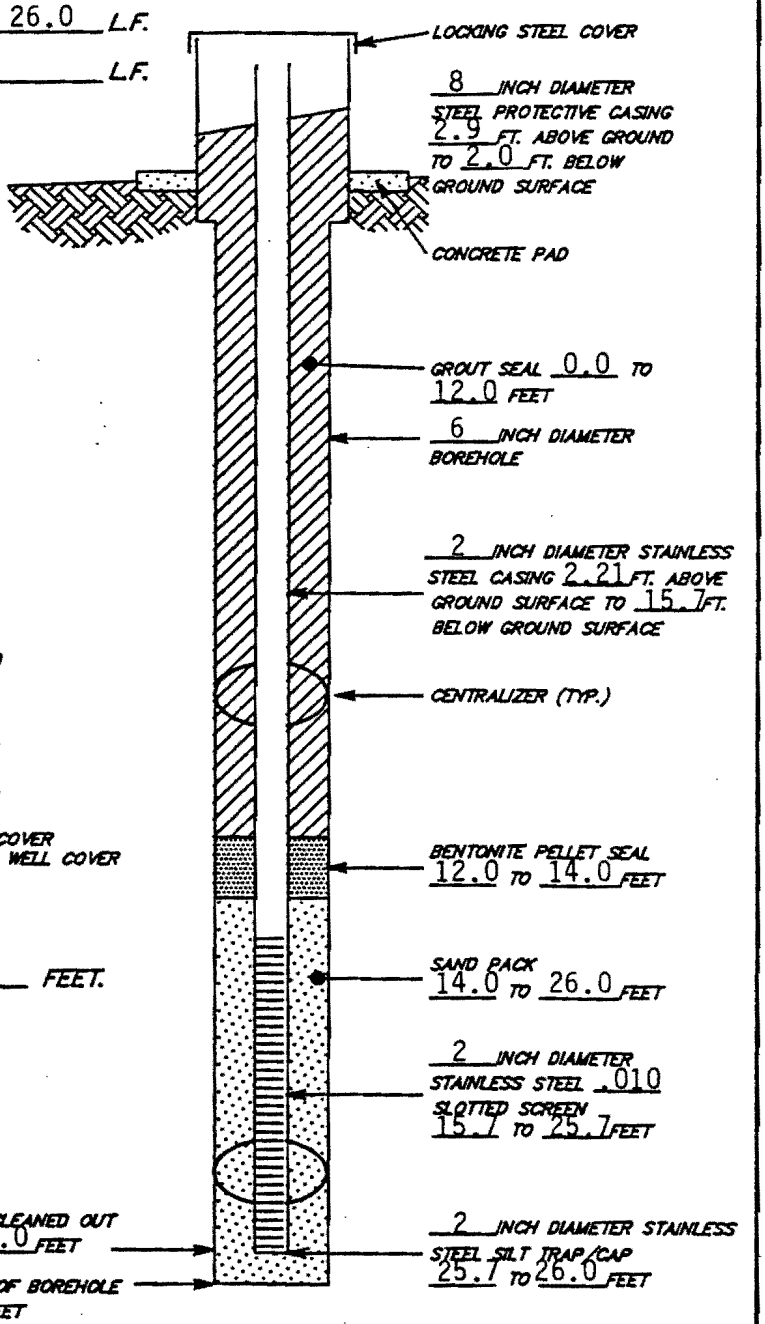
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 23.0 FEET.

CENTRALIZERS AT 4.0 FEET.
15.0 FEET.
25.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 815

DATE: 5/20/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/20/87	02
BENTONITE		5/20/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/20/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/20/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	5/20/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/20/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/21/88	02
GROUT		5/21/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE John W. Anderson 5/20/87

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WELL No. 815

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/21/87	[illegible]
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/21/87	[illegible]
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/21/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/21/87	[illegible]

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/21/88
John M. McLoughlin

[illegible] 5/21/87
John W. Anderson

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WELL No. 815

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump with Air Compressor

DEVELOPMENT BEGAN DATE: 2/24/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/21/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 10.3

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 428.9 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: R. C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 6.4 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/21/88 AT 23.0 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/21/88
John M. McLoughlin

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 815
LOCATION: Main Plant
DATE: 2/29/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 10.3 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/29/88	37.4					
3/1/88	112.4					
3/2/88	90.2					
3/3/88	86.8					
3/17/88	45.9					
3/18/88	27.2					
3/21/88	29.0		5 JTU's	428.9	41.64	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	428.9	41.64	

COMMENTS

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0815 DATE OF TEST: 4/11/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 19.40 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 4.90 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 29

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
3.8821
3.9576

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WELL No. 815

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	10.250	5.350
20.00	9.920	5.020
30.00	9.630	4.730
40.00	9.410	4.510
50.00	9.180	4.280
60.00	8.960	4.060
75.00	8.700	3.800
90.00	8.460	3.560
105.00	8.250	3.350
120.00	8.050	3.150
150.00	7.710	2.810
180.00	7.440	2.540
240.00	7.000	2.100
300.00	6.670	1.770
360.00	6.400	1.500
420.00	6.190	1.290
480.00	6.040	1.140
540.00	5.890	.990
600.00	5.770	.870
720.00	5.580	.680
840.00	5.430	.530
960.00	5.350	.450
1080.00	5.280	.380
1200.00	5.220	.320
1320.00	5.170	.270
1440.00	5.130	.230
1560.00	5.110	.210
1680.00	5.080	.180
1800.00	5.050	.150

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WELL No. 815

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 2.69E-06 FT/SEC = 8.19E-05 CM/SEC

TRANSMISSIVITY = 2.69E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 3.53E-06 FT/SEC = 1.08E-04 CM/SEC

TRANSMISSIVITY = 3.53E-05 FT**2/SEC

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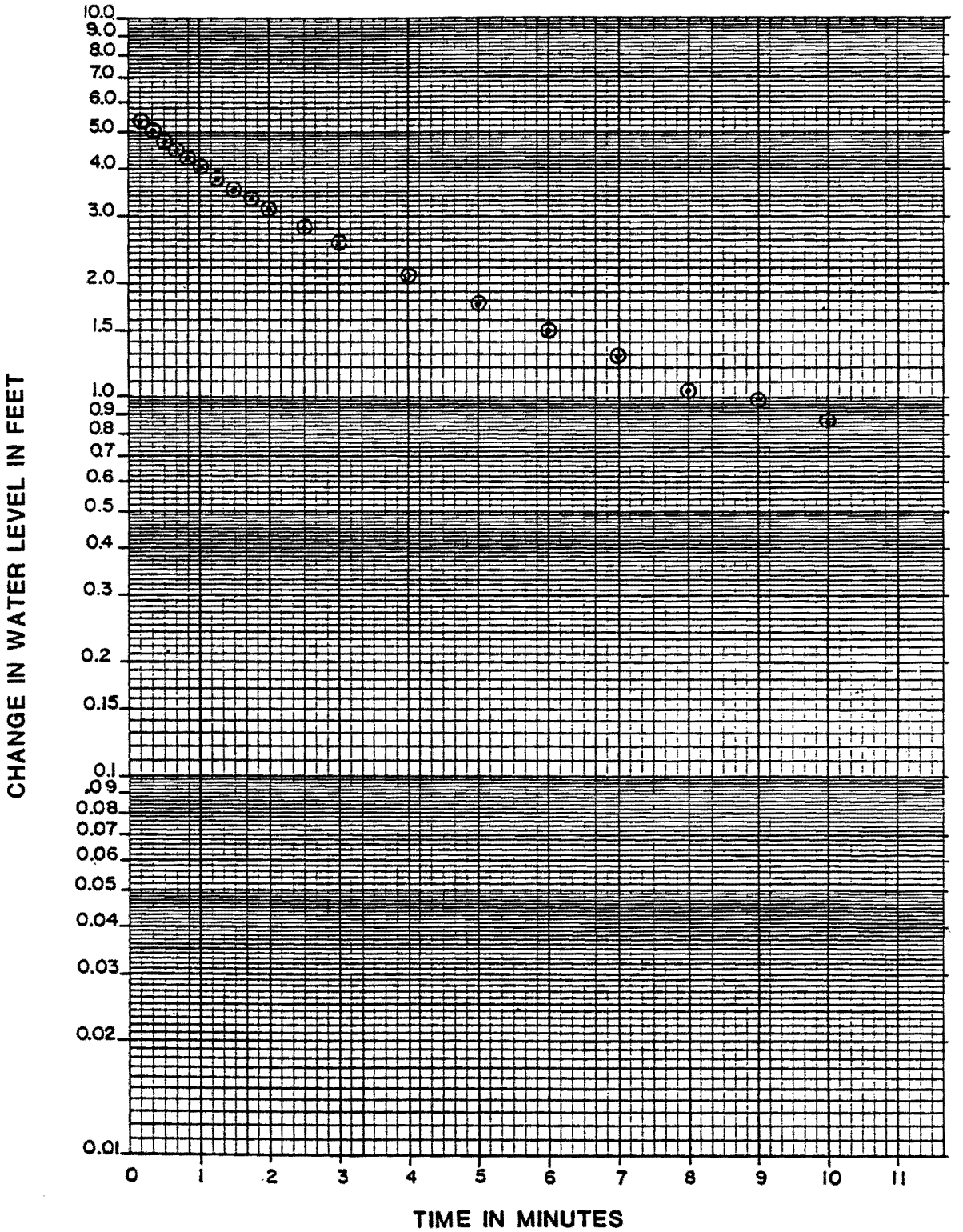
WELL No. 815

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0815S01

WELL NO.: 0815

LOCATION: 1.0' - 1.3'

TYPE: Soil

SAMPLER: John Anderson (SIGNATURE)

DATE: 5/19/87

TIME: 7:50 Am

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
John Anderson	5/19/87	11:20	MCI	Chuck	5/19/87	11:20	MCI
Chuck	5/26/87	11:40	MCI	Ryel	5/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0815502

WELL NO.: 0815

LOCATION: 6.2'-6.4'

TYPE: Soil

SAMPLER: John Anderson (SIGNATURE)

DATE: 5/17/87

TIME: 8:10 AM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
John Anderson	5/19/87	11:20	MCI	Clutts	5/19/87	11:20	MCI
Clutts	5/26/87	11:40	"	Ryelhart	5/26/87	11:40	ORNL

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
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1.0 General Information

1.1 Well Location

Monitoring well number 816 is located in the Main Plant area. It is approximately 100 feet northeast of Building 3087. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 23,134.24, E 31,746.72 (X-10 grid) or latitude 35° 55' 48.5" and longitude 84° 19' 01.5" Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 816 was drilled by A.L. Clark Drilling Services, Inc. A Driltech air rotary rig was used to drill this boring for monitor well installation under the operation of Steve Clark with the assistance of Steve Kirk. Drilling commenced on 5/13/87 and was finished on 5/15/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/13/87 The Driltech drill rig was mobilized to the staked location and set up. A 14-inch boring was augered from surface to bedrock at 10.75 feet. Ten inch surface casing was set and grouted.

5/14/87 The boring was advanced from 10.75 feet to 40 feet with an 8-inch tricone air rotary bit and 4-inch stainless steel casing was set and grouted.

5/15/87 The boring was deepened from 40 feet to a total depth of 60 feet with a 3 7/8 inch tricone air rotary bit.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Charles W. Stanley. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

No soil samples were collected during drilling. A drill water sample was collected from the water pump on the drill rig on 5/15/87. A chain of custody form for this sample is included with this data package. Analytical results for the water sample described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was an open hole or type C well, without a stainless steel screen. A fourteen-inch diameter boring was augered from ground surface to bedrock (10.75 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a

depth of 40.0 feet. A four-inch diameter stainless steel casing was installed and tremie grouted from the bottom of the eight-inch diameter boring at 40.0 feet and extending 2.5 feet above ground surface. The air rotary method was then used to drill a 3 7/8 inch diameter boring (open hole interval) from the bottom of the four-inch diameter stainless steel casing at 40.0 feet to a total depth of 60.0 feet. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 816 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 219.6 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/3/88 at a depth of 54.8 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

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2.5 Hydraulic Conductivity Testing

Well number 816 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 8.57×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 816

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/13/87	CWS
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/13/87	CWS
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/13/87	CWS
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/13/87	CWS
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/13/87	CWS
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/13/87	CWS

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE CWS 5/13/87
Charles W. Stanley

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 816

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Charles W. Stanley 5/13/87

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WELL No. 816

ORNL MONITORING WELL LOG

PAGE 1 OF 1

LOCATION: Main Plant
DRILLER: Steve Clark
HELPER: Steve Kirk
DRILL: Driltech

DATE: START: 5/13/87
FINISH: 5/15/87
LOGGED BY: Charles W. Stanley & Bryn D. Howze
HEALTH PHYSICST: N/A

TYPE DRILLING: Auger and Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 10.7'
DEPTH DRILLED IN ROCK: 58.6'
TOTAL DEPTH OF WELL: 47.9'

DRILLING FLUID SAMPLES:
TYPE: Drill Water DATE: 5/15/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	5.2			Soil and subsoil, clay, moderate brown, dry
				plastic, abundant chert gravels
5.2	8.0			Limestone, medium gray, with locally calcite
				stringers, hard, dry, cobble size
8.0	9.9			Clay, dark gray, plastic, moist with gravels
9.9	10.7			Limestone, medium gray with locally calcite
				stringers, hard, dry, cobble size
	10.7			Auger refusal
10.7	58.6			Moderately hard to hard drilling*
	58.6			TOTAL DEPTH
				* No detailed lithologic description available
				for the interval from 10.7' to 58.6' due to
				the use of a containment box.

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WELL No. 816

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Charles W. Stanley
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- ☒ 14 INCH AUGER 10.75 L.F.
- ☐ ____ INCH AUGER ____ L.F.
- ☒ 8 INCH ROTARY 29.25 L.F.
- ☒ 3.88 INCH ROTARY 20.00 L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 23,134.24
E 31,746.72
ELEV. GROUND 823.44
ELEV. TOP STAINLESS STEEL CASING 825.93

DRILLING DATES:
STARTED: 5/13/87
FINISHED: 5/1/87

MATERIALS USED

EST. VOL.	USED VOL.	
	N/A	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	14.25	FT. OF 10 IN. SURFACE CASING
3.2	5.0	SACKS OF CEMENT (SURFACE CASING)
	10.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	30.0	GALLONS OF WATER (SURFACE CASING)
	42.5	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
8.8	10.0	SACKS OF CEMENT (S.S. CASING)
	20.0	POUNDS OF POWDERED BENTONITE (S.S. CASING)
	60.0	GALLONS OF WATER (S.S. CASING)
	25.0	POUNDS OF BENTONITE PELLETS (STAINLESS STEEL CASING SEAL)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage

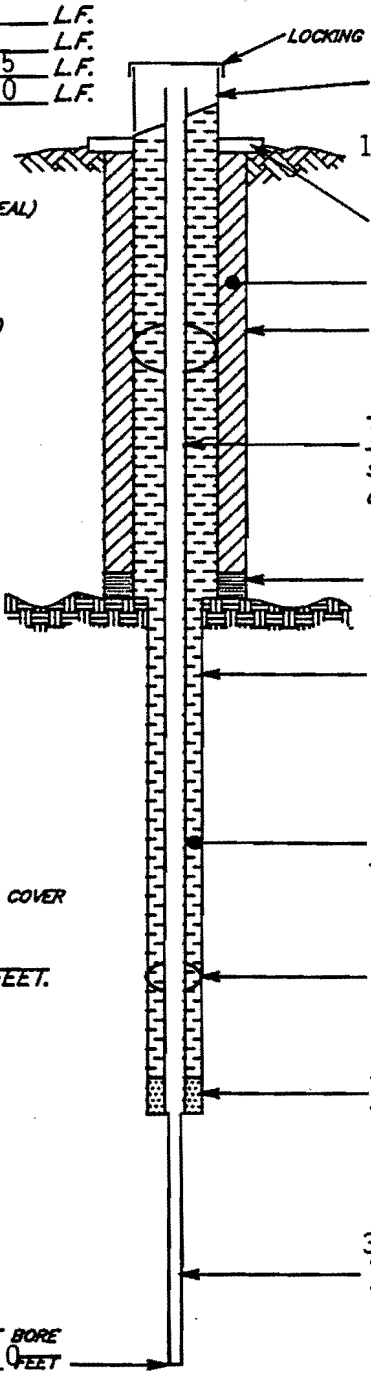
SURFACE CASING TREMIE GROUTED YES ☒ NO ☐
STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

MONITORING WELL PUMP BASE SET AT 54.8 FEET.

CENTRALIZERS AT 2 FEET.
20 FEET.
35 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE C WELL

NOT TO SCALE

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 816

DATE: 5/14/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/14/87	02
BENTONITE		5/14/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/14/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/14/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	5/14/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/14/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/3/88	02
GROUT		5/14/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE CWS 5/14/87
Charles W. Stanley

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 816

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/15/87	CWS
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/15/87	CWS
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/3/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/15/87	CWS

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/3/88
John M. McLoughlin

CWS 5/15/87
Charles W. Stanley

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 816

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 2/29/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/3/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 36.6

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 219.6 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 5.3 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/3/88 AT 54.8 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/3/88
John M. McLoughlin

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WELL NO. 816
LOCATION: Main Plant
DATE: 2/29/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 36.6 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/29/88	55.0					
3/1/88	54.7					
3/2/88	59.3					
3/3/88	50.6	Clear	5 JTU's	219.6	6	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	219.6	6	

COMMENTS Average pH = 8.2

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WELL No. 816

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0816 DATE OF TEST: 4/13/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 18.60 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 53.32 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 18.60 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 5.03 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 26

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
2.5712
2.5813

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WELL No. 816

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
40.00	7.590	2.560
50.00	7.560	2.530
60.00	7.520	2.490
75.00	7.490	2.460
90.00	7.470	2.440
105.00	7.450	2.420
120.00	7.420	2.390
150.00	7.350	2.320
180.00	7.280	2.250
240.00	7.170	2.140
300.00	7.080	2.050
360.00	6.980	1.950
420.00	6.870	1.840
480.00	6.770	1.740
540.00	6.680	1.650
600.00	6.640	1.610
720.00	6.470	1.440
840.00	6.360	1.330
960.00	6.240	1.210
1080.00	6.150	1.120
1200.00	6.060	1.030
1320.00	5.960	.930
1440.00	5.890	.860
1560.00	5.820	.790
1680.00	5.780	.750
1800.00	5.730	.700

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 2.81E-06 FT/SEC = 8.57E-05 CM/SEC

TRANSMISSIVITY = 5.23E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 2.81E-06 FT/SEC = 8.57E-05 CM/SEC

TRANSMISSIVITY = 5.23E-05 FT**2/SEC

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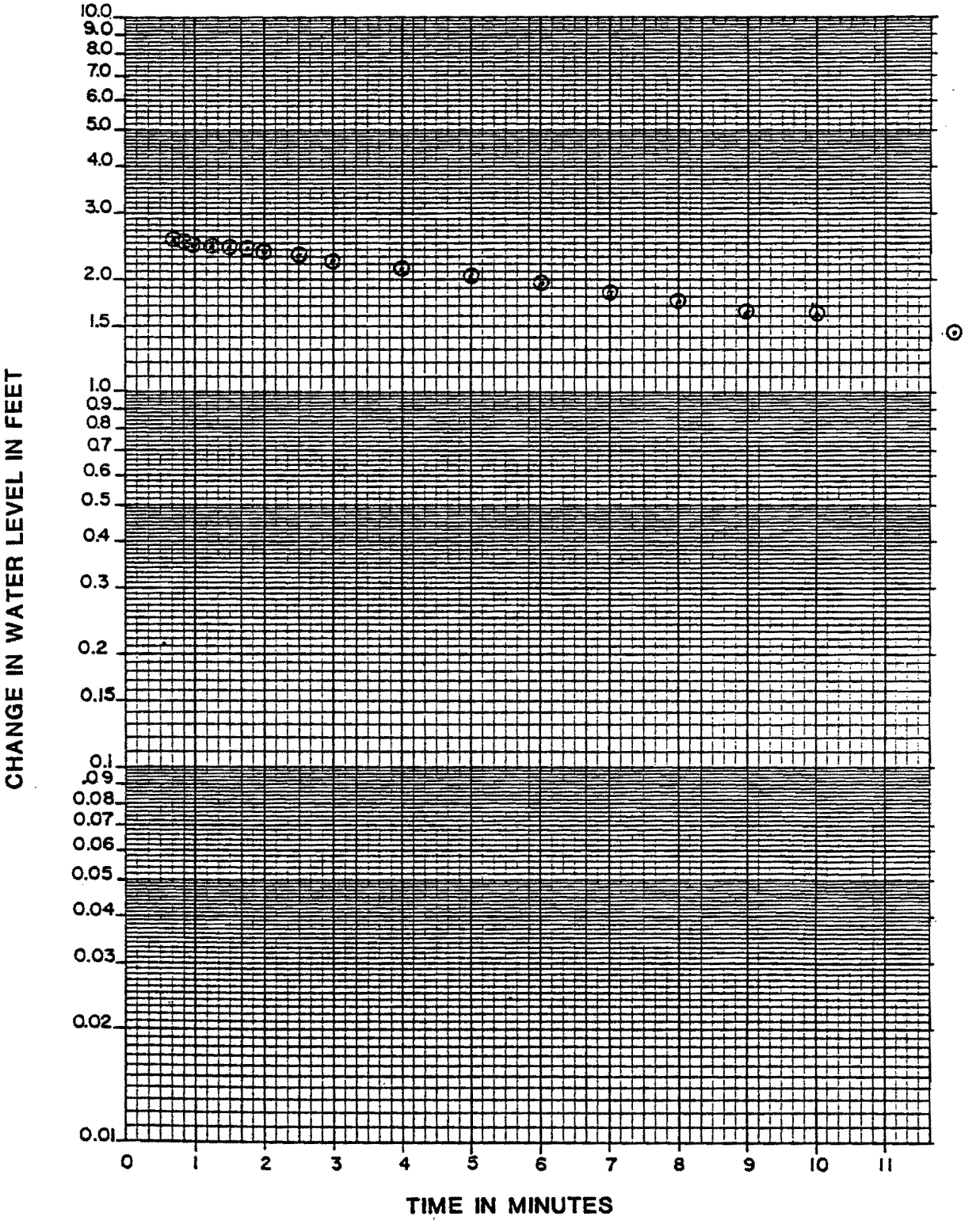
WELL No. 816

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0816W01

WELL NO.: 0816

LOCATION: Main Plant @ 60'

TYPE: DRILL WATER

SAMPLER: [signature] (SIGNATURE)

DATE: 5/15/87

TIME: 9:30 AM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/26/87	11:40AM	MCI	[signature]	5/26/87	11:40	ORNL

REMARKS:

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725 Pellissippi Parkway
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1.0 General Information

1.1 Well Location

Monitoring well number 817 is located in the Main Plant area. It is 100 feet north of Building 3044. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,754.33, E 31,781.01 (X-10 grid) or latitude 35° 55' 45.6" and longitude 84° 18' 58.5". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 817 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech and a Schramm Rotadrill rig were used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced on 5/14/87 and was finished on 5/19/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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A Schramm rig was set up at the staked drilling location. After drilling to 6.7 feet, the Schramm began blowing oil from the exhaust and was pulled off the boring. A Gus Pech rig was brought in to complete the boring. The boring was advanced to a total depth of 11.0 feet. The boring was then cleaned by bailing.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologists Michael L. Ebers and John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and

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Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0817S01 was collected in the split spoon interval from 3.8 feet to 4.0 feet on 5/14/87 and soil sample 0817S02 was collected in the split spoon interval from 5.5 feet to 5.7 feet on 5/14/87. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 10.4 to 10.6 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.4 to 10.4 feet. A two-inch diameter stainless steel casing was installed

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above the screen from 5.4 feet to 2.7 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 10.6 feet, with a 2 foot bentonite pellet seal poured into the annular space above the sandpack from 2.0 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 817 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 55.3 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 4/15/88 at a depth of 7.5 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

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2.5 Hydraulic Conductivity Testing

Well number 817 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 1.08×10^{-4} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 817

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/14/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/14/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/19/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/14/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/14/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/14/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/14/87

Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 817

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE [signature] 5/14/87
Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 817

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, II & A. L. Clark, III
HELPER: Richard Pickel
DRILL: Schramm Rotadrill & Gus Pech

DATE: START: 5/14/87
FINISH: 5/19/87
LOGGED BY: Michael L. Ebers & John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split spoons, Augers
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 6.7'
DEPTH DRILLED IN ROCK: 4.3'
TOTAL DEPTH OF WELL: 11.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.2		40%	Grass and topsoil
0.2	2.0		40%	Clay, moderate yellowish brown with abundant chert and a few limestone fragments up to 1/2", dry and crumbly
2.0	3.2		75%	Clay, moderate brown with dark grayish brown mottles, few very small chert fragments, very slightly moist, fairly competent
3.2	4.6	0817S01 @3.8-4.0'	100%	Clay, finely mottled to speckled, light to dark brown with chert pebbles and fragments up to 1/4", very crumbly
4.6	6.7		75%	Clay, mottled, pale yellowish brown and dark yellowish orange with abundant chert fragments up to 1", soft, somewhat moist, plastic
	6.7			Split spoon refusal
6.7	11.0			Limestone, wet, low permeability
	11.0			TOTAL DEPTH

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WELL No. 817

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A.L. Clark Drilling Services

DRILLER: A. L. Clark, II
A. L. Clark, III
HELPER: Richard Pickel

EQUIPMENT ☒ 6 INCH AUGER 11.0 L.F.
☐ _____ INCH AUGER _____ L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,754.32
E 31,781.01
ELEV. GROUND 811.22
ELEV. TOP STAINLESS STEEL CASING 813.93

DRILLING DATES:
STARTED: 5/14/87
FINISHED: 5/15/87

MATERIALS USED

EST. VOL.	USED VOL.	
	5.0	FEET OF 2 IN. S.S. SCREEN
	8.1	FEET OF 2 IN. S.S. CASING
3	3	SACKS OF SAND
35	35	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

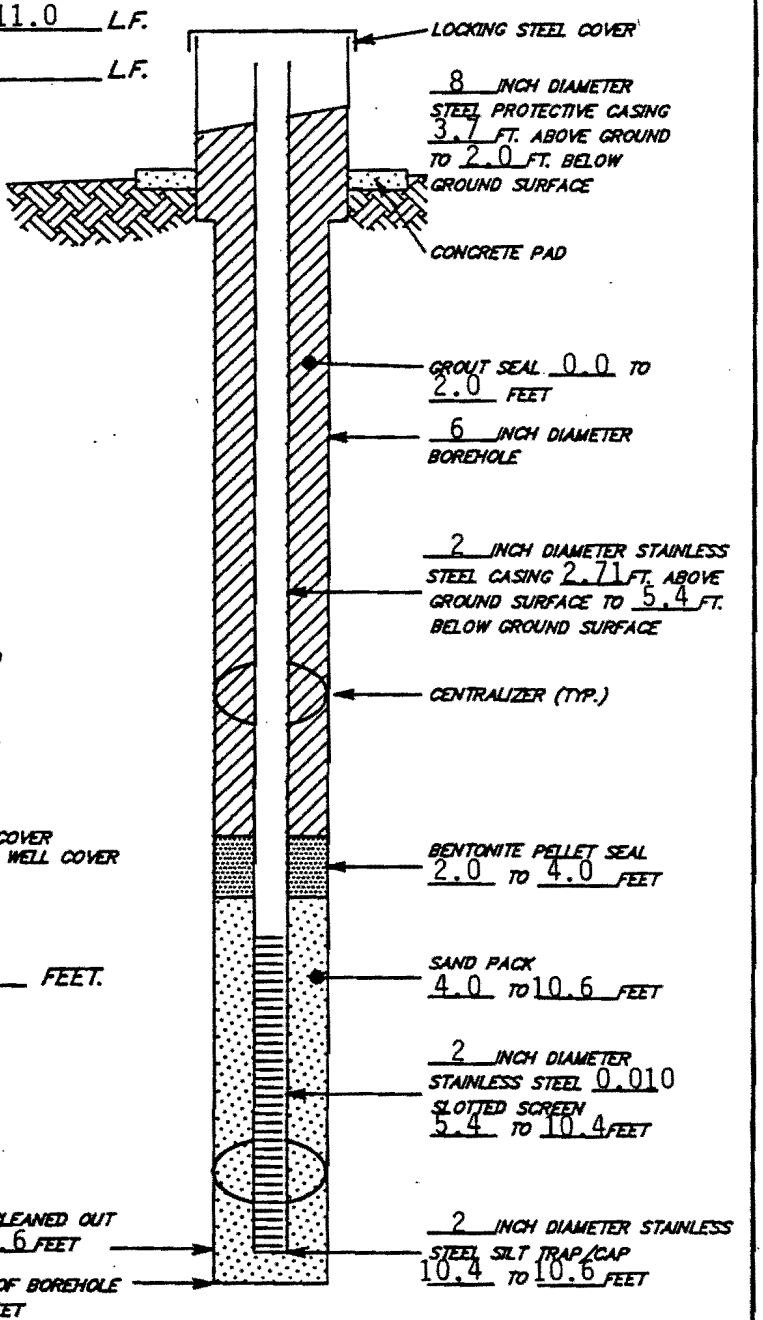
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 7.5 FEET.

CENTRALIZERS AT 2.0 FEET.
10.6 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 817

DATE: 5/14/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/19/87	02
BENTONITE		5/19/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/19/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/19/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	5/19/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/19/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	4/15/87	02
GROUT		5/20/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	02

COMMENTS:

OBSERVER SIGNATURE/DATE John W. Anderson 5/19/87

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WELL No. 817

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/19/87	
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/19/87	
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	4/15/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/19/87	

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 4/15/88
John M. McLoughlin

5/19/87
John W. Anderson

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WELL No. 817

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/7/88 TIME:

DEVELOPMENT ENDING DATE: 4/15/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 7.5

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 55.3 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

*TURBIDITY AT END OF DEVELOPMENT: _____ JACKSON TURBIDITY UNITS

- ☐ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☒ MOD. TURBID
- ☐ MUDDY

*TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 5.3 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 4/15/88 AT 7.5 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

* This well exhibited a very slow rate of recharge. Only 55 gallons of water was removed from the well from 3/7/88 to 4/15/88. The produced water on 4/15/88 was still turbid to muddy.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 4/15/88
John M. McLoughlin

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 817
LOCATION: Main Plant
DATE: 3/7/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 7.5 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/7/88	3.4					
3/8/88	3.4					
3/9/88	3.4					
3/10/88	5.1					
3/17/88	5.1					
3/18/88	5.1					
3/21/88	5.2					
3/28/88	5.5					
3/29/88	5.5					
3/30/88	5.1					
3/31/88	-0-					
4/4/88	5.1					
4/6/88	5.1					
4/8/88	5.1					
4/11/88	3.4					
4/13/88	3.4					
4/15/88	3.4			55.30	7.37	
RESULTS AT END OF DEVELOPMENT		Mod. Turbid	-----	55.30	7.37	

COMMENTS Average pH = 8.6

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WELL No. 817

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0817 DATE OF TEST: 4/26/89

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.25 INCHES
DIAMETER OF DRILLED HOLE = 6.00 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 5.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 4.95 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 4.95 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 3.70 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 22

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED
VALUES FOR HO
(FEET)

1.6899
1.7699

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WELL No. 817

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	6.760	3.060
20.00	6.430	2.730
30.00	6.090	2.390
40.00	5.820	2.120
50.00	5.650	1.950
60.00	5.470	1.770
75.00	5.260	1.560
90.00	5.090	1.390
105.00	4.930	1.230
120.00	4.820	1.120
150.00	4.650	.950
180.00	4.540	.840
240.00	4.450	.750
300.00	4.400	.700
360.00	4.380	.680
420.00	4.370	.670
480.00	4.360	.660
540.00	4.340	.640
600.00	4.330	.630
720.00	4.330	.630
840.00	4.320	.620
960.00	4.320	.620

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 3.54E-06 FT/SEC = 1.08E-04 CM/SEC

TRANSMISSIVITY = 1.75E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 4.82E-06 FT/SEC = 1.47E-04 CM/SEC

TRANSMISSIVITY = 2.38E-05 FT**2/SEC

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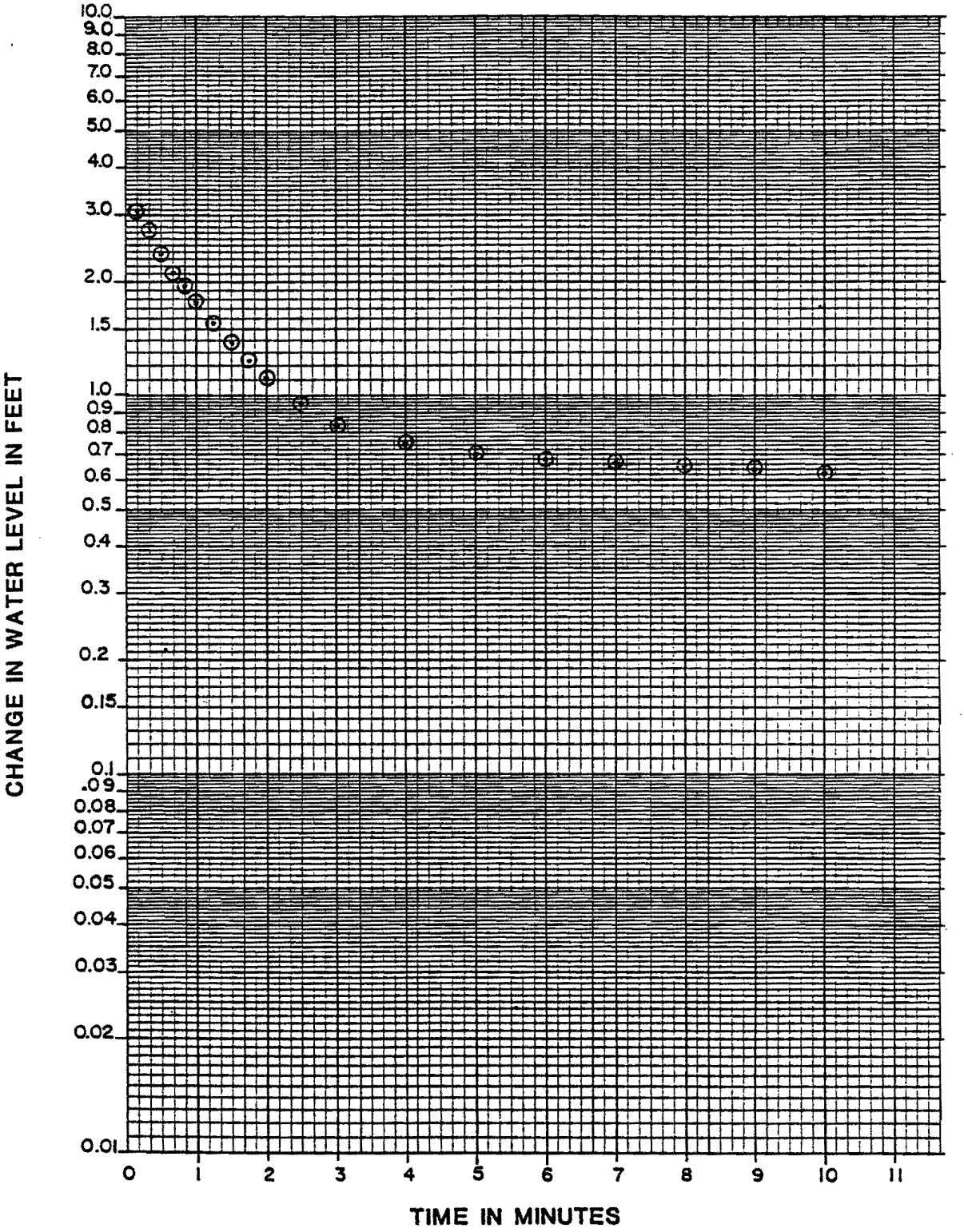
WELL No. 817

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0817501 ~~0817502~~

WELL NO.: 0817

LOCATION: MAIN PLANT @ 3.8' TO 4.0'

TYPE: SOIL

SAMPLER: [signature] (SIGNATURE)

DATE: 5/14/87

TIME: 11:00 A.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/26/87	11:40AM	MCI	[signature]	5/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0817S02

WELL NO.: 0817

LOCATION: MAIN PLANT @ 5.5-5.7

TYPE: SOIL

SAMPLER: [signature] (SIGNATURE)

DATE: 5/14/87

TIME: 11:00 AM.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/26/87	11:40AM	MCI	[signature]	5/26/87	11:40	ORNL

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
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1.0 General Information

1.1 Well Location

Monitoring well number 818 is located in the Main Plant area. It is located on the south side of Substation Drive north of SWSA 2. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,564.56, E 32,390.33 (X-10 grid) or latitude 35° 55' 47.4" and longitude 84° 18' 51.1". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 818 was drilled by A.L. Clark Drilling Services, Inc. A Driltech air rotary rig was used to drill this boring for monitor well installation under the operation of Steve Clark with the assistance of Steve Kirk. Drilling commenced on 5/20/87 and was finished on 6/2/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/21/87 The Driltech rig was moved to the well site and set up. The boring was split spooned from 0.0 feet to 6.0 feet. The boring was reamed and drilled from the surface to 13.2 feet with a 14-inch auger and 12.5 feet of 10-inch surface casing was placed in the boring.

5/22/87 The 10-inch surface casing was grouted.

5/26/87 The diverter and containment box were installed and the boring deepened from 12.5 feet to 40.0 feet with an 8 3/4 inch tricone air rotary bit. Four-inch stainless steel caisng was installed from the surface to 40.0 feet.

5/27/87 The 4-inch stainless steel casing was grouted.

5/28/87 The boring was deepened from 40.0 feet to 60.0 feet with a 3 7/8 inch tricone air rotary bit.

5/29/87 The boring was deepened from 60.0 feet to 80.0 feet with a 3 7/8 inch tricone air rotary bit.

6/1/87 The boring was deepened from 80.0 feet to 100.0 feet with a 3 7/8 inch tricone air rotary bit.

6/2/87 The boring had 29 feet of water overnight. Well completed open hole, from 40.0 to 100.0 feet.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel

screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0818S01 was collected in the split spoon interval from 4.0 feet to 4.2 feet on 5/21/87 and soil sample 0818S02 was collected in the augered interval at 13.2 feet on 5/21/87. A drill water sample was collected from the water pump on

the drill rig on 5/26/87. Analytical results for these three samples described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was an open hole or type C well, without a stainless steel screen. A fourteen-inch diameter boring was augered from ground surface to bedrock (13.2 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a depth of 40.0 feet. A four-inch diameter stainless steel casing was installed and tremie grouted from the bottom of the eight-inch diameter boring at 40.0 feet and extending 2.6 feet above ground surface. The air rotary method was then used to drill a 3 7/8 inch diameter boring (open hole interval) from the bottom of the four-inch diameter stainless steel casing at 40.0 feet to a total depth of 100.0 feet. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 818 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified

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cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 80 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/3/88 at a depth of 94.8 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 818 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 1.31×10^{-6} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 818

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/21/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/21/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/26/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/21/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/21/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/21/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/21/87
Michael L. Ebers

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WELL No. 818

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/21/87
Michael L. Ebers

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WELL No. 818

ORNL MONITORING WELL LOG

LOCATION: Main Plant - SWSA 2
DRILLER: Steve Clark
HELPER: Steve Kirk
DRILL: Driltech

DATE: START: 5/21/87
FINISH: 6/2/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Auger, Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: three
TYPE: two soil & one drill water
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 12.0'
DEPTH DRILLED IN ROCK: 88.0'
TOTAL DEPTH OF WELL: 100.0'

DRILLING FLUID SAMPLES:
TYPE: Drill Water DATE: 5/26/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.5		100%	Topsoil and organic matter, dark brown
0.5	6.0	0818S01	20%	Clay, light brown and pale yellowish orange,
		@4.0'-4.2'		dry, friable with 70% chert (very light gray
				to medium light gray fragments up to 1"),
				slightly moist from 4.0' to 6.0', very
				friable, no bulk density due to friable samples
	6.0			Split spoon refusal
6.0	12.0			Clay, light brown, slightly moist, 20% chert,
				very light gray to medium light gray
12.0	12.5			Limestone, olive gray, fine grained, thin
				bedded, weathered, flat cobbles
	12.5			14" Auger refusal
12.5	17.0	0818S02		Limestone, hard drilling, soft at 16.0' -
		@13.2'		16.5'*
17.0	21.0			Cavity, no resistance
21.0	34.0			Limestone, hard drilling
34.0	35.0			Cavity
35.0	40.0	0818W01		Limestone, hard drilling, medium gray and
		@40.0'		olive gray, fine-grained

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WELL No. 818

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
40.0	46.0			Limestone, hard
46.0	46.5			Fairly soft drilling
46.5	100.0			Limestone, hard drilling (soft drilling 82.0' - 82.2') olive gray, fine-grained, dense
	100.0			TOTAL DEPTH
				* No detailed lithologic description available for the interval from 12.5' to 100.0' due to the use of a containment box.

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WELL No. 818

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- ☒ 14 INCH AUGER 12.5 L.F.
- ☐ ____ INCH AUGER ____ L.F.
- ☒ 8 3/4 INCH ROTARY 27.5 L.F.
- ☒ 3 7/8 INCH ROTARY 60.0 L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,564.56
E 32,390.33
ELEV. GROUND 851.55
ELEV. TOP STAINLESS STEEL CASING 854.13

DRILLING DATES:
STARTED: 5/21/87
FINISHED: 6/2/87

MATERIALS USED

EST. VOL.	USED VOL.	
	25	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	16.1	FT. OF 10 IN. SURFACE CASING
3.8	7.0	SACKS OF CEMENT (SURFACE CASING)
	25	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	42	GALLONS OF WATER (SURFACE CASING)
	42.6	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
8.4	14.0	SACKS OF CEMENT (S.S. CASING)
	25	POUNDS OF POWDERED BENTONITE (S.S. CASING)
	84	GALLONS OF WATER (S.S. CASING)
	25	POUNDS OF BENTONITE PELLETS (STAINLESS STEEL CASING SEAL)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities and fractures

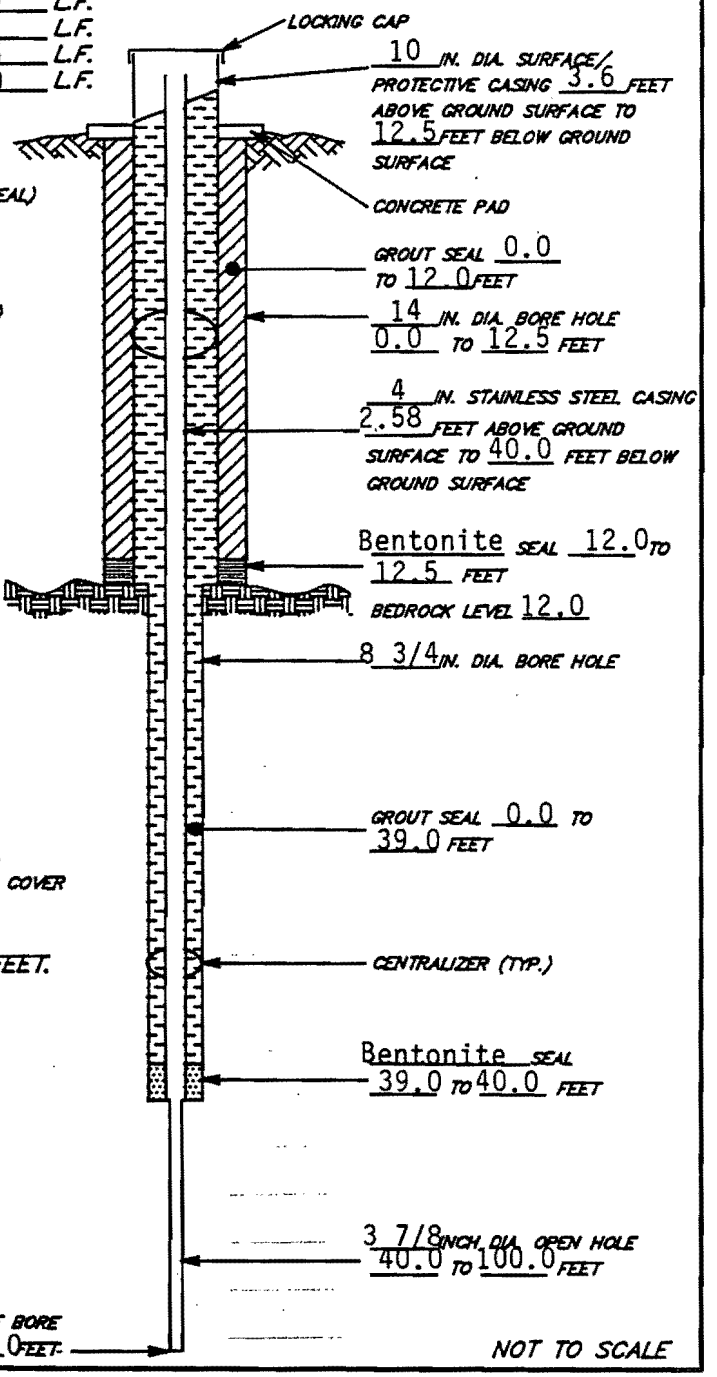
SURFACE CASING TREMIE GROUTED YES ☒ NO ☐
STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

MONITORING WELL PUMP BASE SET AT 94.8 FEET.

CENTRALIZERS AT 5.0 FEET.
20.0 FEET.
40.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE C WELL

NOT TO SCALE

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WELL No. 818

DATE: 5/21/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		N/A	N/A
BENTONITE		5/21/87 5/26/87	02 02
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ☐ NO)	N/A	N/A
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/26/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	5/26/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/26/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/3/88	02
GROUT		5/22/87 5/27/87	05 05
WELL COVERS		5/87	01
SURFACE CASING		5/22/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/21/87
Michael L. Ebers

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WELL No. 818

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/2/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/2/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/2/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/2/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/2/88
John M. McLoughlin

Michael L. Ebers 6/2/87
Michael L. Ebers

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WELL No. 818

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 2/29/88 TIME:

DEVELOPMENT ENDING DATE: 3/2/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 40.0

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 80.0 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Steve L. Laman, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 35.3 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/3/88 AT 94.8 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/3/88
John M. McLoughlin

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 818
LOCATION: Main Plant
DATE: 2/29/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 40.0 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/29/88	27.20					
3/1/88	30.60					
3/2/88	22.20	Clear	5 JTU's	80.0	2	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	80.0	2	

COMMENTS Average pH = 8.7

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0818 DATE OF TEST: 4/8/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 60.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 62.58 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 60.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 8.97 FEET
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 23

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)

2.5998
2.6002

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WELL No. 818

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
75.00	11.550	2.580
90.00	11.560	2.590
105.00	11.540	2.570
120.00	11.560	2.590
150.00	11.570	2.600
180.00	11.570	2.600
240.00	11.560	2.590
300.00	11.550	2.580
360.00	11.540	2.570
420.00	11.530	2.560
480.00	11.520	2.550
540.00	11.520	2.550
600.00	11.510	2.540
720.00	11.510	2.540
840.00	11.500	2.530
960.00	11.490	2.520
1080.00	11.480	2.510
1200.00	11.460	2.490
1320.00	11.450	2.480
1440.00	11.440	2.470
1560.00	11.430	2.460
1680.00	11.430	2.460
1900.00	11.420	2.450

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 4.29E-08 FT/SEC = 1.31E-06 CM/SEC

TRANSMISSIVITY = 2.57E-06 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 4.29E-08 FT/SEC = 1.31E-06 CM/SEC

TRANSMISSIVITY = 2.57E-06 FT**2/SEC

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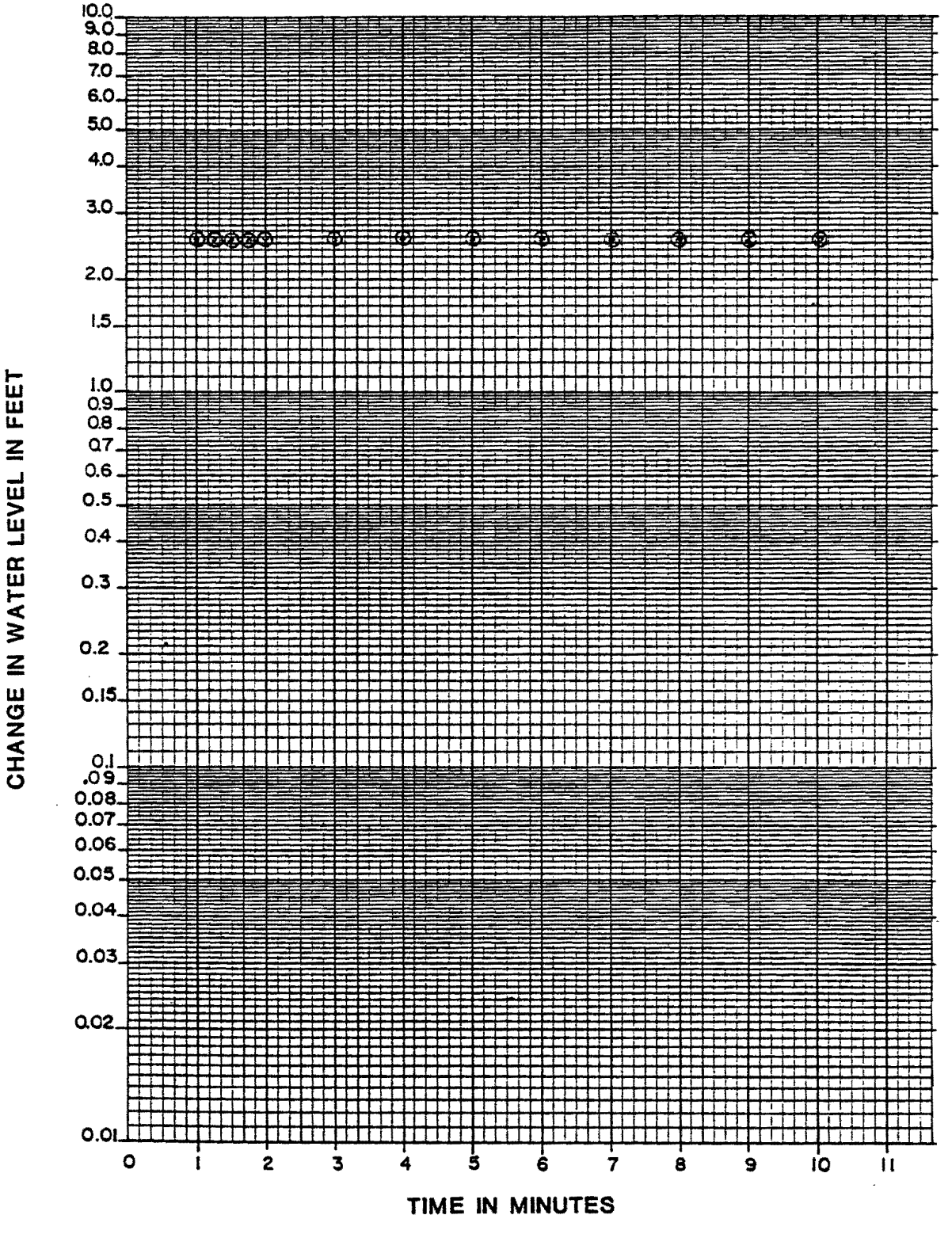
WELL No. 818

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0818S01

WELL NO.: 0818

LOCATION: Main Plant - SWSAZ 4.0-4.2'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 5/21/87

TIME: 9.50 A.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/26/87	11:40AM	MCI	[signature]	5/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0818S02

WELL NO.: 0818

LOCATION: MAIN PLANT – SWSA 2 @ 13.2'

TYPE: SOIL

SAMPLER: Michael S. Ehm (SIGNATURE)

DATE: 5/21/87

TIME: 10:50 A.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
Michael S. Ehm	5/26/87	11:40 AM	MCI	[illegible]	5/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0818W01

WELL NO.: 0818

LOCATION: MAIN PLANT @40'

TYPE: DRILL WATER

SAMPLER: Michael J. Ebner (SIGNATURE)

DATE: 5/26/87

TIME: 11:00 A.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
Michael J. Ebner	5/26/87	11:40 AM	MCI	[illegible]	5/26/87	11:40	ORNL

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 819 is located in the Main Plant area. It is east of SWSA 2, 30 feet inside the boundary fence. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,382.40, E 32,714.87 (X-10 grid) or latitude 35° 55' 47.7" and longitude 84° 18' 46.6". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 819 was drilled by A.L. Clark Drilling Services, Inc. A Driltech air rotary rig was used to drill this boring for monitor well installation under the operation of Steve Clark with the assistance of Steve Kirk. Drilling commenced on 5/18/87 and was finished on 5/20/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/18/87 The Driltech was mobilized to the staked location and set up on plastic sheeting. The interval from 0.0 feet to 3.8 feet was split spooned. The boring was then augered from the surface to 4.5 feet using a 14-inch auger. A 5 1/2 foot joint of 10" surface casing was set and grouted.

5/19/87 The boring was deepened from 4.5 feet to 40.0 feet with an 8-inch tricone air rotary. Fourty feet of 4-inch stainless steel casing were installed and grouted.

5/20/87 The boring was deepened from 40.0 feet to 60.0 feet with a 3 7/8 inch tricone air rotary. This interval was left open.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologists Michael L. Ebers and John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

One soil sample and two water samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. The soil sample, 0819S01, was collected in the split spoon interval from 0.3 feet to 0.6 feet on 5/18/87. The two drill water samples were collected from the water pump on the drill rig on 5/19/87 and 5/20/87. Analytical results for the soil and water samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 4.0 feet to 4.3 feet. The sample was measured, weighed and a bulk density of 2.1 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was an open hole or type C well, without a stainless steel screen. A fourteen-inch diameter boring was augered from ground surface to bedrock (4.5 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a depth of 40.0 feet. A four-inch diameter stainless steel casing was installed and tremie grouted from the bottom of the eight-inch diameter boring at 40.0 feet and extending 2.5 feet above ground surface. The air rotary method was then used to drill a 3 7/8 inch diameter boring (open hole interval) from the bottom of the four-inch diameter stainless steel casing at 40.0 feet to a total depth of 60.0 feet. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 819 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 90 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was

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5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/23/88 at a depth of 56.8 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 819 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 4.20×10^{-6} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 819

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/18/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/18/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/19/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/18/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/18/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/18/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/19/87
Michael L. Ebers

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WELL No. 819

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/18/87
Michael L. Ebers

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WELL No. 819

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: Steve Clark
HELPER: Steve Kirk
DRILL: Driltech

DATE: START: 5/18/87
FINISH: 5/20/87
LOGGED BY: Michael L. Ebers & John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split spoon, Auger & Tricone
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: one
TYPE: soil
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 4.5'
DEPTH DRILLED IN ROCK: 55.5'
TOTAL DEPTH OF WELL: 60.0'

DRILLING FLUID SAMPLES:
TYPE: Drill Water DATE: 5/19/87
Drill Water 5/20/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.3		100%	Topsoil, moderate brown with roots and rock
				fragments
0.3	1.1	0819S01	100%	Clay, light brown, silty, dry, friable,
		@0.3-0.6'		abundant chert fragments
1.1	2.0		0	No recovery
2.0	3.7		60%	Clay, light brown, moist, plastic, chert and
				rock fragments
	3.7			Split spoon refusal
3.7	4.5			Clay, light brown, moist, plastic, limestone
				pebbles and cobbles and chert fragments
				Bulk Density @ 4.0' to 4.3' = 2.05 grams/cm³
	4.5			Auger refusal
4.5	7.0			Limestone
7.0	9.0			Cavity, mud filled
9.0	32.0			Limestone, very hard, broke @ 20' to 21'
32.0	40.0			Limestone, fairly hard
40.0	60.0			Limestone, hard, 1" break at 43'
	60.0			TOTAL DEPTH

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WELL No. 819

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- ☒ 14 INCH AUGER 4.5 L.F.
- ☐ INCH AUGER L.F.
- ☒ 8 3/4 INCH ROTARY 35.5 L.F.
- ☒ 3 7/8 INCH ROTARY 20.0 L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,382.40
E 32,714.87
ELEV. GROUND 827.83
ELEV. TOP STAINLESS STEEL CASING 830.28

DRILLING DATES:
STARTED: 5/18/87
FINISHED: 5/20/87

MATERIALS USED

EST. VOL.	USED VOL.	
	15.0	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	7.9	FT. OF 10 IN. SURFACE CASING
1.4	3.0	SACKS OF CEMENT (SURFACE CASING)
	6.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	18.0	GALLONS OF WATER (SURFACE CASING)
	42.5	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
8.4	13.0	SACKS OF CEMENT (S.S. CASING)
	25.0	POUNDS OF POWDERED BENTONITE (S.S. CASING)
	75.0	GALLONS OF WATER (S.S. CASING)
	20.0	POUNDS OF BENTONITE PELLETS (STAINLESS STEEL CASING SEAL)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Fractures, Cavities and Spillage

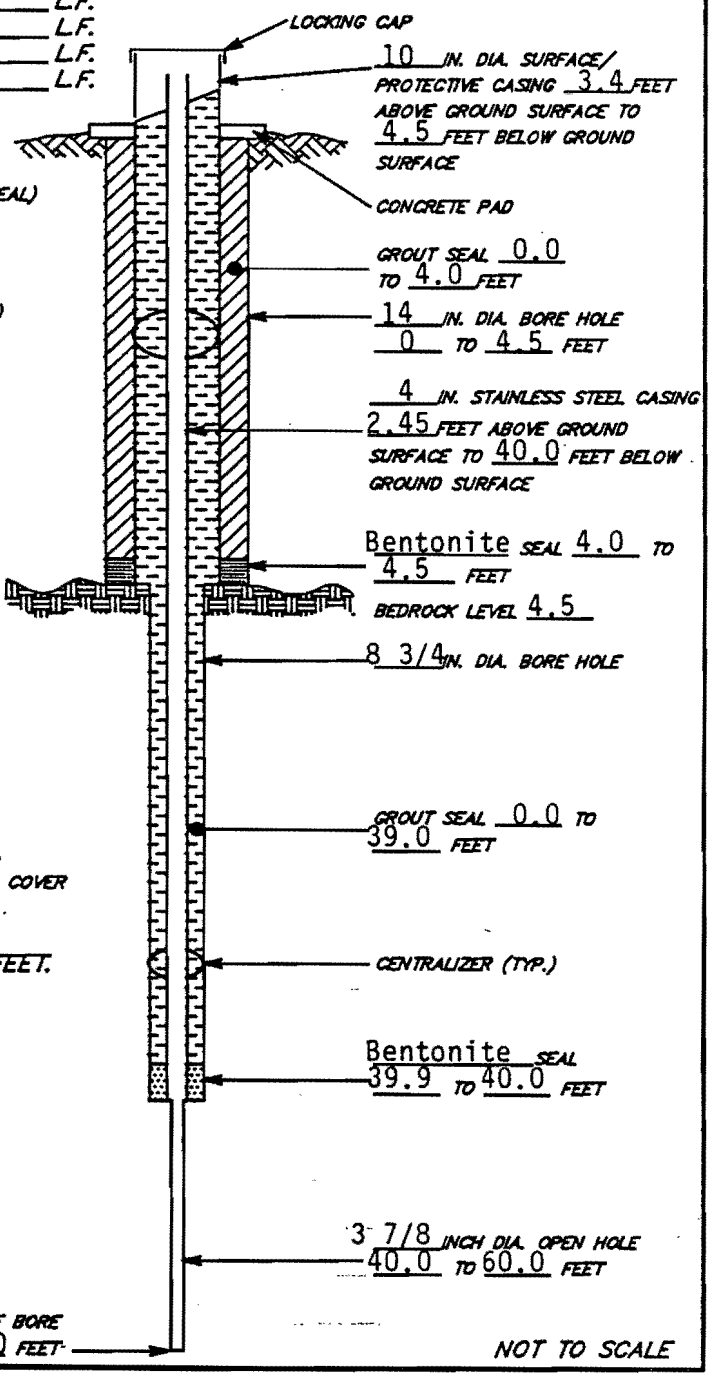
SURFACE CASING TREMIE GROUTED YES ☒ NO ☐
STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

MONITORING WELL PUMP BASE SET AT 56.8 FEET.

CENTRALIZERS AT 3.0 FEET.
20.0 FEET.
40.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE C WELL

NOT TO SCALE

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WELL No. 819

DATE: 5/18/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		N/A	N/A
BENTONITE		N/A	N/A
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ☐ NO)	N/A	N/A
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/19/87	02
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	5/19/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/19/87	01
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/23/88	02
GROUT		5/18/87 5/19/87	05 05
WELL COVERS		5/87	01
SURFACE CASING		5/18/87	02

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 5/18/87
Michael L. Ebers

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WELL No. 819

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/20/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/20/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/4/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/20/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/4/88
John M. McLoughlin

Michael L. Ebers 5/20/87
Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 819

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump with Air Compressor

DEVELOPMENT BEGAN DATE: 3/3/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/4/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 27.0

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 90 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: Slight Organic Odor

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 19.8 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/23/88 AT 56.8 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/23/88
John M. McLoughlin

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 819
LOCATION: Main Plant
DATE: 3/3/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 27.0 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/3/88	45	Clear				
3/4/88	45	Clear	5 JTU's	90	3.3	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	90	3.3	

COMMENTS

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 819

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0819 DATE OF TEST: 4/13/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 20.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 37.90 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 20.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.59 FEET
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 27

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
2.5024
2.5029

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WELL No. 819

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
30.00	4.110	2.520
40.00	4.110	2.520
50.00	4.100	2.510
60.00	4.090	2.500
75.00	4.090	2.500
90.00	4.080	2.490
105.00	4.080	2.490
120.00	4.080	2.490
150.00	4.080	2.490
180.00	4.070	2.480
240.00	4.060	2.470
300.00	4.050	2.460
360.00	4.050	2.460
420.00	4.040	2.450
480.00	4.030	2.440
540.00	4.030	2.440
600.00	4.020	2.430
720.00	4.010	2.420
840.00	4.000	2.410
960.00	3.990	2.400
1080.00	3.980	2.390
1200.00	3.970	2.380
1320.00	3.960	2.370
1440.00	3.950	2.360
1560.00	3.940	2.350
1680.00	3.930	2.340
1800.00	3.920	2.330

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.38E-07 FT/SEC = 4.20E-06 CM/SEC

TRANSMISSIVITY = 2.75E-06 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.38E-07 FT/SEC = 4.20E-06 CM/SEC

TRANSMISSIVITY = 2.75E-06 FT**2/SEC

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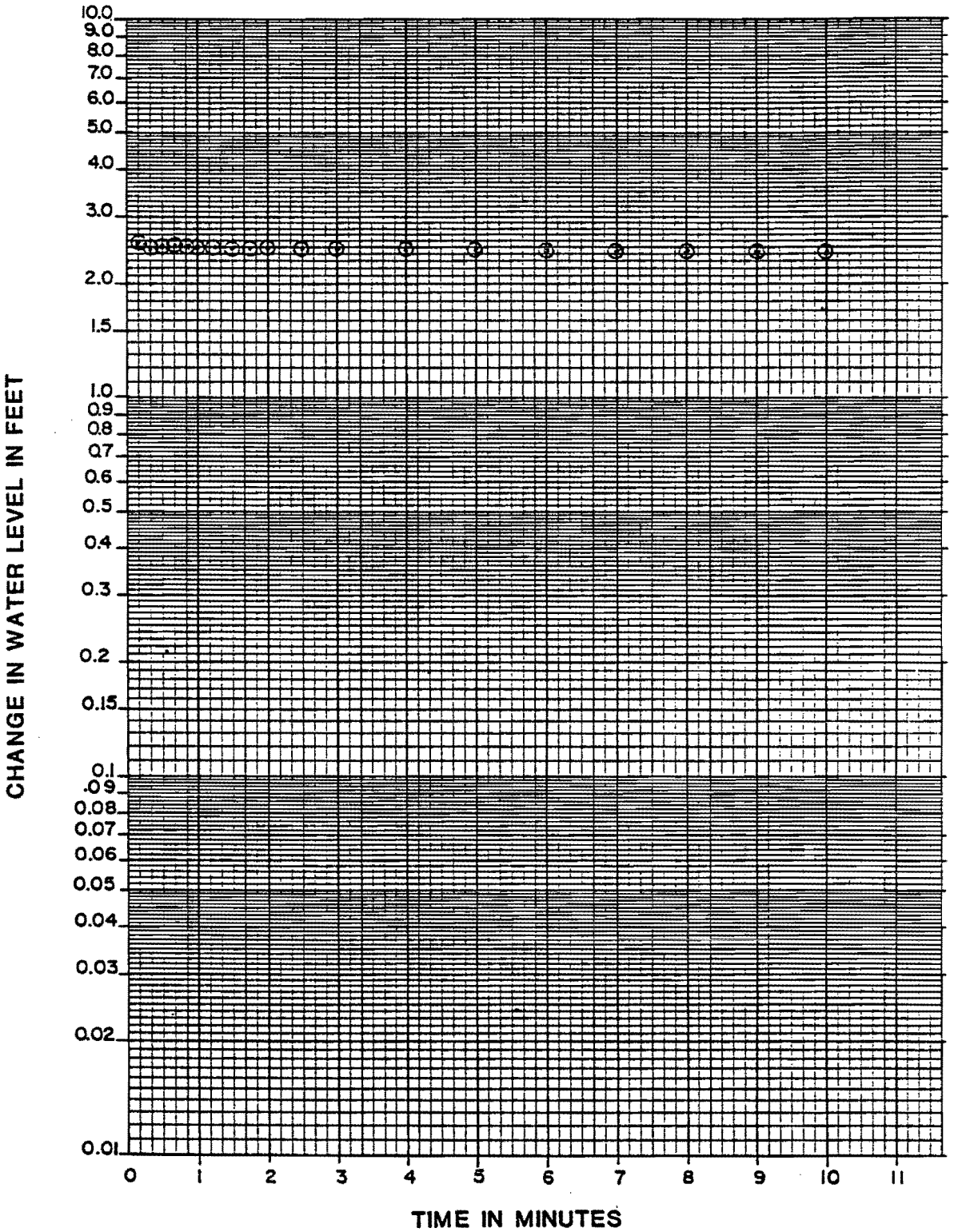
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 819

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0819501

WELL NO.: 0819

LOCATION: MAIN PLANT - SWSA 2 0.3' TO 0.6'

TYPE: SOIL

SAMPLER: [signature] (SIGNATURE)

DATE: 5/18/87

TIME:

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/26/87	11:40AM	MCI	[signature]	5/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0819W01

WELL NO.: 0819

LOCATION: MAIN PLANT - SWSA 2

TYPE: DRILL WATER

SAMPLER: [signature] (SIGNATURE)

DATE: 5/19/87

TIME: 10:45 A.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/26/87	11:40AM	MCI	[signature]	5/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0819W02

WELL NO.: 0819

LOCATION: SWSA 2 - MAIN PLANT
DRILL WATER @ 40'

TYPE: DRILL WATER

SAMPLER: [signature] (SIGNATURE)

DATE: 5/20/87

TIME: 10:30 A.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	5/21/87	11:40 AM	MCI	[signature]	5/21/87	11:40	ORNL

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
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1.0 General Information

1.1 Well Location

Monitoring well number 820 is located in the Main Plant area. It is south of SWSA 2 approximately 300 feet north of Building 4500 N. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,341.77, E 32,422.00 (X-10 grid) or latitude 35° 55' 45.7" and longitude 84° 18' 49.3". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 820 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III. Drilling commenced on 6/22/87 and was finished on 7/2/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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6/22/87 The Gus Pech was mobilized to the staked location and set up on plastic. The interval from 0.0 feet to 2.2 feet was split spooned and the hole was augered from the surface to 6.0 feet with a 6 3/4 inch auger.

6/23/87-6/29/87 The boring was augered from 6.0 feet to 20.0 feet in medium hard to hard limestone.

6/30/87 Bailed boring all day.

7/1/87 Bailed boring and installed 15 feet of 2 inch stainless steel screen and 7.8 feet of stainless steel casing, followed by a sandpack and bentonite seal.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

One soil sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. A chain of custody form for this soil sample is included with this data package. Soil sample 0820S01 was collected in the split spoon interval from 0.3 feet to 0.5 feet on 6/22/87. Analytical results for the soil sample described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 1.9 feet to 2.2 feet. The sample was measured, weighed and a bulk density of 2.0 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 19.8 to 20.0 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 4.8 to 19.8 feet. A two-inch diameter stainless steel casing was installed above the screen from 4.8 feet to 3.0 feet above ground surface. A sandpack was then poured into the annular space from 3.5 to 20.0 feet, with a 2.0 foot bentonite pellet seal poured into the annular space above the sandpack from 1.5 to 3.5 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 820 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 39.1 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/8/88 at a depth of 17.5 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 820 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 8.92×10^{-6} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 820

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/22/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/22/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	7/1/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/22/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/22/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/22/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 7/1/87
Michael L. Ebers

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WELL No. 820

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/22/87
Michael L. Ebers

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WELL No. 820

ORNL MONITORING WELL LOG

LOCATION: Main Plant - SWSA 2
DRILLER: A. L. Clark, III
HELPER: None
DRILL: Gus Pech

DATE: START: 6/22/87
FINISH: 7/1/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split spoon, Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: one
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 2.2'
DEPTH DRILLED IN ROCK: 17.8'
TOTAL DEPTH OF WELL: 20.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.2		100%	Clay and topsoil, moderate brown with roots
0.2	0.9	0820S01	100%	Clay, moderate brown, damp, fairly soft
		@0.3-0.5'		
0.9	2.2		100%	Shale, weathered with limestone pebbles,
				grayish orange and olive gray, slightly damp
				Bulk Density @ 1.9' - 2.2' = 2.0 grams/cm³
	2.2			Split spoon refusal
2.2	5.5			Shale, weathered with limestone pebbles,
				grayish orange and olive gray, slightly damp
5.5	10.0			Limestone, hard, fine grained, olive gray, dry
10.0	10.8			Shale, soft, dry
10.8	15.3			Limestone, hard, moist at 15'
15.3	18.1			Limestone, shaly, fairly soft, moist
18.1	18.3			Limestone, hard, moist
18.3	20.0			Limestone, shaly, fairly soft, moist
	20.0			TOTAL DEPTH

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WELL No. 820

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER:

EQUIPMENT ☒ 6 INCH AUGER 20.0 L.F.
☐ _____ INCH AUGER _____ L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,341.77
E 32,422.00
ELEV. GROUND 807.35
ELEV. TOP STAINLESS STEEL CASING 810.33

DRILLING DATES:
STARTED: 6/22/87
FINISHED: 7/1/87

MATERIALS USED

EST. VOL.	USED VOL.	
	15.0	FEET OF 2 IN. S.S. SCREEN
	7.8	FEET OF 2 IN. S.S. CASING
3.0	5.0	SACKS OF SAND
30.0	35.0	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2	POUNDS OF POWDERED BENTONITE
	6	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage and Irregular Auger
Boring Diameter

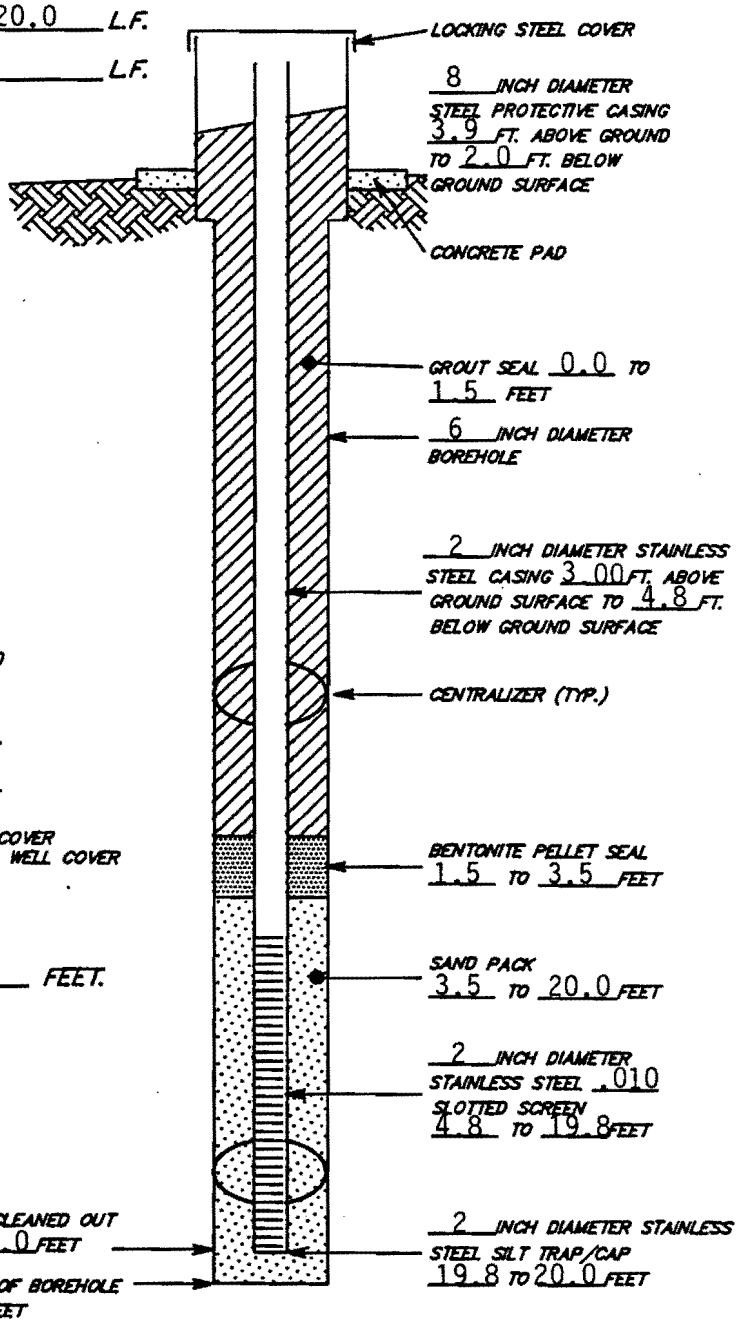
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 17.1 FEET.

CENTRALIZERS AT 5 FEET.
20 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 820

DATE: 6/22/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		7/1/87	02
BENTONITE		7/1/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES □ NO)	7/1/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES □ NO)	7/1/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES □ NO)	7/1/87	04
STAINLESS STEEL CAPS	(PREPACKAGED □ YES ■ NO)	7/1/87	02
MONITORING WELL PUMP	(PREPACKAGED ■ YES □ NO)	3/8/88	02
GROUT		7/2/87	08
WELL COVERS		7/87	01
SURFACE CASING		7/87	02

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 7/1/87
Michael L. Ebers

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WELL No. 820

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	7/1/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	7/1/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/8/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	7/1/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/8/88
John M. McLoughlin

Michael L. Ebers 7/1/87
Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 820

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/3/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/8/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 11.4

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 39.1 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: _____

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 4.8 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/8/88 AT 17.1 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/8/88
John M. McLoughlin

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 820
LOCATION: Main Plant
DATE: 3/3/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 11.4 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/3/88	10.0					
3/4/88	9.7					
3/7/88	10.1					
3/8/88	9.3	Clear	5 JTU's	39.1	3.43	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	39.1	3.43	

COMMENTS Average pH = 7.4

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WELL No. 820

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0820 DATE OF TEST: 4/13/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 15.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 12.53 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 15.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 5.33 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 30

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)

1.0311
1.0306

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WELL No. 820

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	6.100	.750
20.00	6.120	.770
30.00	6.230	.880
40.00	6.320	.970
50.00	6.390	1.040
60.00	6.410	1.060
75.00	6.450	1.100
90.00	6.460	1.110
105.00	6.460	1.110
120.00	6.460	1.110
150.00	6.460	1.110
180.00	6.460	1.110
240.00	6.440	1.090
300.00	6.420	1.070
360.00	6.400	1.050
420.00	6.380	1.030
480.00	6.360	1.010
540.00	6.340	.990
600.00	6.320	.970
720.00	6.300	.950
840.00	6.280	.930
960.00	6.260	.910
1080.00	6.240	.890
1200.00	6.220	.870
1320.00	6.200	.850
1440.00	6.190	.840
1560.00	6.180	.830
1680.00	6.170	.820
1800.00	6.160	.810
1920.00	6.150	.800

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WELL No. 820

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 2.93E-07 FT/SEC = 8.92E-06 CM/SEC

TRANSMISSIVITY = 4.39E-06 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.46E-07 FT/SEC = 4.44E-06 CM/SEC

TRANSMISSIVITY = 2.18E-06 FT**2/SEC

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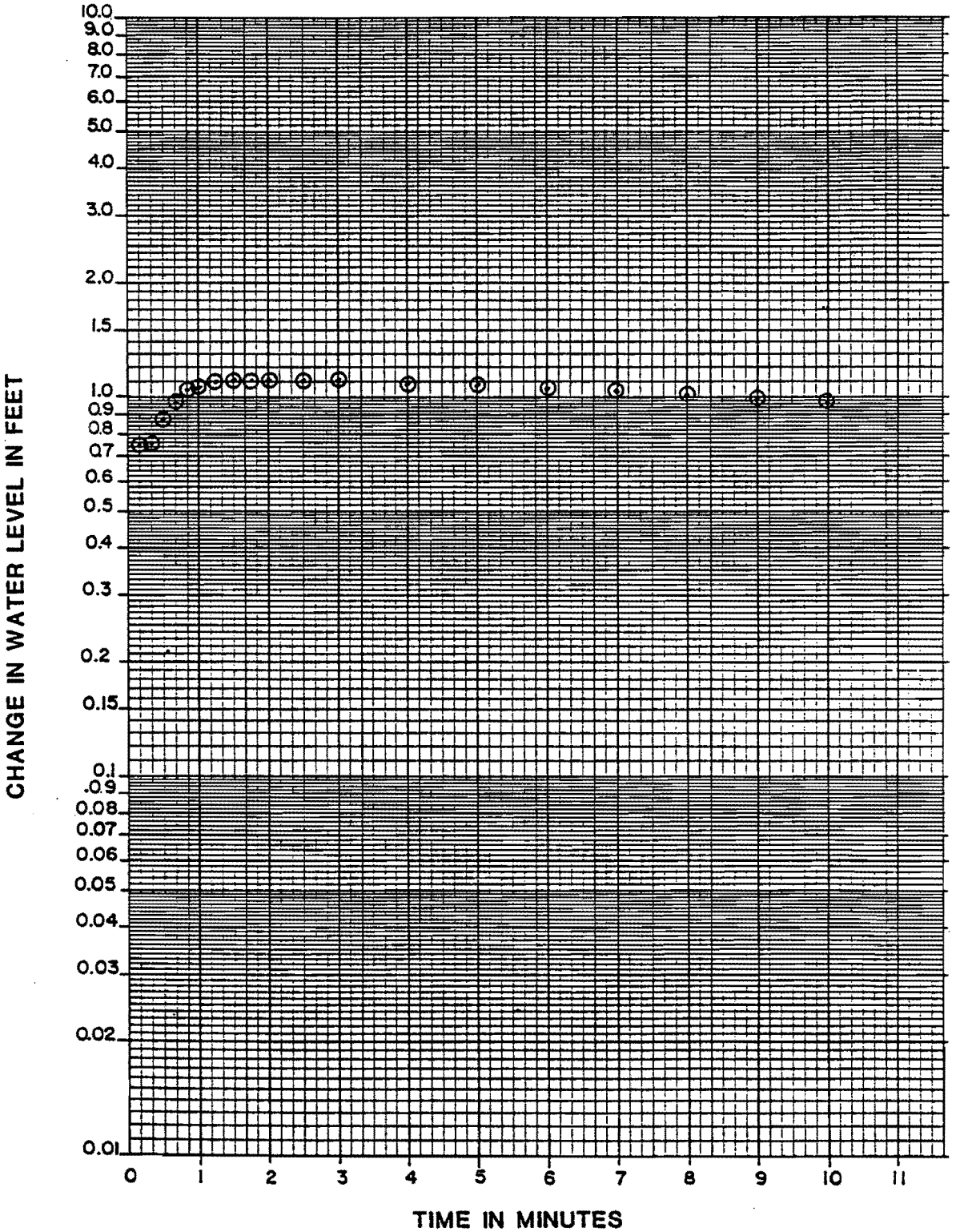
WELL No. 820

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0820S01

WELL NO.: 0820

LOCATION: MAIN PLANT SWSA 2

TYPE: SOIL

SAMPLER: [signature] (SIGNATURE)

0.3' TO 0.5'

DATE: 6/22/87

TIME: 12:00PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	7/31/87	1:30PM.	MCI	Nancy Ower	7/31/87	1:30pm	

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 821 is located in the Main Plant area. It is located south of SWSA 6 approximately 300 feet north of Building 4500 N. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,340.67, E 32,435.98 (X-10 grid) or latitude 35° 55' 45.8" and longitude 84° 18' 49.1'. Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 821 was drilled by A.L. Clark Drilling Services, Inc. A Driltech rig was used to drill this boring for monitor well installation under the operation of Steve Clark with the assistance of Steve Kirk. Drilling commenced on 6/12/87 and was finished on 6/22/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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6/12/87 The Driltech was mobilized to the staked location and set up on plastic.

6/15/87 The boring was drilled from the surface to 7.6 feet with a 14 inch auger. A 10.2 foot piece of 10 3/4 inch surface pipe was installed and grouted with 3 sacks of cement.

6/16/87 The diverter and containment box were installed and the boring deepened from 7.6 feet to 40.0 feet with an 8 inch tricone air rotary bit. Fourty feet of 4 inch stainless steel casing were installed.

6/18/87 The 4 inch stainless steel casing was grouted.

6/19/87 The boring was deepened from 40 feet to 70 feet with a 3 7/8 inch tricone air rotary bit.

6/22/87 The boring was deepened from 70 feet to 80 feet with a 3 7/8 inch tricone air rotary bit. The boring made 40 feet of water in one hour.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical

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Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

A drill water sample was collected from the water pump on the drill rig on 6/22/87. A chain of custody form for this sample is included in this data package. Analytical results for the water sample described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was an open hole or type C well, without a stainless steel screen. A fourteen-inch diameter boring was augered from ground

surface to bedrock (7.6 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a depth of 40.0 feet. A four-inch diameter stainless steel casing was installed and tremie grouted from the bottom of the eight-inch diameter boring at 40.0 feet and extending 2.3 feet above ground surface. The air rotary method was then used to drill a 3 7/8 inch diameter boring (open hole interval) from the bottom of the four-inch diameter stainless steel casing at 40.0 feet to a total depth of 80.0 feet. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 821 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 168.6 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/11/88 at a depth of

75.1 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 821 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 1.10×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 821

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/15/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/15/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	MLE
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	6/16/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/15/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/15/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/15/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/16/87
Michael L. Ebers

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WELL No. 821

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/15/87

Michael L. Ebers

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WELL No. 821

ORNL MONITORING WELL LOG

LOCATION: Main Plant - SWSA 2
DRILLER: Steve Clark
HELPER: Steve Kirk
DRILL: Driltech

DATE: START: 6/15/87
FINISH: 6/22/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Auger and Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 7.6'
DEPTH DRILLED IN ROCK: 72.4'
TOTAL DEPTH OF WELL: 80.0'

DRILLING FLUID SAMPLES:
TYPE: Drill Water DATE: 6/22/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.2			Topsoil and roots
0.2	5.0			Clay, moderate yellowish brown, silty, dry
				with abundant limestone cobbles, medium light
				gray and olive gray, fine grained, locally
				medium grained
5.0	7.6			Limestone, medium light gray and olive gray,
				fine grained, thin bedded, weathered, dry
	7.6			14" Auger refusal
7.6	17.0			Limestone, hard*
17.0	17.2			Shale
17.2	24.1			Limestone, hard
24.1	24.3			Shale
24.3	36.3			Limestone, hard
36.3	36.6			Shale
36.6	40.0			Limestone, hard
40.0	60.0			Limestone, hard, thin breaks at 52' and 54'
60.0	80.0	0821W01		Limestone, hard
		@ 80'		
	80.0			TOTAL DEPTH

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WELL No. 821

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
				* No detailed lithologic description available for the interval from 19.1' to 81.0' due to the use of a containment box.

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WELL No. 821

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- ☒ 14 INCH AUGER 7.6 L.F.
- ☐ INCH AUGER L.F.
- ☒ 8 INCH ROTARY 32.4 L.F.
- ☒ 3 7/8 INCH ROTARY 40.0 L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,340.67
E 32,435.98
ELEV. GROUND 808.55
ELEV. TOP STAINLESS STEEL CASING 810.88

DRILLING DATES:
STARTED: 6/15/87
FINISHED: 6/22/87

MATERIALS USED

EST. VOL.	USED VOL.	
	25	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	10.0	FT. OF 10 IN. SURFACE CASING
2.0	3.0	SACKS OF CEMENT (SURFACE CASING)
	6.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	20.0	GALLONS OF WATER (SURFACE CASING)
	42.3	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
8.4	8.0	SACKS OF CEMENT (S.S. CASING)
	16.0	POUNDS OF POWDERED BENTONITE (S.S. CASING)
	56.0	GALLONS OF WATER (S.S. CASING)
	25	POUNDS OF BENTONITE PELLETS (STAINLESS STEEL CASING SEAL)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage and irregular auger boring diameter

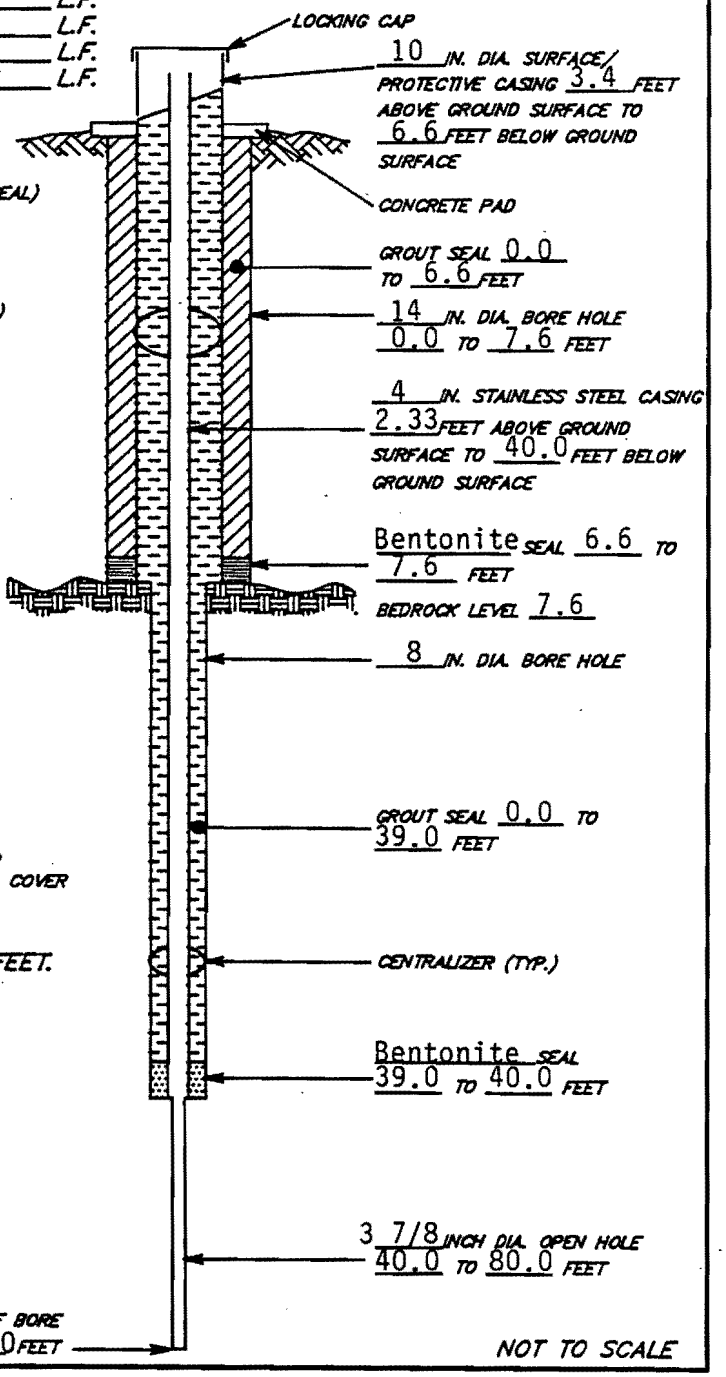
SURFACE CASING TREMIE GROUTED YES ☒ NO ☐
STAINLESS STEEL CASING TREMIE GROUTED YES ☒ NO ☐

WELL COVER USED
- ☒ LOCKING STEEL COVER
- ☐ FLUSH MOUNTED WELL COVER
- ☐ OTHER

MONITORING WELL PUMP BASE SET AT 75.1 FEET.

CENTRALIZERS AT 3.0 FEET.
20.0 FEET.
40.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE C WELL

NOT TO SCALE

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WELL No. 821

DATE: 6/15/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		N/A	N/A
BENTONITE		6/15/87 6/16/87	02 01
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ☐ NO)	N/A	N/A
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	6/16/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	6/16/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ☐ YES ■ NO)	6/16/87	02
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/11/88	02
GROUT		6/15/87	08
WELL COVERS		6/87	01
SURFACE CASING		6/15/87	02

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/16/87
Michael L. Ebers

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WELL No. 821

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/22/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/22/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/4/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/22/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/4/88
John M. McLoughlin

Michael L. Ebers 6/22/87
Michael L. Ebers

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WELL No. 821

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/4/88 TIME:

DEVELOPMENT ENDING DATE: 3/4/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 49.1

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 168.6 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Steve L. Laman, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 6.2 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/11/88 AT 75.1 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M McLoughlin 3/8/88
John M. McLoughlin

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WELL NO. 821
LOCATION: Main Plant
DATE: 3/4/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 49.1 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/4/88	168.6	Clear	5 JTU's	168.6	3.43	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	168.6	3.43	

COMMENTS Average pH = 8.1

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WELL No. 821

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0821 DATE OF TEST: 4/13/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 40.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 72.19 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 40.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 4.68 FEET
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 32

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
2.3869
2.3943

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WELL No. 821

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	7.230	2.550
20.00	7.280	2.600
30.00	7.230	2.550
40.00	7.220	2.540
50.00	7.170	2.490
60.00	7.150	2.470
75.00	7.140	2.460
90.00	7.110	2.430
105.00	7.070	2.390
120.00	7.050	2.370
150.00	7.000	2.320
180.00	6.960	2.280
240.00	6.890	2.210
300.00	6.820	2.140
360.00	6.780	2.100
420.00	6.740	2.060
480.00	6.710	2.030
540.00	6.680	2.000
600.00	6.650	1.970
720.00	6.630	1.950
840.00	6.600	1.920
960.00	6.580	1.900
1080.00	6.550	1.870
1200.00	6.530	1.850
1320.00	6.510	1.830
1440.00	6.490	1.810
1560.00	6.470	1.790
1680.00	6.440	1.760
1800.00	6.440	1.760
1920.00	6.430	1.750
2040.00	6.410	1.730
2160.00	6.390	1.710

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WELL No. 821

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 3.61E-07 FT/SEC = 1.10E-05 CM/SEC

TRANSMISSIVITY = 1.44E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 3.61E-07 FT/SEC = 1.10E-05 CM/SEC

TRANSMISSIVITY = 1.44E-05 FT**2/SEC

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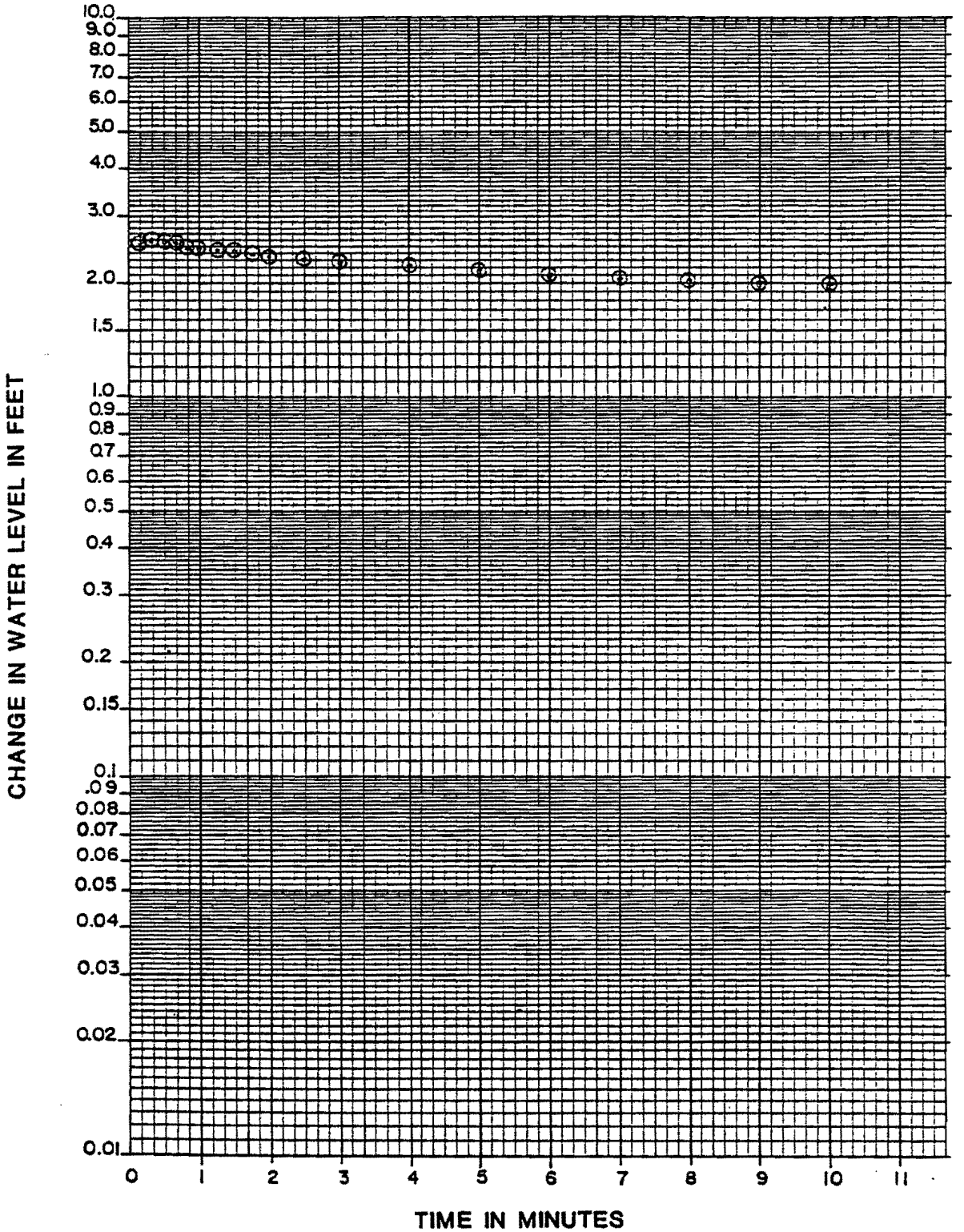
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 821

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0821W01

WELL NO.: 0821

LOCATION: Main Plant SWSA 2 @ 80'

TYPE: DRILL WATER

SAMPLER: [signature] (SIGNATURE)

DATE: 6/22/87

TIME: 9:30AM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	6/22/87	9:30AM	MCI	Nancy Owen	6/22/87	9:30 am	

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 822 is located in the Main Plant area. It is located south of SWSA 2 approximately 250 feet north of Building 4500 N. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,262.75, E 32,116.67 (X-10 grid) or latitude 35° 55' 43.4" and longitude 84° 18' 51.8". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 822 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced on 6/15/87 and was finished on 6/18/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

6/15/87 The Gus Pech was mobilized to the staked location and set up on plastic. The boring was split spooned from the surface to 6.0 feet. The boring was then reamed out from the surface to 6.0 feet with a 6 3/4 inch auger.

6/16/87 The boring was augered from 6.0 feet to 11.0 feet with 6 3/4 inch augers.

6/17/87 The boring was augered from 11.0 feet to 15.6 feet total depth with 6 3/4 inch augers.

6/18/87 The boring was cleaned out with a bailer and 10.0 feet of 2 inch stainless steel screen and 7.1 feet of 2 inch stainless steel casing were installed. A sandpack was placed from 3.5 feet to 15.2 feet and a 2 foot bentonite seal installed above the sandpack.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs.

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2-4.). A checklist of the cleaned materials is included with this data package.

2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0822S01 was collected in the split spoon interval from 0.3 feet to 0.45 feet on 6/15/87 and soil sample 0822S02 was collected in the split spoon interval from 4.3 feet to 4.4 feet on 6/15/87. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 5.6 feet to 6.0 feet. The sample was measured, weighed and a bulk density of 2.0 grams/cm^3 was calculated.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.0 to 15.2 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.0 to 15.0 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.0 feet to 2.1 feet above ground surface. A sandpack was then poured into the annular space from 3.5 to 15.2 feet, with a 2 foot bentonite pellet seal poured into the annular space above the sandpack from 1.5 to 3.5 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 822 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 350.8 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was

5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/2/88 at a depth of 12.8 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 822 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously removing a known quantity of water from the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 1.28×10^{-3} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 822

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/15/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/15/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	6/18/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/15/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/15/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/15/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/18/87
Michael L. Ebers

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WELL No. 822

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/15/87
Michael L. Ebers

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WELL No. 822

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech

DATE: START: 6/15/87
FINISH: 6/18/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Sherrie Chadwick

TYPE DRILLING: Split Spoon and Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 6.0'
DEPTH DRILLED IN ROCK: 9.6'
TOTAL DEPTH OF WELL: 15.6'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.2		100%	Topsoil and gravel
0.2	2.0	0822S01	65%	Clay, moderate yellowish brown with medium
		@0.3-0.45'		gray mottles, damp, dense and plastic
2.0	4.0		0	No recovery
4.0	6.0	0822S02	40%	Shale, weathered, greenish gray, few thin
		@4.3-4.4'		laminations of olive gray shale, bedding 45°
				to horizontal, slightly moist, crumbly
				Bulk Density @ 5.6' to 6.0' = 2.0 grams/cm³
	6.0			Split spoon refusal
6.0	8.0			Shale, weathered, greenish gray and olive gray
8.0	15.6			Limestone, hard, soft @ 13.0' to 13.3'
	15.6			TOTAL DEPTH

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WELL No. 822

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: None

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,262.75
E 32,116.67
ELEV. GROUND 797.58
ELEV. TOP STAINLESS STEEL CASING 799.63

DRILLING DATES:
STARTED: 6/15/87
FINISHED: 6/18/87

EQUIPMENT ☒ 6 INCH AUGER 15.6 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.2	FEET OF 2 IN. S.S. SCREEN
	7.1	FEET OF 2 IN. S.S. CASING
2.1	2.5	SACKS OF SAND
25.0	25.0	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	7.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage

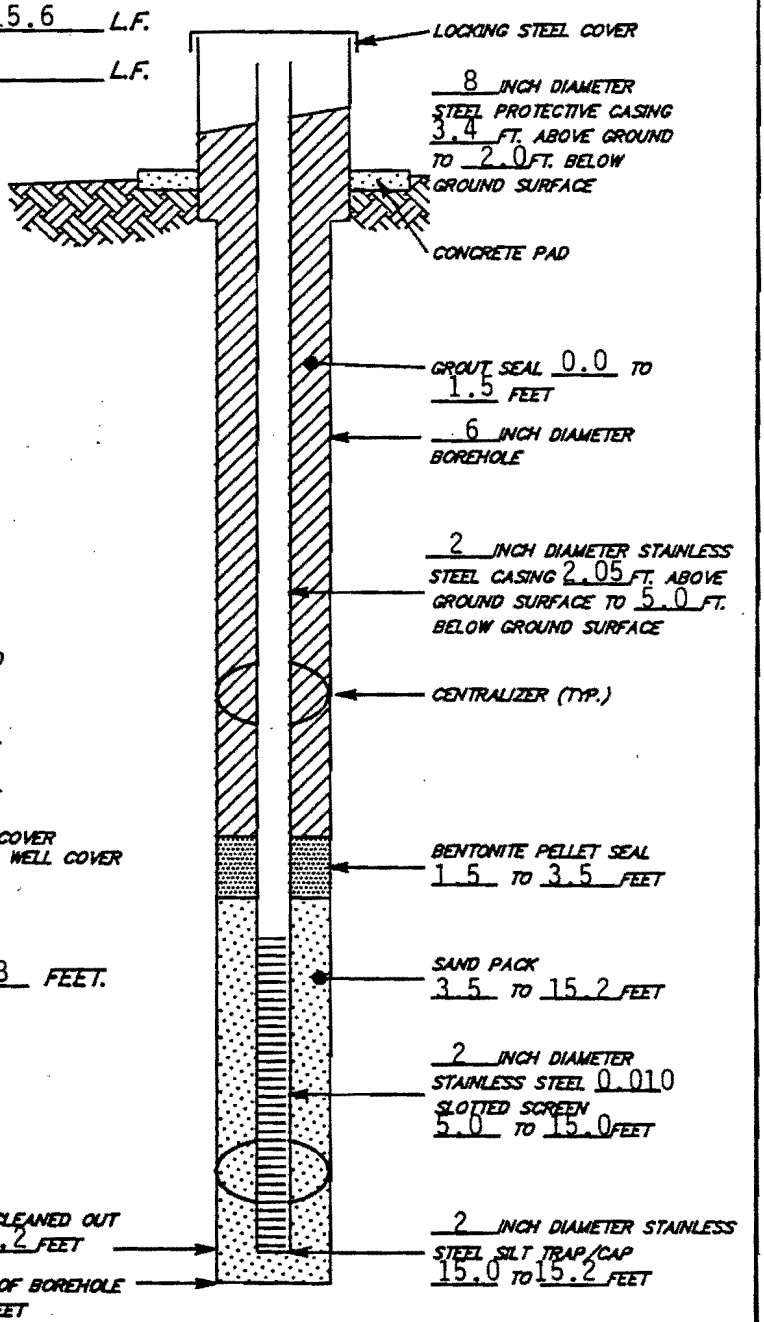
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.8 FEET.

CENTRALIZERS AT 5.0 FEET.
15.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 822

DATE: 6/19/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		6/18/87	02
BENTONITE		6/18/87	01
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	6/18/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	6/18/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	6/18/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	6/18/87	02
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/2/88	02
GROUT		6/19/87	08
WELL COVERS		7/87	01
SURFACE CASING		7/87	02

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/19/87
Michael L. Ebers

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WELL No. 822

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/18/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/18/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/2/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/18/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/2/88
John M. McLoughlin

Michael L. Ebers 6/18/87
Michael L. Ebers

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WELL No. 822

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 2/29/88 TIME:

DEVELOPMENT ENDING DATE: 3/2/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 9.5

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 350.8 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Richard H. Ketelle, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 6.2 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/2/88 AT 12.8 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/2/88
John M. McLoughlin

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WELL NO. 822
LOCATION: Main Plant
DATE: 2/29/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 9.5 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
2/29/88	112.4					
3/1/88	112.4					
3/2/88	126.0	Clear	5 JTU's	350.8	36.93	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	350.8	36.93	

COMMENTS Average pH = 8.2

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0822 DATE OF TEST: 4/13/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 15.80 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 8.00 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 16

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WELL No. 822

HYDRAULIC CONDUCTIVITY CALCULATIONS

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.3315
.3800
.4519
.5607
.7015
.7654
.9044
.9575
1.0286
1.0965
1.2417
1.2723

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	7.010	.990
20.00	7.400	.600
30.00	7.560	.440
40.00	7.680	.320
50.00	7.750	.250
60.00	7.820	.180
75.00	7.840	.160
90.00	7.890	.110
105.00	7.910	.090
120.00	7.930	.070
150.00	7.930	.070
180.00	7.960	.040
240.00	7.960	.040
300.00	7.960	.040
360.00	7.960	.040
420.00	7.960	.040

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WELL No. 822

HYDRAULIC CONDUCTIVITY CALCULATIONS

```
*****************************************************************

            METHOD OF BOUWER AND RICE

  COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

   PERMEABILITY =  4.21E-05 FT/SEC          =  1.28E-03 CM/SEC

   TRANSMISSIVITY =  4.21E-04 FT**2/SEC


  COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

   PERMEABILITY =  5.58E-05 FT/SEC          =  1.70E-03 CM/SEC

   TRANSMISSIVITY =  5.58E-04 FT**2/SEC
```

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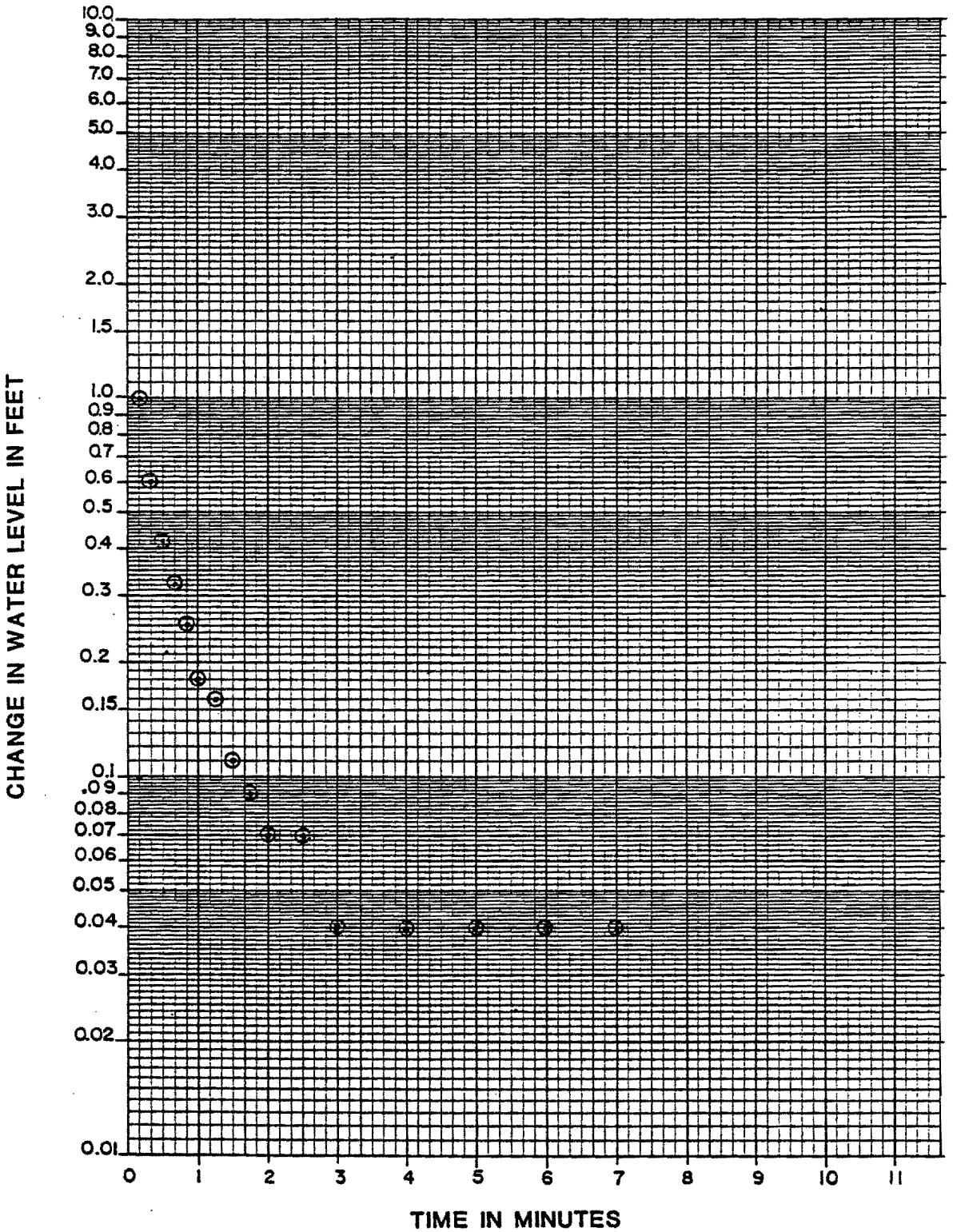
WELL No. 822

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0822 S01

WELL NO.: 0822

LOCATION: Main Plant SWSA 2 @ 0.3 - 0.45'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 6/15/87

TIME: 2:30 PM.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	6/22/87	9:30AM	MCI	Nancy Owen	6/22/87	9:30 am	

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0822 S02

WELL NO.: 0822

LOCATION: Main Plant SWSA 02 @ 4.3-4.4'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 6/15/87

TIME: 2:30 P.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	6/22/87	9:30 AM	MCI	Nancy Owen	6/22/87	9:30 a	

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 823 is located in the Main Plant area. It is 25 feet north of Building 4501. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 22,057.30, E 32,141.78 (X-10 grid) or latitude 35° 55' 41.8" and longitude 84° 18' 50.2" Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 823 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced on 6/10/87 and was finished on 6/11/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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The drill rig and equipment were mobilized to the staked drilling location and set up on plastic sheeting. Continuous split spoon samples were taken from ground surface to a depth of 9.3 feet at which point limestone was encountered. The split spoon boring was then reamed to a diameter of 6.5 inches using solid stem augers. This boring was advanced in rock to a total depth of 15.6 feet. The cuttings produced during drilling were removed from the borehole by bailing.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0823S01 was collected in the split spoon interval from 1.1 feet to 1.3 feet on 6/10/87 and soil sample 0823S02 was collected in the split spoon interval from 6.4 feet to 6.6 feet on 6/10/87. Analytical results for these soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 3.5 feet to 4.0 feet. The sample was measured, weighed and a bulk density of 2.0 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.0 to 15.2 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.0 to 15.0 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.0 feet to 0.7 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 15.3 feet, with a 2.0 foot bentonite pellet seal poured into the annular space above the sandpack from 2.0 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 823 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 141.1 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 4/15/88 at a depth of 11.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 823 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 8.05×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 823

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/10/87	[illegible]
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/10/87	[illegible]
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	[illegible]
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	6/10/87	[illegible]
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/10/87	[illegible]
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/10/87	[illegible]
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/10/87	[illegible]

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE [signature] 6/10/87
John W. Anderson

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WELL No. 823

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE 6/10/87
John W. Anderson

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WELL No. 823

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech

DATE: START: 6/10/87
FINISH: 6/11/87
LOGGED BY: John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split Spoon and Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 9.3'
DEPTH DRILLED IN ROCK: 6.3'
TOTAL DEPTH OF WELL: 15.6'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.6		40%	Topsoil, dark brown with organic material
0.6	2.0	0823S01	100%	Clay, silty with limestone fragments,
		@1.1'-1.3'		medium brown, damp
2.0	4.0		100%	Clay, silty with limestone fragments, medium
				brown, dry
				Bulk Density @ 3.5' - 4.0' = 2.0 grams/cm³
4.0	6.0		100%	Clay, silty with abundant limestone fragments,
				olive green, moist
6.0	9.3	0823S02	100%	Clay, silty with chert and limestone frag-
		@6.4'-6.6'		ments, light green, wet
	9.3			Split spoon refusal
9.3	9.5			Limestone, dark gray, wet
9.5	12.5			Limestone, soft, light gray, wet
12.5	13.2			Limestone, hard, light gray, wet
13.2	14.5			Limestone, soft, light gray, wet
14.5	15.6			Limestone, hard, light gray, dry
	15.6			TOTAL DEPTH

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WELL No. 823

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Richard Pickel

LOCATION Main Plant
ORNL GRID COORDINATES
N 22,057.30
E 32,141.78
ELEV. GROUND 799.51
ELEV. TOP STAINLESS STEEL CASING 800.23

DRILLING DATES:
STARTED: 6/10/87
FINISHED: 6/11/87

EQUIPMENT ☒ 6.5 INCH AUGER 15.6 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	5.7	FEET OF 2 IN. S.S. CASING
3.0	4.0	SACKS OF SAND
35	35	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2	POUNDS OF POWDERED BENTONITE
	5.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage

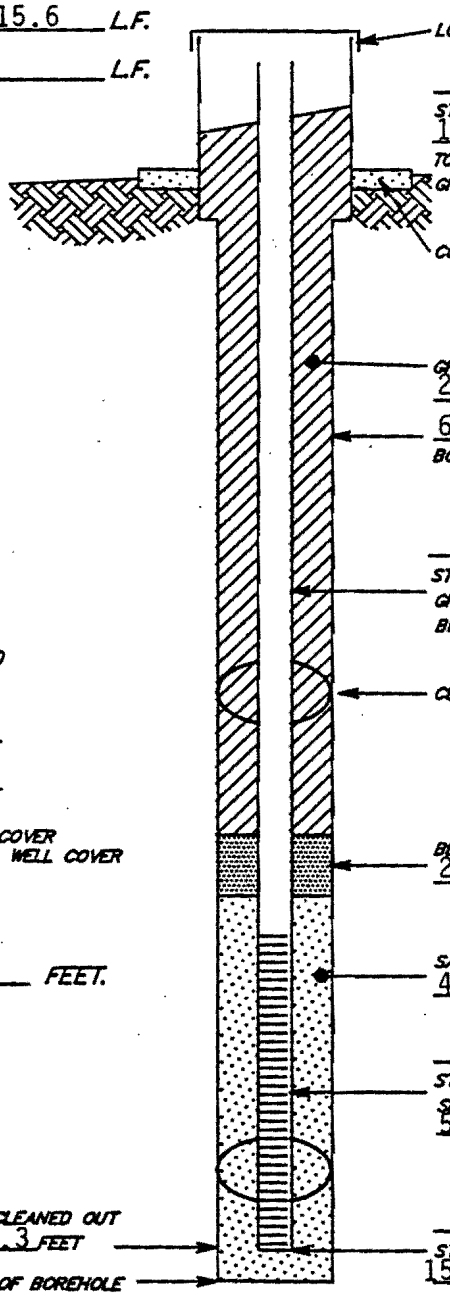
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 11.2 FEET.

CENTRALIZERS AT 5.0 FEET.
14.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 823

DATE: 6/12/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		6/11/87	02
BENTONITE		6/11/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	6/11/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	6/11/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	6/11/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	6/11/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	4/15/88	02
GROUT		6/12/87	04
WELL COVERS		6/87	01
SURFACE CASING		6/87	02

COMMENTS:

OBSERVER SIGNATURE/DATE 6/11/87
John W. Anderson

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WELL No. 823

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/11/87	[illegible]
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/11/87	[illegible]
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	4/15/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/11/87	[illegible]

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 4/15/88
John M. McLoughlin

[illegible] 6/11/87
John W. Anderson

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WELL No. 823

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/7/88 TIME: _____

DEVELOPMENT ENDING DATE: 4/15/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 7.6

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 141.1 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

*TURBIDITY AT END OF DEVELOPMENT: _____ JACKSON TURBIDITY UNITS

- ☐ CLEAR
- ☒ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

*TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 5.1 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 4/15/88 AT 11.2 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

* This well exhibited a slow rate of recharge. Only 141.1 gallons of water was removed from the well from 3/7/88 through 4/15/88. The produced water on 4/15/88 was still slightly cloudy.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 4/15/88
John M. McLoughlin

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WELL NO. 823
LOCATION: Main Plant
DATE: 3/7/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 7.6 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/7/88	11.9					
3/8/88	11.9					
3/9/88	11.9					
3/10/88	11.9					
3/17/88	10.2					
3/18/88	11.9					
3/21/88	10.2					
3/28/88	13.6					
3/29/88	11.9					
3/30/88	11.9					
3/31/88	-0-					
4/4/88	4.0					
4/6/88	3.9					
4/8/88	4.0					
4/11/88	11.9					
4/13/88	11.9					
4/15/88	11.9			141.1	18.57	
RESULTS AT END OF DEVELOPMENT		Slightly Cloudy		141.1	18.57	

COMMENTS Average pH = 8.4

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WELL No. 823

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0823 DATE OF TEST: 4/26/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.25 INCHES
DIAMETER OF DRILLED HOLE = 6.50 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.50 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 9.50 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 1.13 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 24

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)

1.2595
1.2757

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WELL No. 823

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	2.760	1.630
20.00	2.610	1.480
30.00	2.520	1.390
40.00	2.460	1.330
50.00	2.420	1.290
60.00	2.360	1.230
75.00	2.320	1.190
90.00	2.280	1.150
105.00	2.250	1.120
120.00	2.200	1.070
150.00	2.170	1.040
180.00	2.120	.990
240.00	2.060	.930
300.00	2.010	.880
360.00	1.960	.830
420.00	1.930	.800
480.00	1.900	.770
540.00	1.870	.740
600.00	1.850	.720
720.00	1.800	.670
840.00	1.770	.640
960.00	1.740	.610
1080.00	1.710	.580
1200.00	1.690	.560

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 2.64E-06 FT/SEC = 8.05E-05 CM/SEC

TRANSMISSIVITY = 2.24E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 1.44E-06 FT/SEC = 4.37E-05 CM/SEC

TRANSMISSIVITY = 1.22E-05 FT**2/SEC

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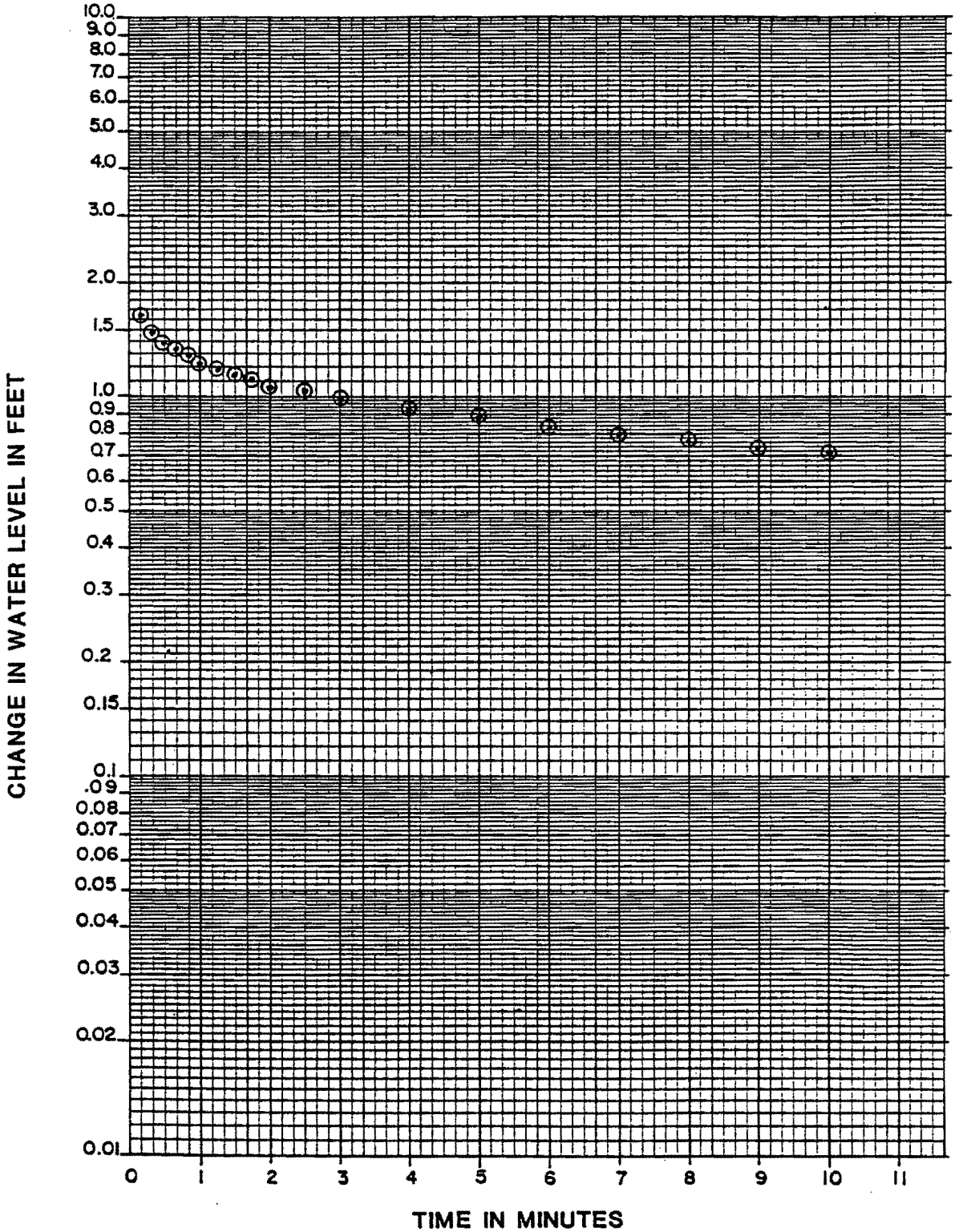
WELL No. 823

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0823 S01

WELL NO.: 0823

LOCATION: 1.1' - 1.3'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 4/10/87

TIME: 9:22

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	11/25/87	9:30	MCI	[signature]	11/25/87	9:30	MCI
[signature]	11/25/87	2:40PM	MCI	[signature]	11-25-87	2:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0823S02

WELL NO.: 0823

LOCATION: 6.4'-6.6'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 6/10/87

TIME:

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	11/25/87	9:30	MCI	[signature]	11/25/87	9:30	MCI
[signature]	11/25/87	2:40PM	MCI	Nancy Owen	11-25-87	2:40	ORNL

REMARKS:

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1.0 General Information

1.1 Well Location

Monitoring well number 824 is located in the Main Plant area. It is located south of Southside Drive approximately 50 feet north of the HTML Building. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,399.22, E 31,932.03 (X-10 grid) or latitude 35° 55' 35.3" and longitude 84° 18' 47.8". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 824 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced on 6/2/87 and was finished on 6/4/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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6/2/87 The Gus Pech drill rig was mobilized to the staked location and set up on plastic sheeting. The interval from the surface to 10.0 feet was split spooned and the boring was reamed with 6 3/4 inch augers from the surface to 11.0 feet.

6/3/87 The boring was augered from 11.0 feet to 15.0 feet with 6 3/4 inch augers.

6/4/87 The boring was deepened from 15.0 feet to 16.0 feet and bailed clean with a steel bailer. Two inch stainless steel casing, screen, sandpack and bentonite seal were installed.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0824S01 was collected in the split spoon interval from 3.2 feet to 3.4 feet on 6/2/87 and soil sample 0824S02 was collected in the split spoon interval from 5.6 feet to 5.8 feet on 6/2/87. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 7.4 feet to 7.8 feet. The sample was measured, weighed and a bulk density of 2.1 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.3 to 15.6 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.3 to 15.3 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.3 feet to 0.5 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 15.6 feet, with a 2.5 foot bentonite pellet seal poured into the annular space above the sandpack from 1.5 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 824 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 120.7 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 4/15/88 at a depth of 12.5 below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 824 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 4.92×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 824

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/2/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/2/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	6/4/87	MLE
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/2/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/2/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/2/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/4/87
Michael L. Ebers

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WELL No. 824

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/2/87
Michael L. Ebers

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WELL No. 824

ORNL MONITORING WELL LOG

PAGE 1 OF 1

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech

DATE: START: 6/2/87
FINISH: 6/4/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Sherrie Chadwick

TYPE DRILLING: Split Spoons and Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 10.0'
DEPTH DRILLED IN ROCK: 6.0'
TOTAL DEPTH OF WELL: 16.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.3		100%	Topsoil with roots
0.3	2.3		100%	Clay, moderate to dark yellowish brown with
				few dark yellowish mottles, fine silty,
				slightly moist, slightly crumbly
2.3	3.2		100%	Clay, light brown to moderate brown, few
				limestone gravels to 1/2", plastic, slightly
				moist
3.2	4.9	0824S01	100%	Clay, moderate yellowish brown, silty,
		@3.2-3.4'		slightly moist, slightly crumbly
4.9	6.9	0824S02	100%	Clay, dark yellowish brown, fine silty, moist,
		@5.6-5.8'		soft, plastic
6.9	9.8		75%	Clay, dark yellowish brown with small light
				olive and moderate brown mottles, silty with
				20% rounded chert pebbles to 1 inch
				Bulk Density @ 7.4' to 7.8' = 2.1 grams/cm³
9.8	10.0			Limestone, olive gray, fine grained, few
				birdseyes
	10.0			Split spoon refusal
10.0	16.0			Limestone, hard, as above
	16.0			TOTAL DEPTH

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WELL No. 824

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Richard Pickel

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,399.22
E 31,932.03
ELEV. GROUND 787.05
ELEV. TOP STAINLESS STEEL CASING 787.71
DRILLING DATES:
STARTED: 6/2/87
FINISHED: 6/4/87

EQUIPMENT ☒ 6 INCH AUGER 16.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	5.8	FEET OF 2 IN. S.S. CASING
2.0	3.0	SACKS OF SAND
25.0	30.0	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, spillage and irregular auger boring diameter

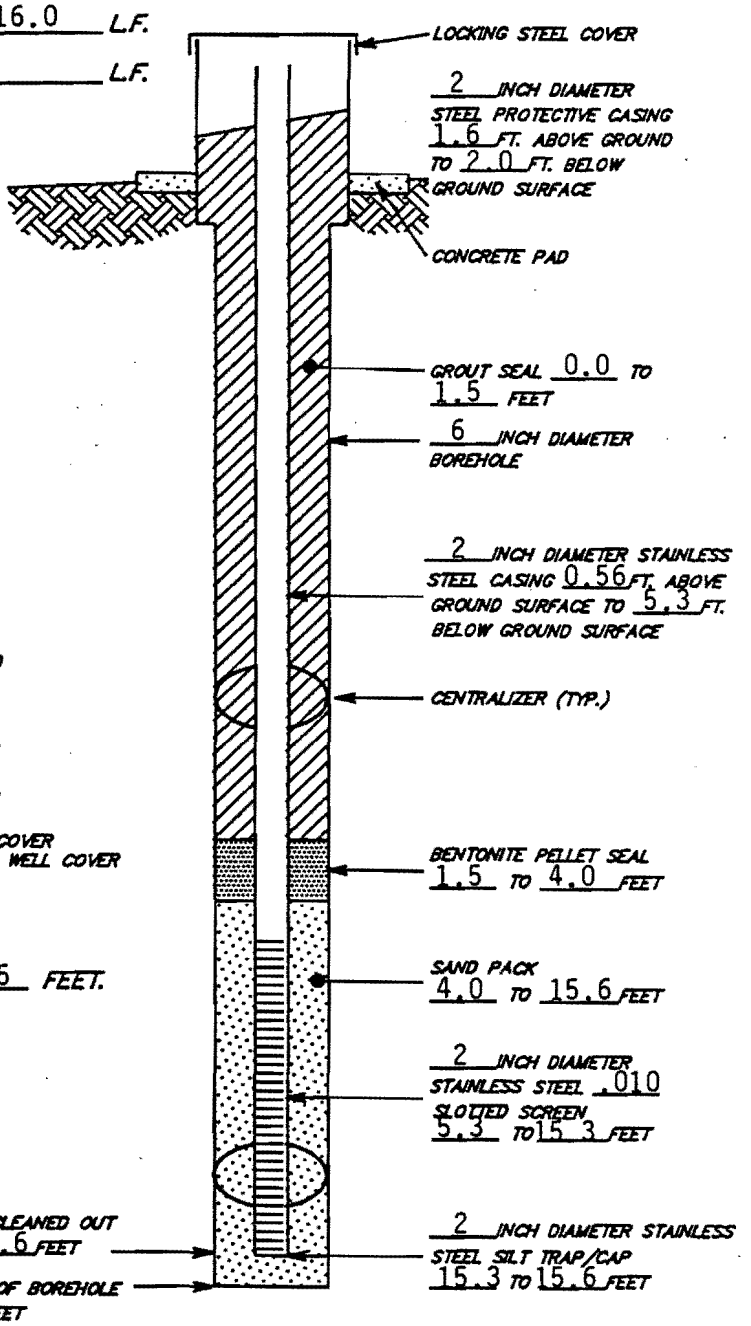
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.5 FEET.

CENTRALIZERS AT _____ FEET.
5.0 FEET.
15.0 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 824

DATE: 6/2/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		6/2/87	02
BENTONITE		6/4/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	6/4/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	6/4/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	6/4/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	6/4/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	4/15/88	02
GROUT		6/4/87	07
WELL COVERS		6/87	01
SURFACE CASING		6/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 6/4/87
Michael L. Ebers

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WELL No. 824

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/4/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/4/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	4/15/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/4/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 4/15/88
John M. McLoughlin

Michael L. Ebers 6/4/87
Michael L. Ebers

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WELL No. 824

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/14/88 TIME: _____

DEVELOPMENT ENDING DATE: 4/15/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 6.5

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 120.7 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

* TURBIDITY AT END OF DEVELOPMENT: _____ JACKSON TURBIDITY UNITS

- ☐ CLEAR
- ☒ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

* TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 6.5 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 4/15/88 AT 12.5 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

* This well exhibited a slow rate of recharge. Only 120.7 gallons of water was removed from the well from 3/14/88 to 4/15/88. The produced water on 4/15/88 was still slightly cloudy.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 4/15/88
John M. McLoughlin

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WELL NO. 824
LOCATION: Main Plant
DATE: 3/14/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 6.5 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/14/88	13.6					
3/15/88	13.6					
3/16/88	11.9					
3/17/88	13.6					
3/18/88	13.6					
3/21/88	10.2					
3/28/88	10.2					
3/29/88	6.8					
3/30/88	8.5					
3/31/88	-0-					
4/4/88	3.4					
4/6/88	3.4					
4/8/88	3.4					
4/11/88	2.8					
4/13/88	2.9					
4/15/88	2.8			120.7	18.57	
RESULTS AT END OF DEVELOPMENT		Slightly Cloudy		120.7	18.57	

COMMENTS Average pH = 8.1

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WELL No. 824

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0824 DATE OF TEST: 4/26/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.25 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.43 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.43 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 2.75 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 29

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
3.2547
3.3229

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WELL No. 824

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	7.260	4.510
20.00	7.020	4.270
30.00	6.850	4.100
40.00	6.680	3.930
50.00	6.570	3.820
60.00	6.440	3.690
75.00	6.240	3.490
90.00	6.090	3.340
105.00	5.940	3.190
120.00	5.810	3.060
150.00	5.510	2.760
180.00	5.250	2.500
240.00	4.830	2.080
300.00	4.480	1.730
360.00	4.170	1.420
420.00	4.010	1.260
480.00	3.880	1.130
540.00	3.810	1.060
600.00	3.730	.980
720.00	3.640	.890
840.00	3.550	.800
960.00	3.480	.730
1080.00	3.420	.670
1200.00	3.360	.610
1320.00	3.300	.550
1440.00	3.270	.520
1560.00	3.230	.480
1680.00	3.200	.450
1800.00	3.170	.420

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WELL No. 824

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.61E-06 FT/SEC = 4.92E-05 CM/SEC

TRANSMISSIVITY = 1.36E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 2.19E-06 FT/SEC = 6.67E-05 CM/SEC

TRANSMISSIVITY = 1.85E-05 FT**2/SEC

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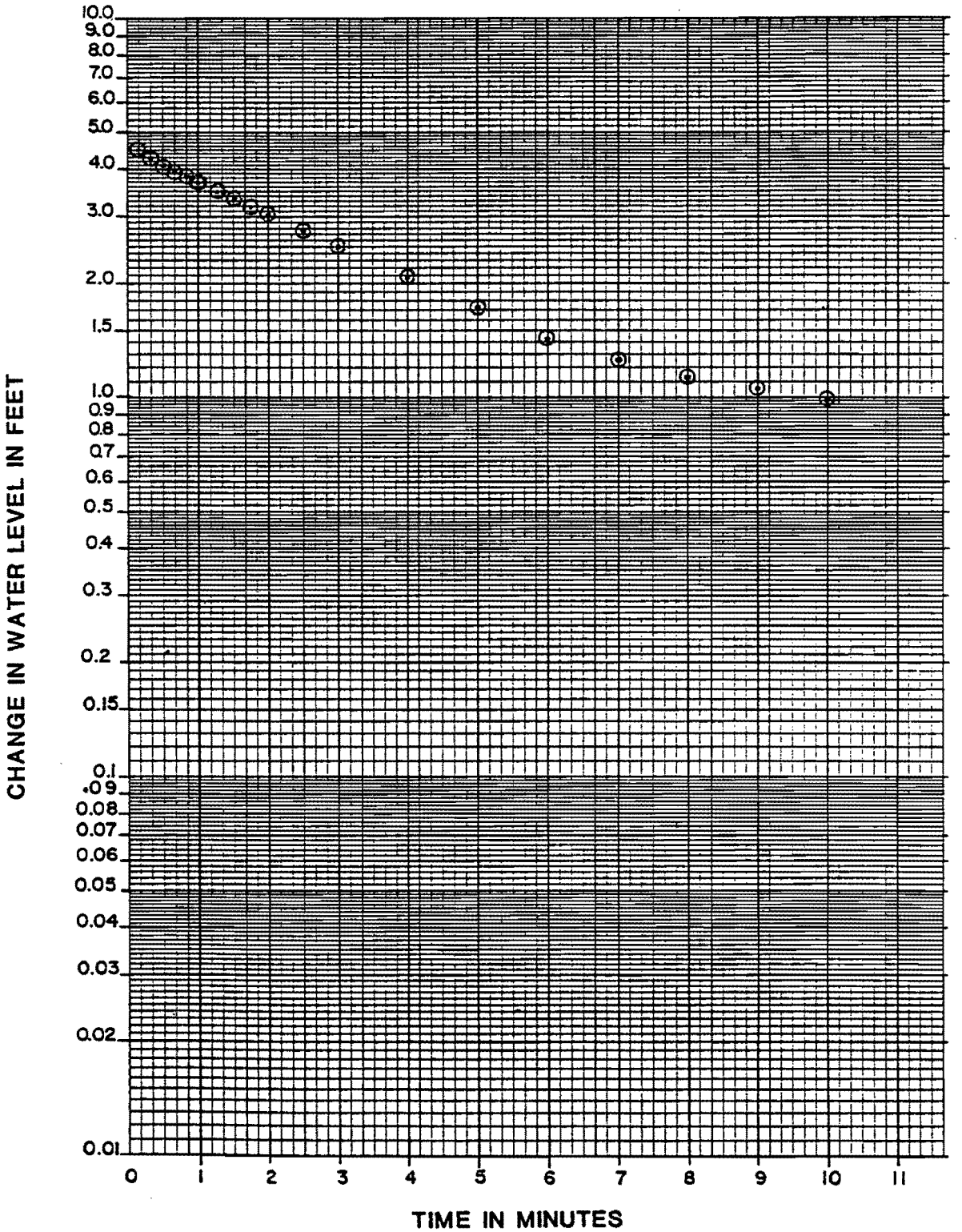
WELL No. 824

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0824501

WELL NO.: 0824

LOCATION: MAIN PLANT 3.2' TO 3.4'

TYPE: SOIL

SAMPLER: [signature] (SIGNATURE)

DATE: 6/2/87

TIME: 2:00 PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	6/22/87	9:30AM	MCI	Nancy Owen	6/22/87	9:30 am	

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0824S02

WELL NO.: 0824

LOCATION: MAIN PLANT 5.6'-5.8'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 6/2/87

TIME: 2:15PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	6/22/87	9:30AM		Nancy Owen	6/22/87	9:30am	

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 825 is located in the Main Plant area. It is west of the HTML Building in the Main Plant area. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,388.34, E 31,666.17 (X-10 grid) or latitude 35° 55' 33.7" and longitude 84° 18' 50.5". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 825 was drilled by A.L. Clark Drilling Services, Inc. A Driltech air rotary rig was used to drill this boring for monitor well installation under the operation of Steve Clark with the assistance of Steve Kirk. Drilling commenced on 5/5/87 and was finished on 5/8/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/5/87 Set up drill and bore with 14 inch diameter auger to 13.75 feet. Install 10 inch surface casing to 13.75 feet and grout into place.

5/6/87 Resume drilling with 8 inch air rotary bit to 41.5 feet. Driller installed 4 inch stainless steel casing into hole but did not grout into place.

5/7/87 Driller grouted 4 inch stainless steel casing in place.

5/8/87 Drilled with 3 7/8 inch air rotary to total depth of 60.0 feet.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Charles W. Stanley and John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

No samples were collected during drilling of well #825.

2.4 Installation and Development

2.4.1 Installation

This was an open hole or type C well, without a stainless steel screen. A fourteen-inch diameter boring was augered from ground surface to bedrock (13.75 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a depth of 41.5 feet. A four-inch diameter stainless steel casing was installed and tremie grouted from the bottom of the eight-inch diameter boring at 41.5 feet and extending 2.6 feet above ground

surface. The air rotary method was then used to drill a 3 7/8 inch diameter boring (open hole interval) from the bottom of the four-inch diameter stainless steel casing at 41.5 feet to a total depth of 60.0 feet. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 825 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 224.8 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/11/88 at a depth of 54.4 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 825 was tested for the determination of hydraulic

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conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 2.42×10^{-4} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 825

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/5/87	CWS
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/5/87	CWS
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/5/87	CWS
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/5/87	CWS
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/5/87	CWS
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/5/87	CWS

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE [signature] 5/5/87
Charles W. Stanley

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 825

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE 5/5/87

Charles W. Stanley

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 825

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: Steve Clark
HELPER: Steve Kirk
DRILL: Driltech

DATE: START: 5/5/87
FINISH: 5/8/87
LOGGED BY: John W. Anderson & Charles W. Stanley
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Auger, Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 12.75'
DEPTH DRILLED IN ROCK: 47.25'
TOTAL DEPTH OF WELL: 60.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	3.0			Soil, dark brown, topsoil, roots, occasional gravels, silty, friable
3.0	9.0			Clay, medium reddish brown, silty, friable with abundant chert and shale fragments, soft, moist
9.0	12.75			Clay, medium brown, silty, plastic, occasional chert and shale fragments
12.75	13.75			Rock, hard
	13.75			Auger refusal
13.75	41.5			Limestone, medium gray with occasional siltstone interbeds and calcite, hard
41.5	60.0			Limestone, medium gray
	60.0			TOTAL DEPTH

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WELL No. 825

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Charles W. Stanley & John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- [x] 14 INCH AUGER 13.75 L.F.
- [ ] INCH AUGER L.F.
- [x] 8 INCH ROTARY 27.75 L.F.
- [x] 3.75 INCH ROTARY 18.5 L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,388.34
E 31,666.17
ELEV. GROUND 787.96
ELEV. TOP STAINLESS STEEL CASING 790.28

DRILLING DATES:
STARTED: 5/5/87
FINISHED: 5/8/87

MATERIALS USED

EST. VOL.	USED VOL.	
	N/A	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	17.15	FT. OF 10 IN. SURFACE CASING
7.0	7.0	SACKS OF CEMENT (SURFACE CASING)
	11.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	55	GALLONS OF WATER (SURFACE CASING)
	43.8	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
9.0	15.0	SACKS OF CEMENT (S.S. CASING)
	25.0	POUNDS OF POWDERED BENTONITE (S.S. CASING)
	105	GALLONS OF WATER (S.S. CASING)
	25	POUNDS OF BENTONITE PELLETS (STAINLESS STEEL CASING SEAL)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, Spillage and Irregular Auger Boring Diameter

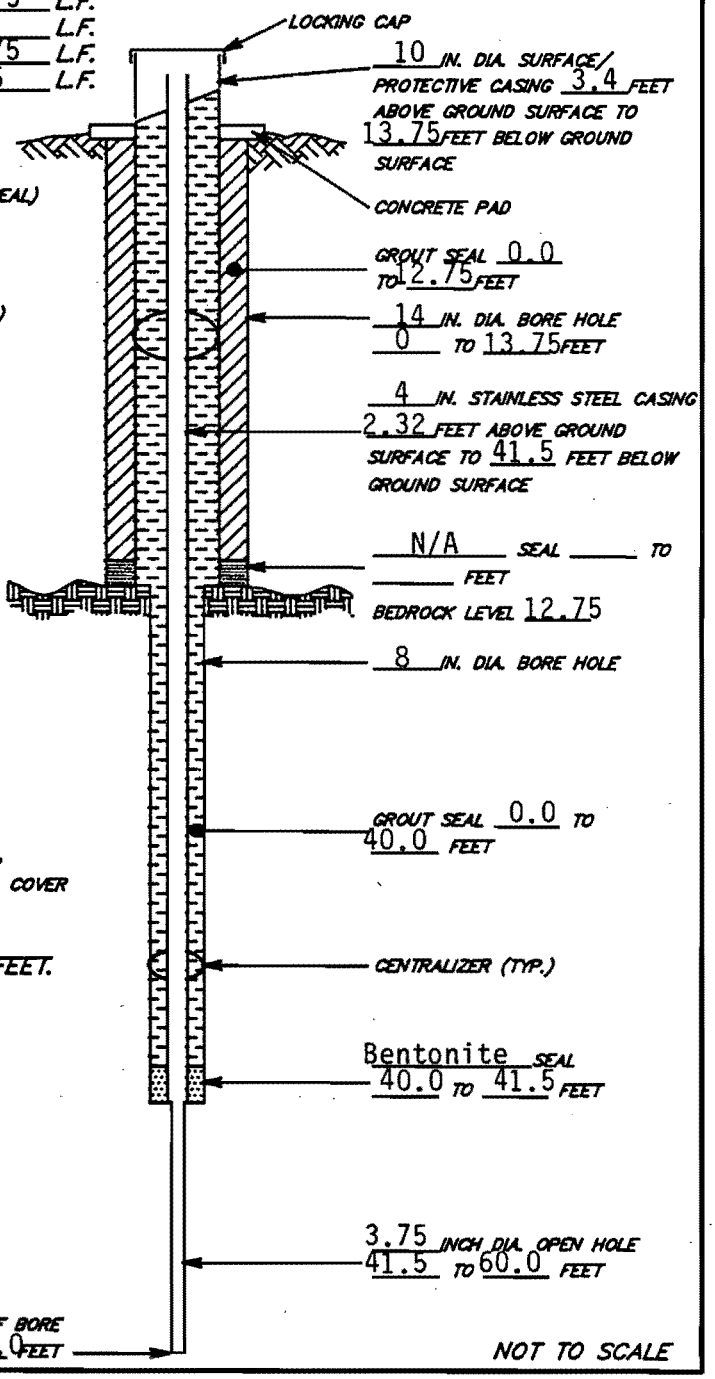
SURFACE CASING TREMIE GROUTED YES [x] NO [ ]
STAINLESS STEEL CASING TREMIE GROUTED YES [x] NO [ ]

WELL COVER USED
- [x] LOCKING STEEL COVER
- [ ] FLUSH MOUNTED WELL COVER
- [ ] OTHER

MONITORING WELL PUMP BASE SET AT 54.4 FEET.

CENTRALIZERS AT 5 FEET.
20 FEET.
39 FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE C WELL

NOT TO SCALE

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WELL No. 825

DATE: 5/6/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL			DATE USED	BATCH NUMBER
SAND			N/A	N/A
BENTONITE			5/6/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED	☐ YES ☐ NO)	N/A	N/A
STAINLESS STEEL CASING	(PREPACKAGED	■ YES ☐ NO)	5/6/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED	☐ YES ■ NO)	5/6/87	01
STAINLESS STEEL CAPS	(PREPACKAGED	☐ YES ■ NO)	5/6/87	04
MONITORING WELL PUMP	(PREPACKAGED	■ YES ☐ NO)	3/11/88	02
GROUT			5/6/87	04
WELL COVERS			5/87	01
SURFACE CASING			5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE CWS 5/6/87
Charles W. Stanley

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WELL No. 825

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/8/87	CWS
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/8/87	CWS
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/11/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/8/87	CWS

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/11/88
John M. McLoughlin

5/8/87
Charles W. Stanley

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WELL No. 825

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/11/88 TIME:

DEVELOPMENT ENDING DATE: 3/11/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 36.0

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 224.8 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 7.6 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/11/88 AT 54.4 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/11/88
John M. McLoughlin

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WELL NO. 825
LOCATION: Main Plant
DATE: 3/11/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 36.0 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/11/88	224.8	Clear	5 JTU's	224.8	6.24	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	224.8	6.24	

COMMENTS Average pH = 7.2

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0825 DATE OF TEST: 4/14/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 3.88 INCHES
DIAMETER OF DRILLED HOLE = 3.88 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 20.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 51.15 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 20.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 7.94 FEET
ESTIMATED POROSITY OF GRAVEL PACK = 1.00
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 30

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
2.0784
2.0113

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WELL No. 825

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	9.780	1.840
20.00	10.320	2.380
30.00	10.150	2.210
40.00	9.990	2.050
50.00	9.910	1.970
60.00	9.770	1.830
75.00	9.680	1.740
90.00	9.570	1.630
105.00	9.450	1.510
120.00	9.380	1.440
150.00	9.260	1.320
180.00	9.140	1.200
240.00	8.940	1.000
300.00	8.810	.870
360.00	8.700	.760
420.00	8.600	.660
480.00	8.540	.600
540.00	8.460	.520
600.00	8.410	.470
720.00	8.310	.370
840.00	8.240	.300
960.00	8.180	.240
1080.00	8.120	.180
1200.00	8.090	.150
1320.00	8.040	.100
1440.00	8.020	.080
1560.00	8.000	.060
1680.00	7.980	.040
1800.00	7.960	.020
1920.00	7.950	.010

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HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 7.95E-06 FT/SEC = 2.42E-04 CM/SEC

TRANSMISSIVITY = 1.59E-04 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 7.95E-06 FT/SEC = 2.42E-04 CM/SEC

TRANSMISSIVITY = 1.59E-04 FT**2/SEC

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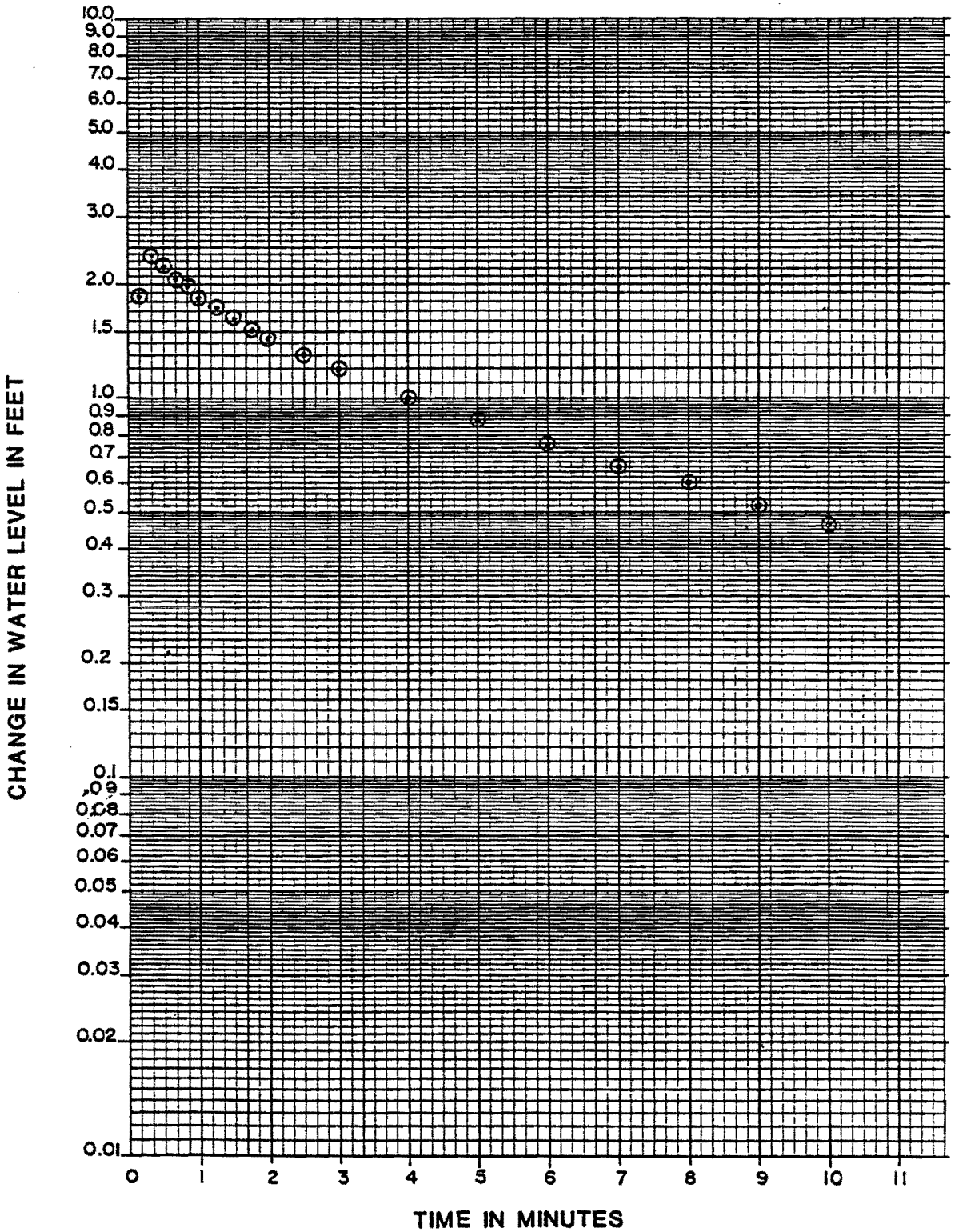
WELL No. 825

HYDRAULIC CONDUCTIVITY CALCULATIONS



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1.0 General Information

1.1 Well Location

Monitoring well number 826 is located in the Main Plant area. It is 100 feet east of Building 3534. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,387.29, E 31,654.36 (X-10 grid) or latitude 35° 55' 33.6" and longitude 84° 18' 50.6". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 826 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III with the assistance of Richard Pickel. Drilling commenced and was finished on 5/13/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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The drill rig and equipment were mobilized to the staked location and set up over plastic sheeting. Continuous split spoon samples were taken from ground surface to a depth of 11.8 feet, at which point limestone was encountered. The split spoon boring was then reamed to 6.5 inches using solid stem augers. The boring was then advanced in rock to a total depth of 16 feet. The cuttings produced during drilling were removed by bailing.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0826S01 was collected in the split spoon interval from 0.8 feet to 1.0 feet on 5/13/87 and soil sample 0826S02 was collected in the split spoon interval from 8.5 feet to 8.7 feet on 5/13/87. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 8.7 feet to 9.3 feet. The sample was measured, weighed and a bulk density of 2.0 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.0 to 15.2 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.0 to 15.0 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.0 feet to 2.6 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 16.0 feet, with a 2.0 foot bentonite pellet seal poured into the annular space above the sandpack from 2.0 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 826 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 215.9 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/28/88 at a depth of 12.1 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 826 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 2.20×10^{-3} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 826

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/13/87	[illegible]
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/13/87	[illegible]
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	[illegible]
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/13/87	[illegible]
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/13/87	[illegible]
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/13/87	[illegible]
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/13/87	[illegible]

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE [signature] 5/13/87
John W. Anderson

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WELL No. 826

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE 5/13/87

John W. Anderson

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 826

ORNL MONITORING WELL LOG

PAGE 1 OF 1

LOCATION: Main Plant
DRILLER: A. L. Clark, III
HELPER: Richard Pickel
DRILL: Gus Pech

DATE: START: 5/13/87
FINISH: 5/13/87
LOGGED BY: John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split Spoon and Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 11.8'
DEPTH DRILLED IN ROCK: 4.2'
TOTAL DEPTH OF WELL: 16.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	1.0	0826S01	100%	Topsoil, dark brown with limestone gravel and
		@0.8-1.0'		organic material
1.0	2.0		100%	Clay, silty, orange brown with limestone
				fragments, damp
2.0	4.0		50%	Clay, silty, brown with limestone fragments,
				damp
4.0	6.0		30%	Clay, silty, grayish brown with limestone
				fragments and light green clay nodules, moist
6.0	6.9			Clay, silty, orange brown with limestone
				fragments
6.9	8.0		100%	Clay, silty, grayish brown, moist
				Bulk Density @ 7.4' to 8.0' = 1.8 grams/cm³
8.0	10.0	0826S02	100%	Clay, silty, dark gray with small limestone
		@8.5-8.7'		fragments, wet
				Bulk Density @ 8.7' to 9.3' = 2.0 grams/cm³
10.0	11.8		40%	Limestone, residual, sand to medium gravel
				sized with loose silty clay, wet
11.8	16.0			Limestone, shaly
	16.0			TOTAL DEPTH

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WELL No. 826

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Richard Pickel

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,387.29
E 31,654.36
ELEV. GROUND 788.07
ELEV. TOP STAINLESS STEEL CASING 790.64

DRILLING DATES:
STARTED: 5/13/87
FINISHED: 5/13/87

EQUIPMENT ☒ 6 INCH AUGER 16.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	7.6	FEET OF 2 IN. S.S. CASING
3.0	4.0	SACKS OF SAND
25	25	POUNDS OF BENTONITE PELLETS
0.5	0.5	SACKS OF CEMENT
	1.0	POUNDS OF POWDERED BENTONITE
	2.5	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage and Irregular Auger Boring Diameter

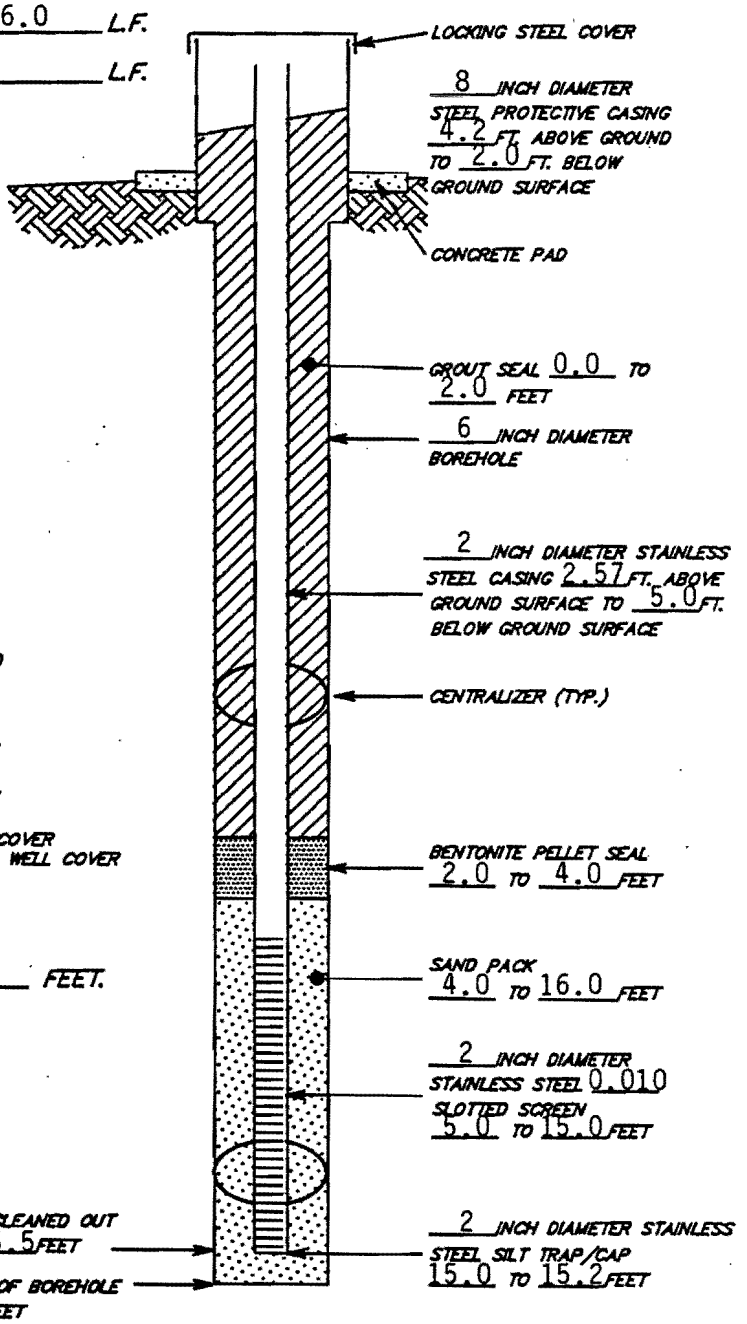
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.1 FEET.

CENTRALIZERS AT 10.0 FEET.
15.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 826

DATE: 5/13/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/13/87	04
BENTONITE		5/13/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/13/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/13/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	5/13/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/13/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/28/88	02
GROUT		5/13/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE John W. Anderson 5/13/87

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WELL No. 826

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/13/87	[illegible]
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/13/87	[illegible]
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/28/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/13/87	[illegible]

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/28/88
John M. McLoughlin

[illegible] 5/13/87
John W. Anderson

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WELL No. 826

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/14/88 TIME:

DEVELOPMENT ENDING DATE: 3/28/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 5.0

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 215.9 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 9.0 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/28/88 AT 12.1 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/28/88
John M. McLoughlin

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WELL NO. 826
LOCATION: Main Plant
DATE: 3/14/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 5.0 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/14/88	25.50					
3/15/88	30.60					
3/16/88	25.50					
3/17/88	17.00					
3/18/88	39.10					
3/21/88	40.80					
3/25/88	23.80					
3/28/88	13.60	Clear	5 JTU's	215.90	43.18	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	215.90	43.2	

COMMENTS Average pH = 7.2

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WELL No. 826

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0826 DATE OF TEST: 4/14/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 6.28 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 4.58 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 19

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WELL No. 826

HYDRAULIC CONDUCTIVITY CALCULATIONS

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.2179
.2294
.2430
.2593
.2786
.3004
.3351
.3849
.4249
.4734
.5079
.5518
.5766

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	4.980	.400
20.00	4.990	.410
30.00	4.960	.380
40.00	4.860	.280
50.00	4.760	.180
60.00	4.740	.160
75.00	4.710	.130
90.00	4.690	.110
105.00	4.690	.110
120.00	4.680	.100
150.00	4.670	.090
180.00	4.660	.080
240.00	4.650	.070
300.00	4.640	.060
360.00	4.630	.050
420.00	4.630	.050
480.00	4.630	.050
540.00	4.630	.050
600.00	4.630	.050

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WELL No. 826

HYDRAULIC CONDUCTIVITY CALCULATIONS

```
*****************************************************************
                METHOD OF BOUWER AND RICE

   COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

    PERMEABILITY =  7.23E-05 FT/SEC          =  2.20E-03 CM/SEC

    TRANSMISSIVITY =  7.23E-04 FT**2/SEC


   COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

    PERMEABILITY =  3.85E-05 FT/SEC          =  1.17E-03 CM/SEC

    TRANSMISSIVITY =  3.85E-04 FT**2/SEC
```

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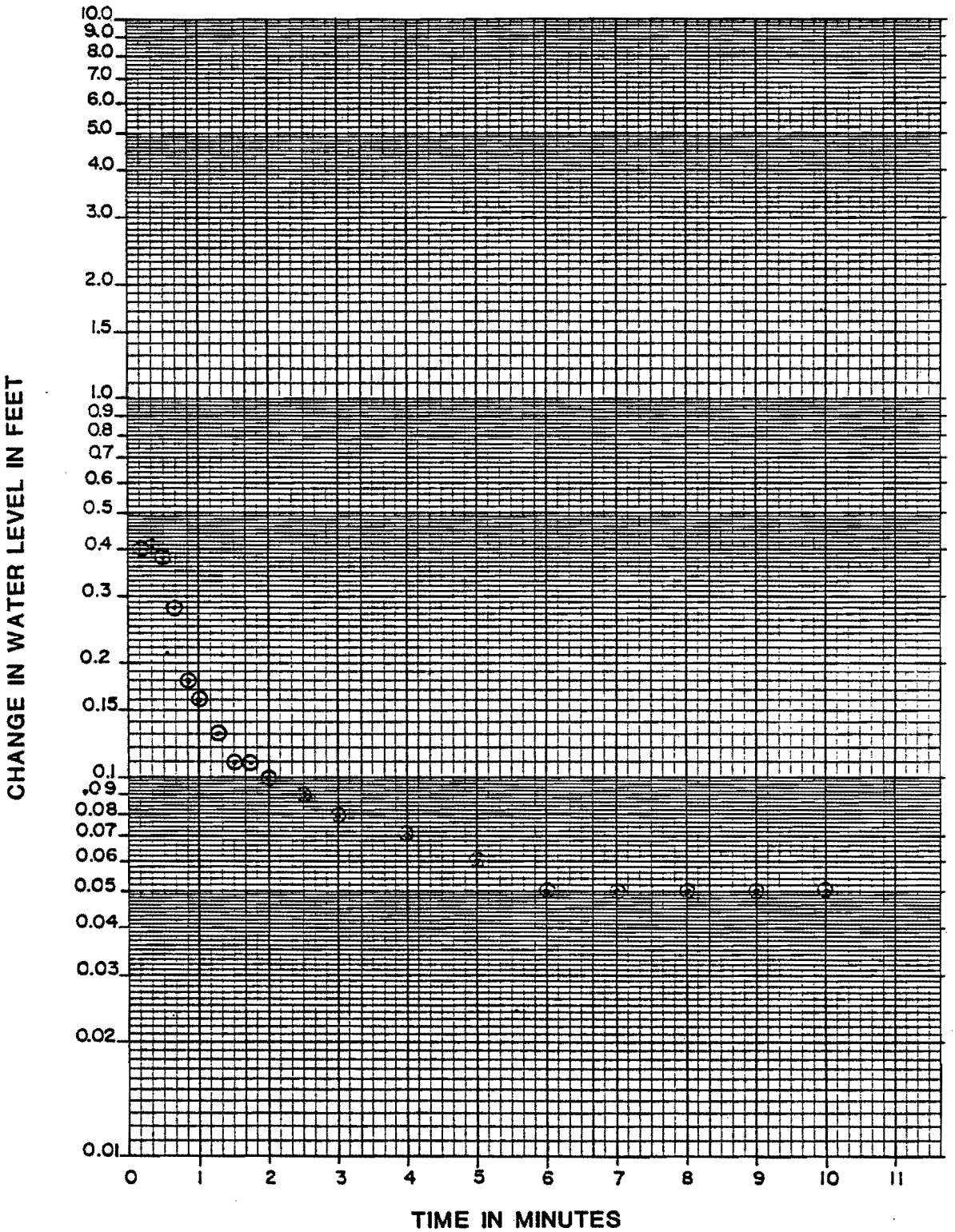
WELL No. 826

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0826 S01 ~~0826 S1~~

WELL NO.: 0826

LOCATION: 0.8 - 1.0'

TYPE: Soil

SAMPLER: John Anderson (SIGNATURE)

DATE: 5/13/87

TIME: 10:43

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
John Anderson	5/18/87	7:48	MCI	[illegible]	5/18/87	7:48	MCI
[illegible]	6/2/87	9:00	MCI	[illegible]	6/2/87	0900	ORNL CPA

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0826 S02 ~~0826 S2~~

WELL NO.: 0826

LOCATION: 8.5 - 8.7'

TYPE: Soil

SAMPLER: John Anderson (SIGNATURE)

DATE: 5/13/87

TIME: 11:00

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
John Anderson	5/18/87	7:48	MCI	[illegible]	5/18/87	7:49	MCI
[illegible]	6/2/87	0900	MCI	[illegible]	6/2/87	0900	ORNL CPA

REMARKS:

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1.0 General Information

1.1 Well Location

Monitoring well number 827 is located in the Main Plant area. It is located 40 feet northeast of SWSA 1. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,012.45, E 30,813.54 (X-10 grid) or latitude 35° 55' 25.9" and longitude 84° 18' 56.5". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 827 was drilled by A.L. Clark Drilling Services, Inc. A Schramm Rotadrill air rotary rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, II with the assistance of Joe Clark. Drilling commenced on 4/29/87 and was finished on 4/30/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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4/29/87 The drill rig was mobilized to the staked location and set up on plastic sheeting. Split spoon samples were taken from the surface to 9.5 feet. The boring was then augered from the surface to 16.6 feet. The boring was bailed and left to recharge overnight.

4/30/87 The boring was bailed and 10.2 feet of 2 inch stainless steel screen and casing were installed. A sandpack was placed from 3.5 feet to 14.9 feet and a 1.8 foot bentonite seal placed above the sandpack.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 0827S01 was collected in the split spoon interval from 2.1 feet to 2.3 feet on 4/29/87 and soil sample 0827S02 was collected in the split spoon interval from 8.3 feet to 8.5 feet on 4/29/87. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

A bulk density soil sample was collected from the split spoon sample interval from 2.1 feet to 2.5 feet. The sample was measured, weighed and a bulk density of 1.87 grams/cm^3 was calculated.

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2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 14.6 to 14.8 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 4.4 to 14.6 feet. A two-inch diameter stainless steel casing was installed above the screen from 4.4 feet to 2.5 feet above ground surface. A sandpack was then poured into the annular space from 3.5 to 14.9 feet, with a 1.8 foot bentonite pellet seal poured into the annular space above the sandpack from 1.7 to 3.5 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 827 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 899.2 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

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2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/16/88 at a depth of 11.8 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

2.5 Hydraulic Conductivity Testing

Well number 827 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 3.65×10^{-4} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 827

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	4/29/87	MLE
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	4/29/87	MLE
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	4/30/87	MLE
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	N/A	
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	4/29/87	MLE
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	4/29/87	MLE
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	4/29/87	MLE

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 4/30/87
Michael L. Ebers

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WELL No. 827

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Michael L. Ebers 4/29/87

Michael L. Ebers

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 827

ORNL MONITORING WELL LOG

LOCATION: Main Plant - SWSA 1
DRILLER: A. L. Clark, II
HELPER: Joe Clark
DRILL: Schramm Rotadrill

DATE: START: 4/29/87
FINISH: 4/30/87
LOGGED BY: Michael L. Ebers
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split Spoon and Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: two
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 9.5'
DEPTH DRILLED IN ROCK: 7.1'
TOTAL DEPTH OF WELL: 16.6'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	0.3		70%	Gravel and grass
0.3	2.0		70%	Clay, moderate yellowish brown, silty, dry,
				crumbly with limestone gravels scattered
				throughout (fill)
2.0	4.0	0827S01	75%	Clay, mottled dark yellowish orange and
		@2.1-2.3'		moderate yellowish brown, silty, slightly
				moist from 5' to 6', bulk density sample @
				2.1' to 2.5', bulk density = 1.87 grams/cm³
4.0	6.5		100%	Clay, dark yellowish brown with dark yellowish
				orange mottles, silty, and weathered silty
				sandstone fragments up to 1" diameter, pale
				yellowish orange, slightly moist, somewhat
				crumbly
6.5	9.0	0827S02	100%	Clay, light brown, grayish brown and moderate
		@8.3-8.5'		greenish yellow in upper part grading into
				deeply weathered shale in lower 6", plastic,
				very moist
9.0	9.5		100%	Shale, weathered, light olive to moderate
				olive brown, dip approx. 30° to horizontal

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WELL No. 827

ORNL MONITORING WELL LOG

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
	9.5			Split spoon refusal
9.5	10.5			Sandstone, grayish red, very fine grained,
				hard
10.5	15.0			Clay, medium light brown, soft
15.0	16.2			Sandstone, grayish red, very fine grained,
				hard
16.2	16.6			Shale, olive gray, soft
	16.6			TOTAL DEPTH

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WELL No. 827

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Michael L. Ebers PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, II HELPER: Steve Kirk

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,012.45
E 30,813.54
ELEV. GROUND 784.63
ELEV. TOP STAINLESS STEEL CASING 787.17

DRILLING DATES:
STARTED: 4/28/87
FINISHED: 4/30/87

EQUIPMENT ☒ 6 INCH AUGER 16.6 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.2	FEET OF 2 IN. S.S. SCREEN
	6.9	FEET OF 2 IN. S.S. CASING
2.1	3.5	SACKS OF SAND
25	25	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	7.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, Spillage and Irregular Auger Boring Diameter

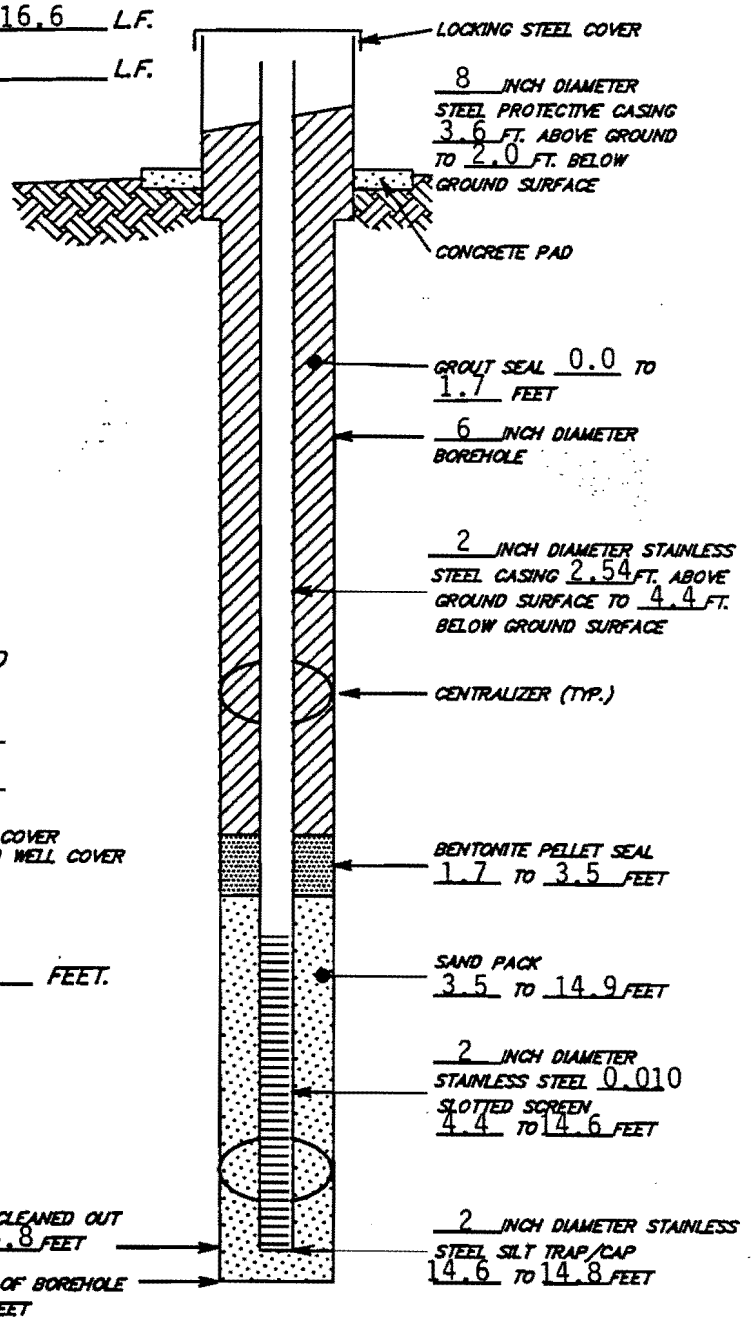
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 11.8 FEET.

CENTRALIZERS AT 4.0 FEET.
14.8 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 827

DATE: 4/30/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		4/30/87	02
BENTONITE		4/30/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ☐ YES ■ NO)	4/30/87	02
STAINLESS STEEL CASING	(PREPACKAGED ☐ YES ■ NO)	4/30/87	01
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	4/30/87	01
STAINLESS STEEL CAPS	(PREPACKAGED ☐ YES ■ NO)	4/30/87	01
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/16/88	02
GROUT		5/1/87	04
WELL COVERS		5/87	01
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Michael L. Ebers 4/30/87
Michael L. Ebers

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 827

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	4/30/87	MLE
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	4/30/87	MLE
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/16/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	4/30/87	MLE

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/16/88
John M. McLoughlin

Michael L. Ebers 4/30/87
Michael L. Ebers

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 827

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/10/88 TIME:

DEVELOPMENT ENDING DATE: 3/16/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 8.2

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 899.2 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 4.0 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/16/88 AT 11.8 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M McLoughlin 3/16/88
John M. McLoughlin

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 827
LOCATION: Main Plant
DATE: 3/10/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 8.2 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/10/88	224.8					
3/11/88	168.6					
3/15/88	393.4					
3/16/88	112.4	Clear	5 JTU's	899.2	109.66	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	899.2	109.66	

COMMENTS Average pH = 7.7

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WELL No. 827

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0827 DATE OF TEST: 4/5/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 8.40 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 8.40 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 3.30 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 19

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.3551
.3714

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WELL No. 827

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	3.860	.560
20.00	3.770	.470
30.00	3.700	.400
40.00	3.660	.360
50.00	3.620	.320
60.00	3.610	.310
75.00	3.570	.270
90.00	3.550	.250
105.00	3.530	.230
120.00	3.490	.190
150.00	3.450	.150
180.00	3.440	.140
240.00	3.430	.130
300.00	3.410	.110
360.00	3.380	.080
420.00	3.380	.080
480.00	3.380	.080
540.00	3.380	.080
600.00	3.380	.080

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.20E-05 FT/SEC = 3.65E-04 CM/SEC

TRANSMISSIVITY = 1.01E-04 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 6.10E-06 FT/SEC = 1.86E-04 CM/SEC

TRANSMISSIVITY = 5.12E-05 FT**2/SEC

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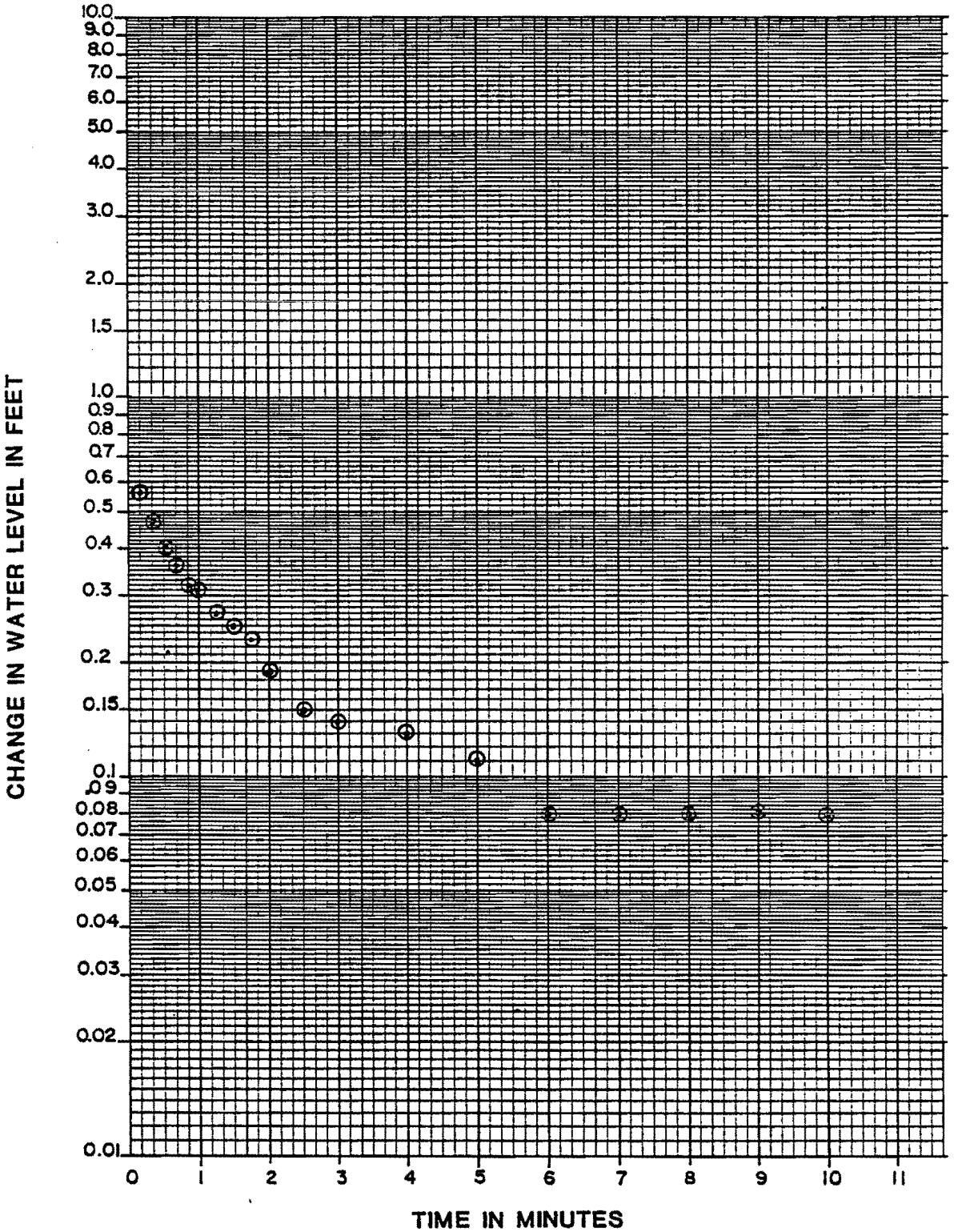
WELL No. 827

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0827501 ~~827-51~~

WELL NO.: 827-51

LOCATION: MAIN PLANT NEAR SWSA 1 @2.1'-2.3'

TYPE: SOIL

SAMPLER: [signature] (SIGNATURE)

DATE: 4/29/87

TIME: 1:30 P.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	4/29/87	4:30 P.M.	MCI	[signature]	4/29/87	4:30	MCI
[signature]	5/26/87	11:40	"	[signature]	4/26/87	11:40	ORNL

REMARKS:

MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0827S02
~~827 S2~~

WELL NO.: 827-S2

LOCATION: MAIN PLANT NEAR SWSA 1 @ 8.3-8.5'

TYPE: Soil

SAMPLER: [signature] (SIGNATURE)

DATE: 4/29/87

TIME: 2:00 P.M.

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
[signature]	4/29/87	4:30 P.M.	MCI	[signature]	4/29/87	4:30	mci
[signature]	5/26/87	11:40	"	[signature]	5/26/87	11:40	ORNL

REMARKS:

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

1.0 General Information

1.1 Well Location

Monitoring well number 828 is located in the Main Plant area. It is approximately 50 feet south of SWSA 1. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 20,815.23, E 30,741.43 (X-10 grid) or latitude 35° 55' 23.9" and longitude 84° 18' 55.9". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 828 was drilled by A.L. Clark Drilling Services, Inc. A Driltech air rotary rig was used to drill this boring for monitor well installation under the operation of Steve Clark with the assistance of Steve Kirk. Drilling commenced on 6/26/87 and was finished on 6/29/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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A Driltech rig was mobilized to the staked drilling location and set up. A 14 inch boring was drilled to bedrock and surface casing installed. After the surface casing set up for 24 hours, drilling progressed with an 8 inch bit to the originally planned depth of 30 feet. At this point, the boring was checked and found to be dry. It was decided to extend the boring to a depth of 50 feet. At this depth, the boring was found to have a good rate of recharge. Four inch stainless steel casing and screen were installed.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist John W. Anderson. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

No samples were collected during the drilling of this boring.

2.4 Installation and Development

2.4.1 Installation

This was a type B well. A fourteen-inch diameter boring was augered from ground surface to bedrock (11.7 feet). A ten-inch diameter string of decontaminated steel surface casing was installed and tremie grouted in place. The surface casing minimizes potential cross contamination between the regolith and bedrock water bearing zones. The air rotary method was then used to drill an eight-inch diameter boring to a total depth of 50.0 feet. A four-inch diameter stainless steel silt trap was installed from 49.0 to 49.2 feet. Above the silt trap, a four-inch diameter stainless steel screen was installed from 29.0 feet to 49.0 feet. A four-inch diameter

stainless steel casing was installed from the top of the screen at 29.0 feet and extending 1.3 feet above ground surface. A sandpack was then poured into the annular space from 27.0 to 49.2 feet, with a 2.0 foot bentonite seal poured into the annular space above the sandpack from 25.0 to 27.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 828 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 232.7 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/24/88 at a depth of 46.4 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

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2.5 Hydraulic Conductivity Testing

Well number 828 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously removing a known quantity of water from the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 8.96×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 828

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	6/26/87	[illegible]
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	6/26/87	[illegible]
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	[illegible]
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	6/26/87	[illegible]
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	6/26/87	[illegible]
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	6/26/87	[illegible]
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	6/26/87	[illegible]

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE [signature] 6/26/87
John W. Anderson

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P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 828

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE [signature] 6/29/87

John W. Anderson

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725 Pellissippi Parkway
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WELL No. 828

ORNL MONITORING WELL LOG

LOCATION: Main Plant
DRILLER: Steve Clark
HELPER: Steve Kirk
DRILL: Driltech

DATE: START: 6/26/87
FINISH: 6/29/87
LOGGED BY: John W. Anderson
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Auger and Air Rotary
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: None
TYPE: N/A
CONTAINMENT TYPE: Auger pan, plastic and containment box

THICKNESS OF SOIL (REFUSAL DEPTH): 11.7'
DEPTH DRILLED IN ROCK: 38.3'
TOTAL DEPTH OF WELL: 49.0'

DRILLING FLUID SAMPLES:
TYPE: Drill Water DATE: 6/26/87

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	11.7			Interbedded silty clay and siltstone, with
				shale, highly weathered
	11.7			Auger refusal
11.7	17.0			Limestone, light gray, highly weathered
17.0	19.0			Open, void
19.0	50.0			Alternating layers of hard and soft limestone
	50.0			TOTAL DEPTH

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WELL No. 828

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: John W. Anderson
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: Steve Clark HELPER: Steve Kirk

DRILLING METHOD:
- [x] 14 INCH AUGER 11.7 L.F.
- [ ] INCH AUGER L.F.
- [x] 8 INCH ROTARY 38.3 L.F.
- [ ] INCH ROTARY L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 20,815.23
E 30,741.43
ELEV. GROUND 814.11
ELEV. TOP STAINLESS STEEL CASING 815.44

DRILLING DATES:
STARTED: 6/26/87
FINISHED: 6/29/87

MATERIALS USED

EST. VOL.	USED VOL.	
	N/A	POUNDS OF BENTONITE PELLETS (SURFACE CASING SEAL)
	11.7	FT. OF 10 IN. SURFACE CASING
3.3	5.0	SACKS OF CEMENT (SURFACE CASING)
	10.0	POUNDS OF POWDERED BENTONITE (SURFACE CASING)
	30.0	GALLONS OF WATER (SURFACE CASING)
	30.3	FT. OF 4 IN. DIA. STAINLESS STEEL CASING
	20.0	FT. OF 4 IN. DIA. STAINLESS STEEL SCREEN
7	7	SACKS OF SAND
35	50	POUNDS OF BENTONITE PELLETS
12.0	12.0	SACKS OF CEMENT (WELL CASING)
	24	POUNDS OF POWDERED BENTONITE (WELL CASING)
	72	GALLONS OF WATER (WELL CASING)
	2.5	FT. OF 10 IN. STEEL PROTECTIVE CASING

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Spillage

SURFACE CASING TREMIE GROUTED YES [x] NO [ ]

STAINLESS STEEL CASING TREMIE GROUTED YES [x] NO [ ]

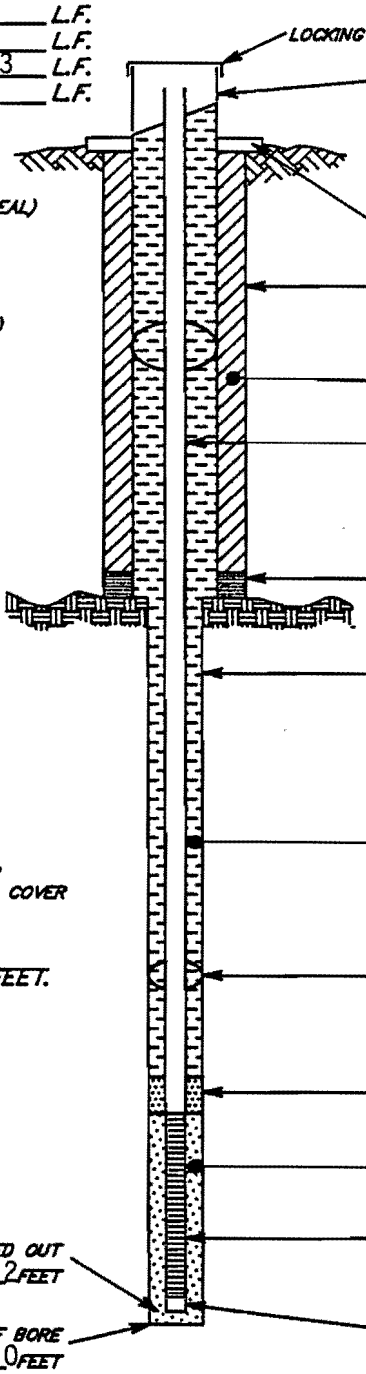
WELL COVER USED
- [x] LOCKING STEEL COVER
- [ ] FLUSH MOUNTED WELL COVER
- [ ] OTHER

SILT TRAP USED YES [x] NO [ ]

MONITORING WELL PUMP BASE SET AT 46.4 FEET.

CENTRALIZERS AT 2 FEET.
10 FEET.
28 FEET.
48 Feet.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE B WELL

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WELL No. 828

DATE: 6/29/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		6/29/87	02
BENTONITE		6/29/87	06
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	6/29/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	6/29/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ■ YES ☐ NO)	6/29/87	04
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	6/29/87	04
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/24/88	02
GROUT		6/29/87	06
WELL COVERS		6/29/87	01
SURFACE CASING		6/29/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE John W. Anderson 6/29/87

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725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 828

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	6/29/87	JG
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	6/29/87	JG
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/24/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	6/29/87	JG

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/24/88
John M. McLoughlin

6/29/87
John W. Anderson

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 828

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/16/88 TIME:

DEVELOPMENT ENDING DATE: 3/24/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 29.0

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 232.7 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- [x] CLEAR
- [ ] SLIGHTLY CLOUDY
- [ ] MOD. TURBID
- [ ] MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: Rudy C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- [ ] GROUND SURFACE
- [ ] STORM SEWERS
- [x] DRUMS
- [ ] TANK TRUCK
- [ ] STORAGE TANKS
- [ ] OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 31.1 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/24/88 AT 46.4 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/24/88
John M. McLoughlin

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL NO. 828
LOCATION: Main Plant
DATE: 3/16/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 29.0 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/16/88	44.20					
3/17/88	40.07					
3/18/88	39.10					
3/21/88	11.90					
3/22/88	44.32					
3/23/88	25.00					
3/24/88	28.10	Clear	5 JTU's	232.7	8.0	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	232.7	8.0	

COMMENTS Average pH = 7.7

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WELL No. 828

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0828 DATE OF TEST: 4/7/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 4.25 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 4.25 INCHES
DIAMETER OF DRILLED HOLE = 8.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 20.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 16.00 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 16.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 14.02 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 0 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 29

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
1.2461
1.2550

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WELL No. 828

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	12.330	1.690
20.00	12.380	1.640
30.00	12.550	1.470
40.00	12.630	1.390
50.00	12.720	1.300
60.00	12.770	1.250
75.00	12.830	1.190
90.00	12.860	1.160
105.00	12.890	1.130
120.00	12.920	1.100
150.00	12.950	1.070
180.00	12.990	1.030
240.00	13.060	.960
300.00	13.090	.930
360.00	13.140	.880
420.00	13.170	.850
480.00	13.180	.840
540.00	13.210	.810
600.00	13.230	.790
720.00	13.260	.760
840.00	13.310	.710
960.00	13.350	.670
1080.00	13.390	.630
1200.00	13.410	.610
1320.00	13.430	.590
1440.00	13.460	.560
1560.00	13.480	.540
1680.00	13.500	.520
1800.00	13.520	.500

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WELL No. 828

HYDRAULIC CONDUCTIVITY CALCULATIONS

****

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 2.94E-06 FT/SEC = 8.96E-05 CM/SEC

TRANSMISSIVITY = 4.71E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 2.17E-06 FT/SEC = 6.62E-05 CM/SEC

TRANSMISSIVITY = 3.47E-05 FT**2/SEC

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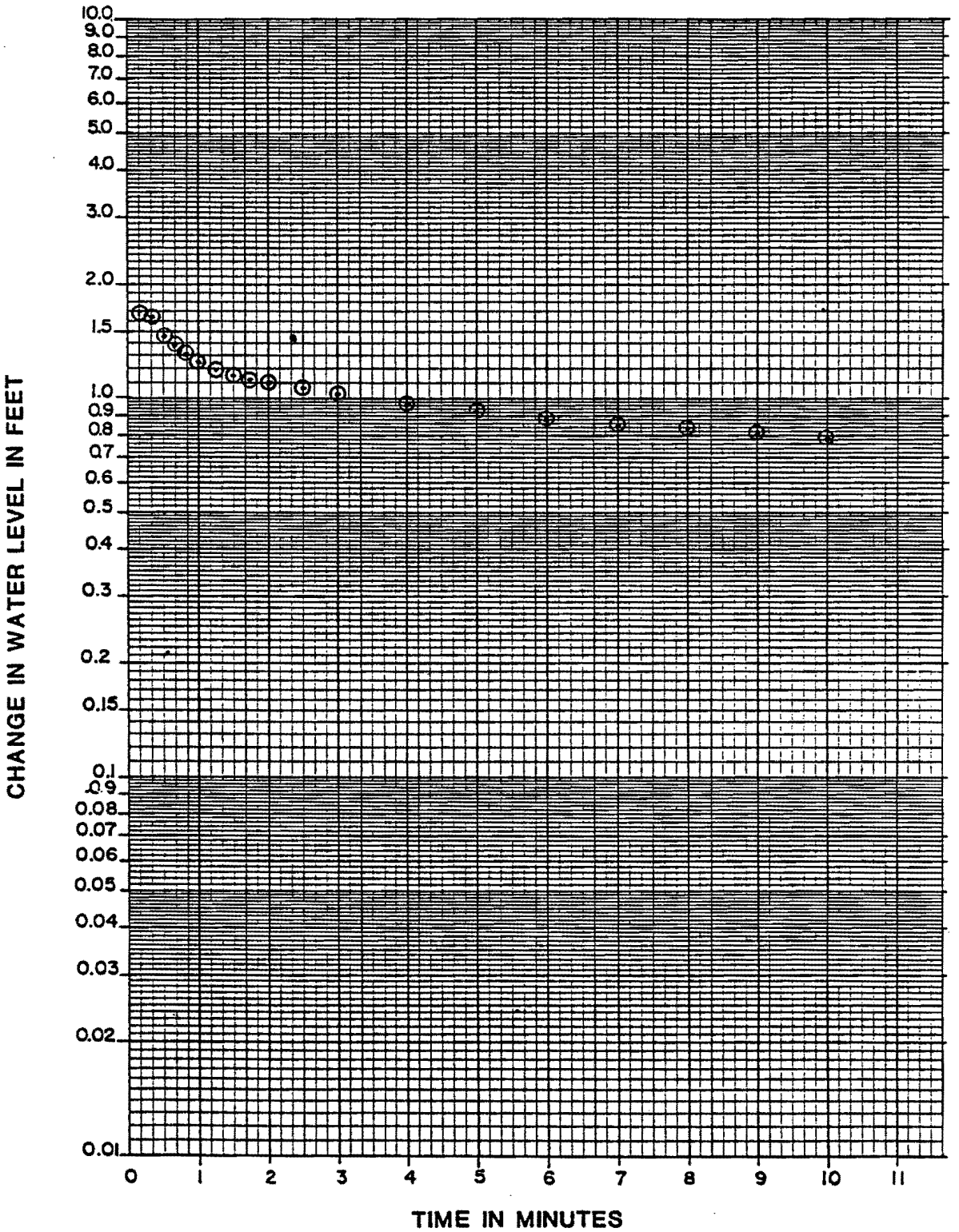
WELL No. 828

HYDRAULIC CONDUCTIVITY CALCULATIONS



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1.0 General Information

1.1 Well Location

Monitoring well number 829 is located in the Main Plant area. It is 10 feet west of the chained boundary of SWSA 1. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,026.12, E 30,557.11 (X-10 grid) or latitude 35° 55' 24.6" and longitude 84° 18' 59.2". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 829 was drilled by A.L. Clark Drilling Services, Inc. A Gus Pech drill rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, III and Richard Pickel with the assistance of Joe Clark. Drilling commenced on 4/30/87 and was finished on 5/5/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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4/30/87 A drill rig was moved on site and set up; drilled to a total depth of 14.4 feet with 6 3/4 inch diameter augers. Encountered bedrock at a depth of 7.7 feet. Two soft zones (one from 8.8 feet to 9.0 feet and one from 13.6 feet to 14.1 feet) were present within the bedrock interval.

5/1/87 Borehole was advanced to a total depth of 16.1 feet. Bailing of boring, to extract cuttings and drill water, was initiated. It became evident that the rock fragments were being washed into the boring.

5/1/87 Cleaning out hole was completed. Tip of well screen was placed at a depth of 15.3 feet below the surface.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologist Richard E. Flohr. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

Two soil samples were collected during drilling, placed in I-CHEM specialty cleaned glass containers, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. Chain of custody forms for these samples are included with this data package. Soil sample 829-1 was collected in the split spoon interval from 1.0 feet to 1.3 feet on 4/30/87 and soil sample 829-2 was collected in the split spoon interval from 5.0 feet to 5.3 feet on 4/30/87. Analytical results for the two soil samples described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt

trap was installed from 15.1 tp 15.3 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.0 to 15.1 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.0 feet to 1.9 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 15.3 feet, with a 1.5 foot bentonite pellet seal poured into the annular space above the sandpack from 2.5 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 829 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 1,619.5 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/28/88 at a depth of 12.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

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2.5 Hydraulic Conductivity Testing

Well number 829 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 6.78×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 829

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	4/30/87	REF
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	4/30/87	REF
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/5/87	REF
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	4/30/87	REF
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	4/30/87	REF
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	4/30/87	REF

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE Richard E. Flohr 5/5/87
Richard E. Flohr

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WELL No. 829

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE Richard E. Flohr 4/30/87

Richard E. Flohr

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WELL No. 829

ORNL MONITORING WELL LOG

LOCATION: Main Plant - SWSA 1

DRILLER: A. L. Clark, III, Richard Pickel

HELPER: Richard Pickel, Joe Clark

DRILL: Gus Pech

DATE: START: 4/30/87

FINISH: 5/1/87

LOGGED BY: Richard E. Flohr

HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split Spoon, Solid Stem Augers

LUBRICANT TYPE: Molykote 1000

No. SAMPLES TAKEN: two

TYPE: soil

CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 7.7'

DEPTH DRILLED IN ROCK: 8.4'

TOTAL DEPTH OF WELL: 16.1'

DRILLING FLUID SAMPLES:

TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	2.0	829-1	100%	Topsoil, brown and gravels to 0.6', clay,
		@1.0-1.3'		slightly sandy, grayish brown with rock
				fragments, wet
2.0	4.0		100%	Clay, slightly sandy, grayish brown, with
				subangular rock fragments
4.0	7.2	829-2	80%	Clay, slightly sandy, brown with black
		@5.0-5.3'		staining, with subangular rock fragments
7.2	7.7			Rock fragments, clayey
	7.7			Split spoon refusal
7.7	8.4			Rock fragments, clayey
8.4	16.1			Limestone, hard, soft at 8.8' to 9.0' and
				13.6' to 14.1'
	16.1			TOTAL DEPTH

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WELL No. 829

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Richard E. Flohr
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III & Richard Pickel
HELPER: Joe Clark

EQUIPMENT ☒ 6 INCH AUGER 16.1 L.F.
☐ _____ INCH AUGER _____ L.F.

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,026.12
E 30,557.11
ELEV. GROUND 775.56
ELEV. TOP STAINLESS STEEL CASING 777.48
DRILLING DATES:
STARTED: 4/30/87
FINISHED: 5/1/87

MATERIALS USED

EST. VOL	USED VOL	
	10.1	FEET OF 2 IN. S.S. SCREEN
	6.9	FEET OF 2 IN. S.S. CASING
2.6	8.5	SACKS OF SAND
39	130	POUNDS OF BENTONITE PELLETS
1.0	1.0	SACKS OF CEMENT
	2.0	POUNDS OF POWDERED BENTONITE
	6.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES

Borehole required considerable cleaning due to washing materials into hole. Hole was greatly enlarged explaining additional sand and bentonite.

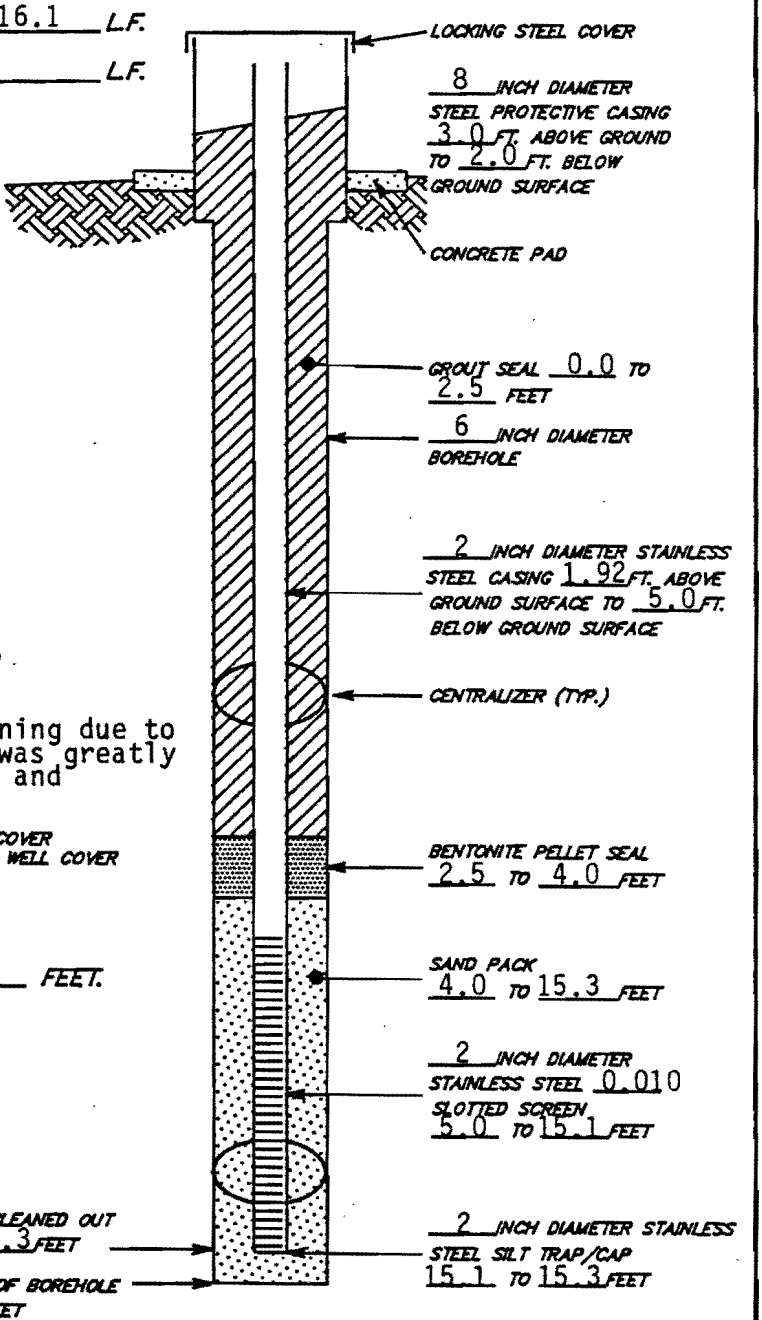
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.2 FEET.

CENTRALIZERS AT 5.0 FEET.
15.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 829

DATE: 5/5/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL		DATE USED	BATCH NUMBER
SAND		5/5/87	02
BENTONITE		5/5/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED ■ YES ☐ NO)	5/5/87	04
STAINLESS STEEL CASING	(PREPACKAGED ■ YES ☐ NO)	5/5/87	03 & 04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED ☐ YES ■ NO)	5/5/87	02
STAINLESS STEEL CAPS	(PREPACKAGED ■ YES ☐ NO)	5/5/87	03
MONITORING WELL PUMP	(PREPACKAGED ■ YES ☐ NO)	3/28/88	02
GROUT		5/6/87	04
WELL COVERS		5/87	02
SURFACE CASING		5/87	01

COMMENTS:

OBSERVER SIGNATURE/DATE Richard E. Flohr 5/6/87
Richard E. Flohr

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WELL No. 829

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/5/87	REF
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/5/87	REF
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/28/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/5/87	REF

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/28/88
John M. McLoughlin

Richard E. Flohr 5/5/87
Richard E. Flohr

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WELL No. 829

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/8/88 TIME: _____

DEVELOPMENT ENDING DATE: 3/28/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 9.2

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 1619.5 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- [x] CLEAR
- [ ] SLIGHTLY CLOUDY
- [ ] MOD. TURBID
- [ ] MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: R. C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:

- [ ] GROUND SURFACE
- [ ] STORM SEWERS
- [x] DRUMS
- [ ] TANK TRUCK
- [ ] STORAGE TANKS
- [ ] OTHER _____

INITIAL PRE-DEVELOPMENT WATER DEPTH: 0.3 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/28/88 AT 12.2 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO. _____

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John M. McLoughlin 3/28/88
John M. McLoughlin

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WELL NO. 829
LOCATION: Main Plant
DATE: 3/8/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 9.2 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/8/88	224.8					
3/9/88	168.6					
3/10/88	N/W					
3/11/88	N/W					
3/17/88	112.4					
3/18/88	56.2					
3/21/88	N/W					
3/22/88	281.0					
3/23/88	196.7					
3/24/88	252.9					
3/25/88	281.0					
3/28/88	45.9	Clear	5 JTU's	1619.5	176	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	1619.5	176	

COMMENTS

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WELL No. 829

HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0829 DATE OF TEST: 4/5/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 14.28 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 4.70 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 22

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
.5267
.5480

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WELL No. 829

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
30.00	5.460	.760
40.00	5.400	.700
50.00	5.360	.660
60.00	5.310	.610
75.00	5.250	.550
90.00	5.200	.500
105.00	5.160	.460
120.00	5.130	.430
150.00	5.070	.370
180.00	5.040	.340
240.00	4.980	.280
300.00	4.940	.240
360.00	4.910	.210
420.00	4.890	.190
480.00	4.880	.180
540.00	4.850	.150
600.00	4.850	.150
720.00	4.840	.140
840.00	4.830	.130
960.00	4.820	.120
1080.00	4.820	.120
1200.00	4.810	.110

(**********)

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 2.22E-06 FT/SEC = 6.78E-05 CM/SEC

TRANSMISSIVITY = 2.22E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 2.96E-06 FT/SEC = 9.02E-05 CM/SEC

TRANSMISSIVITY = 2.96E-05 FT**2/SEC

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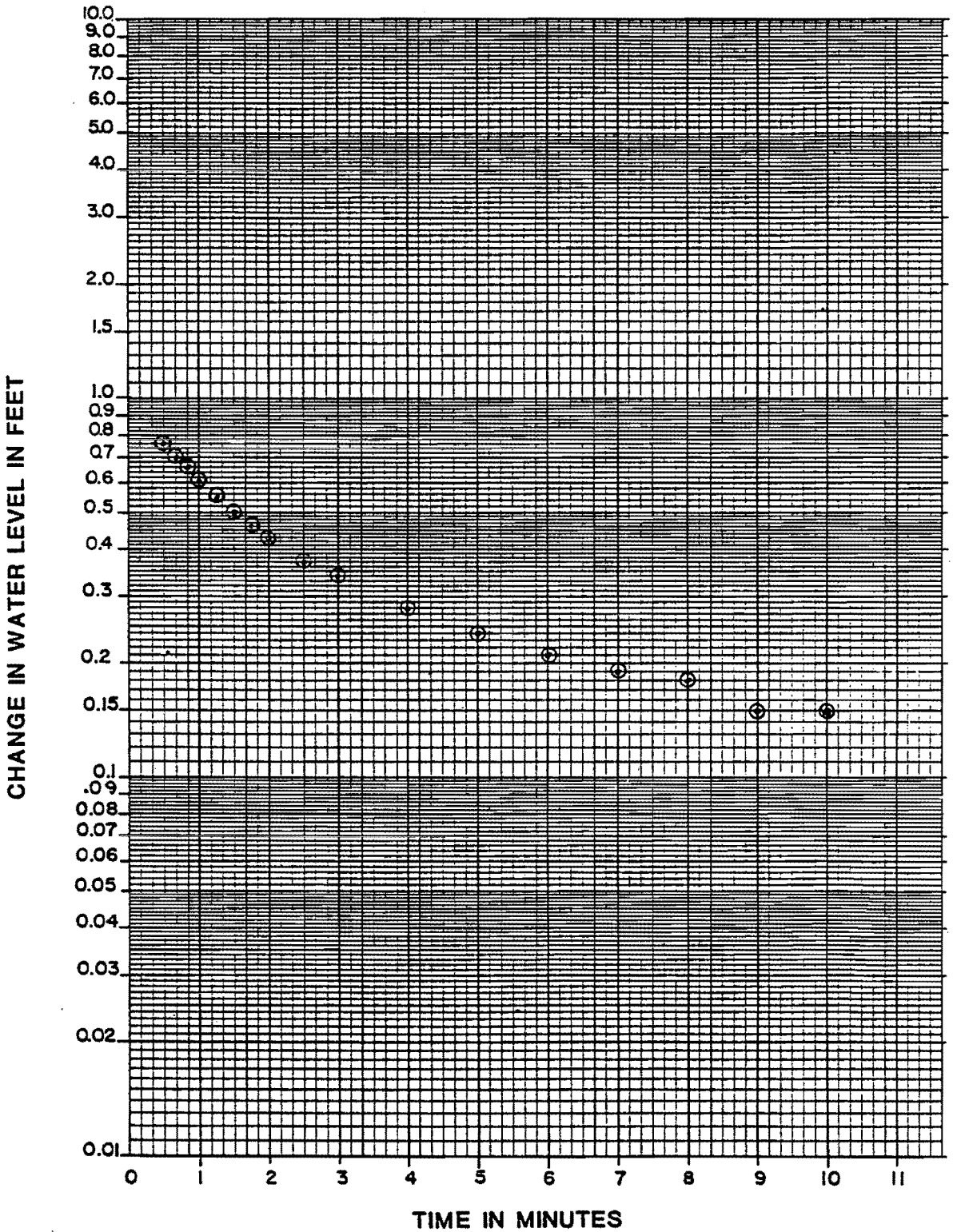
WELL No. 829

HYDRAULIC CONDUCTIVITY CALCULATIONS



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CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 829 1

WELL NO.: 829

LOCATION: 1.0' - 1.3' deep

TYPE: Soil

SAMPLER: Richard Flohr (SIGNATURE)

DATE: 4/30/87

TIME: 2:30 PM

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
Richard Flohr	5/1/87	10:45AM	MCI	KI Webb	5/1/87	10:45	

REMARKS:

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CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 829 2

WELL NO.: 829

LOCATION: 5.0'-5.3' deep

TYPE: Soil

SAMPLER: Richard Flohr (SIGNATURE)

DATE: 4/30/87

TIME: 2:50 pm

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
Richard Flohr	5/1/87	10:45 AM	MCI	K T Webb	5/1/87	10:45	

REMARKS:

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1.0 General Information

1.1 Well Location

Monitoring well number 830 is located in the Main Plant area. It is located in the coal yard, 150 feet southwest of Building 3544. The location is shown on ORNL drawing number C3E 20004 A078. Survey coordinates for this well are N 21,211.72, E 30,659.52 (X-10 grid) or latitude 35° 55' 26.7" and longitude 84° 18' 59.4". Coordinate data were provided by Martin Marietta Energy Systems. The method used for conversion from X-10 grid to Tennessee State Plane Coordinates came from the publication "Tennessee Valley Authority Data Services Branch and Mapping Services Branch, Oak Ridge, Tennessee, DOE Plant Control, November 6, 1985, Field Book: ESS-3115, pp. 1-20." The latitude and longitude were calculated by Adams Craft Herz Walker Engineering, Inc. using methods from the U.S. Coast and Geodetic Survey Publication 62-4, "State Plane Coordinates by Automatic Data Processing."

1.2 Drilling Information

Well number 830 was drilled by A.L. Clark Drilling Services, Inc. A Schramm Rotadrill air rotary rig was used to drill this boring for monitor well installation under the operation of A. L. Clark, II with the assistance of A. L. Clark, III. Drilling commenced on 5/11/87 and was finished on 5/14/87. Paragraph 2.4.1 includes a detailed discussion of the well installation and a well schematic is included on the well installation/completion form. A synopsis of the drilling activity follows:

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5/11/87 The Schramm drill rig was mobilized to the staked location and set up on plastic sheeting. The interval from the surface to 9.0 feet was split spooned and the intervel from 0.0 feet to 11.0 feet was reamed and augered.

5/12/87 The boring was deepened from 9.0 feet to 16.0 feet total depth with 6 inch augers, bailed dry and allowed to recharge overnight.

5/13/87 The boring was bailed and stainless steel screen and casing installed followed by a sandpack and bentonite seal.

5/14/87 Grouted annular space from 2.0 feet to the surface.

This well was logged by Engineering, Design and Geosciences Group, Inc. (EDGe), hydrogeologists Charles W. Stanley and Michael L. Ebers. All well construction materials and supplies were from Martin Marietta Energy Systems approved batches. The batch origin of individual items is shown on the included Monitoring Well Materials Certification form.

2.0 Technical Information

2.1 Decontamination Procedures

The drilling rig, down hole tools, surface casing, stainless steel screen, stainless steel casing, centralizers, and stainless steel silt trap underwent the cleaning and decontamination procedures outlined in the drilling specifications (Release Specific Technical Directions For Regulatory Compliance Monitoring Wells Phase 1, Oak Ridge National Laboratory, Oak Ridge, W.O. K-4147, April 1987, pgs. 2-4.). A checklist of the cleaned materials is included with this data package.

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2.2 Geology

The Main Plant is located in Melton Valley which is in the Valley and Ridge Physiographic Province of East Tennessee. The Main Plant area is underlain by limestone, siltstone and calcareous shale of the Ordovician Chickamauga Group. The Chickamauga Group is 1735 feet thick in the Main Plant area and has been separated into eight mappable subdivisions. They are in ascending order lettered A through H. The average angle of dip in the Main Plant area is 36 degrees dipping to the southeast, and the average direction of strike is north 58 degrees east.

2.3 Sample Collection

One soil sample was collected during drilling, placed in an I-CHEM specialty cleaned glass container, sealed and submitted to Sample Receiving, Analytical Chemistry Division, Bldg. 4500S, ORNL. A chain of custody form for this sample is included with this data package. Soil sample 0830S01 was collected in the split spoon interval from 9.0 feet to 9.2 feet on 5/11/87. Analytical results for the soil sample described above can be obtained from the Remedial Action Program data base at ORNL.

2.4 Installation and Development

2.4.1 Installation

This was a type A well. A two-inch diameter stainless steel silt trap was installed from 15.0 to 15.2 feet. Above the silt trap a two-inch diameter stainless steel screen was installed from 5.0 to

15.0 feet. A two-inch diameter stainless steel casing was installed above the screen from 5.0 feet to 3.0 feet above ground surface. A sandpack was then poured into the annular space from 4.0 to 15.2 feet, with a 2.0 foot bentonite pellet seal poured into the annular space above the sandpack from 2.0 to 4.0 feet. The annular space from the top of the bentonite seal to the surface was tremie grouted with a cement/bentonite slurry. A detailed schematic of the well is included on the well installation/completion form.

2.4.2 Well Development

Well number 830 was developed to remove drill cuttings, silt, and other fines from the monitoring well. The monitoring well was developed using a Geoguard pump with an air compressor. All pumps and/or bailers were cleaned prior to use according to specified cleaning procedures (see Paragraph 2.1). The well was developed until a measured total of 267.0 gallons of water had been evacuated and the clarity of the discharge water was approved by the company representative. The final turbidity value measured at completion was 5 JTU's. A development form showing the exact method of development and other pertinent data is appended.

2.4.3 Installation of Dedicated Monitoring Well Pump

After the well was developed, a dedicated monitoring well pump (Geoguard pump model No. 5614) was installed on 3/29/88 at a depth of 12.2 feet below ground surface. These pumps are decontaminated at American Sigma and are sent prepackaged. A copy of the pump certification is kept on file at ORNL.

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2.5 Hydraulic Conductivity Testing

Well number 830 was tested for the determination of hydraulic conductivity of the aquifer in the vicinity of the well screen. This was accomplished by instantaneously adding a known quantity of water to the monitoring well and measuring the response of the water level over time. The changing water levels were measured using a Druck Model DPI-600 pressure transducer. The hydraulic conductivity (shown as permeability on the hydraulic conductivity calculations printout attached) value of 5.54×10^{-5} cm/second was calculated using the Bouwer and Rice method. A computer printout of the hydraulic conductivity calculations is included in this data package.

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WELL No. 830

PRE-DRILLING CHECKLIST FOR MONITORING WELLS

PRE-DRILLING TASKS		COMPLIANCE DATE	COMPLIANCE INITIALS
1.	EXCAVATION PERMIT OBTAINED.	5/11/87	CWS
2.	ALL EQUIPMENT HAS BEEN CLEANED BEFORE DRILLING.	5/11/87	CWS
3a.	SCREEN AND CASINGS HAVE BEEN WASHED, STEAMED, RINSED WITH DE-IONIZED OR DISTILLED WATER, RINSED WITH ISOPROPYL ALCOHOL, WRAPPED WITH PROTECTIVE COVERING AND STORED OFF THE GROUND.	N/A	
3b.	PRE-PACKAGED SCREENS, CASINGS AND CENTRALIZERS WERE USED.	5/11/87	CWS
4.	WORK AREA FOR SAMPLE EXAMINATION COVERED WITH CLEAN POLYETHYLENE.	5/11/87	CWS
5.	CLEAN KNIVES, GLOVES, SAMPLE JARS AND LABELS ON-HAND.	5/11/87	CWS
6.	POLYETHYLENE COVER IN PLACE OVER HOLE.	5/11/87	CWS

ADDITIONAL NOTES/OBSERVATIONS:

OBSERVER SIGNATURE/DATE: 5/11/87

Charles W. Stanley

EDGe Engineering, Design & Geosciences Group, Inc.
725 Pellissippi Parkway
P.O. Box 23010 Knoxville, Tn 37933-1010 (615)966-9788

WELL No. 830

DECONTAMINATION CHECKLIST
DRILLING EQUIPMENT

EQUIPMENT	SCRAPE	STEAM CLEAN	STEAM RINSE	ISOPROPYL ALCOHOL RINSE	DEIONIZED WATER RINSE
RIG	X	X	X	N/A	N/A
AUGERS	X	X	X	X	X
BITS	X	X	X	X	X
RODS	X	X	X	X	X
SAMPLERS	X	X	X	X	X
PIPES	X	X	X	X	X
WORK TOOLS	X	X	X	X	X
AUGER PINS	X	X	X	X	X

OBSERVER SIGNATURE/DATE _____ 5/11/87

Charles W. Stanley

EDGe Engineering, Design & Geosciences Group, Inc.
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WELL No. 830

ORNL MONITORING WELL LOG

LOCATION: Main Plant-East of Coal Yard
DRILLER: A. L. Clark, II
HELPER: A. L. Clark, III
DRILL: Schramm Rotadrill

DATE: START: 5/11/87
FINISH: 5/13/87
LOGGED BY: Charles W. Stanley & Michael L. Ebers
HEALTH PHYSICST: Paul Eldridge

TYPE DRILLING: Split Spoons, Auger
LUBRICANT TYPE: Molykote 1000
No. SAMPLES TAKEN: one
TYPE: soil
CONTAINMENT TYPE: Auger pan and plastic

THICKNESS OF SOIL (REFUSAL DEPTH): 9.0'
DEPTH DRILLED IN ROCK: 7.0'
TOTAL DEPTH OF WELL: 16.0'

DRILLING FLUID SAMPLES:
TYPE: N/A DATE:

DEPTH (FEET) FROM	TO	SAMPLE (NUMBER & INTERVAL)	PERCENT RECOVERY (SPLIT SPOONS)	SOIL/BEDROCK DESCRIPTION
0.0	2.0		10%	Soil and subsoil, medium yellowish brown, dry, silty with abundant limestone gravels, medium gray
2.0	4.6			Subsoil, medium yellowish brown, dry, silty with abundant limestone gravels, medium gray
4.6	7.0			Clay, medium light gray, silty, moist, plastic scattered gravels throughout
7.0	9.0	0830S01 @9.0-9.2'		Clay, medium gray, silty, plastic, moist
	9.0			Split spoon refusal
9.0	16.0			Limestone, gray, shaly, soft at 11.5-12.0'
	16.0			TOTAL DEPTH

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WELL No. 830

WELL INSTALLATION/COMPLETION FORM

O.R.N.L. MONITORING WELL PROGRAM

LOGGED BY: Charles W. Stanley & Michael L. Ebers
PROOFED BY: Michael L. Ebers

DRILLING COMPANY: A. L. Clark Drilling Services

DRILLER: A. L. Clark, III HELPER: Richard Pickel

LOCATION Main Plant
ORNL GRID COORDINATES
N 21,211.72
E 30,659.52
ELEV. GROUND 778.35
ELEV. TOP STAINLESS STEEL CASING 781.35

DRILLING DATES:
STARTED: 5/11/87
FINISHED: 5/13/87

EQUIPMENT ☒ 6 INCH AUGER 16.0 L.F.
☐ _____ INCH AUGER _____ L.F.

MATERIALS USED

EST. VOL.	USED VOL.	
	10.0	FEET OF 2 IN. S.S. SCREEN
	8.0	FEET OF 2 IN. S.S. CASING
2.0	3.7	SACKS OF SAND
28.0	35.0	POUNDS OF BENTONITE PELLETS
0.7	0.7	SACKS OF CEMENT
	1.0	POUNDS OF POWDERED BENTONITE
	4.0	GALLONS OF WATER (CEMENTING)

REASON FOR DIFFERENCES BETWEEN ESTIMATED VOLUMES AND USED VOLUMES
Cavities, Spillage and Irregular Auger Boring Diameter

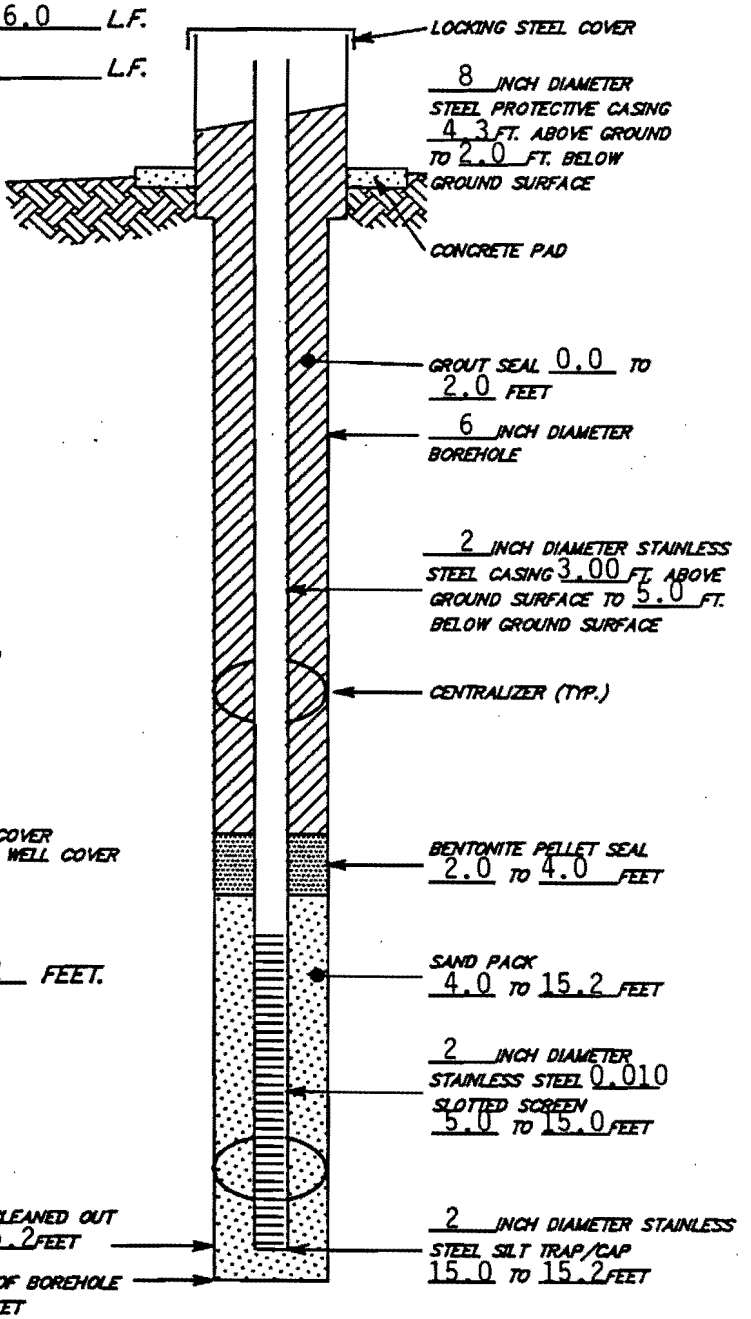
WELL COVER USED ☒ LOCKING STEEL COVER
☐ FLUSH MOUNTED WELL COVER
☐ OTHER

SILT TRAP USED YES ☒ NO ☐

MONITORING WELL PUMP BASE SET AT 12.2 FEET.

CENTRALIZERS AT 4.0 FEET.
15.0 FEET.
_____ FEET.

NOTE:
ALL DEPTHS ARE MEASURED FROM GROUND SURFACE UNLESS OTHERWISE NOTED:



TYPE A WELL

NOT TO SCALE

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WELL No. 830

DATE: 5/13/87

MONITORING WELL MATERIALS CERTIFICATION

ITEM/MATERIAL			DATE USED	BATCH NUMBER
SAND			5/13/87	04
BENTONITE			5/13/87	02
STAINLESS STEEL SCREEN	(PREPACKAGED	■ YES ☐ NO)	5/13/87	04
STAINLESS STEEL CASING	(PREPACKAGED	■ YES ☐ NO)	5/13/87	04
STAINLESS STEEL CENTRALIZERS	(PREPACKAGED	☐ YES ■ NO)	5/13/87	01
STAINLESS STEEL CAPS	(PREPACKAGED	■ YES ☐ NO)	5/13/87	04
MONITORING WELL PUMP	(PREPACKAGED	■ YES ☐ NO)	3/29/88	02
GROUT			5/14/87	04
WELL COVERS			5/14/87	01
SURFACE CASING			5/14/87	02

COMMENTS:

OBSERVER SIGNATURE/DATE [signature] 5/14/87
Charles W. Stanley

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WELL No. 830

POST-WELL COMPLETION CHECKLIST

POST-WELL COMPLETION TASKS	COMPLIANCE DATE	COMPLIANCE INITIALS
1. MUD SCRAPED FROM AUGERS, SAMPLERS, AND ALL OTHER EQUIPMENT.	5/13/87	CWS
2. ALL MUD FROM RIG AND EQUIPMENT SCRAPINGS AND CUTTINGS DISPOSED OF IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED.	5/13/87	CWS
3. WELL DEVELOPED IN ACCORDANCE WITH THE SPECIFICATION* PROVIDED AND DETAILS OF THE DEVELOPMENT ACTIVITY RECORDED.	3/29/88	JMM
4. DRILLING SITE PROPERLY CLEANED UP AFTER COMPLETION OF WELL INSTALLATION.	5/13/87	CWS

* RELEASE SPECIFIC TECHNICAL DIRECTIONS FOR REGULATORY COMPLIANCE MONITORING WELLS PHASE I, OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, W.O. K-4147, APRIL 1987.

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/29/88
John M. McLoughlin

Charles W. Stanley 5/13/87
Charles W. Stanley

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WELL No. 830

MONITORING WELL DEVELOPMENT FORM

DEVELOPMENT DETAILS

METHOD OF DEVELOPMENT: Geoguard Pump and Air Compressor

DEVELOPMENT BEGAN DATE: 3/14/88 TIME:

DEVELOPMENT ENDING DATE: 3/29/88

DEVELOPMENT OBSERVED BY: John M. McLoughlin, EDGe

ONE WELL VOLUME: (GALLONS) 7.2

TOTAL WATER REMOVED DURING DEVELOPMENT (GALLONS): 267.0 (REFER TO WELL DEVELOPMENT PROGRESS SHEET FOR DETAILS)

TURBIDITY AT END OF DEVELOPMENT: 5 JACKSON TURBIDITY UNITS

- ☒ CLEAR
- ☐ SLIGHTLY CLOUDY
- ☐ MOD. TURBID
- ☐ MUDDY

TURBIDITY DETERMINED AND WELL APPROVED BY: R. C. Williams, MMES

ODOR OF WATER: None

WATER DISCHARGED TO:
- ☐ GROUND SURFACE
- ☐ STORM SEWERS
- ☒ DRUMS
- ☐ TANK TRUCK
- ☐ STORAGE TANKS
- ☐ OTHER

INITIAL PRE-DEVELOPMENT WATER DEPTH: 5.5 Feet from surface

DATE DEDICATED MONITORING WELL PUMP INSTALLED 3/29/88 AT 12.2 FEET BELOW GROUND SURFACE

TYPE OF PUMP INSTALLED Geoguard PUMP MODEL 5614

BATCH SERIAL NO.

DEVELOPMENT OBSERVATIONS

OBSERVER SIGNATURE/DATE John Michael McLoughlin 3/29/88
John M. McLoughlin

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WELL NO. 830
LOCATION: Main Plant
DATE: 3/14/88

MONITORING WELL DEVELOPMENT PROGRESS

ONE WELL VOLUME = 7.2 GALLONS

DATE	GALLONS PUMPED	DESCRIPTION OF TURBIDITY	MEASURED TURBIDITY (JTU'S)	TOTAL GALLONS PUMPED	TOTAL WELL VOLUMES PUMPED	COMMENTS
3/14/88	40.8					
3/15/88	37.5					
3/16/88	39.1					
3/17/88	37.4					
3/18/88	42.5					
3/21/88	13.6					
3/24/88	8.5					
3/25/88	11.9					
3/28/88	17.0					
3/29/88	18.7		5 JTU's	267.0	37.08	
RESULTS AT END OF DEVELOPMENT		Clear	5 JTU's	267.0	37.08	

COMMENTS Average pH = 7.2

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HYDRAULIC CONDUCTIVITY CALCULATIONS

PROGRAM SLUGT, VERSION 4.1, NOV. 1986

THIS PROGRAM CALCULATES MEAN TRANSMISSIVITIES FROM SLUG-TEST DATA BASED ON TWO ANALYTICAL APPROACHES:

(1) METHOD OF COOPER, BREDEHOEFT AND PAPADOPULOS, 1967 (ARTICLE IN VOL.3, NO.1 OF WRR ENTITLED "RESPONSE OF A FINITE DIAMETER WELL TO AN INSTANTANEOUS CHARGE OF WATER")

(2) METHOD OF BOUWER AND RICE, 1976 (ARTICLE IN VOL. 12, NO.3 OF WRR ENTITLED "A SLUG TEST FOR DETERMINING HYDRAULIC CONDUCTIVITY OF UNCONFINED AQUIFERS WITH COMPLETELY OR PARTIALLY PENETRATING WELLS")

WELL NO.: 0830 DATE OF TEST: 4/8/88

PROJECT NO.: 22000620 CLIENT: MMES

SITE LOCATION: MAIN PLANT

EDGE, INC. FIELD INVESTIGATOR: MICHAEL L. EBERS

INPUT DATA ARE:

INNER CASING DIAMETER = 2.20 INCHES
INNER SCREEN OR OPEN-HOLE DIAMETER = 2.20 INCHES
DIAMETER OF DRILLED HOLE = 6.75 INCHES
LENGTH OF SCREEN OR INTAKE PORTION = 10.00 FEET
DEPTH FROM STATIC LEVEL TO BOTTOM OF SCREEN = 12.20 FEET
THICKNESS OF SATURATED AQUIFER ZONE = 10.00 FEET
DEPTH TO STATIC WATER LEVEL BELOW REF. POINT = 2.73 FEET
ESTIMATED POROSITY OF GRAVEL PACK = .20
FALLING-HEAD INDEX = 1 ("1" IF FALLING,"0" IF RISING)
NUMBER OF DEPTH-TIME DATA POINTS = 24

HO WAS COMPUTED FROM INTERCEPT OF PLOT OF LOG(H) VS. TIME

SUCCESSIVE COMPUTED VALUES FOR HO (FEET)
1.2465
1.2801

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WELL No. 830

HYDRAULIC CONDUCTIVITY CALCULATIONS

TIME (SEC)	DEPTH TO WATER (FEET)	HEAD (FEET)
10.00	4.850	2.120
20.00	4.630	1.900
30.00	4.450	1.720
40.00	4.310	1.580
50.00	4.200	1.470
60.00	4.110	1.380
75.00	3.820	1.090
90.00	3.720	.990
105.00	3.620	.890
120.00	3.540	.810
150.00	3.490	.760
180.00	3.450	.720
240.00	3.400	.670
300.00	3.360	.630
360.00	3.340	.610
420.00	3.280	.550
480.00	3.250	.520
540.00	3.210	.480
600.00	3.180	.450
720.00	3.150	.420
840.00	3.110	.380
960.00	3.090	.360
1080.00	3.070	.340
1200.00	3.050	.320

(**********)

METHOD OF BOUWER AND RICE

COMPUTED RESULTS USING DIAMETER OF DRILLED HOLE:

PERMEABILITY = 1.82E-06 FT/SEC = 5.54E-05 CM/SEC

TRANSMISSIVITY = 1.82E-05 FT**2/SEC

COMPUTED RESULTS USING DIAMETER OF CASING AND SCREEN:

PERMEABILITY = 2.43E-06 FT/SEC = 7.42E-05 CM/SEC

TRANSMISSIVITY = 2.43E-05 FT**2/SEC

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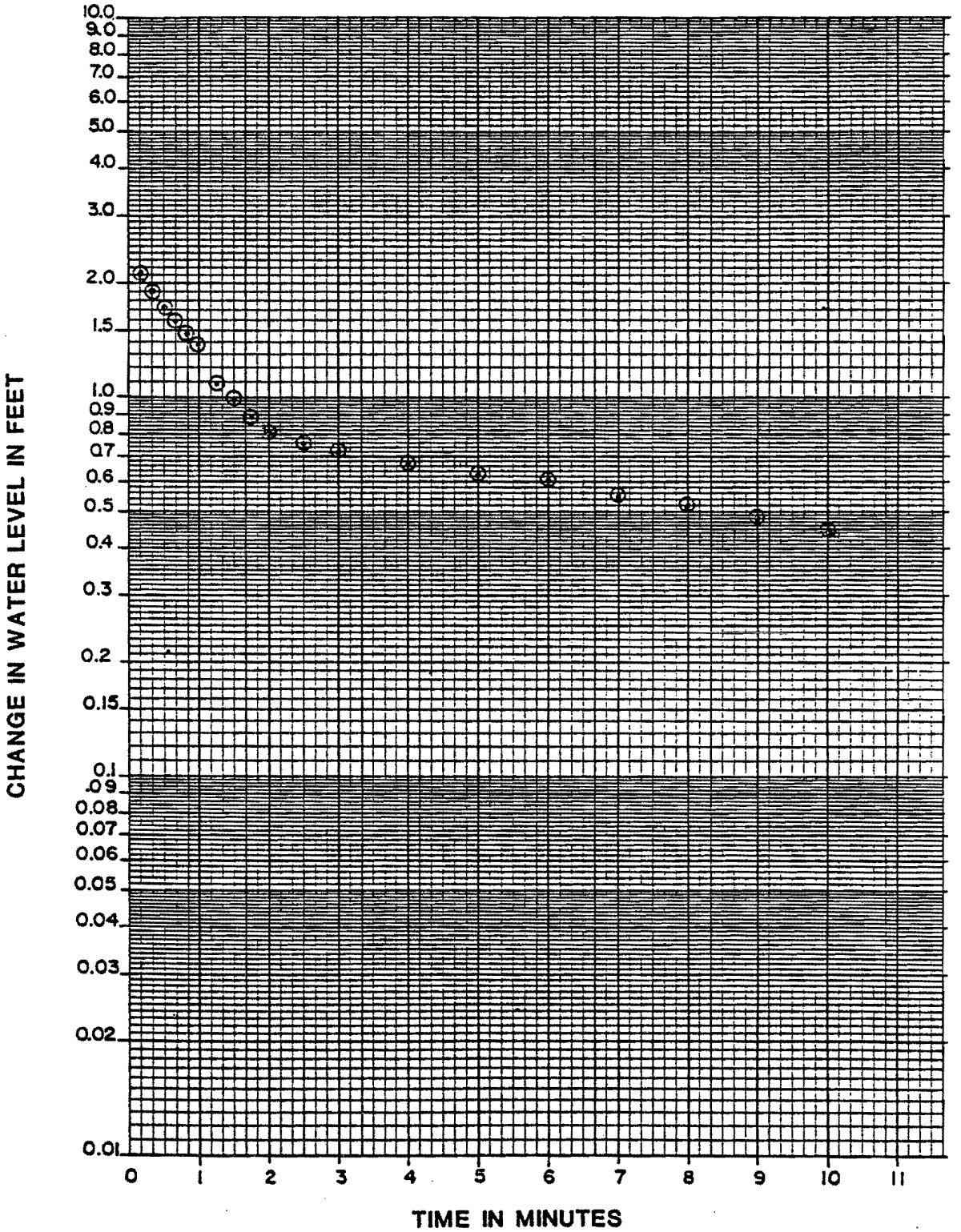
WELL No. 830

HYDRAULIC CONDUCTIVITY CALCULATIONS



MCI/CONSULTING ENGINEERS, INC.
NASHVILLE KNOXVILLE HUNTSVILLE LOUISVILLE
(615) 966-9788

CHAIN OF CUSTODY RECORD
FOR
MARTIN MARIETTA ENERGY SYSTEMS
OAK RIDGE NATIONAL LABORATORY

SAMPLE NUMBER: 0830501
~~0830 S/~~

WELL NO.:	LOCATION:	TYPE:
0830	9.0' - 9.2'	Soil
SAMPLER: (SIGNATURE)		DATE: 5-11-87 / TIME: 12:10

RELINQUISHED BY: (SIGNATURE)	DATE:	TIME:	WITH:	RECIEVED BY: (SIGNATURE)	DATE:	TIME:	WITH:
	5/26/87	11:40	MCI		5/26/87	11:40	ORNL

REMARKS:

Appendix B - Examples of Analytical Data Available

Names, types, length, and labels of variables in the water quality well-drilling data set

NAME	TYPE	LENGTH	LABEL
ANALYSIS	CHARACTER	10	ANALYSIS PERFORMED BY LAB
CHARGE_N	CHARACTER	8	CHARGE NUMBER
COMPDATE	NUMERIC	8	DATE ANALYSIS COMPLETED
COM1_ACD	CHARACTER	65	ACD COMMENT 1
COM2_ACD	CHARACTER	80	ACD COMMENT 2
COM3_ACD	CHARACTER	80	ACD COMMENT 3
CUSTNAME	CHARACTER	20	ACD CUSTOMER NAME
CUSTSAMP	CHARACTER	15	INVESTIGATOR SAMPLE ID
ENTR_ACD	NUMERIC	8	DATE ACD DATA ENTERED BY DBM
EXT	CHARACTER	12	EXTRACTION TECHNIQUE
LAB	CHARACTER	10	LABORATORY PERFORMING ANALYSES
PREFIX	CHARACTER	2	DATA QUALIFIER FOR "RESULT"
PROC_NUM	CHARACTER	14	PROCEDURE NUMBER
PROJ_NUM	CHARACTER	4	PROJECT NUMBER
RAD_ERR	NUMERIC	8	RAD ANALYSIS ERROR (2 S.D.)
RECVDATE	NUMERIC	8	DATE RECEIVED
RECVDATT	NUMERIC	8	DATE/TIME SAMPLES RECEIVED
REQNO	CHARACTER	12	ACD REQUEST NUMBER
RESULT	NUMERIC	8	RESULT REPORTED FOR "ANALYSIS"
SAMP	CHARACTER	10	ACD LABORATORY SAMPLE ID
SAMPDATT	NUMERIC	8	DATE AND TIME SAMPLED
SAMPDESC	CHARACTER	32	SAMPLE DESCRIPTION
SAMPFREQ	CHARACTER	12	SAMPLING FREQUENCY
SAMPMATX	CHARACTER	16	SAMPLE MATRIX
SAMPSER	CHARACTER	10	SAMPLE SERIES
TASK	CHARACTER	12	RAP INVESTIGATOR /TASK
TRANDATE	NUMERIC	8	DATE DATA AVAILABLE
TYPE_ANL	CHARACTER	10	GENERAL TYPE OF ANALYSIS
UNITS	CHARACTER	10	MEASUREMENT UNITS FOR "RESULT"
VERI_ACD	CHARACTER	3	ACD DATA VERIFIED

Results of chemical and radiological analyses for selected rock, soil, and drilling water samples from WELL 0745[1]

ANALYSIS	ROCK SAMPLE	SOIL SAMPLE	ROCK,SOIL UNITS	DRILLING WATER	WATER UNITS
% WATER	18.860	25.390	%(WEIGHT)	.[3]	
AG	<0.490[2]	<0.470	UG/G	<0.050	MG/L
AL	3.200	42.000	UG/G	<0.200	MG/L
AS	<0.980	<0.940	UG/G	<0.100	MG/L
B	<0.780	<0.750	UG/G	<0.080	MG/L
BA	<0.200	<0.190	UG/G	<0.020	MG/L
BE	<0.020	<0.019	UG/G	<0.002	MG/L
CA	51.000	30.000	UG/G	40.000	MG/L
CD	<0.049	<0.047	UG/G	<0.005	MG/L
CO	<0.098	<0.094	UG/G	<0.010	MG/L
CO-60	<2.000	<2.000	BQ/KG	.	
CR	<0.390	<0.380	UG/G	<0.040	MG/L
CS-137	<2.000	8.700	BQ/KG	.	
CU	<0.200	<0.190	UG/G	<0.020	MG/L
FE	0.660	21.000	UG/G	0.120	MG/L
GA	<2.900	<2.800	UG/G	<0.300	MG/L
GROSS BETA	1500.000	1100.000	BQ/KG	.	
K-40	580.000	570.000	BQ/KG	.	
LI	<2.000	<1.900	UG/G	<0.200	MG/L
MG	6.900	7.600	UG/G	10.000	MG/L
MN	<0.049	0.140	UG/G	0.006	MG/L
MO	<0.390	<0.380	UG/G	<0.040	MG/L
NA	16.000	6.300	UG/G	6.900	MG/L
NI	<0.590	<0.570	UG/G	<0.060	MG/L
P	<2.900	<2.800	UG/G	<0.300	MG/L
PB	<2.000	<1.900	UG/G	<0.200	MG/L
SB	<2.000	<1.900	UG/G	<0.200	MG/L
SE	<2.000	<1.900	UG/G	<0.200	MG/L
SI	31.000	66.000	UG/G	1.900	MG/L
SN	<0.490	<0.470	UG/G	<0.050	MG/L
SR	0.780	0.130	UG/G	0.100	MG/L
TI	<0.200	0.490	UG/G	<0.020	MG/L
TOC	.	.		1.400	MG/L
V	<0.098	<0.094	UG/G	<0.010	MG/L
ZN	<0.200	<0.190	UG/G	0.041	MG/L
ZR	<0.200	<0.190	UG/G	<0.020	MG/L

[1]Results generally have two significant digits.
[2]"<" Indicates concentration less than the detection limit; value reported was the detection limit.
[3]Missing value indicates analysis not performed.

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