BOTTOM ASH TRANSPORT SYSTEM EVALUATION

CARDINAL GENERATING STATION

SL-018068

Prepared for
Buckeye Power, Inc.

October 9, 2023
Project No.: A13770.006
Issue: For Use, Rev. 0

Prepared By

Sargent & Lundy

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LEGAL NOTICE

CARDINAL UNIT 1, 2, & 3

BOTTOM ASH TRANSPORT SYSTEM EVALUATION

ISSUE SUMMARY AND APPROVAL PAGE

This is to certify that this report has been prepared, reviewed and approved in accordance with Sargent & Lundy's Standard Operating Procedure SOP-0405, which is based on ANSI/ISO/ASSQC Q9001 Quality Management Systems.

Rev.	Purpose of Issue	Date	Sections Affected
0	Issue for Use	10/09/2023	All

Mechanical Input Prepared By
David Wu Digitally signed by David Wu Date: 2023.10.09 10:46:29-05'00'

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CARDINAL UNIT 1, 2, & 3

BOTTOM ASH TRANSPORT SYSTEM EVALUATION

CERTIFICATION PAGE

I certify that this report was prepared by me or under my supervision and that I am a registered professional engineer under the laws of the State of Ohio.
I certify that I am familiar with the 40 CFR 423 regulation requirements and the Cardinal Generating Station Facility.

Certified By: Digitally signed by David E. Nielson, P.E. Date: 2023.10.10 10:03:37 -05'00' Date: ____________

David E. Nielson
(P.E. No. E-89402)

STATE OF OHIO
DAVID E. NIELSON
E-89402
REGISTERED
PROFESSIONAL ENGINEER

Seal:

Digitally signed by David E. Nielson, P.E.
Date: 2023.10.10 10:04:17 -05'00'

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A. Bottom Ash Volume Calculation, 2020-03682

B. Bottom Ash System Rainfall Estimate, 2023-02951

C. Bottom Ash Purge Water Suspended Solids Estimate, 2023-02785

D. Chart on EPA-600/7-80-067, pg 17

References

1. Email Correspondence from David Wu, 8:51am, October 3, 2023

EXECUTIVE SUMMARY

The Cardinal Generating Station (Cardinal) consists of three steam electric generating units fueled by pulverized coal and is located near Brilliant, Ohio. All three units are equipped with a common bottom ash handling system which includes a CCR compliant retrofitted Bottom Ash Pond (the "Bottom Ash Pond"). The bottom ash handling system at each of the station's three units sluices bottom ash transport water (BATW) via several pipes to the Bottom Ash Pond. The primary purpose of the Bottom Ash Pond is for sedimentation of the bottom ash particles for removal and disposal. BATW is recycled to the station for reuse and for use in the plant's flue gas desulfurization (FGD) system. BATW from the Bottom Ash Pond may be discharged to the Low Volume Waste stream pond (LVW Pond), as needed, to obtain the target recirculation BATW quality. Sargent & Lundy (S&L) was retained to evaluate the Steam Electric Effluent Limitation Guideline (ELG) compliance strategy for the BATW stream in support of the facility's certification requirements in association with 40 CFR 423.19 (c).

Existing U.S. Environmental Protection Agency (EPA) ELG standards require that the total volume of bottom ash purge water discharged from the BATW system must be reduced or eliminated to the extent achievable using best management control measures (40 CFR 423.13(k)(2(i)(B)). The total volume of bottom ash purge water that may be discharged per day is determined on a case-by-case basis by the permitting authority; however, in no event shall such discharge exceed a 30-day rolling average of ten percent of the primary active wetted bottom ash system volume (the primary wetted volume or "PWV"). The primary wetted volume consists of bottom ash transport water from four (4) approved system categories, including discharge needed to maintain system water chemistry.

S&L reviewed Cardinal drawings and documents to prepare a calculation of the system's primary active wetted bottom ash system volume (primary wetted volume), evaluated the system influents and effluents, and developed a narrative description of the wastewater treatment system as it is anticipated to be configured to increase recirculation and reduce flows out of the systems. As part of this evaluation, S&L also evaluated the rainfall volume that can be managed by the system and water load under various operating conditions and how surge events affect the need for discharge. This evaluation is intended to support the technical information needed to fulfill Cardinal's initial certification requirements at 40 CFR 423.19(c) for facilities that discharge BATW pursuant to §423.13(k)(2)(i).

The total primary wetted volume of Cardinal's bottom ash water systems is summarized in Table ES-1,

Table ES-1: Primary Wetted Volume

Bottom Ash System	Primary Wetted Volume (gallons)	Maximum Allowable Discharge (30-day rolling average gallons per day)
Combined Unit 1, 2, & 3	657,345	65,735

While Cardinal has a high recycle rate bottom ash transport system, it was never designed to function as a zero-discharge system. Modifications to the high recycle system have been implemented to minimize the need to purge water out of the system. These modifications include improvements to equipment, process controls, and operations focused on maximizing recirculation without impacting operations and maintenance.

Nevertheless, bottom ash purge water from two of the four approved categories of purge water are relevant to operation and maintenance of the Cardinal bottom ash system and support a daily discharge of up to 10% of the PWV on a 30-day rolling average basis. When the system modifications necessary to assure maximum recirculation are implemented, water chemistry becomes challenging and total suspended solids (TSS) and pH can be managed with purging to avoid impacts to system operation or maintenance. Occasionally, the ash sluicing lines must be maintained, during these maintenance events, Unit 1 & 2 boiler room sump pumps and Unit 3 ash pit pumps are routed to the LVW pond. Finally, on occasion maintenance may require complete drainage of the bottom ash system.

Based on an assessment of bottom ash purge water quantities, the projected BATW discharge rate on a %PWV 30-day rolling average basis, calculated as the sum of the discharges for each bottom ash purge water category, is summarized in Table ES-2.

Table ES-2: The 30-Day Rolling Average Discharge Volume as a Percent of Primary Active

Type of Discharge Event	Units 1, 2, and 3
Exceeding 10-year, 24-hour (or longer duration) storm event *See 40 CFR §423.13(k)(2)(i)(A)(1)*	0%
Regular discharge needs to maintain water balance due to wastewater inflows *See 40 CFR §423.13(k)(2)(i)(A)(2)*	0%
Regular discharge needs to maintain water chemistry *See 40 CFR §423.13(k)(2)(i)(A)(3)*	5.7%
Other infrequent maintenance events *See 40 CFR §423.13(k)(2)(i)(A)(4)*	8.6%
Total % of PWV of coincident maximum volume discharged per day	Up to 14.3%
Total % Discharge Volume Requested	10%
Operational strategies may be employed to reduce the total 30-day rolling average discharge lower than the sum of the individual contributors. The requested 10% total discharge volume reflects the implementation of these strategies.	

1. INTRODUCTION

The Cardinal Station is located near Brilliant, OH and has three (3) pulverized coal fired steam electric units with a combined net output of approximately 1,880 megawatts (MW). Units 1 and 2 are B&W opposed-firing boilers and have a gross capacity of 615 MW, each. Unit 3 is also a pulverized coal boiler and has a gross capacity of 650 MW. All units burn bituminous coal and are equipped with a common bottom ash handling system.

The Cardinal bottom ash system includes a CCR compliant retrofitted bottom ash pond (the "Bottom Ash Pond"). The bottom ash handling system at each of the station's three units sluices bottom ash transport water (BATW) via several pipes to the Bottom Ash Pond. The primary purpose of the Bottom Ash Pond is to settle out bottom ash particles for disposal. BATW is recycled to the station for reuse and for use in the plant's flue gas desulfurization (FGD) system. BATW from the Bottom Ash Pond may be discharged to the Low Volume Waste stream pond (LVW Pond), as needed, to obtain the target recirculation water quality and ultimately to the Ohio River. This discharge is regulated by the station's active National Pollutant Discharge Elimination System (NPDES) permit.

The U.S. Environmental Protection Agency (EPA) has promulgated Effluent Limitations Guidelines (ELG) and Standards for the Steam Electric Power Generating Point Source Category (40 CFR Part 423). The ELG standards have been revised and amended several times since they were first promulgated in 1974, including amendments published in 2015 and 2020. The 2015 amendments, published as a final rule in the Federal Register on November 3, 2015, imposed a zero-discharge limitation for all pollutants in BATW for any electric generating unit with a total nameplate capacity above 50 megawatts (MW), including the discharge of pollutants in BATW in a high recycle rate system (80 FR 67838, November 3, 2015). Technologies required to comply with the 2015 requirement generally required facilities to recycle most of their BATW or convert to dry ash handling systems.

On October 13, 2020, the EPA published a reconsidered ELG rule which revised the requirements for BATW and allowed the discharge of a limited amount of bottom ash purge water (85 FR 64650, October 13, 2020, the "2020 Reconsideration Rule"). Standards in the 2020 Reconsideration Rule, codified at 40 CFR 423.13(k)(2)(i)(A), allow the discharge of pollutants in bottom ash purge water from a properly installed, operated, and maintained bottom ash system under the following conditions:

(1) To maintain system water balance when precipitation-related inflows are generated from storm events exceeding a 10-year storm event of 24-hours or longer duration.

(2) To maintain system water balance when regular inflows from wastestreams other than bottom ash transport water exceed the ability of the bottom ash system to accept recycled water and segregating these other wastestreams is not feasible.

(3) To maintain system water chemistry where installed equipment at the facility is unable to manage pH, corrosive substances, substances or conditions causing scaling, or fine particulates to below levels which impact system operation or maintenance.

(4) To conduct maintenance not otherwise included above.

The total volume of the bottom ash purge water discharges listed above must be determined on a case-by-case basis but in no event shall the discharge exceed a 30-day rolling average of ten percent of the primary active wetted bottom ash system volume (primary wetted volume or "PWV").

This evaluation was prepared to assess the Cardinal BATW system operating conditions associated with the §423(k)(2)(i) discharge allowance, and to support the technical information needed to fulfill Cardinal's initial certification requirements at 40 CFR 423.19(c) for facilities that discharge BATW pursuant to §423.13(k)(2)(i).

2. SCOPE OF EVALUATION

The scope of this evaluation includes discussion of the following pertinent elements of the plant design and operation based on the Cardinal Station drawings and documents provided by Cardinal Operating Company:

- The Primary Active Wetted Bottom Ash System Volume
- List of All Potential Discharges
- Narrative Description of the Wastewater Treatment Systems

3. THE PRIMARY ACTIVE WETTED BOTTOM ASH SYSTEM VOLUME

S&L developed a primary wetted volume calculation including all bottom ash and ash water handling equipment, piping, and trenches based on drawings provided by Cardinal Operating Company. Per 40 CFR 423.11(aa), the term "primary active wetted bottom ash system volume" is defined as the maximum volumetric capacity of bottom ash transport water in all non-redundant piping (including recirculation piping) and primary bottom ash collection and recirculation loop tanks (e.g., bins, troughs, clarifiers, and hoppers) of a wet bottom ash system, excluding the volumes of surface impoundments, secondary bottom ash system equipment (e.g., installed spares, redundancies, and maintenance tanks), and non-bottom ash transport systems that may direct process water to the bottom ash.

Based on the definition in 423.11(aa), the total calculated primary wetted volume at Cardinal was determined for each of the bottom ash systems. The primary wetted volume, and corresponding maximum allowable discharge is provided in Table 1. Please refer to Appendix A – Bottom Ash Volume Calculation for the calculation details, including material assumptions, information, and calculations used to determine the primary wetted bottom volume.

Table 1: Primary Wetted Volume

Bottom Ash System	Primary Wetted Volume (gallons)	Maximum Allowable Discharge (30-day rolling average gallons per day)
Combined Unit 1, 2, & 3	657,345	65,735

4. LIST OF ALL POTENTIAL DISCHARGES

Provided the Cardinal bottom ash systems are installed, operated, and maintained in accordance with industry standards, the following discharges are expected from the system:

- Discharges to Balance Precipitation-related Flows
    - 10-year / 24-hour storm or larger event collected in bottom ash system
- Discharges to Maintain System Water Chemistry
    - Water discharges to maintain bottom ash system pH
- Maintenance Related Discharges
    - Discharge to drain the system in a timely manner
    - Maintain bottom ash system water balance during ash sluice pipeline maintenance

Discharges to balance wastewater flow are not expected because other wastewater streams are not directed to the bottom ash system at Cardinal.

4.1 DISCHARGES TO BALANCE PRECIPITATION-RELATED INFLOWS

As part of this evaluation, S&L evaluated storms exceeding the 10-year 24-hour storm event, including longer durations to determine how such rainfall events affect the need to discharge purge water from the bottom ash system. Please refer to Appendix B – Bottom Ash System Rainfall Estimate for the calculation details, including material assumptions, information, and calculations used to determine the 10-year 24-hour rainfall event.

Equipment included in the surge capacity calculation is summarized in Table 2.

Table 2 - Systems and Volume Included in Surge Capacity

Bottom Ash System	Available Surge Volume (Gallons)
Units 1, 2, and 3 Bottom Ash System	
Units 1 & 2 Boiler Room Sump Surge Volume	2,796
Units 3 Ash Hopper Pit Sump Surge Volume	1,492
Units 1 & 2 Ash Hopper Surge Volume	3,733
Unit 3 Ash Hopper Surge Volume	2,747
Surge Volume of Bottom Ash Pond	11,057,384
Total Units 1, 2, and 3 Surge Capacity	**11,068,153**

During sluicing operations, bottom ash is sluiced to the Bottom Ash Pond. Ash is stored in the settling pond and, on occasion, dredged into trucks for final storage in a landfill. The maximum quantity of ash is approximately equal to the volume available in the settling pond following several years of continuous operation. For this evaluation, it is assumed that the rainfall event occurs during the sluicing operation; thus, the volume of ash collected within the bottom ash system is subtracted from the available volume in the surge tank.

Stormwater flows for the 10-year events and the 50-year events are summarized in Figure 1 and Figure 2, respectively and compared to the calculated surge capacity summarized above.

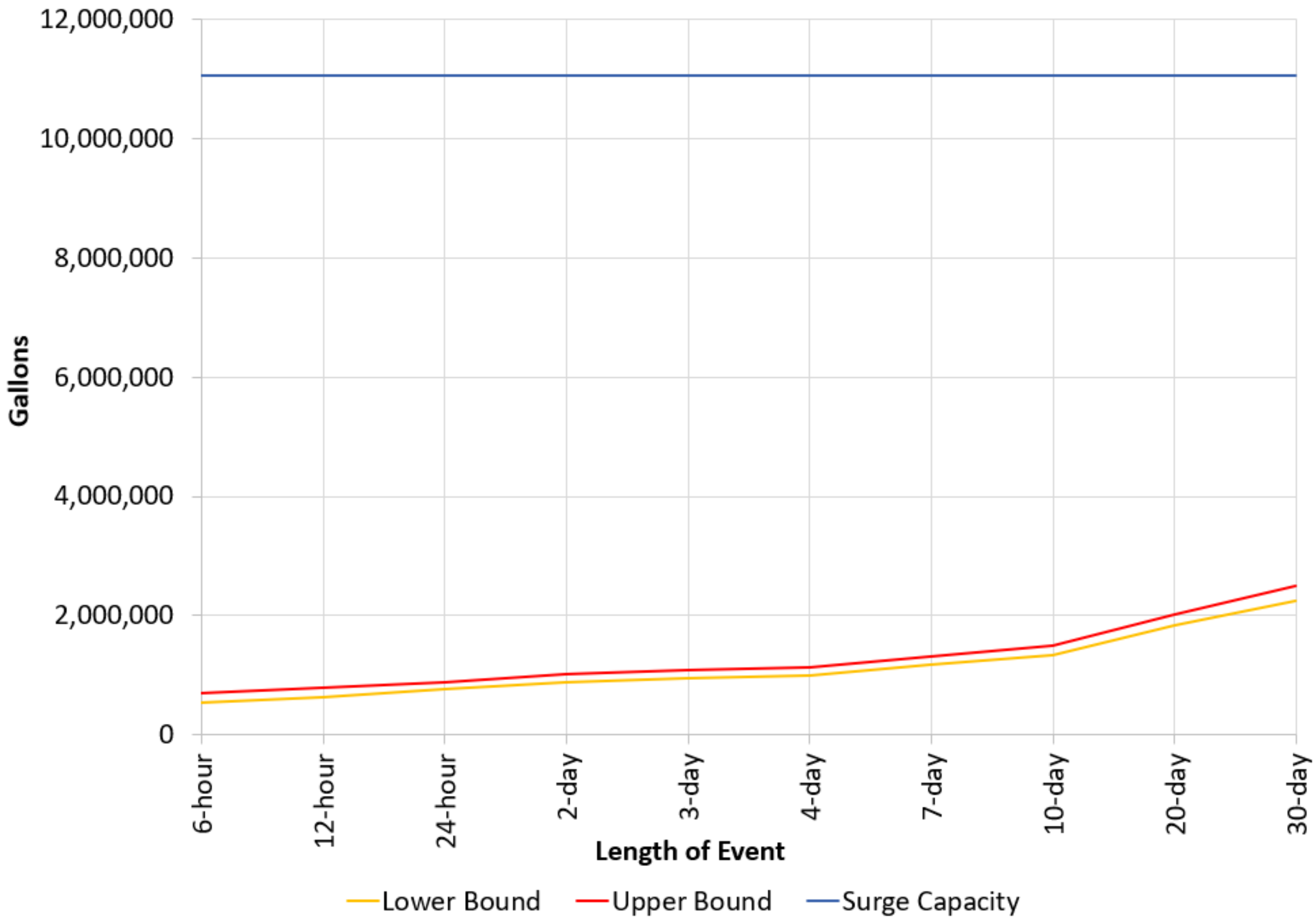

Figure 1 – 10-year Storm Events Rain Runoff Evaluation

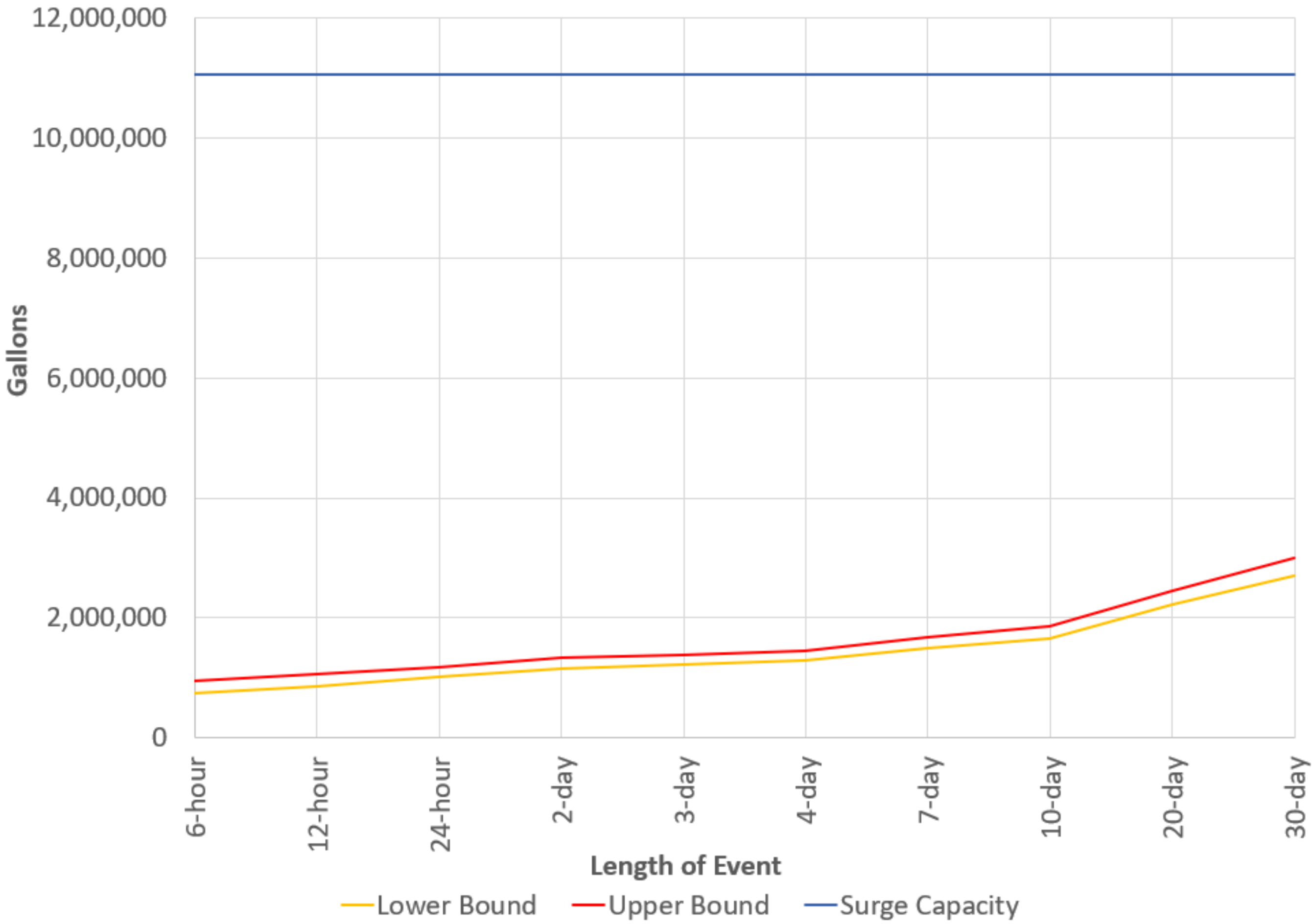

Figure 2 - 50-year Storm Events Rain Runoff Evaluation

As shown in Figure 1 and Figure 2 above, the Bottom Ash Pond is adequately sized to contain 100% of the stormwater runoff volume generated during either the 10-year or 50-year storm events, which would allow Cardinal to not discharge from the Bottom Ash Pond during each of the stormwater events evaluated up to the 50-year, 30-day event.

Free board was also added to the pond depth to ensure that the pond will not overtop its berms.

4.2 DISCHARGES TO BALANCE WASTEWATER INFLOWS

Water in the bottom ash systems at Cardinal is recirculated to the extent feasible. Services such as hopper wall cooling, seal trough water, and ash fluidization in the hoppers are supplied from recirculated water. Therefore, no discharge is required to maintain system balance from wastewater inputs other than BATW.

4.3 DISCHARGES TO MAINTAIN SYSTEM WATER CHEMISTRY

The EPA studied the behavior of coal ash particles in water in its study titled "Behavior of Coal Ash Particles in Water: Trace Metal Leaching and Ash Settling" (EPA-600/7-80-067, March 1980). The study was conducted at Tennessee Valley Authority (TVA) coal-fired power plants. The report addressed six major areas of concern in wet ash disposal, namely, the (1) characteristics of ashes and ash pond effluents, (2) effects of ash and raw water characteristics on the pH of ash pond water, (3) methods for pH adjustment of ash pond effluents, (4) settling characteristics of both fly ash and bottom ash, (5) leaching of minerals from ashes, and (6) relationship of trace metals to pH and concentration of suspended solids in ash pond effluents. Of specific interest are the evaluations of ash pond water quality characteristics in relation to the chemical quality of the fuel burned at twelve TVA coal-fired power stations.

The primary system chemistry concern is the buildup of bottom ash fines in the recirculating transport water. Fines enter the bottom ash system with other, larger, particles of ash falling into the hopper and occasionally from fracturing of the larger particles of ash due to the thermal shock of entering the hopper water. Some fines exit the bottom ash system through entrainment in bottom ash purge water and ash in trucks being taken to landfill. The fines will concentrate in the bottom ash water until the mass flow rate of fines into the system is equal to the mass flow rate of fines exiting. According to Cardinal operating data, the plant maintains a total suspended solids (TSS) concentration in the BATW of less than 19.7 mg/L at 99% confidence to protect bottom ash system pumps from excessive abrasion damage. Table 3 provides an estimate of the bottom ash purge water discharge needed at Cardinal to maintain a TSS concentration of 19.7 mg/L. Please refer to Appendix C – Bottom Ash Purge Water Suspended Solids Estimate for the calculation details, including material assumptions, information, and calculations used by the certifying professional engineer to determine the primary wetted bottom volume.

Table 3 - Estimated Bottom Ash Purge Water Discharge to Maintain TSS

Bottom Ash System	Bottom Ash Purge
Unit 1, 2, and 3	5.3% of PWV

Another system chemistry concern is the scaling or corrosivity of the BATW in high-recycle bottom ash handling systems. S&L used Cardinal fuel ash quality and the chart on page 17 of the coal ash study referenced above (EPA-600/7-80-067, pg. 17) to estimate the pH of the high-recycle bottom ash handling system at Cardinal. The chart relates the ratio of ash calcium oxide and magnesium oxide concentrations to the ash sulfur trioxide concentration [(CaO + MgO)/SO_3 (mole ratio)]. All of the units at Cardinal burn the same fuel, the results of applying the EPA analysis are shown in Table 4.

Table 4 – Estimate of Bottom Ash System Equilibrium pH

Fuel	Fuel Ash Calcium Oxide (%)	Fuel Ash Magnesium Oxide (%)	Fuel Ash Sulfur Tri-Oxide (%)	Ratio of (CaO+MgO) to SO_3	Estimated pH
Marshall County Coal Resources	3.20	0.72	2.69	1.46	<3 (acidic)
Ohio County Coal Resources	2.31	0.59	2.20	1.31	<3 (acidic)
Iron Senergy	3.59	0.78	3.85	1.14	<3 (acidic)
Tunnel Ridge	1.81	0.73	1.63	1.56	<3 (acidic)

The predicted acidic chemistry of the bottom ash system at Cardinal will occur at system chemical equilibrium, which takes time to achieve. In order to prevent the system from reaching chemical equilibrium, water in the system may be continuously discharged and made-up with fresh utility or service water. The maximum allowable discharge rate allowed by the 2020 Reconsideration Rule (i.e., 10% of PWV per day) would provide the greatest protection from constituents in the ash creating acidic water in the system.

4.4 MAINTENANCE RELATED DISCHARGES

An allowance to discharge from the BATW system is needed to conduct maintenance activities. In order to drain the entire bottom ash system for maintenance and maintain the 30-day rolling average per day discharge requirement taking into account discharges addressed in Sections 4.1 through 4.3, an allowable discharge equal to or greater than the following is needed:

$$\frac{\%PWV}{day} = \left((TSV/PWV)\right) / 30\ days$$

Where:
TSV: Total System Volume
PWV: Primary Wetted Volume
%PWV/day: Minimum Percentage of Primary Wetted Volume per Day

At Cardinal, the bottom ash handling system has a total system volume (without the Bottom Ash Pond) of 723,792 gallons and a PWV of 657,345 gallons. Thus, in order to drain the system completely for a maintenance event and maintain the 30-day rolling average per day discharge requirement, an allowable discharge for maintenance on a %PWV/day basis greater than the following is needed:

$$\frac{\%PWV}{day} = \left(((723{,}792)/657{,}345)\right) / 30\ days = \frac{3.7\%PWV}{day}$$

According to e-mail correspondence with Cardinal Operations Personnel, on each unit, during normal operation, certain sumps (boiler room sump on Unit 1 and 2, ash pit sump on Unit 3) collect bottom ash transport water. The water from the sumps is pumped through the non-operating bottom ash transport pipeline on each unit. This normally keeps that bottom ash transport water contained within the "closed loop" system.

However, on occasion, the bottom ash lines need maintenance work. When one of the two bottom ash lines on a unit requires maintenance (while the generating unit is still in service), the one remaining sluice pipeline is employed to transport ash to the bottom ash pond. The pipeline on which maintenance is being performed is unavailable for use to convey the sump water. During these maintenance events, water from the applicable sump is routed to the LVW Pond.

Based on historical operations, the average time needed to perform maintenance on one of these transport lines is approximately 8 hours. The estimated volume of water discharged as a percentage of PWV per day during one of these maintenance events may be calculated using the following formulae:

$$MWV = SPC \times EOD$$

Where:
MWV: Maintenance Water Volume (gallons)
SPC: Sump Pump Capacity (gpm)
EOD: Estimated Operation Duration (min)

$$\frac{\%PWV}{day} = \left((MWV/PWV)\right)/_{30\ days}$$

Where:
MWV: Total System Volume
PWV: Primary Wetted Volume
%PWV/day: Minimum Percentage of Primary Wetted Volume per Day

For example, during a Unit 1 sluice pipeline outage, the Unit 1 boiler room sump (rated at 2000 gpm) may operate for the entirety of the 8-hour (480-minute) maintenance period.

$$MWV = 2000 \times 480 = 960{,}000\ gallons$$

$$\frac{\%PWV}{day} = \left((960{,}000/657{,}345)\right)/_{30\ days} = \frac{4.9\%PWV}{day}$$

The total discharge requested for these maintenance activities is the total of the two events, or 8.6% of PWV per day.

4.5 TOTAL DISCHARGES

The minimum 30-day rolling average discharge rate on a %PWV per day basis is calculated as the sum of the discharges necessary for each bottom ash purge water category. The minimum discharge for the combined units at Cardinal is summarized in the Table 5.

Table 5 - The 30-Day Rolling Average Discharge Volume as a Percent of Primary Active Wetted Bottom Ash System Volume

Type of Discharge Event	**Units 1, 2 and 3**
Exceeding 10-year, 24-hour (or longer duration) storm event *See 40 CFR §423.13(k)(2)(i)(A)(1)*	0%
Regular discharge needs to maintain water balance due to wastewater inflows *See 40 CFR §423.13(k)(2)(i)(A)(2)*	0%
Regular discharge needs to maintain water chemistry *See 40 CFR §423.13(k)(2)(i)(A)(3)*	5.7%
Other infrequent maintenance events *See 40 CFR §423.13(k)(2)(i)(A)(4)*	8.6%
Total % of PWV of coincident maximum volume discharged per day	Up to 14.3%
Total % Discharge Volume Requested	10%
Operational strategies may be employed to reduce the total 30-day rolling average discharge lower than the sum of the individual contributors. The requested 10% total discharge volume reflects the implementation of these strategies.	

5. NARRATIVE DESCRIPTION OF THE WASTEWATER TREATMENT SYSTEMS

Cardinal is equipped with the following wastewater treatment systems which do not treat bottom ash transport water:

- Unit 1 & 2 Sewage Treatment Plant for Domestic Wastewater (Outfall 006)
- Unit 3 Sewage Treatment Plant for Domestic Wastewater (Outfall 008)
- Common FGD Wastewater Treatment System (Outfall 601)

Cardinal is equipped with the following wastewater treatment systems which do treat bottom ash transport water:

- Bottom Ash Pond Discharge (To FGD)

Prior to December 31, 2025, Cardinal will install, commission, and startup the following wastewater treatment system:

- Flue gas desulfurization wastewater treatment system compliant with discharge limitations in 40 CFR 423.

5.1 NON-BOTTOM ASH TREATMENT DISCHARGES

The Unit 1&2 Sewage Treatment System for Domestic Wastewater discharges to Outfall 006. The system receives a blend of domestic sewage and air conditioning condensate. The system consists of aeration, activated sludge, sedimentation, flocculation, sand filtration, and UV disinfection, which removes activated sludge and disinfects the domestic sewage. The Unit 1&2 Sewage Treatment System discharges a daily average of 0.02 MGD into the Riddles Run. This flow is not expected to significantly change in the future.

The Unit 3 Sewage Treatment System for Domestic Wastewater discharges to Outfall 008. The system receives a blend of domestic sewage and laboratory wastewater. The system consists of aeration, activated sludge, sedimentation, flocculation, sand filtration, and UV disinfection, which removes activated sludge and disinfects the domestic sewage. The Unit 3 Sewage Treatment System discharges a daily average of 0.02 MGD into the Ohio River. This flow is not expected to change significantly in the future.

The FGD Wastewater Treatment System discharges to Internal Outfall 601. The system receives a blend of Unit 1, 2, and 3 FGD wastewater. The system consists of equalization, neutralization, primary clarification, and secondary clarification, which removes suspended solids and neutralizes the stream. The FGD Wastewater Treatment System discharges a daily average of 0.78 MGD into the Outfall 001, which discharges to the Ohio River. This flow may be reduced due to future changes to the operation of Cardinal Station.

5.2 BOTTOM ASH TREATMENT DISCHARGES

The Bottom Ash Pond discharge is located at the southern end of the plant site. The system consists of a sedimentation basin which removes suspended solids from bottom ash transport water. This system recirculates the majority of the water it receives to the suction of the bottom ash system recirculation pumps located on the north bank of the Bottom Ash Pond. In order to control pH, suspended solid fines, and other constituents, a certain amount of water is discharged to the FGD. This flow is not expected to change in the future.

5.3 FUTURE WASTEWATER TREATMENT SYSTEMS

Prior to December 31,2025, Cardinal will install a polishing bioreactor to treat the effluent of the existing FGD wastewater treatment system. The bioreactor system, which uses microorganisms to reduce soluble pollutants, will be designed meet the ELG limits. The capacity of the system is 440 gpm based on Cardinal Station operating data.

APPENDIX A.

BOTTOM ASH VOLUME CALCULATION

Buckeye Power

Cardinal Station

DOCUMENT NO. 2020-03682
BOTTOM ASH SYSTEM WETTED VOLUME CALCULATION

Rev. 0
August 15, 2023

Sargent & Lundy

ISSUE SUMMARY

Form SOP-0402-07, Revision 12

DESIGN CONTROL SUMMARY

CLIENT:	Buckeye Power	UNIT & NO.: 1, 2, 3	Page No.: 2
PROJECT NAME:	Cardinal Generating Station		
PROJECT NO.:	13770-006	☐ NUCLEAR SAFETY RELATED ☑ NOT NUCLEAR SAFETY RELATED	
CALC. NO.:	2020-03682		
TITLE:	Bottom Ash Volume Wetted Calculation		
EQUIPMENT NO.:			

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Initial Issue

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PREPARER	N. Clough	Nathaniel Clough (Digitally signed by Nathaniel Clough Date: 2023.08.15 09:11:25 -05'00')	DATE:	15-Aug-23
REVIEWER	D. Wu	David Wu (Digitally signed by David Wu Date: 2023.08.15 11:04:35-05'00')	DATE:	15-Aug-23
APPROVER	D. Wu		DATE:	15-Aug-23

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

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BOTTOM ASH SYSTEM WETTED VOLUME CALCULATION

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BOTTOM ASH SYSTEM WETTED VOLUME CALCULATION

1.0	**PURPOSE AND SCOPE:**				
1.01	The Cardinal power station consists of three (3) units. Project 13770.006 includes the lining and closure of the existing bottom ash ponds for each units.				
1.02	The purpose of this calculation is to determine the primary active wetted volume of the revised bottom ash system in accordance with ELG regulations in order to estimate the allowance of purge (10% of the primary active wetted bottom ash volume).				
Item	**Description**	**Reference**	**Unit of Measure**	**Data Value**	**Input (V/UV/EJ)**
2.0	**DESIGN INPUTS:**				
2.01	ELG Proposed Rule Section 423.11(aa), Specialized Definitions, is provided below for basis of included equipment: *The term "primary active wetted bottom ash system volume" means the maximum volumetric capacity of bottom ash transport water in all non-redundant piping (including recirculation piping) and primary bottom ash collection and recirculation loop tanks (e.g., bins, troughs, clarifiers, and hoppers) of a wet bottom ash system, excluding the volumes of surface impoundments, secondary bottom ash system equipment (e.g., installed spares, redundancies, and maintenance tanks), and non-bottom ash transport systems that may direct process water to the bottom ash .*				V
2.02	The specific gravity of the water is 1.00 and the density is 62.4 lb/ft3.				EJ
2.03	Units 1 & 2 Ash Hopper and Seal Trough volumes are determined per drawings in Attachment 8.02.				V
2.04	Units 1 & 2 Boiler Room Sump volume is determined per drawings in Attachment 8.03.				V
2.05	The pipe length for Units 1 & 2 overflow piping to the Boiler Room Sump is determined per Attachment 8.06.				V
2.06	Unit 3 Ash Hopper and Seal Trough volumes are determined per drawings in Attachment 8.05.				V
2.07	Unit 3 Ash Hopper Pit Sump volume is determined per drawings in Attachment 8.09.				V
2.08	Ash Water Recirculation Pump (AWRP) Pipe lengths were determined using drawings and Google Earth images shown in Attachment 8.07.				EJ
2.09	Units 1, 2 & 3 Bottom Ash water piping volume is determined per the Bill of Materials in Attachment 8.04.				V
2.10	Routing for the piping from the Units 1 & 2 Bottom Ash Pumps to Jet Pumps is determined using Attachment 8.10.				V
2.11	Routing for the piping from the Unit 3 Bottom Ash Pumps to Jet Pumps is determined using Attachment 8.11.				V
Item	**Description**	**Reference**	**Unit of Measure**	**Data Value**	
3.0	**ASSUMPTIONS:**				
3.01	Unit 3 overflow piping to the Ash Hopper Pit Sump is assumed the same length as the Units 1 & 2 overflow piping to the Boiler Room Sump.				EJ
3.02	For all three (3) Units, bottom ash hopper surge volume was taken at high water level, 6" above normal operating level.				EJ
3.03	Seal Trough is assumed to be 6" deep and extends 6" around the ash hoppers.				EJ
3.04	The South Pond was not considered part of the primary wetted volume, however, it is considered part of the surge volume. The South Pond has 5 feet freeboard so an assumed depth of 5 ft is used based on total pond volume for a total of 33.9 acre-feet (based on an average pond area of 6.78 acres).				EJ
3.05	It is assumed that the last 50 ft of piping for the AWRP discharge lines for each Unit is the lower diameter piping (14" nominal for Unit 3 and 12" nominal for Units 1 and 2).				EJ

Item	Description	Variables	Data Value
4.0	**METHODOLOGY & ACCEPTANCE CRITERIA:**		
4.01	The methodology for performing the calculations involves the following principal steps: • Identify all equipment and piping expected to contain ash water during normal plant operation and ash handling processes. • Determine the volume of all identified equipment and piping that is applicable		
4.02	Volume of Rectangular Prism	V = Volume [ft3] l = Length (ft) w = Width (ft) h = Height (ft)	$V = lwh$
4.03	Volume of Triangular Prism	V = Volume [ft3] l = Length (ft) w = Width (ft) h = Height (ft)	$V = lwh\left(\frac{1}{2}\right)$
4.04	Volume of Trapezoidal Prism	V = Volume [ft3] B1 = Base 1 (ft) B2 = Base 2 (ft) h = Height (ft) d = Depth (ft)	$V = \left(\frac{B_1 + B_2}{2}\right)hd$
4.05	Volume of Pyramid	V = Volume [ft^3] h = Height (ft) l = Length (ft) w = Width (ft)	$V = \left(\frac{lwh}{3}\right)$
4.06	Volume of a pipe	V = Volume [ft3] π = Constant {3.14} r = Internal Pipe Radius (ft) L = Length (ft)	$V = \pi r^2 \mathrm{L}$

BOTTOM ASH SYSTEM WETTED VOLUME CALCULATION

Item	Description	Reference	Unit of Measure	Equation	
5.0	**CALCULATIONS:**				
5.01	See Attachment 8.01 for wetted volume summary breakdown				
Item	**Description**	**Reference**	**Unit of Measure**	**Value**	**Accept (Y/N)**
6.0	**RESULTS:**				
6.01	Wetted volume of equipment and piping				
6.02	Units 1 & 2 Ash Hoppers	Attachment 8.02	gal	123,740	Y
6.03	Units 1 & 2 Seal Trough	Assumption 3.05	gal	550	Y
6.04	Units 1 & 2 Overflow Piping	Attachment 8.06	gal	318	Y
6.05	Units 1 & 2 Boiler Room Sump	Attachment 8.03	gal	28,754	Y
6.06	Unit 3 Ash Hoppers	Attachment 8.05	gal	72,187	Y
6.07	Unit 3 Seal Trough	Assumption 3.05	gal	274	Y
6.08	Unit 3 Overflow Piping	Assumption 3.01	gal	159	Y
6.09	Unit 3 Ash Hopper Pit Sump	Attachment 8.09	gal	2,238	Y
6.10	AWRP Piping	Attachment 8.07	gal	185,037	Y
6.11	Piping from Bottom Ash Pump to Jet Pump	Assumption 3.04	gal	4,420	Y
6.12	Piping from Jet Pumps to South Pond	Attachment 8.08	gal	119,591	Y
6.13	Boiler Room Sump and Bottom Ash Hopper Pit Sump Discharge lines to Crossover	Attachments 8.03 and 8.13	gal	7,481	Y
6.14	Units 1 and 2 Boiler Room Sump Crossover Piping to South Pond	Attachment 8.12	gal	92,465	Y
6.15	Unit 3 Ash Hopper Pit Sump Crossover Piping to South Pond	Attachment 8.12	gal	20,131	Y
	TOTAL WETTED VOLUME UNITS 1, 2 & 3		**gal**	**657,345**	**Y**
	Estimated Max Daily Blowdown based on 10% wetted volume over a 30-day rolling average		**gpm**	**46**	**Y**
6.16	**TOTAL VOLUME UNITS 1, 2 & 3**		**gal**	**723,792**	**Y**
6.17	Units 1 & 2 Boiler Room Sump Surge Volume	Attachment 8.03	gal	2,796	Y
6.18	Units 3 Ash Hopper Pit Sump Surge Volume	Attachment 8.09	gal	1,492	Y
6.19	Units 1 & 2 Ash Hopper Surge Volume	Attachment 8.02	gal	3,733	Y
6.20	Unit 3 Ash Hopper Surge Volume	Attachment 8.05	gal	2,747	Y
6.21	Surge Volume of South Pond	Assumption 3.04	gal	11,057,384	Y
7.0	**REFERENCES:**				
7.01	N/A				
8.0	**ATTACHMENTS:**				
8.01	Wetted Ash Volume Calculation Summary				
8.02	U1 & U2 Bottom Ash Hopper Volume				
8.03	U1 & U2 Boiler Room Sump				
8.04	U1, U2 & U3 Bottom Ash Piping Isometrics				
8.05	U3 Bottom Ash Hopper Volume				
8.06	U1 & U2 Bottom Ash Hopper Overflow Pipe				
8.07	AWRP Piping drawings and images				
8.08	Excel Formulas				
8.09	U3 Ash Hopper Pit Sump				
8.10	U1 and U2 Bottom Ash Pumps to Jet Pumps				
8.11	U3 Bottom Ash Pumps to Jet Pumps				
8.12	U1 and U2 Bottom Ash Sump Pump Piping and U3 Ash Hopper Pit Sump Piping from Crossover to South Pond				
8.13	U3 Ash Hopper Pit Sump Discharge pipe to Crossover				

8.01
Wetted Ash Volume Calculation Summary

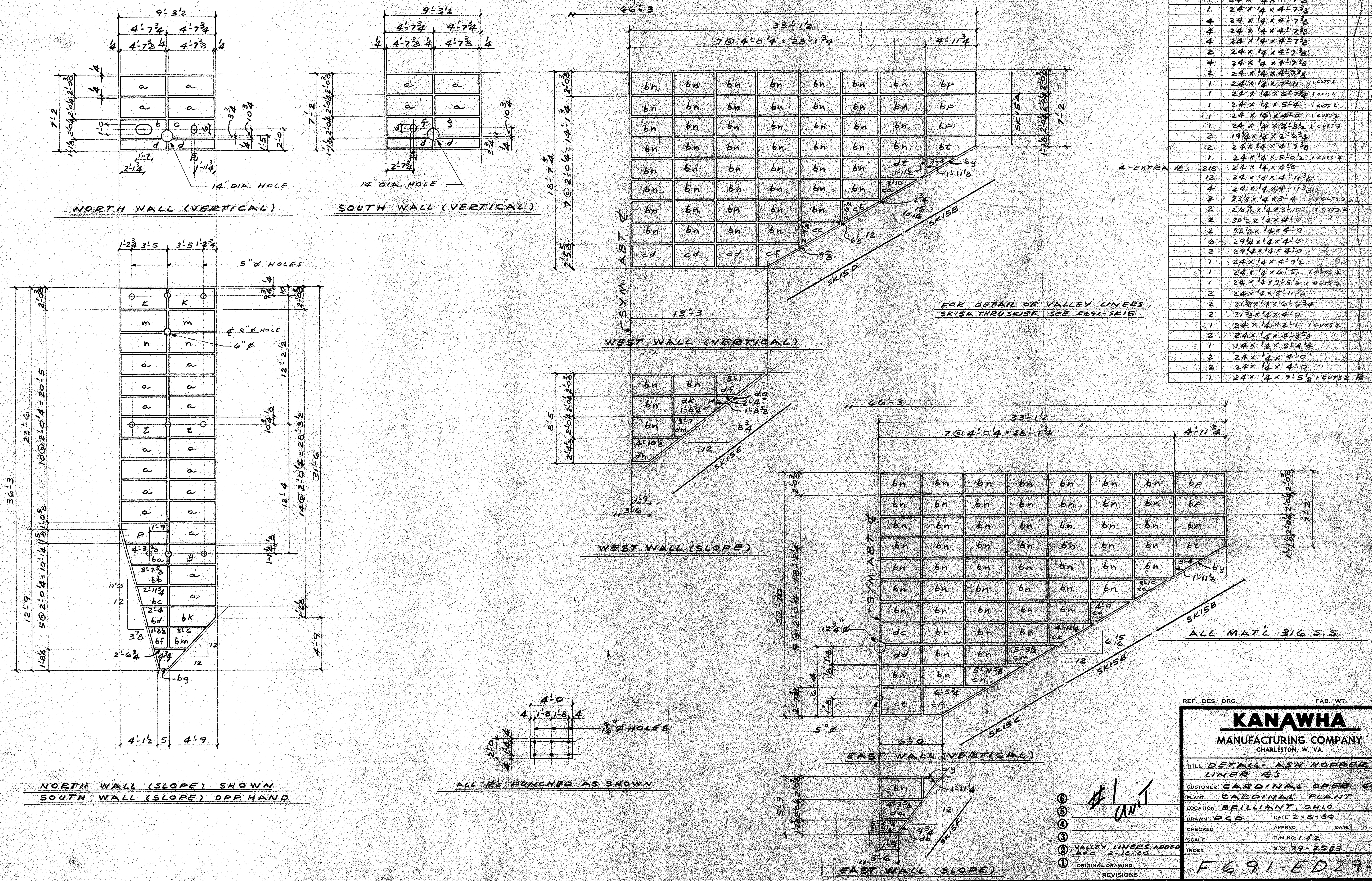
WETTED ASH VOLUME CALCULATION - EQUIPMENT

Piping	Pipe schedule	Pipe nominal dia (in)	Pipe Inner dia (in)	Pipe length (ft)	Pipe Cross Sectional area (ft^2)	Volume (ft^3)	Volume (gal)	Notes
1. Unit 1 Bottom Ash Hopper								
1-01 - Hopper Volume	N/A	N/A	N/A	N/A	N/A	N/A	61,870	
1-02 - Seal Trough (if applicable)	N/A	N/A	N/A	N/A	N/A	36.75	275	
1-03 - Surge Capacity (assume water level to be at emergency overflow level for hopper)	N/A	N/A	N/A	N/A	N/A	249.28	1,867	
1-04 - Overflow piping to Boiler Room Sump	STD	12	12	27	0.79	21.21	159	
1-05 - Boiler Room Sump	N/A	N/A	N/A	N/A	N/A	1,920.00	14,377	First Pump Start level at 666' is used
1-06 - Boiler Room Sump Surge Volume	N/A	N/A	N/A	N/A	N/A	186.72	1,398	Extreme High level alarm at 667'-2" is used
2. Unit 2 Bottom Ash Hopper								
2-01 - Hopper Volume	N/A	N/A	N/A	N/A	N/A	N/A	61,870	
2-02 - Seal Trough (if applicable)	N/A	N/A	N/A	N/A	N/A	36.75	275	
2-03 - Surge Capacity (assume water level to be at emergency overflow level for hopper)	N/A	N/A	N/A	N/A	N/A	249.28	1,867	
2-04 - Overflow piping to Boiler Room Sump	STD	12	12	27	0.79	21.21	159	
2-05 - Boiler Room Sump	N/A	N/A	N/A	N/A	N/A	1,920.00	14,377	First Pump Start level at 666'" is used
2-06 - Boiler Room Sump Surge Volume	N/A	N/A	N/A	N/A	N/A	186.72	1,398	Extreme High level alarm at 667'-2" is used
3. Unit 3 Bottom Ash Hopper								
3-01 - Hopper Volume	N/A	N/A	N/A	N/A	N/A	9,640.42	72,187	
3-02 - Seal Trough (if applicable)	N/A	N/A	N/A	N/A	N/A	36.63	274	
3-03 - Surge Capacity (assume water level to be at emergency overflow level for hopper)	N/A	N/A	N/A	N/A	N/A	366.81	2,747	
3-04 - Overflow piping to Ash Hopper Pit Sump	STD	12	12	27	0.79	21.21	159	
3-05 - Ash Hopper Pit Sump	N/A	N/A	N/A	N/A	N/A	298.94	2,238	First Pump Start level at 80' is used
3-06 - Ash Hopper Pit Sump Surge Volume	N/A	N/A	N/A	N/A	N/A	199.29	1,492	Third Pump Start level at 82' is used
4. Surge Volume of South Pond	N/A	N/A	N/A	N/A	N/A	1,476,680.61	11,057,384	
5. Total Volume of Equipment							238,989	The sum of all volumes above except the Surge Volume of the South Pond

WETTED ASH VOLUME CALCULATION - PIPING

Piping	Pipe schedule	Pipe nominal dia (in)	Pipe Inner dia (in)	Pipe length (ft)	Pipe Cross Sectional area (ft^2)	Volume (ft^3)	Volume (gal)	Notes
1. Piping from Ash Water Recirculation Pump (AWRP) Loop to Units 1, 2, and 3								
1-01a - AWRP Discharge Common Header up to Unit 3	STD	30	29.25	98	4.67	457.30	3,424	
1-01b - AWRP Discharge Common Header up to Unit 3	STD (20)	24	23.25	2522	2.95	7,435.64	55,678	
1-01c - Redundant AWRP Discharge Pipe	STD (20)	24	23.25	2522	2.95	7,435.64	55,678	Redundant AWRP pipe for the discharge common header up to Unit 3
1-02a - AWRP Discharge Dedicated line to Unit 3 Bottom Ash Pump	STD	18	17.25	672	1.62	1,090.62	8,167	
1-02b - AWRP Discharge Dedicated line to Unit 3 Bottom Ash Pump	STD (30)	14	13.25	50	0.96	47.88	359	Assumed 14" nominal piping extend 50 ft to Bottom Ash Pump
1-03 - AWRP Discharge Common Header up to Unit 2	STD (20)	24	23.25	4740	2.95	13,974.99	104,645	
1-04a - AWRP Discharge Dedicated line to Unit 2 Bottom Ash Pump	STD (30)	16	15.25	456	1.27	578.40	4,331	
1-04b - AWRP Discharge Dedicated line to Unit 2 Bottom Ash Pump	STD	12	12	50	0.79	39.27	294	Assumed 12" nominal piping extend 50 ft to Bottom Ash Pump
1-05a - AWRP Discharge Dedicated line to Unit 1 Bottom Ash Pump	STD (30)	16	15.25	826	1.27	1,047.72	7,845	
1-05b - AWRP Discharge Dedicated line to Unit 1 Bottom Ash Pump	STD	12	12	50	0.79	39.27	294	Assumed 12" nominal piping extend 50 ft to Bottom Ash Pump
2. Piping from Bottom Ash Pump to Jet Pump								
2-01 - Unit 1 and Unit 2 Common Bottom Ash Pump to Jet Pump	STD	12	12	550.58	0.79	432.43	3,238	Conservatively used just the lengths of pipe from Att. 8.10 and assumed all pipe was 12"
2-02 - Unit 3 Bottom Ash Pump to Jet Pump	STD	12	12	200.9	0.79	157.79	1,182	Conservatively used just the lengths of pipe from Att. 8.11 and assumed all pipe was 12"
3. Piping from Jet Pump to South Pond								
3-01 - Unit 1 Jet Pump to South Pond	HDPE / Basalt Lined	12	11.8	8448	0.76	6,415.72	48,041	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and another portion is 12" Basalt lined CS (ID 11.93") so 11.8" is used for conservatism
3-02 - Unit 2 Jet Pump to South Pond	HDPE / Basalt Lined	12	11.8	8342	0.76	6,335.52	47,440	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and another portion is 12" Basalt lined CS (ID 11.93") so 11.8" is used for conservatism
3-03 - Unit 3 Jet Pump to South Pond	HDPE / Basalt Lined	12	11.8	4240	0.76	3,219.81	24,110	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and another portion is 12" Basalt lined CS (ID 11.93") so 11.8" is used for conservatism
4. Boiler Room Sump Discharge to the Crossover								
4-01 - Unit 1 Boiler Room Sump Discharge to Crossover	CS Polyurethane-lined pipe (assumed STD)	12	12	756	0.79	593.37	4,443	Assumed the same ID as Carbon Steel STD pipe
4-02 - Unit 2 Boiler Room Sump Discharge to Crossover	CS Polyurethane-lined pipe (assumed STD)	12	12	480	0.79	376.99	2,823	Assumed the same ID as Carbon Steel STD pipe
4-03 - Unit 3 Ash Hopper Pit Sump Discharge to Crossover	Sch. 40	10	10.02	53	0.55	28.75	215	
4-04 - Units 1 and 2 Boiler Room Sump Crossover Piping to South Pond	HDPE / Basalt Lined	12	11.8	8130	0.76	12,348.44	92,465	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and another portion is 12" Basalt lined CS (ID 11.93") so 11.8" is used for conservatism
4-05 - Unit 3 Ash Hopper Pit Sump Crossover Piping to South Pond	HDPE / Basalt Lined	12	11.8	3540	0.76	2,688.40	20,131	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and another portion is 12" Basalt lined CS (ID 11.93") so 11.8" is used for conservatism
5. Total Volume of Piping							484,803	The sum of all volumes above

8.02
U1 & U2 Bottom Ash Hopper Volume



	NO. REQ'D	DESCRIPTION	MAT'L	SYM.
	1	20 3/8 x 1/4 x 2'-4 1 CUTS 2	PL	dg
	2	24 x 1/4 x 4'-0	PL	dk
	1	24 x 1/4 x 4'-5 1/2 1 CUTS 2	PL	dm
	1	27 3/4 x 1/4 x 6'-6 3/4 1 CUTS 2	PL	dn
	1	4 3/4 x 1/4 x 3'-5 1/2 BOTTOM	PL	dp
	2	24 x 1/4 x 4'-0	PL	dt

MARK	NO. REQ'D	DESCRIPTION	MAT'L	SYM.
		ASH HOPPER LINER PL'S		
	42	24 x 1/4 x 4'-7 3/8	PL	a
	1	24 x 1/4 x 4'-7 3/8		b
	1	24 x 1/4 x 4'-7 3/8		c
	4	12 3/4 x 1/4 x 4'-7 3/8		d
	1	24 x 1/4 x 4'-7 3/8		f
	1	24 x 1/4 x 4'-7 3/8		g
	4	24 x 1/4 x 4'-7 3/8		k
	4	24 x 1/4 x 4'-7 3/8		m
	4	24 x 1/4 x 4'-7 3/8		n
	2	24 x 1/4 x 4'-7 3/8		p
	4	24 x 1/4 x 4'-7 3/8		t
	2	24 x 1/4 x 4'-7 3/8		y
	1	24 x 1/4 x 7'-11 1 CUTS 2		ba
	1	24 x 1/4 x 6'-7 3/4 1 CUTS 2		bb
	1	24 x 1/4 x 5'-4 1 CUTS 2		bc
	1	24 x 1/4 x 4'-0 1 CUTS 2		bd
	1	24 x 1/4 x 2'-8 1/2 1 CUTS 2		bf
	2	19 3/4 x 1/4 x 2'-6 3/4		bg
	2	24 x 1/4 x 4'-7 3/8		bk
	1	24 x 1/4 x 5'-0 1/2 1 CUTS 2		bm
4-EXTRA PL'S	218	24 x 1/4 x 4'-0		bn
	12	24 x 1/4 x 4'-10 3/8		bp
	4	24 x 1/4 x 4'-11 3/8		bt
	2	23 1/8 x 1/4 x 3'-4 1 CUTS 2		by
	2	26 9/16 x 1/4 x 3'-10 1 CUTS 2		ca
	2	30 1/2 x 1/4 x 4'-0		cb
	2	33 7/8 x 1/4 x 4'-0		cc
	6	29 1/4 x 1/4 x 4'-0		cd
	2	29 1/4 x 1/4 x 4'-0		cf
	1	24 x 1/4 x 4'-9 1/2		cg
	1	24 x 1/4 x 6'-5 1 CUTS 2		ck
	1	24 x 1/4 x 7'-5 1/2 1 CUTS 2		cm
	2	24 x 1/4 x 5'-11 5/8		cn
	2	31 3/8 x 1/4 x 6'-5 3/4		cp
	2	31 3/8 x 1/4 x 4'-0		ct
	1	24 x 1/4 x 2'-1 1 CUTS 2		cy
	2	24 x 1/4 x 4'-3 5/8		da
	1	14 x 1/4 x 5'-4 1/4		db
	2	24 x 1/4 x 4'-0		dc
	2	24 x 1/4 x 4'-0		dd
	1	24 x 1/4 x 7'-5 1/2 1 CUTS 2	PL	df

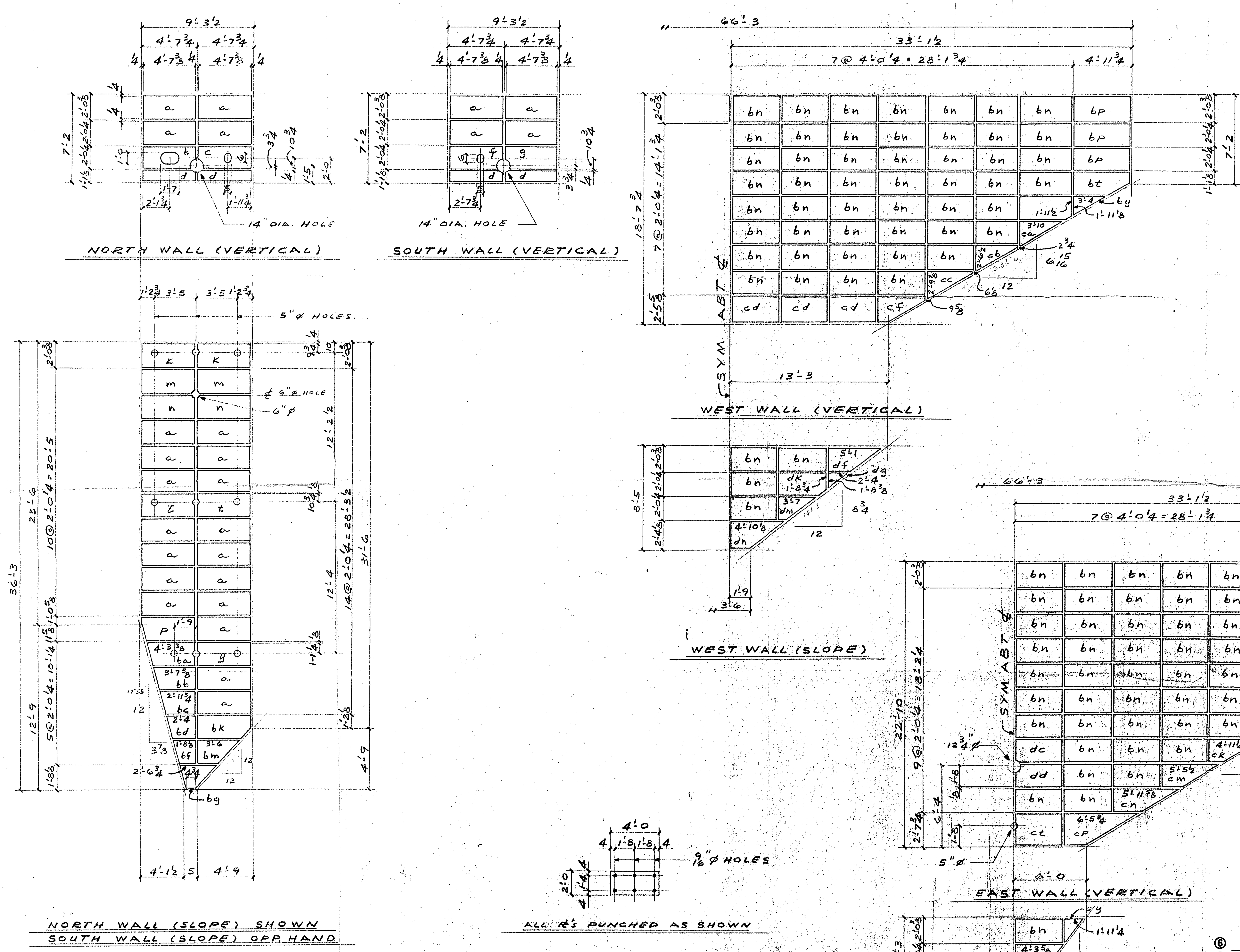
REF. DES. DRG. FAB. WT.

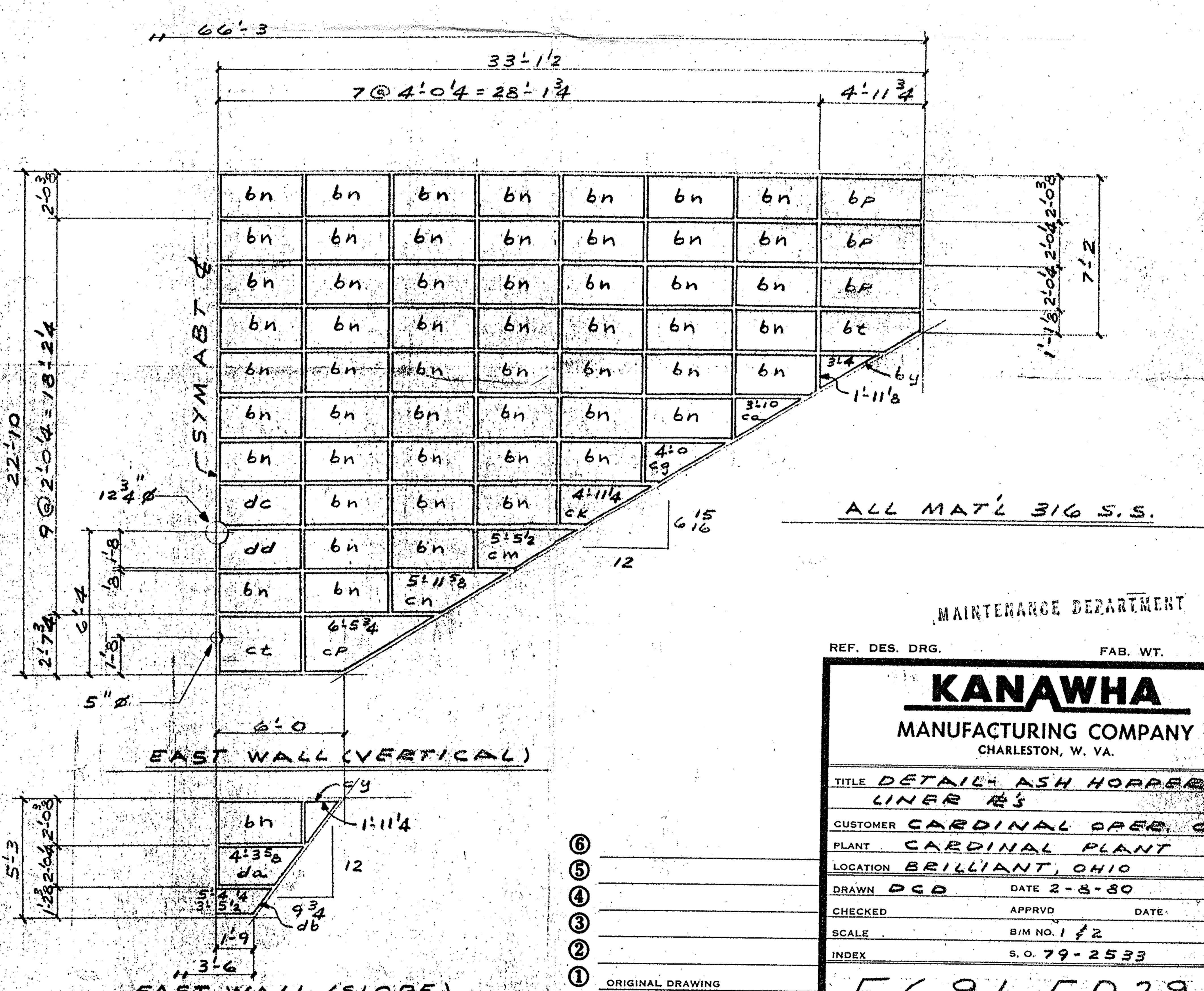
KANAWHA MANUFACTURING COMPANY
CHARLESTON, W. VA.

TITLE: DETAIL- ASH HOPPER LINER PL'S
CUSTOMER: CARDINAL OPER. CO.
PLANT: CARDINAL PLANT
LOCATION: BRILLIANT, OHIO
DRAWN: DCD DATE 2-8-80
CHECKED APPRVD DATE
SCALE B/M NO. 1 & 2
INDEX S.O. 79-2533

F691-ED29-2

REVISIONS
⑥ #1 UNIT
⑤
④
③
② VALLEY LINERS ADDED DCD 2-18-80
① ORIGINAL DRAWING





ALL MAT'L 316 S.S.

NO. REQ'D	DESCRIPTION	MAT'L	SYM.
1	20 3/8 × 1/4 × 2'-4 1 CUTS 2	PL	dg
2	24 × 1/4 × 4'-0	PL	dk
1	24 × 1/4 × 4'-5 1/2 1 CUTS 2	PL	dm
1	27 3/4 × 1/4 × 6'-6 3/4 1 CUTS 2	PL	dn
1	4 3/4 × 1/4 × 3'-5 1/2 BOTTOM	PL	

MARK	NO. REQ'D	DESCRIPTION	MAT'L	SYM.
		ASH HOPPER LINER PL'S		
	42	24 × 1/4 × 4'-7 3/8	PL	a
	1	24 × 1/4 × 4'-7 3/8		b
	1	24 × 1/4 × 4'-7 3/8		c
	4	12 3/4 × 1/4 × 4'-7 3/8		d
	1	24 × 1/4 × 4'-7 3/8		f
	1	24 × 1/4 × 4'-7 3/8		g
	4	24 × 1/4 × 4'-7 3/8		k
	4	24 × 1/4 × 4'-7 3/8		m
	4	24 × 1/4 × 4'-7 3/8		n
	2	24 × 1/4 × 4'-7 3/8		p
	4	24 × 1/4 × 4'-7 3/8		t
	2	24 × 1/4 × 4'-7 3/8		y
	1	24 × 1/4 × 7'-11 1 CUTS 2		ba
	1	24 × 1/4 × 6'-7 3/4 1 CUTS 2		bb
	1	24 × 1/4 × 5'-4 1 CUTS 2		bc
	1	24 × 1/4 × 4'-0 1 CUTS 2		bd
	1	24 × 1/4 × 2'-8 1/2 1 CUTS 2		bf
	2	19 3/4 × 1/4 × 2'-6 3/4		bg
	2	24 × 1/4 × 4'-7 3/8		bk
	1	24 × 1/4 × 5'-0 1/2 1 CUTS 2		bm
4-EXTRA PL'S	218	24 × 1/4 × 4'-0		bn
	12	24 × 1/4 × 4'-11 3/8		bp
	4	24 × 1/4 × 4'-11 3/8		bt
	2	23 1/8 × 1/4 × 3'-4 1 CUTS 2		by
	2	26 9/16 × 1/4 × 3'-10 1 CUTS 2		ca
	2	30 1/2 × 1/4 × 4'-0		cb
	2	33 7/8 × 1/4 × 4'-0		cc
	6	29 1/4 × 1/4 × 4'-0		cd
	2	29 1/4 × 1/4 × 4'-0		cf
	1	24 × 1/4 × 4'-9 1/2		cg
	1	24 × 1/4 × 6'-5 1 CUTS 2		ck
	1	24 × 1/4 × 7'-5 1/2 1 CUTS 2		cm
	2	24 × 1/4 × 5'-11 5/8		cn
	2	31 3/8 × 1/4 × 6'-5 3/4		cp
	2	31 3/8 × 1/4 × 4'-0		ct
	1	24 × 1/4 × 2'-1 1 CUTS 2		cy
	2	24 × 1/4 × 4'-3 5/8		da
	1	14 × 1/4 × 5'-4 1/4		db
	2	24 × 1/4 × 4'-0		dc
	2	24 × 1/4 × 4'-0		dd
	1	24 × 1/4 × 7'-5 1/2 1 CUTS 2	PL	df

MAINTENANCE DEPARTMENT

REF. DES. DRG. FAB. WT.

⑥	
⑤	
④	
③	
②	
①	ORIGINAL DRAWING
	REVISIONS

KANAWHA
MANUFACTURING COMPANY
CHARLESTON, W. VA.

TITLE DETAIL - ASH HOPPER LINER PL'S
CUSTOMER CARDINAL OPER. CO.
PLANT CARDINAL PLANT
LOCATION BRILLIANT, OHIO
DRAWN DCD DATE 2-8-80
CHECKED APPRVD DATE
SCALE B/M NO. 1 & 2
INDEX S.O. 79-2533

F691-ED29-1

CONSULTING ENGINEER
AMERICAN ELECTRIC POWER SERVICE CORP.
NEW YORK, NEW YORK

(2) 3,840,000#/hr. B&W PRESSURIZED BOILER. PULVERIZED FUEL OPERATING HD. 25" H₂O 1966	DESIGN OF ASH HOPPER-WET PLAN & ELEVATIONS	
THE EQUIPMENT AND DESIGN SHOWN ON THIS DRAWING ARE COVERED EITHER BY ISSUED PATENTS OR PENDING APPLICATIONS AND ARE THE EXCLUSIVE PROPERTY OF THE UNITED CONVEYOR CORPORATION.	OHIO POWER COMPANY CARDINAL PLANT UNITS 1 & 2 BRILLIANT, OHIO	
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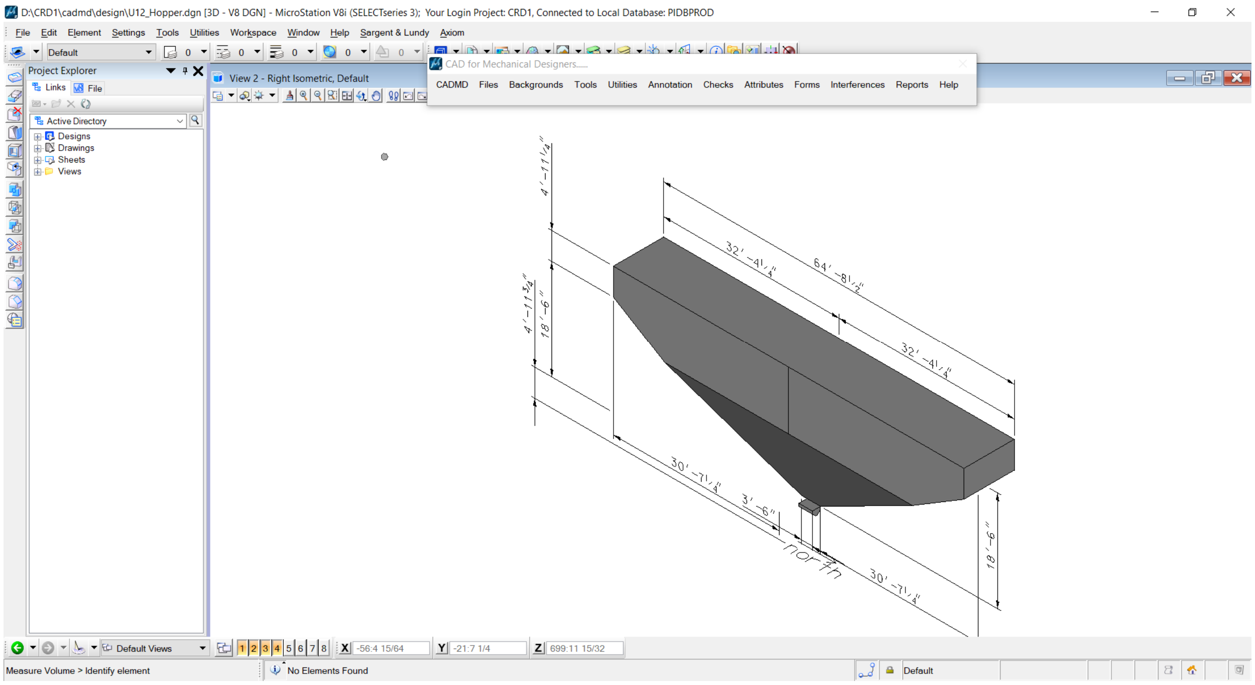
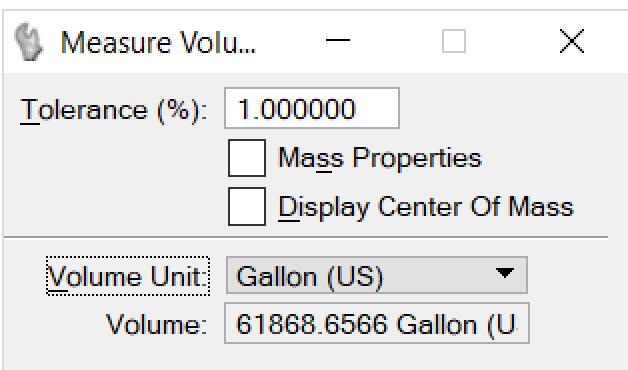
REVISIONS: DETAILED 2-16-65; PER MKD PRINT DATED 9-23-64; 10-5-64 WM; WM 9-1-64; PER MKD PRINT DATED 5-22-64 CACD WM 6-3-64

SECTION A-A
LOOKING EAST
SECTION B-B 527-54343-1
LOOKING NORTH
SECTION X-X
DET. # 5
TOTAL LENGTH IS 64'-8 1/2"
Total Surge Volume is 2x0.5'x32'x7.79' = 249.28 ft^3
32'
685'-5"
685'-5"-669'-6 7/16" = 15.88'
669'-6 7/16" - 666' = 3.54'
666' - 663' 1 11/16" = 2.23'
approximately 14.5'
approximately 17.5'
approximately 6.25'
7.79'
11'
℄ BOILER
℄ FURNACE
℄ HOPPER
CUT WEIR IN FIELD AFTER AIR TEST
OVERFLOW WEIR JACKET & WEIR OVERFLOW PL SEE DET. #2 527-54343-3
WATER LEVEL EL. 685'-5
MAGNETROL CONNS.
3" STD. PIPES WITH CAPS FOR SCAFFOLD SUPPORTS
3" TROUGH DRAIN
OBSER. WINDOW 3-2710-9-8
24 DIA. DOOR 2-2023-5-F WITH 1/8 BAR RING AROUND DOOR OPNG.
CHECK VALVE @ EL. 687'-0 SEE 527-54343-1
PRESSURIZED POKE HOLE 3-2715-1-G
12" PIPE SLEEVE
FIELD SPLICE
PAVING BRICK
CONC. FILL
HARD BURNED PAVING BRICK
CONCRETE FILL
TOP PLATFORM EL. 677'-10
TOP OF STL. EL. 677'-9
12" WEIR BOX DRAIN
2-12" WEIR BOX WITH REMOVABLE COVER PL.
REFRACTORY CEMENT LINING DETAIL #3 527-54343-3
SKIMMER 3/16 316 STAINLESS STL.
1/4 MILD STEEL PL.
BUBBLER PIPE
CLEARANCE REQ'D FOR CYLINDER REMOVAL
10" HYDRAULIC CYLINDER
24"x24" ASH SLUICE GATE
PRESSURIZED POKE HOLE 3-2715-1-G
DURITE TARGET PL.
REMOVABLE SUPPORTS
PLATFORM EL. 659'-0
JETPULSION PUMPS
℄ CRUSHER OUTLET
FRONT OF BOILER
EL. 689'-0
EL. 671'-0
EL. 657'-0
EL. 669'-6
EL. 665'-6
EL. 663'-1
EL. 662'-2
EL. 659'-1
32'-0
33'-1 1/2 OUTSIDE PL.
66'-3 OUTSIDE PL.
℄ HOPPER SYM. ABT. ℄ EXCEPT AS SHOWN & NOTED
℄ GATE
PIPE CAP
2" MALE NPT WATER SUPPLY CONN.
2" SPRAY PIPE
NOTES & REFERNCES 527-54343-3
DESIGN OF ASH HOPPER-WET
SECTIONS THRU HOPPER
OHIO POWER COMPANY
CARDINAL PLANT UNITS 1 & 2
BRILLIANT, OHIO
UNITED CONVEYOR CORP.
CHICAGO 26, ILL.
THE EQUIPMENT AND DESIGN SHOWN ON THIS DRAWING ARE COVERED EITHER BY ISSUED PATENTS OR PENDING APPLICATIONS AND ARE THE EXCLUSIVE PROPERTY OF THE UNITED CONVEYOR CORPORATION.
THIS DRAWING, OWNED BY UNITED CONVEYOR CORPORATION, IS CONDITIONALLY LOANED. BY RECEIVING IT THE RECIPIENT AGREES NOT TO REPRODUCE OR COPY IT, IN WHOLE OR PART, OR TO FURNISH INFORMATION FROM IT TO OTHERS, OR TO MAKE ANY USE OF IT THAT IS, OR MAY BE, INJURIOUS TO UNITED CONVEYOR CORPORATION, AND TO RETURN IT UPON REQUEST.
DRAWN DIETZ 1-7-64
SCALE 1/2=1'-0
DRAWING NUMBER
527-54343-2-
MPD F
REVISIONS

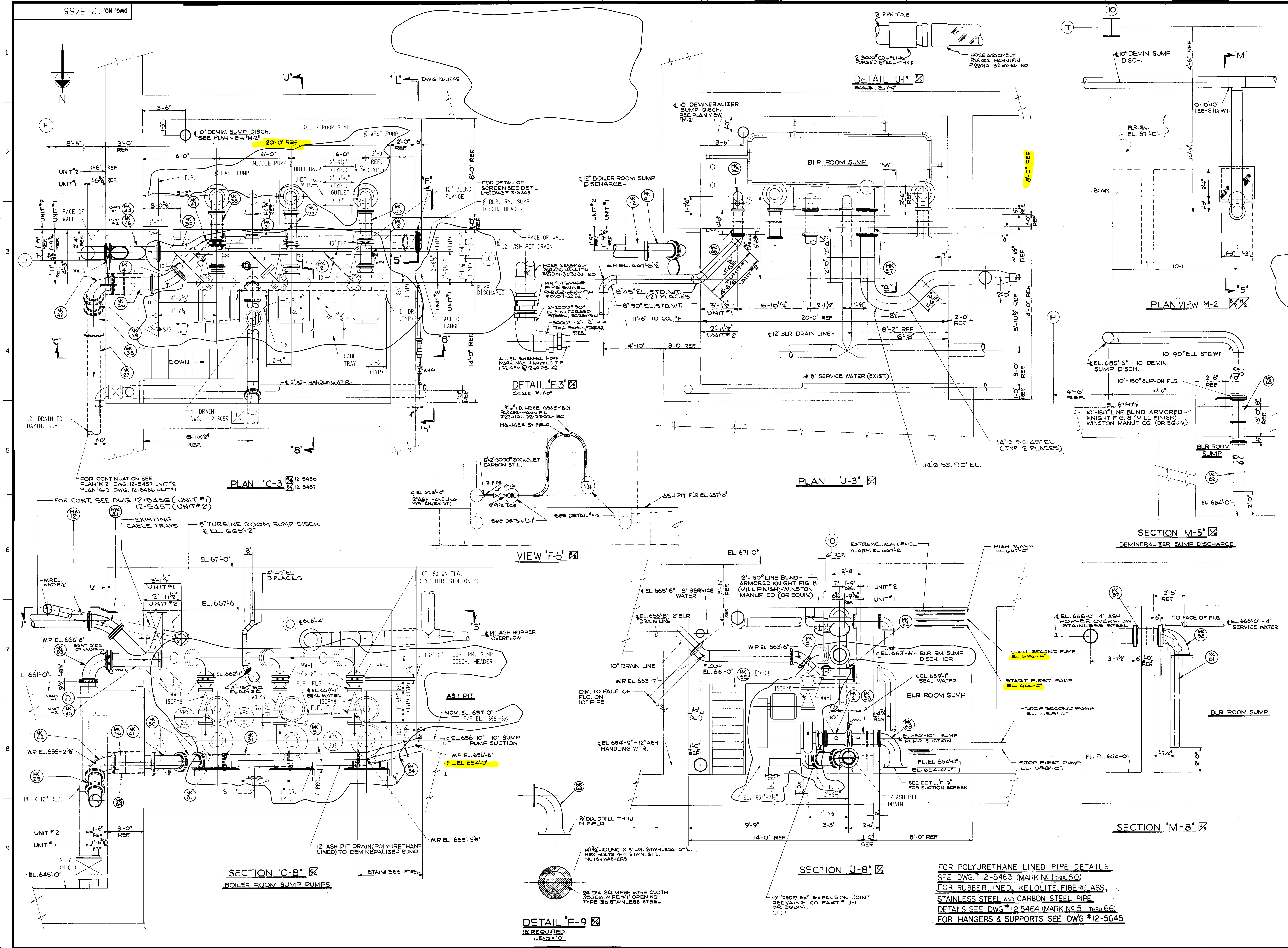
Unit 1/2 Bottom Ash Hopper Wetted Volume = 61,870 gallon

Filename: U12_Hopper.dgn





8.03
U1 & U2 Boiler Room Sump



NOTES

FOR GENERAL NOTES & BOLT SCHEDULE SEE DWG. 12-5457 WASTE WATER DISPOSAL GENERAL ARRANGEMENT UNIT #2

REFERENCE DRAWINGS

FOR REFERENCE DWGS SEE DWG # 12-5457 WASTE WATER DISPOSAL GENERAL ARRANGEMENT UNIT No2.

12-3249	MASONRY
1-2-1419	ELECTRICAL PLAN ASH HOPPER AREA
1-2-5013	STATION DRAINAGE FLOW DIAGRAM
1-2-5055	DRAINAGE PIPING

DATE	NO.	DESCRIPTION	APPD.
11/10/93	1	PER PTS 12897 (EAST PUMP), PTS 12898 (MIDDLE PUMP) & PTS 12899 (WEST PUMP) REVISED UNIT No. 1 & 2 BOILER ROOM SUMP PUMPS WITH HORIZONTAL END SUCTION PUMPS IN PLAN C-3, SECTION C-8 & J-8. DELETED DETAIL F-1 (SEAL WATER CONN AT PUMPS). ADDED TP FOR 1½" DRAIN (C4). ADDED REF. DWG. (03). CRD/GDB/HFS	RY

THIS DRAWING HAS BEEN ELECTRONICALLY SCANNED. SEE MICROFILM RECORDS FOR HISTORY & SIGNATURES. DRAWING REVISION 1

REVISIONS

igsd - /usr6/mech/cardinal/u1_piping/5458.120
igsd - /usr6/mech/cardinal/u1_piping/5458.tg4

OHIO POWER COMPANY

CARDINAL PLANT

BRILLANT OHIO

WASTE WATER DISPOSAL BOILER ROOM SUMP PUMP ARRGT

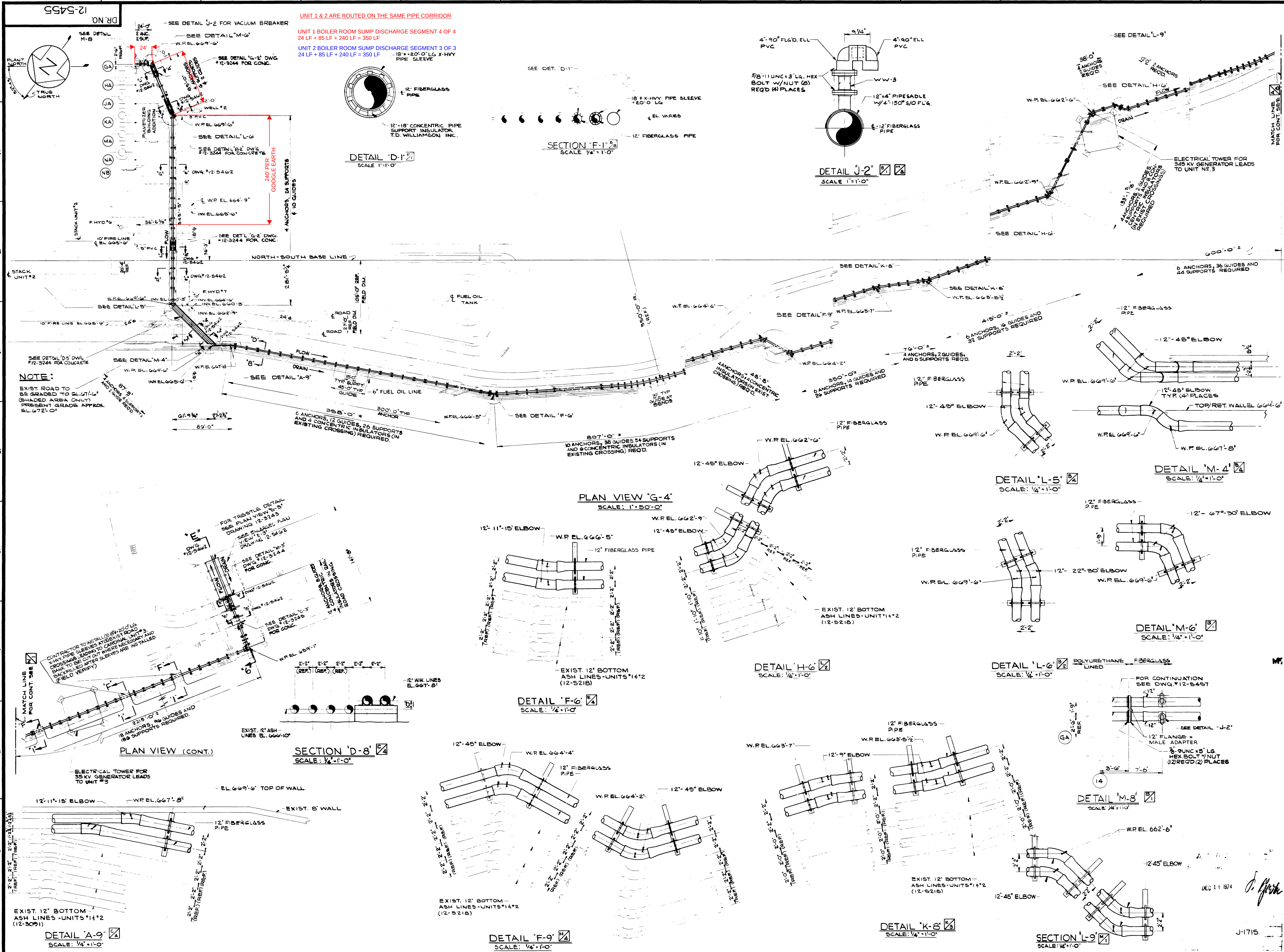
DWG. NO. 12-5458-2

ENGINEERING DIVISION C.P. LUGRIM

DESIGN DEPARTMENT

AMERICAN ELECTRIC POWER 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

SYSTEM DATE-14-NOV-1996 SYSTEM TIME-07:36 PLOT DATE- 3/30/95 PLOTTED BY-GT



GENERAL NOTES

1. ALL FIBERGLASS PIPE TO BE CIBA-GEIGY DUALOY 3000
2. ALL FLG. BOLTS TO BE A-307, GR. B
3. REGARDLESS OF ELEVATIONS, FOOTINGS ARE TO REST ON FIRM, UNDISTURBED SOIL.
4. ALL PIPE SUPPORT TIMBER TO BE 8"×6" SOUTHERN YELLOW PINE CREOSOTED PER A.E.P. SPECIFICATION

LEGEND

⊢⊣	PIPE SUPPORT	SEE DET'L "M-3", DWG.# 12-5462
X—X	PIPE ANCHOR	SEE DET'L "J-2" DWG.# 12-5462
•—•	PIPE GUIDE	SEE DET'L "B-2" DWG.# 12-5462

REFERENCE DRAWINGS

12-5082 FUEL OIL YARD PIPING
12-5135 YARD PIPING
12-5200 ASH REMOVAL PIPING
12-5218 ASH REMOVAL PIPING

DATE	No.	DESCRIPTION	APP'D
8/27/76	3	ADDED 180° RETURN TO VACUUM BRK'R. @ ½	
3/15/76	2	RAISED ROAD CROSSINGS & PIPING NEAR PLANT & ADDED NOTE. DETAIL 'M-4' ADDED (4) 45° ELL'S.	
2/12/75	1	REVISED PIPE ROUTING ARROUND ELECT. TOWERS	

REVISIONS

OHIO POWER COMPANY
BUCKEYE POWER INC.
CARDINAL PLANT
BRILLIANT, OHIO

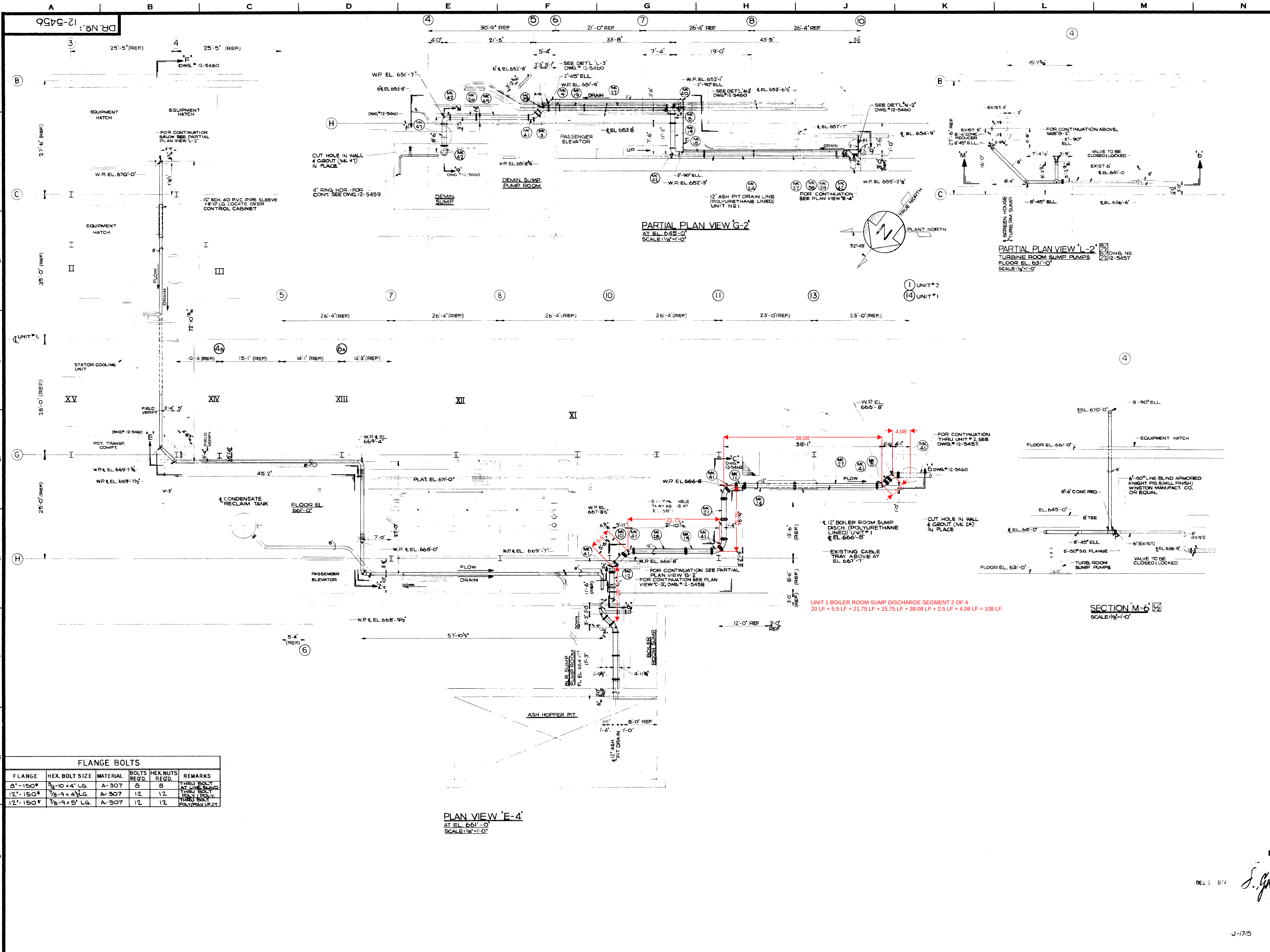
WASTE WATER DISPOSAL YARD PIPING GENERAL ARRANGEMENT

DR. No. 12-5455-3

ARCH.	ELEC.	MECH.	STR.

SCALE: AS NOTED
DR. GLB
CH. LCA
SQ. LDR.
DATE: 12/10/74
APPROVED BY: ENGINEERING DIVISION
DESIGN DIV.

AMERICAN ELECTRIC POWER SERVICE CORP.



FLANGE BOLTS

FLANGE	HEX. BOLT SIZE	MATERIAL	BOLTS REQ'D.	HEX. NUTS REQ'D.	REMARKS
8"-150#	3/4-10 x 4" LG.	A-307	8	8	THRU BOLT AT LINE BLIND
12"-150#	7/8-9 x 4 1/2" LG.	A-307	12	12	THRU BOLT POLY. / POLY.
12"-150#	7/8-9 x 5" LG.	A-307	12	12	THRU BOLT POLY/POLY. LP. JT.

GENERAL NOTES

ALL PIPING 2" & SMALLER TO BE SCH. 80 CARBON STEEL (A 106 B) UNLESS OTHERWISE NOTED.

ALL PIPING 2 1/2" & LARGER TO BE SCH. 40 CARBON STEEL (A53 GR.B) UNLESS OTHERWISE NOTED.

ALL FITTINGS 2" & SMALLER TO BE 3000 # SOCKET WELD FORGED STEEL UNLESS OTHERWISE NOTED.

ALL FITTINGS 2 1/2" & LARGER TO BE STD. WT., BUTT WELD, CARBON STEEL (WPB) UNLESS OTHERWISE NOTED.

ALL FLANGE BOLTS TO BE A-307, GR B.

REFERENCE DRAWINGS

12-5460	WASTE WATER DISPOSAL SECTIONS & DETAILS UNITS #1 & #2
12-5457	WASTE WATER DISPOSAL GENERAL PLAN - UNIT #2
12-5458	WASTE WATER DISPOSAL BOILER ROOM SUMP PUMP ARRANGEMENT - UNITS #1 & #2
12-5459	WASTE WATER DISPOSAL DEMINERALIZER SUMP RING H'DR. GEN. ARR'GT. UNITS #1 & #2
12-5463	WASTE WATER DISPOSAL POLYURETHANE PIPE DETAILS UNITS #1 & #2

DATE	No.	DESCRIPTION	APP'D

REVISIONS

OHIO POWER COMPANY
BUCKEYE POWER INC.
CARDINAL PLANT
BRILLIANT, OHIO

WASTE WATER DISPOSAL GENERAL PLAN UNIT No. 1

DR. No. 12-5456-0

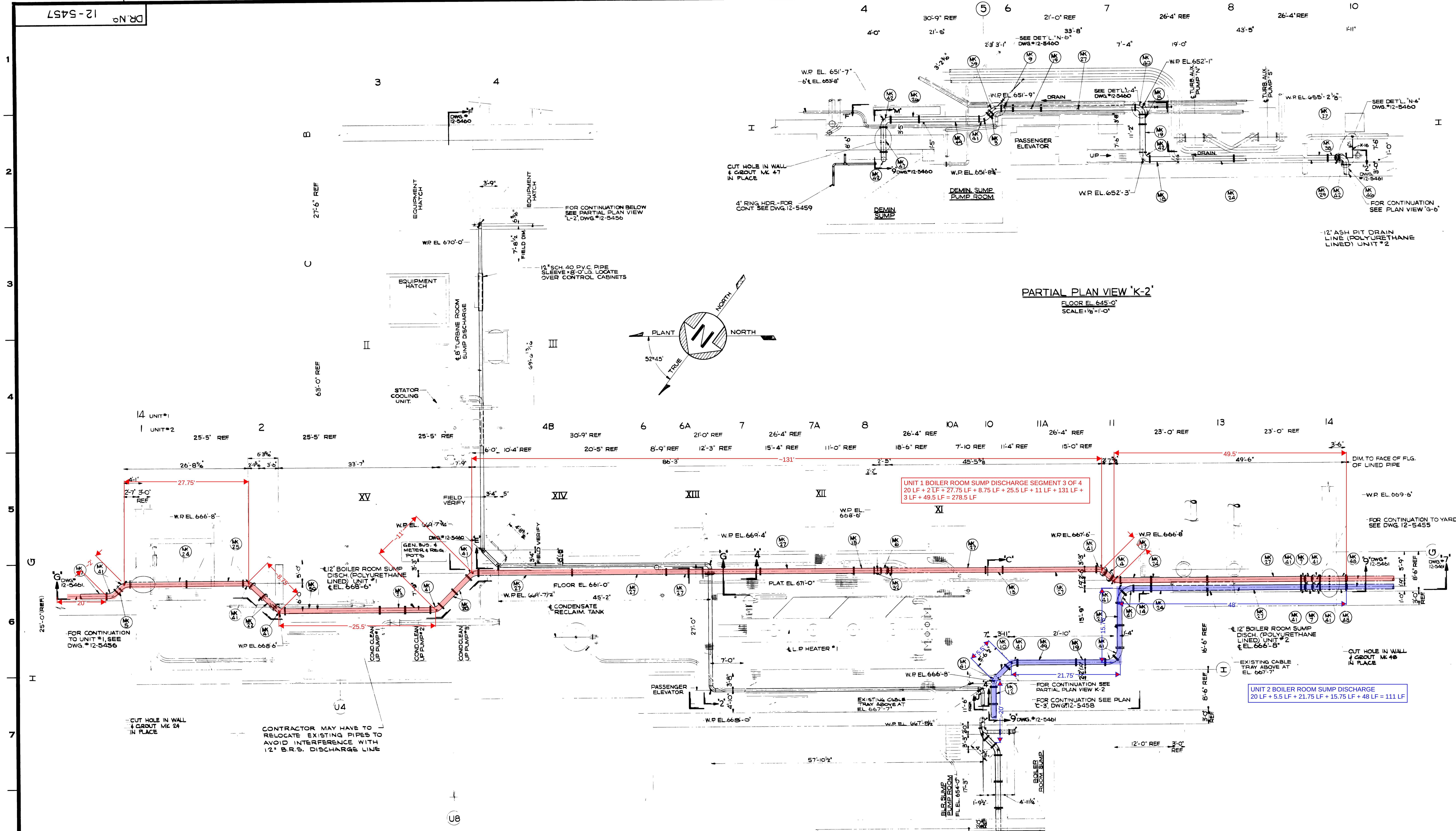
ARCH. | ELEC. | MECH. | STR.

SCALE: 1/8"=1'-0"
DR. STILTNER
CH. GLB 8/13/74
SQ. LDR.
DATE: 12/10/74

APPROVED BY
ENGINEERING DIVISION
DESIGN DIV.

AMERICAN ELECTRIC POWER SERVICE CORP.

DR. No 12-5457



GENERAL NOTES

1.) ALL PIPING 2" & SMALLER TO BE SCH.80 CARBON STEEL (A-106 B) UNLESS OTHERWISE NOTED
2) ALL PIPING 2½" & LARGER TO BE SCH.40 CARBON STEEL (A53 GR.B) UNLESS OTHERWISE NOTED.
3) ALL FITTINGS 2" & SMALLER TO BE 3000# SOCKET WELD FORGED STEEL UNLESS OTHERWISE NOTED.
4.) ALL FITTINGS 2½" & LARGER TO BE STD. WT. BUTT WELD CARBON STEEL UNLESS OTHERWISE NOTED.
5.) ALL FLANGE BOLTS TO BE A-307 GR."B"
6) INSIDE WALLS, FLOOR & CEILING OF B'L'R. R'M. SUMP TO BE COATED W/ "SIKAGARD" AQUA-BASE" (1ST COAT) & "SIKAGARD COLMA-SOL" (2ND COAT) BY SIKA CHEMICAL CORP. (OR EQUIV.)
7) ALL STEEL INSIDE OF B'L'R. R'M. SUMP TO HAVE (2) COATS OF SIPES "SUBWAY BLACK \#80" PAINT APPLIED PER A.E.P. PAINT SPECIFICATION.

REFERENCE DRAWINGS

12-5458	BOILER ROOM SUMP PUMP ARR'G'T UNITS \#1 & \#2
12-5459	DEMIN SUMP RING HDR. GEN. ARR'G'T. UNITS \#1 & \#2
12-5460	SECTIONS & DETAILS UNITS \#1 & \#2
12-5461	SECTIONS & DETAILS UNIT \#2
12-5463	POLYURETHANE PIPE DETAILS UNITS \#1 & \#2

FLANGE BOLTS

FLANGE	HEX. BOLT SIZE	MATERIAL	BOLTS REQ'D.	HEX. NUTS REQ'D.	REMARKS
4"-150#	5/8-11 x 3" LG.	A-307	8	8	THRU BOLT
8"-150#	3/4-10 x 2½" LG.	TYPE 304 STAIN. STL.	8	8	THRU BOLT
8"-150#	3/4-10 x 3½" LG.	A-307 & TYPE 304 S.S.	8	8	THRU BOLT
10"-150#	7/8-9 x 3¾" LG.	TYPE 304 S.S.	12	12	THRU BOLT AT SUCT. HOOD
10"-150#	7/8-9 x 1⅞" LG.	A-307	12	—	POLY. LINED AT KNIFE GATE
10"-150#	7/8-9 x 2½" LG.	A-307	12	—	AT PUMP
10"-150#	7/8-9 x 3" LG.	A-307	12	12	THRU BOLT AT EXP. JT.
10"-150#	7/8-9 x 3¾" LG.	A-307	12	12	THRU BOLT
10"-150#	7/8-9 x 4" LG.	A-307	12	12	POLY. / POLY.
10"-150#	7/8-9 x 4½" LG.	A-307	12	12	THRU BOLT AT LINE BLIND
12"-150#	7/8-9 x 2" LG.	A-307	12	—	POLY. LINED AT KNIFE GATE
12"-150#	7/8-9 x 4½" LG.	A-307	12	12	POLY. / POLY.
12"-150#	7/8-9 x 5" LG.	A-307	12	12	POLY. / POLY. AT LINE BLIND
14"-150#	1"-8 x 4½" LG.	A-307	12	12	THRU BOLT
14"-150#	1"-8 x 5" LG.	TYPE 304 S.S.	12	12	THRU BOLT FIBER. FLG.
14"-150#	1"-8 x 5½" LG.	TYPE 304 S.S.	12	12	THRU BOLT
16"-150#	3/4-10 x 3" LG.	TYPE 304 S.S.	12	12	THRU BOLT SUCT. SCREEN
12"-150#	7/8-9 x 4½" LG.	A-307	12	12	POLY. / POLY.
12"-150#	7/8-9 x 5" LG.	A-307	12	12	LAP JOINT

DRAWING \#12-5458 BOILER ROOM SUMP (rows 4"-150# through 16"-150#)

THIS DRAWING (last two rows)

REVISIONS

DATE	No.	DESCRIPTION	APP'D

OHIO POWER COMPANY
BUCKEYE POWER, INC.
CARDINAL PLANT
BRILLIANT, OHIO

WASTE WATER DISPOSAL
GENERAL PLAN
UNIT \# 2

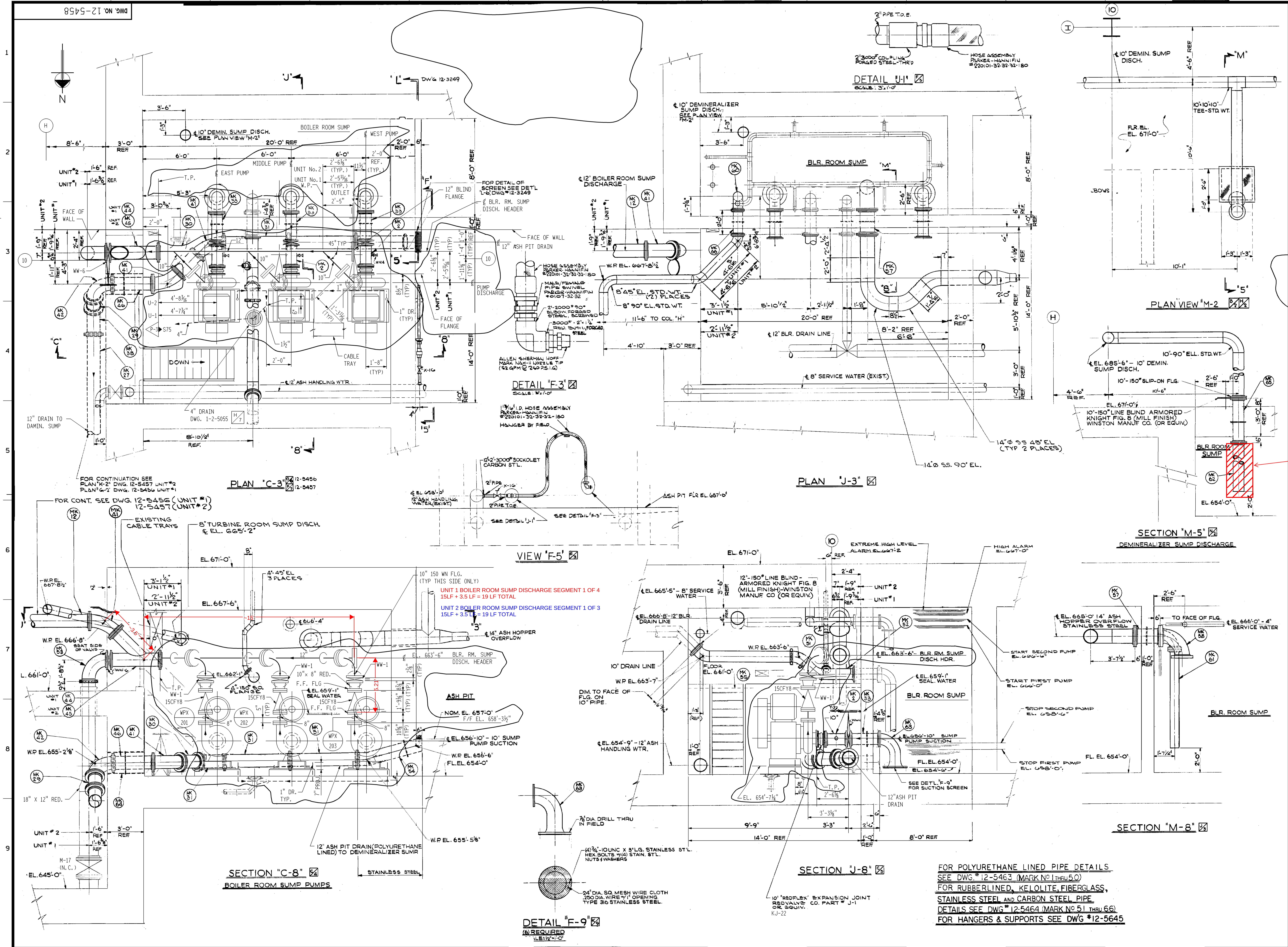
DR. No. 12-5457-0

ARCH. | ELEC. | MECH. | STR.

SCALE: 1/8"=1'-0"
DR. LCA
CH. GLB 8/21/74
SQ. LDR.
DATE: 12/10/74
APPROVED BY
ENGINEERING DIVISION
DESIGN DIV.

AMERICAN ELECTRIC POWER SERVICE CORP.

J-1715



NOTES

FOR GENERAL NOTES & BOLT SCHEDULE SEE DWG. 12-5457 WASTE WATER DISPOSAL GENERAL ARRANGEMENT UNIT #2

REFERENCE DRAWINGS

FOR REFERENCE DWGS SEE DWG # 12-5457 WASTE WATER DISPOSAL GENERAL ARRANGEMENT UNIT NO2.

12-3249	MASONRY
1-2-1419	ELECTRICAL PLAN ASH HOPPER AREA
1-2-5013	STATION DRAINAGE FLOW DIAGRAM
1-2-5055	DRAINAGE PIPING

DATE	NO.	DESCRIPTION	APPD.
11/10/93	1	PER PTS 12897 (EAST PUMP), PTS 12898 (MIDDLE PUMP) & PTS 12899 (WEST PUMP) REVISED UNIT No. 1 & 2 BOILER ROOM SUMP PUMPS WITH HORIZONTAL END SUCTION PUMPS IN PLAN C-3, SECTION C-8 & J-8. DELETED DETAIL F-1 (SEAL WATER CONN AT PUMPS). ADDED TP FOR 1½" DRAIN (C4). ADDED REF. DWG. (03). CRD/GDB/HFS	RY

THIS DRAWING HAS BEEN ELECTRONICALLY SCANNED. SEE MICROFILM RECORDS FOR HISTORY & SIGNATURES. DRAWING REVISION 1

REVISIONS

OHIO POWER COMPANY

CARDINAL PLANT

BRILLANT OHIO

WASTE WATER DISPOSAL BOILER ROOM SUMP PUMP ARRGT

DWG. NO. 12-5458-2

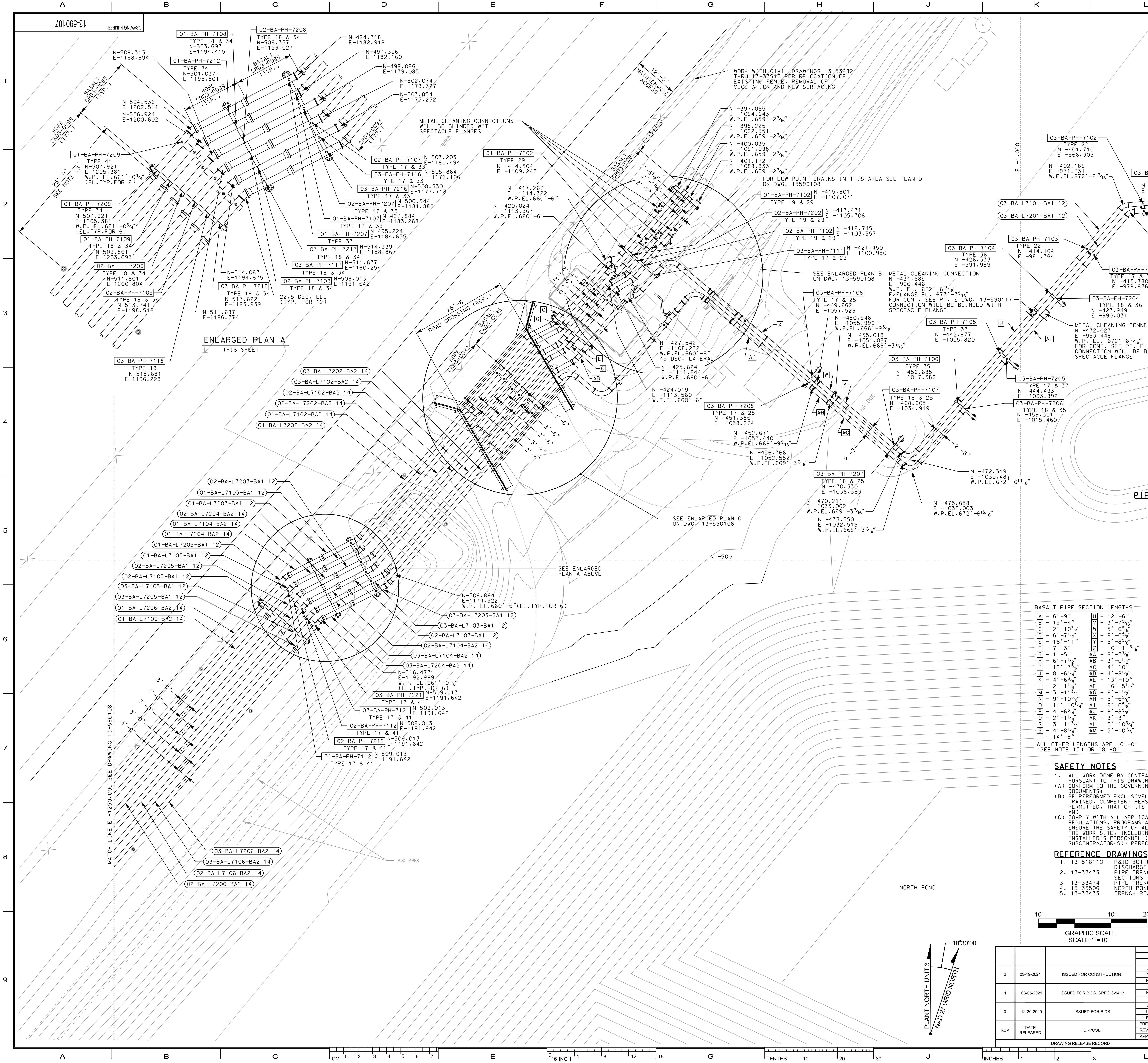
ENGINEERING DIVISION C.P. LUGRIM

DESIGN DEPARTMENT

AMERICAN ELECTRIC POWER

1 RIVERSIDE PLAZA COLUMBUS, OH 43215

8.04
U1, U2 & U3 Bottom Ash Piping Isometrics



PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BA-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL DISMANTLE EXISTING METAL CLEANING WASTE PIPES FOR FUTURE REINSTALLATION IN ACCORDANCE WITH DRAWING 13-590117.
12. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
13. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
14. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.
15. A 10 FOOT LENGTH OF BASALT PIPE IS REQUIRED AFTER EACH CHANGE OF DIRECTION BEFORE TRANSITIONING TO HDPE PIPING.

BASALT PIPE SECTION LENGTHS

A	6'-9"	U	12'-6"
B	15'-4"	V	3'-7 5/16"
C	2'-10 3/4"	W	5'-6 5/8"
D	6'-7 1/2"	X	9'-0 5/8"
E	16'-11"	Y	9'-8 5/8"
F	7'-3"	Z	10'-11 3/16"
G	1'-5"	AA	8'-5 7/8"
H	6'-7 1/2"	AB	3'-0 1/2"
I	12'-7 5/8"	AC	4'-10"
J	8'-6 1/4"	AD	4'-8 1/8"
K	4'-6 3/4"	AE	13'-10"
L	2'-1 1/4"	AF	16'-5 1/2"
M	3'-11 3/4"	AG	6'-1 1/2"
N	9'-10 5/8"	AH	5'-6 5/8"
O	11'-10 1/4"	AI	9'-0 5/8"
P	4'-6 3/4"	AJ	9'-8 5/8"
Q	2'-1 1/4"	AK	3'-3"
R	3'-11 3/4"	AL	5'-10 3/4"
S	4'-8 1/4"	AM	5'-10 7/8"
T	14'-8"		

ALL OTHER LENGTHS ARE 10'-0" (SEE NOTE 15) OR 18'-0"

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33473 PIPE TRENCH ROAD CROSSINGS PLAN & SECTIONS
3. 13-33474 PIPE TRENCH ROAD CROSSINGS DETAILS
4. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2
5. 13-33473 TRENCH ROAD CROSSINGS PLANS AND SECTIONS

10' 10' 20'
GRAPHIC SCALE
SCALE:1"=10'

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS, SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO — BRIAN KLESATH PE.85798 — REGISTERED PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

UNIT: 13 | DRAWING NUMBER: 13-590107 | REV: 2

SCALE: 1" = 10'-0" — ENGINEERING DIVISION

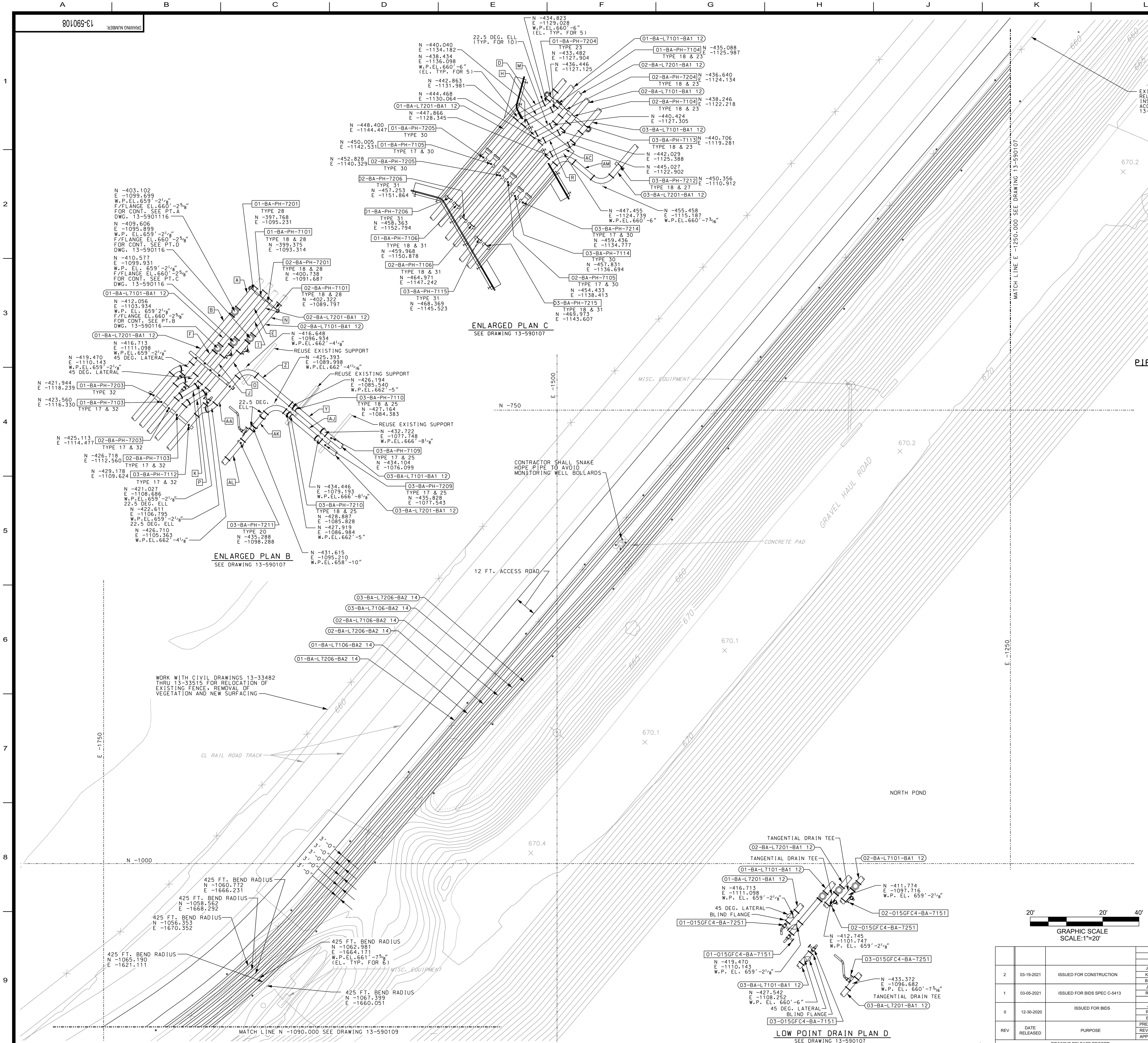
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

**CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913**

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:



PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BS-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL DISMANTLE EXISTING METAL CLEANING WASTE PIPES FOR FUTURE REINSTALLATION IN ACCORDANCE WITH DRAWING 13-590117.
12. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
13. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
14. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.
15. A 10 FOOT LENGTH OF BASALT PIPE IS REQUIRED AFTER EACH CHANGE OF DIRECTION AND BEFORE TRANSITIONING TO HDPE PIPING.

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33505 NORTH POND-TOP OF LINER PLAN-SHEET 1
3. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

UNIT: 13	DRAWING NUMBER: 13-590108	REV: 2

SCALE: 1"=20'
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

REV	DATE RELEASED	PURPOSE	
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH KAR BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH RAM BMK
0	12-30-2020	ISSUED FOR BIDS	JEH RAM BMK
			PREPARED REVIEWED APPROVED

DRAWING RELEASE RECORD

STATE OF OHIO — BRIAN KLESATH PE.85798 — REGISTERED PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

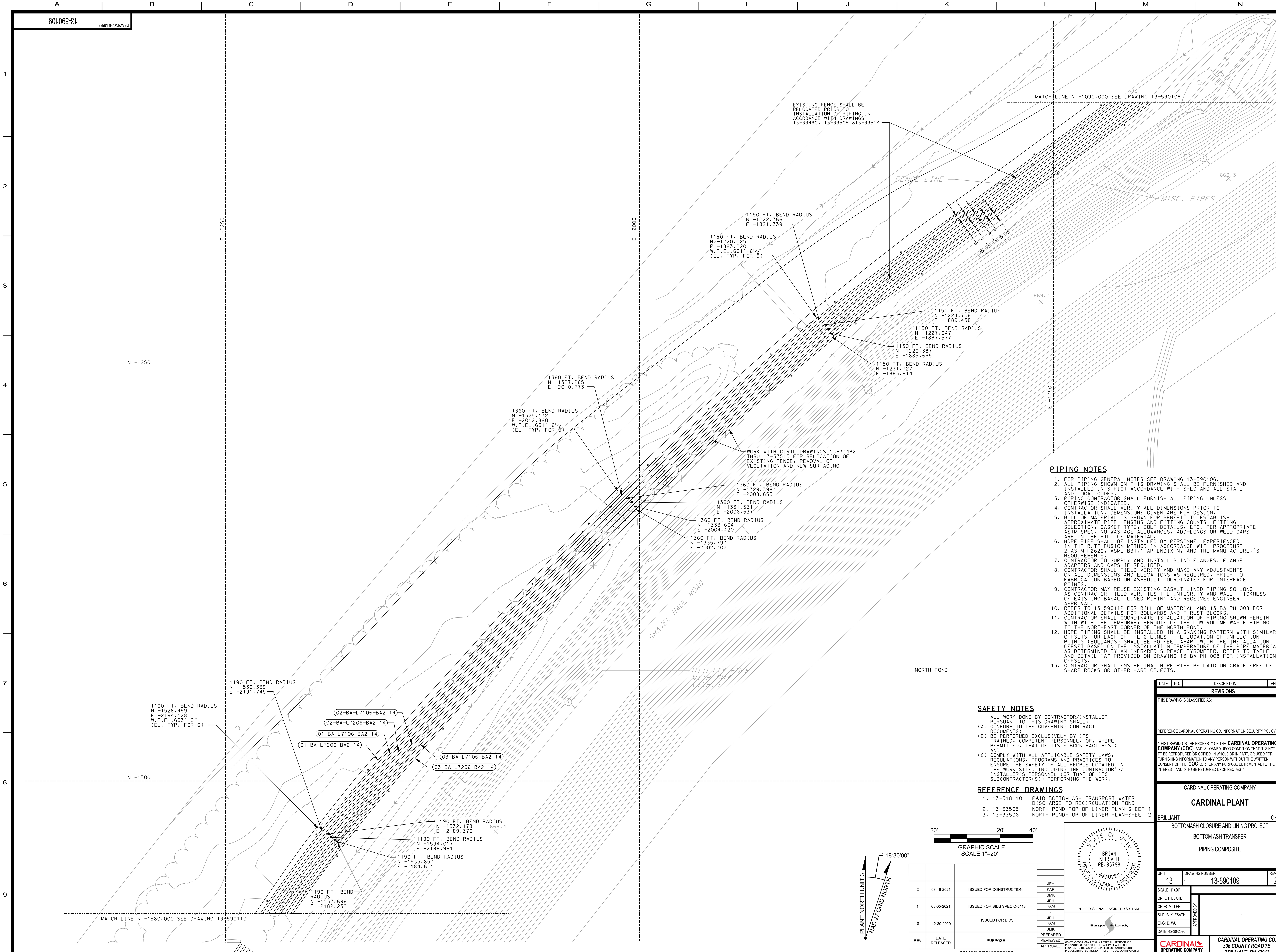
Sargent & Lundy

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:



PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BA-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
12. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
13. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33505 NORTH POND-TOP OF LINER PLAN-SHEET 1
3. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2

20' 20' 40'
GRAPHIC SCALE
SCALE:1"=20'

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO
BRIAN KLESATH PE.85798
REGISTERED
PROFESSIONAL ENGINEER
PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOMASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

UNIT:	DRAWING NUMBER:	REV:
13	13-590109	2

SCALE: 1"=20'
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

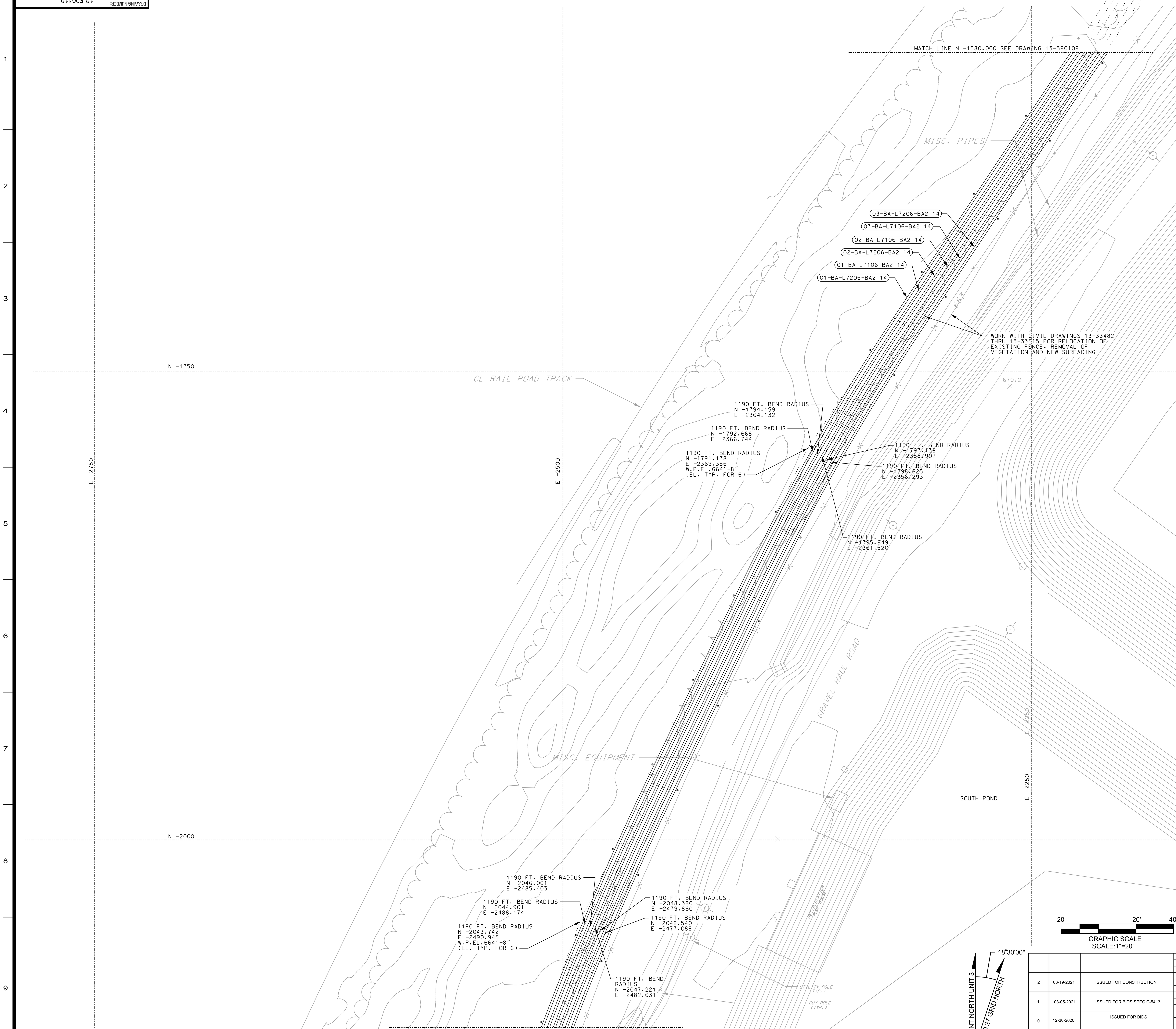
CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

CROSS REFS:

DRAWING NUMBER: 13-590110



PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BA-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
12. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
13. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.

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REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33488 SOUTH POND-EXCAVATION-PLAN
3. 13-33489 SOUTH POND-EXCAVATION-SECTION VIEWS
4. 13-33490 SOUTH POND-TOP OF LINER PROTECTION-PLAN
5. 13-33505 NORTH POND-TOP OF LINER PLAN-SHEET 1
6. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

GRAPHIC SCALE
SCALE:1"=20'
20' 0 20' 40'

2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK
REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED

DRAWING RELEASE RECORD

STATE OF OHIO
BRIAN KLESATH PE.85798
REGISTERED
PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

UNIT: 13
DRAWING NUMBER: 13-590110
REV: 2

SCALE: 1" = 20'-0"
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

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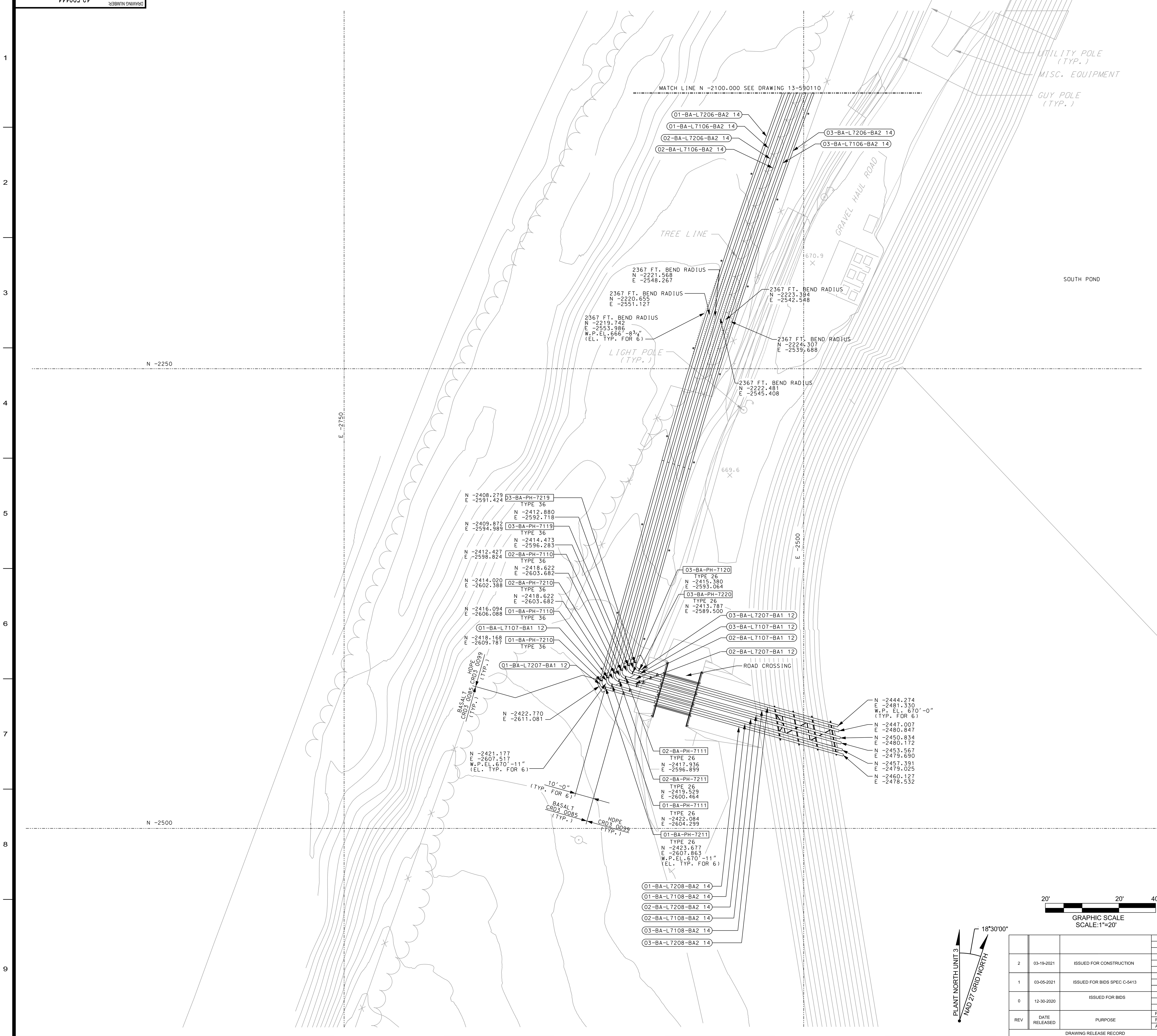
INCHES 1 2 3



PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
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4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BA-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
12. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
13. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.
14. A 10 FOOT LENGTH OF BASALT PIPE IS REQUIRED AFTER EACH CHANGE OF DIRECTION AND BEFORE TRANSITIONING TO HDPE PIPING.

SAFETY NOTES

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REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33488 SOUTH POND-EXCAVATION PLAN
3. 13-33489 SOUTH POND-SECTION VIEWS
4. 13-33490 SOUTH POND-TOP OF LINER PROTECTION-PLAN
5. 13-33473 PIPE TRENCH ROAD CROSSINGS PLANS AND SECTIONS
6. 13-33475 BOTTOM ASH PIPE DISCHARGE SUPPORT PLANS SECTIONS AND DETAILS

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO BRIAN KLESATH PE.85798 REGISTERED PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

UNIT: 13 | DRAWING NUMBER: 13-590111 | REV: 2

SCALE: 1" = 20'-0"
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D.WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

DRAWING NUMBER 13-590112

CROSS REFS:

BILL OF MATERIALS — UNIT 1 BOTTOM ASH TRANSFER-HDPE

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
14	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5201 FT	14 IN	CRD30099	B31.1 NBEP	PIPE (BEND LENGTHS INCLUDED) SEE NOTE 3
14	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS — UNIT 1 BOTTOM ASH TRANSFER-BASALT

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
8	12 IN	CRD30085	B31.1 NBEP	22.5 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	45 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	45 DEG LATERAL
2	12 IN	CRD30085	B31.1 NBEP	90 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	BLIND FLANGE
171 FT	12 IN	CRD30085	B31.1 NBEP	PIPE *
2	12 IN	CRD30085	B31.1 NBEP	TEE
1	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	4 IN	S&L0105	B31.1 NBEP	PIPE
2 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	S&L0105	B31.1 NBEP	FF WELD NECK FLANGE (CLASS 150)
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	14 IN	———	———	SPECTACLE FLANGE
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

REV 2

BILL OF MATERIALS — UNIT 3 PYRITES HANDLING (TEMPORARY ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	14 IN	S&L0105	B31.1 NBEP	45 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
1	14 IN	S&L0105	B31.1 NBEP	90 DEG LR ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
27 FT	14 IN	S&L0105	B31.1 NBEP	PIPE
622 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
2	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150) **
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

REV 2

BILL OF MATERIALS — UNIT 3 SLURRY HOUSE (TEMPORARY ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	14 IN	S&L0105	B31.1 NBEP	45 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
1	14 IN	S&L0105	B31.1 NBEP	90 DEG LR ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
39 FT	14 IN	S&L0105	B31.1 NBEP	PIPE
616 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
2	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
1	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
1	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)

REV 2

BILL OF MATERIALS — UNIT 3 DEMIN. SUMP (TEMPORARY ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	22 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
4	22 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	22 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
2	22 IN	CRD30099	B31.1 NBEP	FF FLANGE (SDR 11)
638 FT	22 IN	CRD30099	B31.1 NBEP	PIPE

REV 2

BILL OF MATERIALS — UNIT 1&2 BOILER ROOM SUMP/SOUTH COAL PILE/BOTTOM ASH SUMP DISCHARGE (TEMPORARY ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	24 X 16 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	24 X 14 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	24 X 10 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
2	24 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	24 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
3	24 IN	CRD30099	B31.1 NBEP	45 DEG LATERAL
1	24 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
600 FT	24 IN	CRD30099	B31.1 NBEP	PIPE
2	16 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	16 IN	CRD30099	B31.1 NBEP	90 DEG FABRICATED ELBOW
12	16 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
31 FT	16 IN	CRD30099	B31.1 NBEP	PIPE
1	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
6	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
26 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
1	10 X 8 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	10 X 6 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	10 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
92 FT	10 IN	CRD30099	B31.1 NBEP	PIPE
1	8 X 4 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	8 X 4 IN	CRD30099	B31.1 NBEP	REDUCING TEE
10 FT	8 IN	CRD30099	B31.1 NBEP	PIPE
2	6 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	6 IN	CRD30096	B31.1 NBEP	FF FRP FLANGE
5	6 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	6 IN	CRD30099	B31.1 NBEP	PIPE
6	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
3	4 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
7 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
4	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2	4 IN	CRD30099	B31.1 NBEP	RF FLANGE ADAPTER (SDR 11)
2	4 IN	S&L0105	B31.1 NBEP	RF SLIP-ON FLANGE (CLASS 150)
12	16 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
6	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
5	6 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
6	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-5901113 AND 13-5901114				

BILL OF MATERIALS — UNIT 2 BOTTOM ASH TRANSFER-HDPE

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
14	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5166 FT	14 IN	CRD30099	B31.1 NBEP	PIPE (BEND LENGTHS INCLUDED) SEE NOTE 3
14	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS — UNIT 2 BOTTOM ASH TRANSFER-BASALT

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	12 X 4 IN	CRD30085	B31.1 NBEP	TANGENTIAL DRAIN TEE
12	12 IN	CRD30085	B31.1 NBEP	22.5 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	90 DEG ELBOW MEDIUM
170 FT	12 IN	CRD30085	B31.1 NBEP	PIPE *
2	12 IN	CRD30085	B31.1 NBEP	TEE
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
1 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	14 IN	———	———	SPECTACLE FLANGE
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS — UNIT 3 PYRITES HANDLING (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	12 IN	CRD30085	B31.1 NBEP	45 DEG ELBOW MEDIUM
1	12 IN	CRD30085	B31.1 NBEP	45 DEG LATERAL
123 FT	12 IN	CRD30085	B31.1 NBEP	PIPE
1	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
1 FT	4 IN	S&L0105	B31.1 NBEP	PIPE
1 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
1	4 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
1	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS — UNIT 3 SLURRY HOUSE (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	14 X 4 IN	CRD30099	B31.1 NBEP	REDUCING TEE
3	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
126 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
1	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS — UNIT 3 DEMIN. SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	22 X 6 IN	CRD30099	B31.1 NBEP	REDUCING TEE
3	22 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	22 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
125 FT	22 IN	CRD30099	B31.1 NBEP	PIPE
1	6 X 4 IN	CRD30099	B31.1 NBEP	REDUCER
1	6 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	4 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS — UNIT 1 BOILER ROOM SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	16 X 2 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	16 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
103 FT	16 IN	CRD30099	B31.1 NBEP	PIPE
2	2 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	2 IN	CRD30099	B31.1 NBEP	PIPE
1	2 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	2 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS — UNIT 2 BOILER ROOM SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	16 X 2 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	16 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
95 FT	16 IN	CRD30099	B31.1 NBEP	PIPE
2	2 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
4 FT	2 IN	CRD30099	B31.1 NBEP	PIPE
1	2 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	2 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS — SOUTH COAL PILE RUNOFF (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	14 X 2 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
88 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
2	2 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
6 FT	2 IN	CRD30099	B31.1 NBEP	PIPE
1	2 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	2 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS — DSI ISLAND SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	6 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	6 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
41 FT	6 IN	CRD30099	B31.1 NBEP	PIPE
1	6 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS — BOTTOM ASH POND LOW POINT SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
63 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWING 13-590115				

BILL OF MATERIALS — UNIT 3 BOTTOM ASH TRANSFER-HDPE

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
14	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5131 FT	14 IN	CRD30099	B31.1 NBEP	PIPE (BEND LENGTHS INCLUDED) SEE NOTE 3
14	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS — UNIT 3 BOTTOM ASH TRANSFER-BASALT

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	12 X 4 IN	CRD30085	B31.1 NBEP	TANGENTIAL DRAIN TEE
16	12 IN	CRD30085	B31.1 NBEP	22.5 DEG ELBOW MEDIUM
5	12 IN	CRD30085	B31.1 NBEP	45 DEG ELBOW MEDIUM
1	12 IN	CRD30085	B31.1 NBEP	45 DEG LATERAL
2	12 IN	CRD30085	B31.1 NBEP	60 DEG ELBOW MEDIUM
8	12 IN	CRD30085	B31.1 NBEP	90 DEG ELBOW MEDIUM
517 FT	12 IN	CRD30085	B31.1 NBEP	PIPE *
2	12 IN	CRD30085	B31.1 NBEP	TEE
2	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
1	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	14 IN	———	———	SPECTACLE FLANGE
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS — METAL CLEANING

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
4	12 IN	S&L0105	B31.1 NBEP	22.5 DEG LR ELBOW (2) 90 DEG ELBOWS CUT TO SUIT
2	12 IN	S&L0105	B31.1 NBEP	45 DEG ELBOW
3	12 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
11	12 IN	S&L0105	B31.1 NBEP	90 DEG LR ELBOW
1	12 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
241 FT	12 IN	S&L0105	B31.1 NBEP	PIPE
397 FT	12 IN	CRD30099	B31.1 NBEP	PIPE
1	12 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
6	12 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150) *
5	12 IN	S&L0105	B31.1 NBEP	TEE
1	12 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWING 13-590117				

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

NOTES

1. BILL OF MATERIAL LISTINGS ARE SHOWN SOLELY FOR CONTRACTOR'S BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND DOES NOT ACCOUNT FOR ADDITIONAL LENGTH OF PIPE REQUIRED TO INSTALL SNAKED PIPING. CONTRACTOR SHALL ACCOUNT FOR ADDITIONAL LENGTHS (ADD LONGS, WASTAGE ALLOWANCES).
2. NUTS, BOLTS, AND GASKETS SHALL BE SUPPLIED BY CONTRACTOR AND ARE NOT LISTED IN THE BILL OF MATERIALS.
3. BILL OF MATERIAL DOES NOT INCLUDE ADDITIONAL PIPE REQUIRED FOR SNAKING PROCEDURE FOR HDPE PIPING INSTALLATION. CONTRACTOR SHALL ACCOUNT FOR ADDITIONAL PIPING NEEDED TO INSTALL HDPE PIPING IN ACCORDANCE WITH DETAIL A & B FROM DRAWING 13-BA-PH-008.
4. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPE, BLIND STECTACLES, CARBON STEEL PIPE FROM UNIT 1, 2 AND 3 BOTTOM ASH PIPING AND METAL CLEANING WASTE DEMOLITION SCOPE. ANY REUSED MATERIALS SHALL BE THOROUGHLY CLEANED BY CONTRACTOR BOTH INSIDE AND OUTSIDE AND ALL WORKING PARTS OF VALVES AND OTHER APPURTENANCES SHALL BE CHECKED BY THE CONTRACTOR FOR PROPER FUCTIONING BEFORE THEY ARE INSTALLED. ANY MALFUNCTIONS SHALL BE REPORTED TO OWNER'S REPRESENTATIVE.

* SPECIAL FLANGES ON NEW BASALT LINED PIPE WILL BE USED TO MATE WITH EXISTING BASALT LINED PIPES AT TIE IN POINTS FOR UNITS 1 AND 2. (2) 45 DEGREE ELBOWS WITH SPECIAL FLANGES AT ONE END WILL BE USED FOR UNIT 3 TO MATE WITH EXISTING BASALT LINED PIPE. CONTRACTOR SHALL MATCH DRILLING TEMPLATE OF EXISTING BASALT LINED PIPE FLANGE WHICH IS 19¼" OD X 12" ID X ¾" THK. CI GASKET W/12 HOLES ⅞" DIA. ON A 17½" BCD.

** SPECIAL CARBON STEEL WELD NECK FLANGE SHALL BE USED TO MATE TO EXISTING BASALT LINED PIPE FLANGE. CONTRACTOR SHALL MATCH DRILLING TEMPLATE OF EXISTING BASALT LINED PIPE FLANGE WHICH IS 19¼" OD X 12" ID X ¾" THK. CI GASKET W/12 HOLES ⅞" DIA. ON A 17½" BCD.

NEW BASALT PIPE FLANGES SHALL MATCH DRILLING TEMPLATE OF NEW ASME B16.5 NPS 14" CLASS 150 FLANGE WHICH IS 12 HOLES 1⅛" DIA. ON A 18¾" BCD.

FOR BASALT LINED PIPE FITTINGS, CONTRACTOR SHALL ENSURE THAT FLANGED ENDS ARE SUITABLE FOR FIT UP (I.E. LOOSE FLANGES).

DATE	NO.	DESCRIPTION	APPD.
REVISIONS			

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
POND PIPING
BILL OF MATERIALS

REV	DATE RELEASED	PURPOSE	PREPARED	REVIEWED	APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH	KAR	BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5314	JEH	RAM	-
0	12-30-2020	ISSUED FOR BIDS	JEH	RAM	BMK

DRAWING RELEASE RECORD

STATE OF OHIO
BRIAN KLESATH PE.85798
REGISTERED
PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

UNIT: 13 | DRAWING NUMBER: 13-590112 | REV: 2

SCALE: NONE
DR: J. HIBBARD
CH: R. MILLER
SUP: B.KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

8.05
U3 Bottom Ash Hopper Volume

Article Number = CD-3-01-16
Article Status =
Series = 600
Plant = Cardinal
Unit = 3
Volume = 1
Section = a
TabTitle = Steam Generating Equipment
Title = Bottom Ash Removal System

March 5, 1992
Descriptive Article C-3-1-16

Cardinal Plant
Unit 3

BOTTOM ASH REMOVAL SYSTEM

Reference Illustrations: Figs. C-3-1-16-1 and C-3-1-16-2

The bottom ash removal system consists of an ash hopper with two hydraulically operated ash gates, two 10 hp motor driven ash crushers, 32 slope jetting nozzles, two door jetting nozzles, two emergency jetting nozzles and two jet pulsion pumps. Each jet pump transports the ash through its own discharge line to the ash disposal area located on the plant property. The system is designed for the removal of ashes once per shift.

Ash Hoppers

Each of the ash hoppers is a refractory lined, steel plate structure supported from the floor of the building. The hopper extends across the full width of the boiler and is located directly under the throat formed by the sloping furnace walls.

Since the steam generator hangs from the structural steel at the top of the building and expands downward, while the ash hopper is supported from below, it is necessary to allow for vertical expansion of approximately 13" and still maintain a gas tight joint between the steam generator and the ash hopper. This is provided for by a water seal consisting of a water filled box or trough attached to the top periphery of the hopper.

A vertical plate or skirt hangs from the lower furnace wall inlet header into the seal trough and expands downward forming a water seal. The seal trough and skirt extend around the entire periphery of the ash hopper. The skirt is made of stainless steel to provide protection against heat and corrosion.

A header around the ash hopper supplies makeup water to the seal trough from twenty nozzles located in each corner and the sides and ends. These nozzles are positioned to circulate water around the seal trough in a counterclockwise direction when viewed from above. See Figure C-3-1-16-2.

The makeup water provided to the seal trough is low head ash service water which is normally supplied by the ash water recirculating pumps. A backup source of low head ash service water is from the river water makeup pumps.

In addition the seal trough makeup nozzles can be flushing nozzles by opening a 6" air operated valve (3WA-032) from the high head ash service water supply. This should be operated once daily for approximately 5 minutes to flush the bottom of the seal trough clear of silt and sediment.

Except when dewatering the ash hopper for inspection, the hopper should be maintained full of water to protect the refractory lining. The water also breaks the fall of large pieces of hot slag which shatter upon contact with the relatively cool water. Refractory cooling water is distributed continuously from a perforated stainless steel spray pipe installed on top of the refractory wall and extending around the complete periphery of the hopper. This is done to keep the refractory which is exposed above the normal water level wet and cool. This water also replaces losses from evaporation and ash gate leakage.

The perforated spray pipe is divided into 14 independent sections, each supplied by a separate line from the low head ash service water system (see above). Each line has an orifice installed to limit the flow of water and to prevent shutting off all flow. A pressure regulating valve (3WA-036) can be bypassed if additional cooling or flushing water flow is desired. See Figure C-3-1-16-2. Dividing this cooling water spray pipe into separate sections guards against damage to all refractory should the water supply be lost to a pipe due to a plugged orifice or line.

Excess water in the ash hopper flows through two normal and one emergency overflow "skimmer caps" each with an 8" stainless steel pipe to a weir box then on to the ash hopper sump. Normally, the refractory cooling water flow to the hopper is in excess of gate and evaporation leakage losses. This results in a continuous flow of water from the overflow weir box to the ash hopper sump.

When ashes are being removed from the hopper, the water level will drop a few feet; the hopper may be left in this condition allowing water level to be restored by the normal flow of refractory cooling water. When the hopper has been dewatered for inspection or some other reason, it should be promptly refilled at least until the sloping floors are covered using the jetting nozzles. Then if desired, the remaining portion can be allowed to fill from the normal flow of refractory cooling water.

Slope jetting nozzles are provided to help move the ashes down the sloping floors of the hopper to the gate openings. There are slope nozzles on each of the outboard slopes. Each nozzle is sized to deliver 80 gpm at 125 psi. Two regulating valves, one for each slope, control water flow to the nozzles. These valves are operated from switches mounted locally on a subpanel in the ash pit.

There is one door jetting nozzle on each wall of the hopper. These nozzles are directed to flush ashes through the gate on the opposite wall. Flow to the door jetting nozzles is regulated by two valves. The door jetting nozzles are operated from switches on the ash handling subpanel.

One emergency jetting nozzle is provided for each ash gate and is located inside the grinder encloser opposite the ash gate. These are to be used when the gates fail to close due to an obstruction. Flow to the emergency jetting nozzle is regulated by local air operated control valves located near the clinker grinder enclosure.

The ash water mixture is discharged from either side of the ash hopper through one of two air and hydraulically operated gates. Filtered water and 100 psi air for operating the ash gates is supplied from the filtered water head tank and the plant air system. Each gate is controlled by a manually operated 4-way valve mounted on the ash gate enclosure. The position of each gate can be determined by observing the position of an indicator device mounted on top of the gate enclosure. An observation door and a flood light mounted on the enclosure of each gate permit viewing the gate and crusher.

Large pieces of ash which will not fit through the gate opening can be rodded either through (1) the aspirated lance doors mounted on each gate enclosure or (2) through the lance doors mounted near the top and at each end of the ash hopper or (3) through the lance door mounted above each gate enclosure on the wall of the hopper.

From each ash gate, the ash water mixture flows into the corresponding crusher where the ash is crushed to a size suitable for pumping. The crusher consists of a heavy crushing roll with removable teeth which is rotated against a stationary set of teeth. The shaft of the crusher roll is supported in bearings mounted in a structural frame which is bolted to the outlet flange of the ash gate enclosure. A packing gland around each shaft opening prevents furnace gasses from leaking out of the furnace housing. Sealing water for the gland is supplied by the seal water pumps from the filtered water head tank.

Each crusher is chain driven through a reduction gear by separate 10 hp, 1780 rpm, 575-volt induction motors. A hydraulic coupling is provided between the motor and reduction gear to prevent overloading the motor or damaging the crusher should scrap iron become lodged between the moving and stationary teeth. The crushers are controlled from the ash handling subpanel. The subpanel contains a control switch marked Forward-Stop-Reverse and a forward-reversing selector switch. Motor current is indicated by an ammeter on the same subpanel. Whenever the crusher motor current rises above normal, indicating that the crusher is stalled, the motor should be reversed to clear the crusher. This is done by turning both switches to the Reverse position. Upon indication of normal current, both switches should be returned to the Forward position to continue discharging ash.

From the crusher, the ash water mixture flows to a jet pump bolted to a transition piece underneath the crusher housing. The jet pump discharges to an ash disposal line running out to the ash disposal area located on the plant property. Only one crusher, the corresponding jet pump and its line are required to remove ashes. A drain valve, located at the outlet of the jet pump, is provided to drain the line during cold weather. This valve should be opened after removing ashes during cold weather. It should be kept closed at all other times, particularly when removing ashes, to prevent the drain line from plugging.

Each jet pump is supplied with water from the bottom ash water pump discharge header, through an air operated valve. The controls for the bottom ash water pumps are located on Panel SV in the control room.

Operating Procedure

The following procedure should be used for operating the bottom ash removal system.

1.Start a bottom ash water pump.

2.Close the ash line drain valve at the jet pump outlet for one jet pump on each hopper.

3.Open the air operated water supply valve to the one jet pump in each hopper that is to be used.

4.Observe pressure gages and confirm:

a. Adequate water supply pressure to the jet pump (main control room).

b. Jet pump discharge pressure is less than supply pressure. If pressures are equal, the ash line is plugged (ash pit).

5.Start the ash crusher for the in-service jet pump.

6.Open the hydraulic gate wide open with the 4-way valve located on the ash gate enclosure observing the jet pump discharge pressure. Increasing pressure indicates the pumping of ash.

7.Immediately open the water supply valve to the door jetting nozzles located on the hopper side opposite the open ash gate. Open the water supply valves to one set of slope jetting nozzles for one minute on each slope. Alternate the two sets of slope jetting nozzles on the hopper until the jet pump discharge pressure decreases indicating removal of all ash.

8.When all ash has been removed, shut off the water to all jetting nozzles, close the ash gates and stop the crusher.

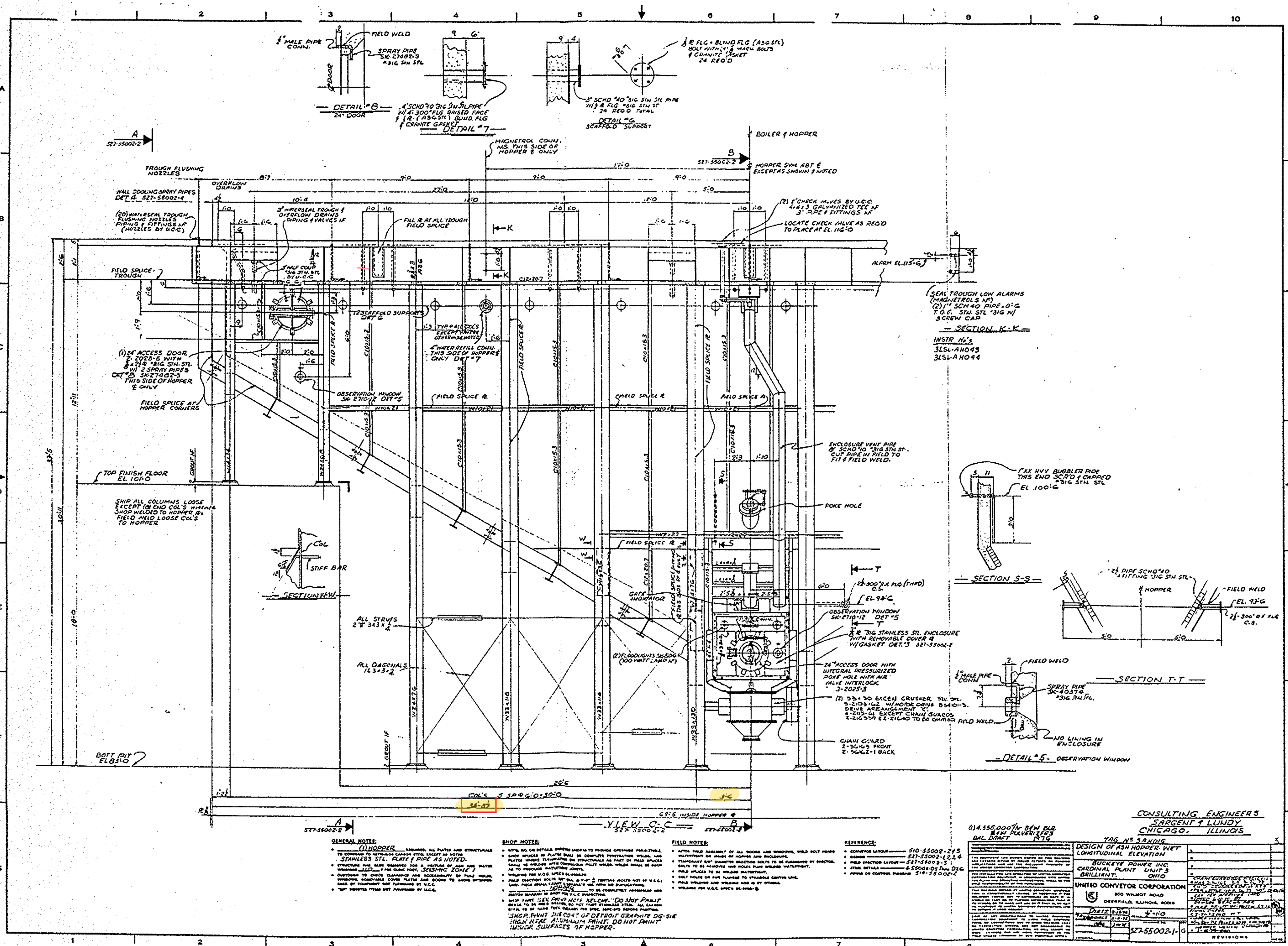
9.After a ten minute flush, close the air operated water supply valve to the jet pump and shut down the bottom ash water pump.

10. In cold weather, open the ash line drain valve located at the jet pump outlet.

It is recommended that once daily the ash hopper be completely dewatered when using the ash crushers and jet pumps to run bottom ash. This is to be done so that the hopper can be inspected for any large pieces of slag remaining in the hopper. If there are any, the jetting nozzles can be used to dislodge the slag and if necessary, it can be broken up by rodding from the aspirated doors. The hopper should be quickly refilled using the jetting nozzles until the sloping floors of the hopper are covered. The remainder of the hopper can be filled with water from the refractory cooling weirs.

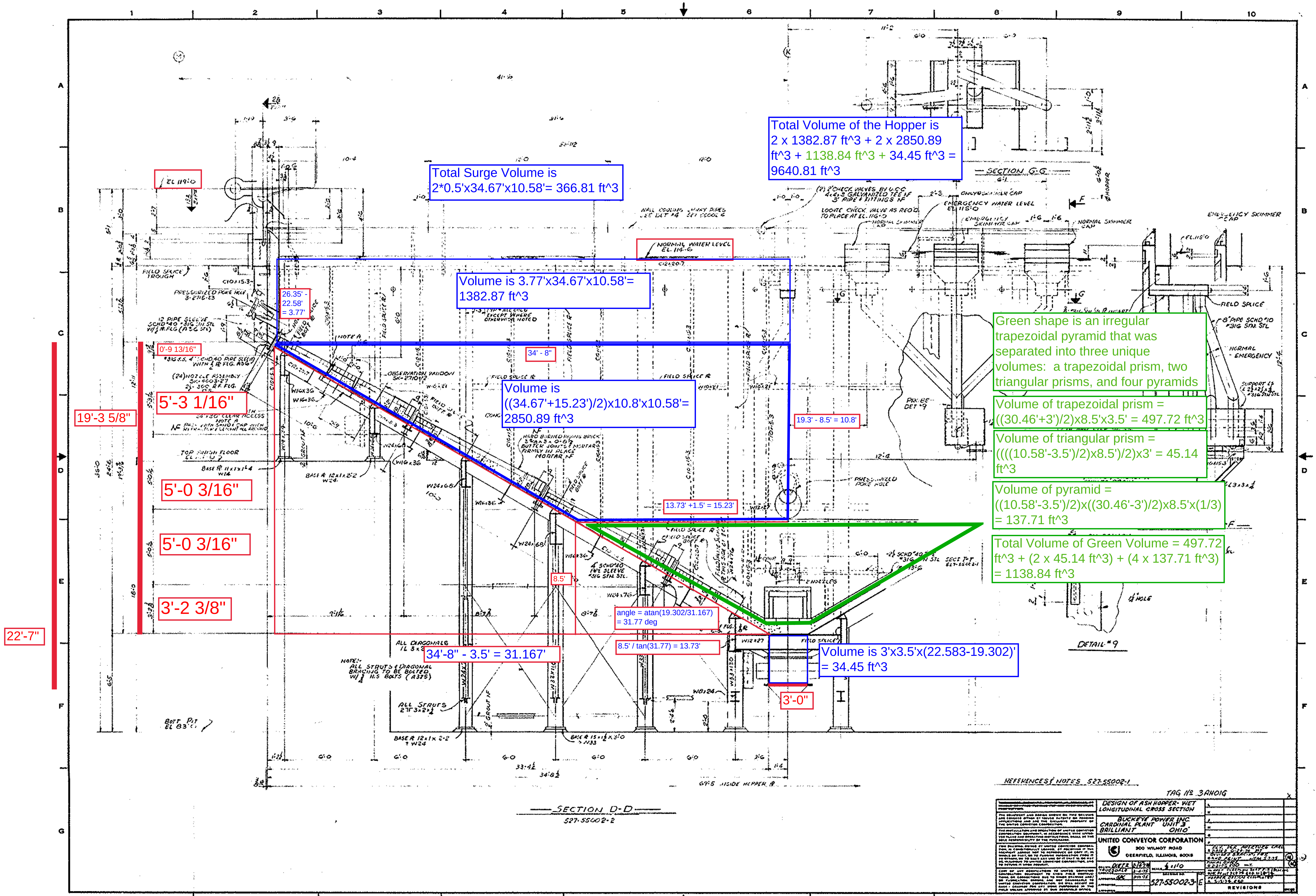
Do not operate any wall slag blowers or IK blowers when removing bottom ash from the boiler and particularly not when the hoppers are empty during inspection. This is necessary to guard against the possibility of dislodging a large piece of slag which could damage the hopper floor due to the low water level in the hopper during these periods.

The time required to empty the hopper after eight hours full load operation using a jet pulsion pump is approximately 30 minutes. The storage capacity of the hopper, 9790 cubic feet and 386 tons is such that if no discharge of ash water mixture took place, due to machinery breakdown for example, it would take approximately 45 hours to fill the hopper with slag at full load operation.

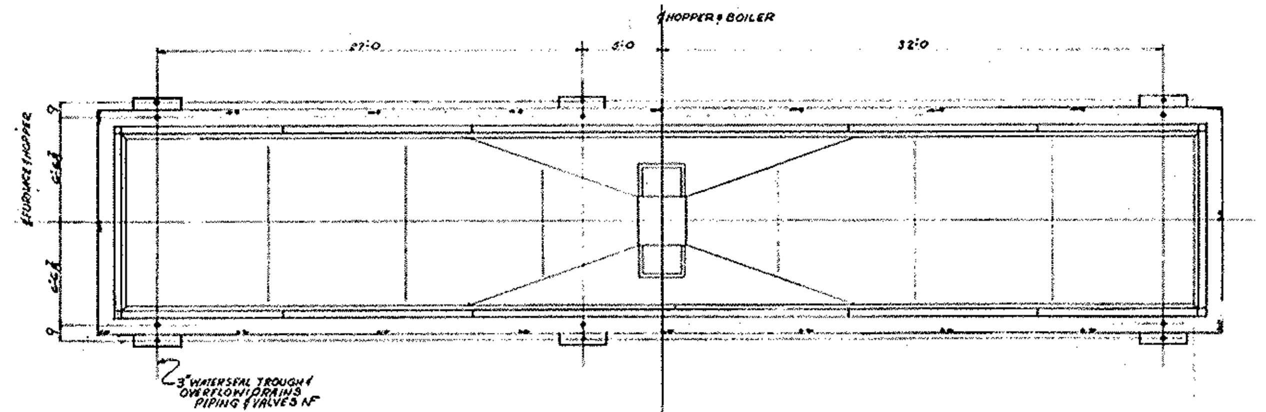


DETAIL #8
24" DOOR
DETAIL #7
DETAIL #G
SCAFFOLD SUPPORT
BOILER ℄ HOPPER
HOPPER SYM ABT ℄ EXCEPT AS SHOWN & NOTED
TROUGH FLUSHING NOZZLES
OVERFLOW DRAINS
FIELD SPLICE
SECTION K-K
INSTR. No's
3LSL-AH043
3LSL-AH044
TOP FINISH FLOOR EL. 101-0
SECTION W-W
SECTION S-S
SECTION T-T
POKE HOLE
ALL STRUTS
ALL DAGONALS
BOTT PIT EL 83-0
DETAIL #5 OBSERVATION WINDOW
VIEW C-C
GENERAL NOTES:
SHOP NOTES:
FIELD NOTES:
REFERENCE:
CONSULTING ENGINEERS
SARGENT & LUNDY
CHICAGO, ILLINOIS
(1) 4,555,000#/hr B&W BLR.
B&W PULVERIZERS
BAL. DRAFT 1976
TAG No 3AH01S
DESIGN OF ASH HOPPER-WET
LONGITUDINAL ELEVATION
BUCKEYE POWER INC.
CARDINAL PLANT UNIT 3
BRILLIANT, OHIO
UNITED CONVEYOR CORPORATION
300 WILMOT ROAD
DEERFIELD, ILLINOIS
527-55002-1- G
REVISIONS

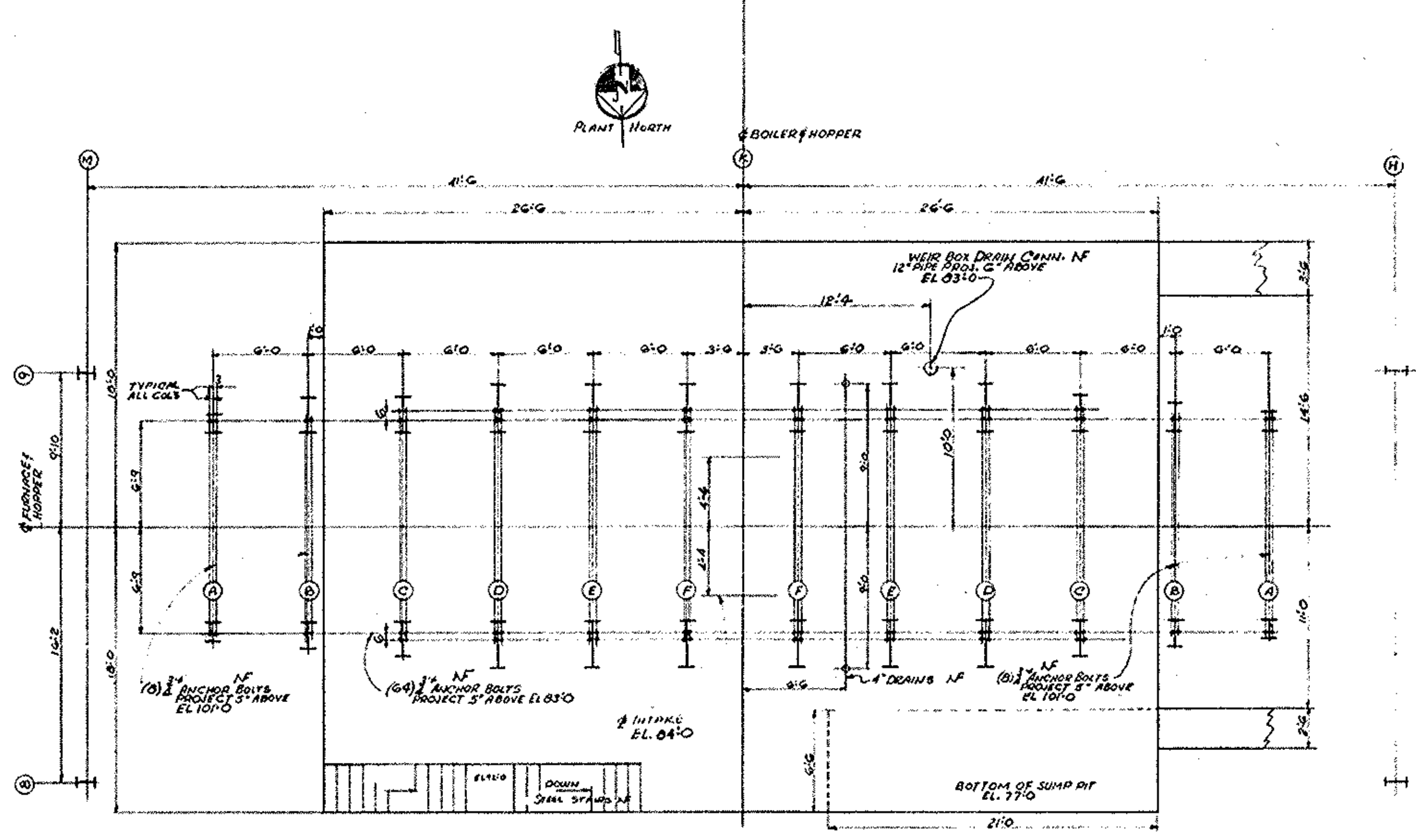
SECTION B-B 527-55002-1
LOOKING WEST
VIEW A-A 527-55002-1
LOOKING WEST
DETAIL #1
DETAIL #2
DILLUTION PIPE IN ENCL.
DETAIL #3
GASKET DETAIL
REFERENCES & NOTES 527-55002-1
℄ FURNACE & HOPPER
ALL WORK & MATERIAL ABOVE THIS LINE BY OTHERS
SUPPLY TUBES
EL 119-0
TOP FINISH FLOOR EL 101-0
BOTT. PIT EL 83-0
PRESSURE VACUUM RELIEF VALVE FLAP TYPE
REFRACTORY CEMENT LINING
6" VENT PIPE SCHD10 316 STN.STL
PRESSURIZED POKE HOLE
HARD BURNED PAVING BRICK
CONCRETE FILL
10 HYDRAULIC CYLINDER
(2) FLOODLIGHTS
24" ACCESS DOOR WITH INTERGAL PRESSURIZED POKE HOLE
EMERGENCY JETTING NOZZLE
CLEARANCE REQ'D FOR CYLINDER REMOVAL
GASKET DET #3
SEE SECTION D-D 527-55002-3 FOR BRACING ON COL'S
NOTE A
PRESSURIZED POKE HOLE
AIR CONN.
REVIEWED FOR
CARDINAL PLANT
UNIT 3
BUCKEYE POWER, INC.
SARGENT & LUNDY
ENGINEERS
1. ☒ NO EXCEPTION TAKEN. CONTRACTOR CAN PROCEED WITH FABRICATION OR CONSTRUCTION
2. ☐ CONTRACTOR CAN PROCEED BASED ON MAKING REVISIONS NOTED AND RESUBMIT.
3. ☐ REVISE AS NOTED AND RESUBMIT. HOLD FABRICATION.
ANY ACTION SHOWN ABOVE IS SUBJECT TO THE TERMS OF THE CONTRACT, AND DOES NOT RELIEVE CONTRACTOR FROM HIS OBLIGATIONS UNDER THE CONTRACT, INCLUDING DESIGN AND DETAILING.
FOR ASH HOPPER & SLURRY TANK
EQUIPMENT NO.
BY E. DOMBROWSKI DATE 4-21-75
SPEC. NO. J-3034 PROJ. NO. 4642
MASTER COPY
THE EQUIPMENT AND DESIGN SHOWN ON THIS DRAWING ARE COVERED EITHER BY ISSUED PATENTS OR PENDING APPLICATIONS AND ARE THE EXCLUSIVE PROPERTY OF THE UNITED CONVEYOR CORPORATION.
THE INSTALLATION AND OPERATION OF UNITED CONVEYOR CORPORATION EQUIPMENT, IN ACCORDANCE WITH APPROVED PLANS AND OPERATING INSTRUCTIONS, SHALL BE THE SOLE RESPONSIBILITY OF THE PURCHASER.
THIS DRAWING, OWNED BY UNITED CONVEYOR CORPORATION, IS CONDITIONALLY LOANED. BY RECEIVING IT THE RECIPIENT AGREES NOT TO REPRODUCE OR COPY IT, IN WHOLE OR PART, OR TO FURNISH INFORMATION FROM IT TO OTHERS, OR TO MAKE ANY USE OF IT THAT IS OR MAY BE INJURIOUS TO UNITED CONVEYOR CORPORATION, AND TO RETURN IT UPON REQUEST.
COST OF ANY MODIFICATIONS TO UNITED CONVEYOR CORPORATION EQUIPMENT TO AVOID FIELD OBSTRUCTIONS, OR CORRECTIONS DUE TO MINOR DRAWING AND/OR FABRICATION ERRORS, ARE NOT CHARGEABLE TO UNITED CONVEYOR CORPORATION. WE WILL ACCEPT NO BACK-CHARGES FOR ANY WORK PERFORMED IN THE FIELD UNLESS APPROVED BY OUR DEERFIELD OFFICE.
DESIGN OF ASH HOPPER - WET
CROSS SECTION & END ELEVATION
BUCKEYE POWER INC.
CARDINAL PLANT UNIT 3
BRILLIANT OHIO
UNITED CONVEYOR CORPORATION
300 WILMOT ROAD
DEERFIELD, ILLINOIS. 60015
DRAWN DIETZ 2-14-74
CHECKED TRUESDALE 3-4-75
APPROVED 3-19-75
SCALE 1/2 = 1'-0
DRAWING NO. 527-55002-2 REV. C
FINAL CHECK
C 2-21-75 ECO
B PRINT 3-28-79 ECO 11-18-74
HOPPER DESIGN COMPLETED
A 3-13-79 ECO
REVISIONS
FORM 500-873



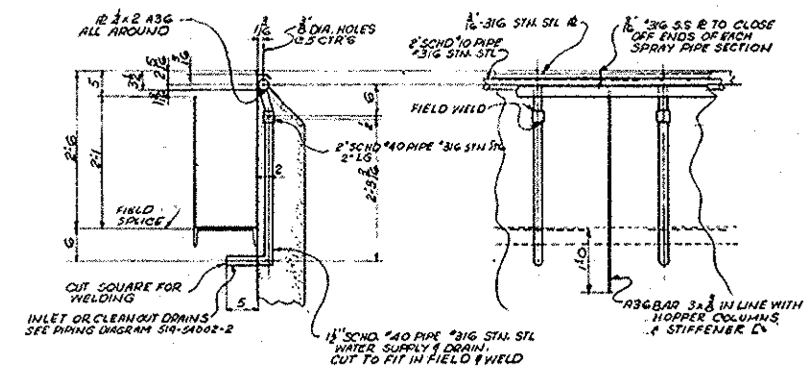
Total Volume of the Hopper is 2 x 1382.87 ft^3 + 2 x 2850.89 ft^3 + 1138.84 ft^3 + 34.45 ft^3 = 9640.81 ft^3
Total Surge Volume is 2*0.5'x34.67'x10.58'= 366.81 ft^3
EL 119'-0
NORMAL WATER LEVEL EL. 114-6
Volume is 3.77'x34.67'x10.58'= 1382.87 ft^3
26.35' - 22.58' = 3.77'
0'-9 13/16"
34' - 8"
Volume is ((34.67'+15.23')/2)x10.8'x10.58'= 2850.89 ft^3
19.3' - 8.5' = 10.8'
13.73' +1.5' = 15.23'
5'-3 1/16"
19'-3 5/8"
5'-0 3/16"
5'-0 3/16"
3'-2 3/8"
22'-7"
8.5'
angle = atan(19.302/31.167) = 31.77 deg
8.5' / tan(31.77) = 13.73'
34'-8" - 3.5' = 31.167'
Volume is 3'x3.5'x(22.583-19.302)' = 34.45 ft^3
3'-0"
Green shape is an irregular trapezoidal pyramid that was separated into three unique volumes: a trapezoidal prism, two triangular prisms, and four pyramids
Volume of trapezoidal prism = ((30.46'+3')/2)x8.5'x3.5' = 497.72 ft^3
Volume of triangular prism = ((((10.58'-3.5')/2)x8.5')/2)x3' = 45.14 ft^3
Volume of pyramid = ((10.58'-3.5')/2)x((30.46'-3')/2)x8.5'x(1/3) = 137.71 ft^3
Total Volume of Green Volume = 497.72 ft^3 + (2 x 45.14 ft^3) + (4 x 137.71 ft^3) = 1138.84 ft^3
SECTION G-G
DETAIL #9
SECTION D-D
527-55002-2
REFERENCES & NOTES 527-55002-1
DESIGN OF ASH HOPPER- WET LONGITUDINAL CROSS SECTION
BUCKEYE POWER INC CARDINAL PLANT UNIT 3 BRILLIANT OHIO
UNITED CONVEYOR CORPORATION
300 WILMOT ROAD DEERFIELD, ILLINOIS, 60015
527-55002-3
REVISIONS



PLAN OF WATERSEAL TROUGH



LAYOUT OF ASH HOPPER PIT & ANCHOR BOLTS



WALL COOLING SPRAY PIPE

DETAIL #4

MAXIMUM LOAD ON EACH COLUMN SEISMIC ZONE Nº 1						
COLUMNS	A	B	C	D	E	F
DEAD+LIVE LD	46^k	71^k	92^k	112^k	130^k	159^k
EQ. LD	7^k	11^k	13^k	15^k	17^k	21^k
TOTAL LD	53^k	82^k	105^k	127^k	147^k	180^k
TRANSVERSAL EQ. SHEAR/COL	1.5^k	2.5^k	3.5^k	4.5^k	5^k	6.5^k
LONGITUDINAL EQ SHEAR	—	—	6^k	6^k	6^k	6^k

REFERENCES & NOTES 527-55002-1

TAG Nº 3AH01G

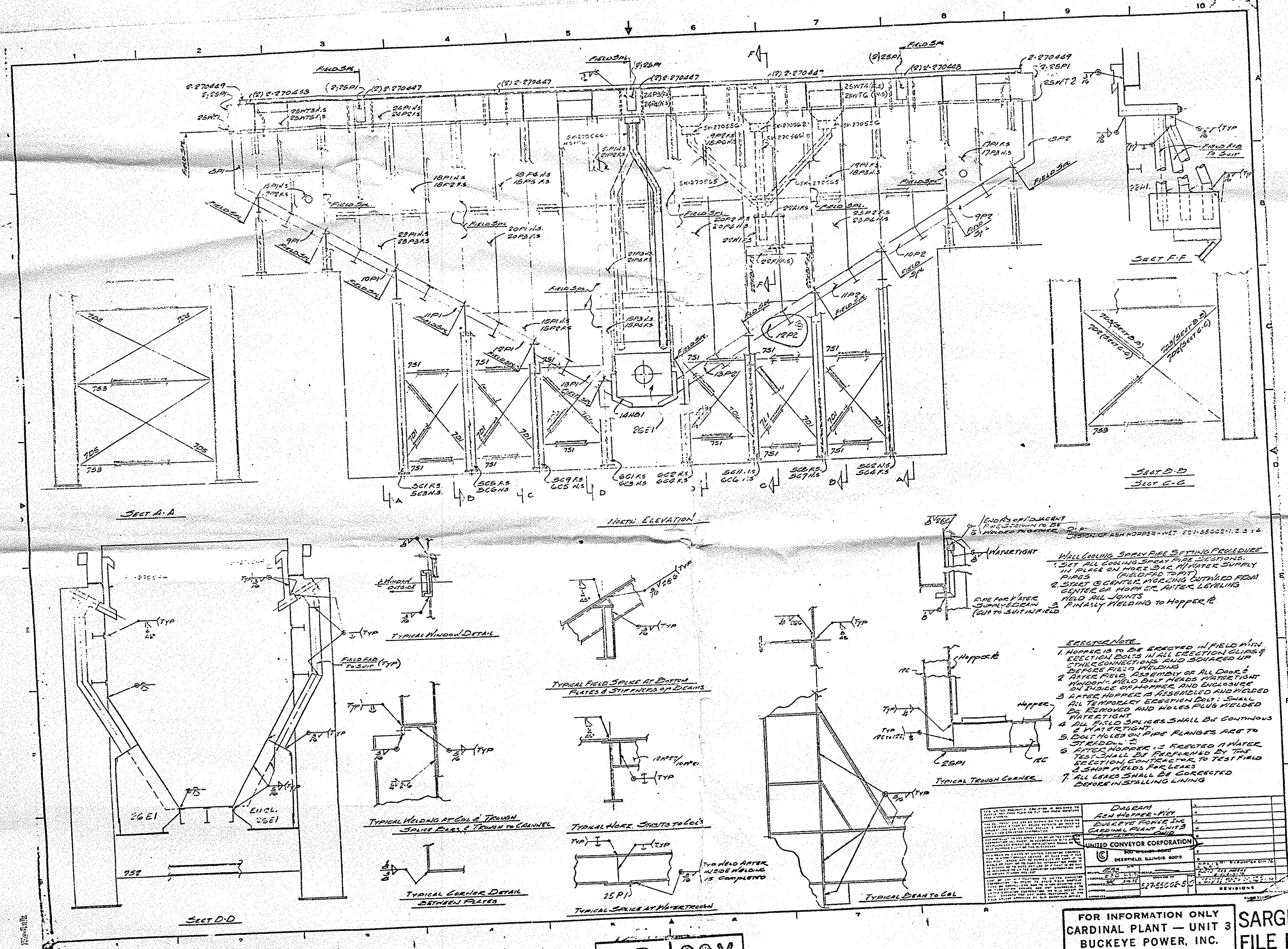
DESIGN OF ASH HOPPER - WET
ANCHOR BOLT & PIT LAYOUT

BUCKEYE POWER INC
CARDINAL PLANT UNIT 3
BRILLIANT, OHIO

UNITED CONVEYOR CORPORATION
300 WILMOT ROAD
DEERFIELD, ILLINOIS, 60015

DIETZ
TRUESDALE
SCALE 1/4" = 1'-0
527-550024 D

REVISIONS



F.P. 30X

FOR INFORMATION ONLY
CARDINAL PLANT — UNIT 3
BUCKEYE POWER, INC.
SARGENT & LUNDY
ENGINEERS
FOR WET ASH HOPPER DIAGRAM
SPEC. NO. J-3034 JOB No. 4642
DATE JUNE 14, 1976

SARGENT & LUNDY
FILE NO. 527-55002-5
REV. C

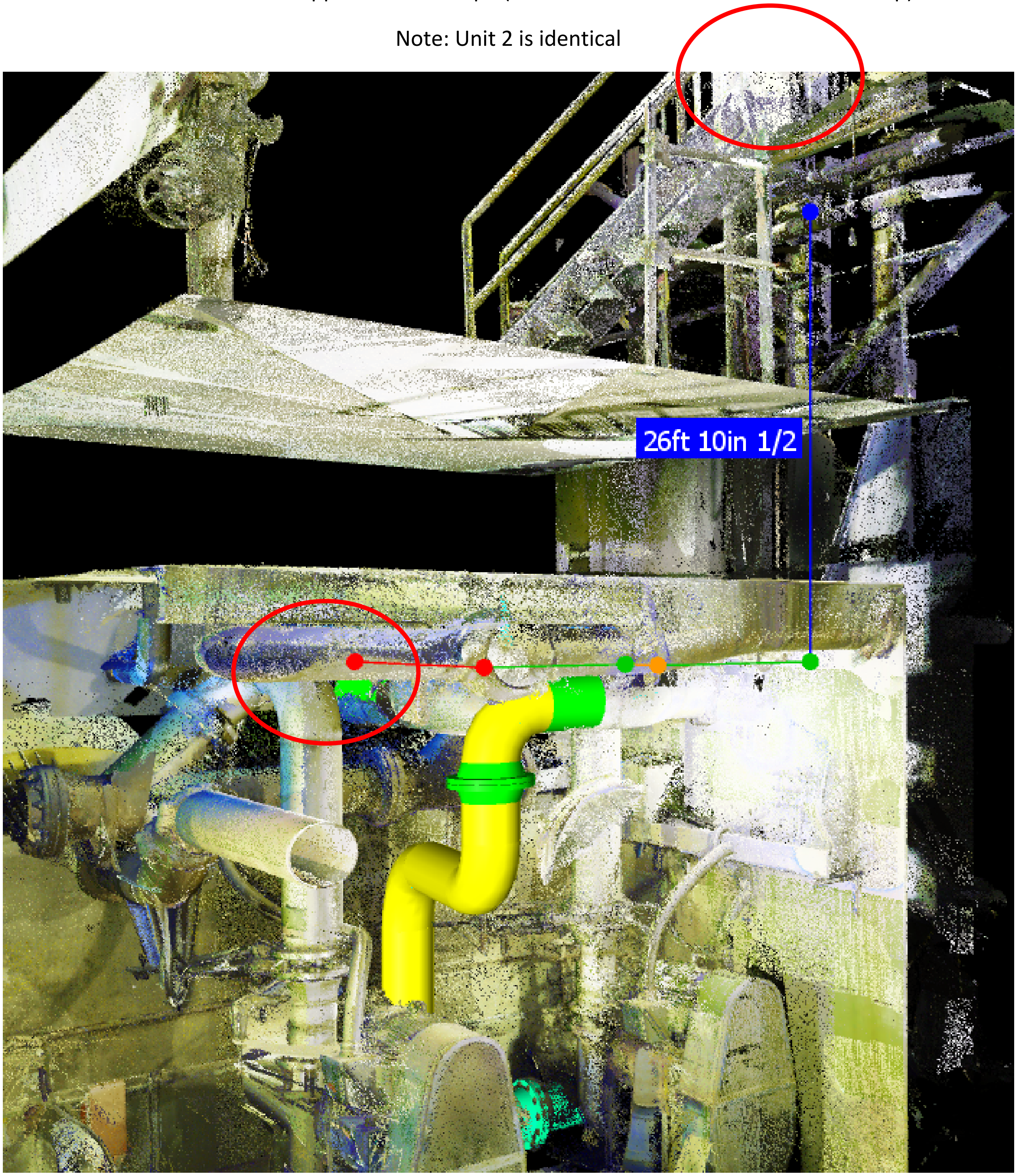
16X

16

8.06
U1 & U2 Bottom Ash Hopper Overflow Pipe

Unit 1 Bottom Ash hopper Overflow Pipe (From Overflow Box to Boiler Room Sump)

Note: Unit 2 is identical

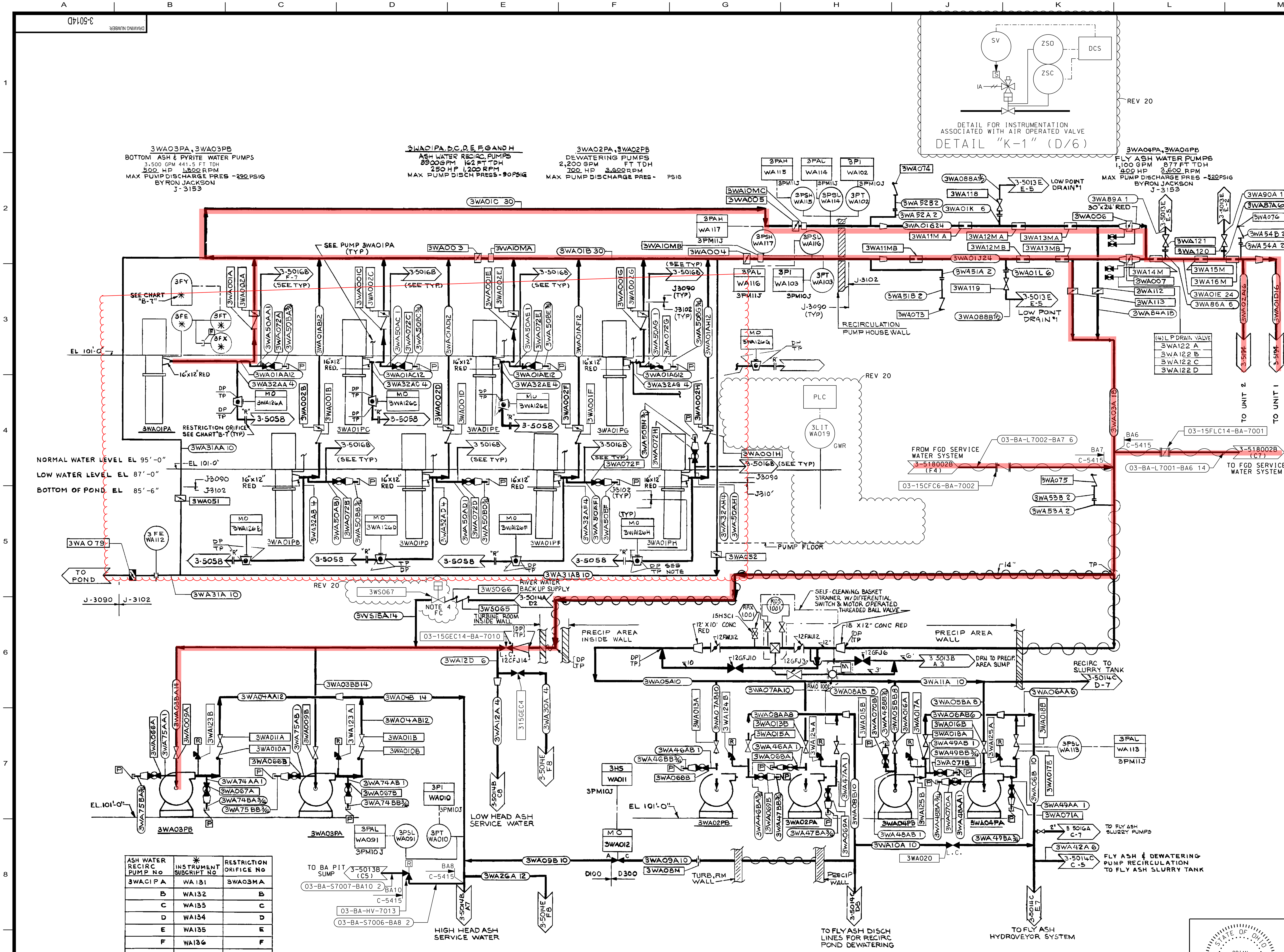


27 LF of pipe

Top Right Circle = Overflow Box

Bottom Left Circle = Connection to Boiler Room Sump

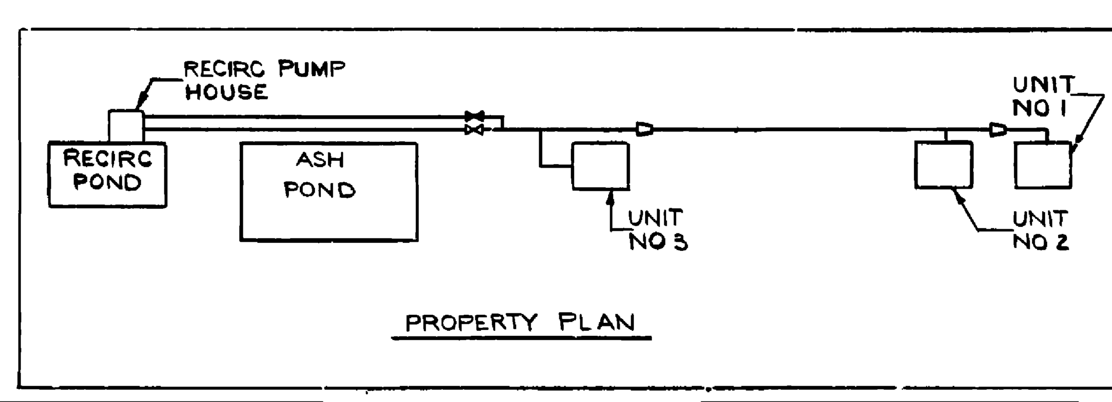
8.07
AWRP Piping drawings and images



ASH WATER RECIRC PUMP No	* INSTRUMENT SUBCRIPT No	RESTRICTION ORIFICE No
3WACIPA	WA131	3WA03MA
B	WA132	B
C	WA133	C
D	WA134	D
E	WA135	E
F	WA136	F
G	WA137	G
H	WA138	H

CHART "B-7"

PDC NUMBER	DESIGN PRESSURE (psig)	DESIGN TEMP. (DEG.F)	MAX OPER. PRESSURE (psig)	MAX OPER. TEMP. (DEG. F)	PIPING CODE	PDT	INSTR. PIPE CODE	INSTR. PDT	INSUL-ATION TYPE	FIELD TEST PRESSURE (psig)	REMARKS
BA10	120	110	110	100	B31.1 NBEP	S&L 0105	B31.1 NBEP	S&L 0659	N	IN SERVICE	CS A106 OR A53
BA6	120	110	110	100	B31.1 NBEP	S&L 0105	B31.1 NBEP	S&L 0659	F	IN SERVICE	CS A106 OR A53
BA7	150	110	140	100	B31.1 NBEP	S&L 0105	B31.1 NBEP	S&L 0659	F	IN SERVICE	CS A53 GR B ERW
BA8	275	110	250	100	B31.1 NBEP	S&L 0305	B31.1 NBEP	S&L 0659	N	580	CS A53 GR B ERW



REV	DATE RELEASED	PURPOSE	
20A	4-20-2021	ISSUE FOR REVIEW	D.WU
19	3-17-2021	ISSUE FOR CONSTRUCTION SPEC C-5415	D.WU / B.KLESATH / B.KLESATH
REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED

DRAWING RELEASE RECORD

STATE OF OHIO
BRIAN KLESATH PE.85798
REGISTERED
PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

GENERAL NOTES

1. SYMBOLS ON THIS DRAWING MAY VARY DUE TO UPDATING CONSISTENT WITH STANDARD SYMBOL DRAWING NO 13-5004F.
2. DP: INDICATES DISCONNECT POINT
   TP: INDICATES TIE-IN POINT
3. TO CONVERT ELEVATIONS SHOWN TO PLANT DATUM, ADD 570'-0".
4. VALVE 3WA067 SHALL BE MODIFIED FROM MANUAL GATE VALVE TO AUTOMATIC AIR OPERATED VALVE. SEE DETAIL "K-1" OF THIS DRAWING FOR INSTRUMENTATION FOR AIR OPERATED VALVE.

REV 20

REFERENCE DRAWINGS

13-MSK-5014A-OPT-1 BOTTOM ASH TROUGH (BAT) OPTION ±1

3-518002B FLOW DIAGRAM UNIT 3 FGD SERVICE WATER DISTRIBUTION

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

FLOW DIAGRAM
P. &I.D.-RECIRCULATED
ASH WATER
CARDINAL PLANT
UNIT 3

UNIT:	DRAWING NUMBER:	REV:
03	3-5014D	20

SCALE: N/A
DR: CC
CH: DW
SUP: APPD
ENG: ENG
DATE: DATE

ENGINEERING DIVISION

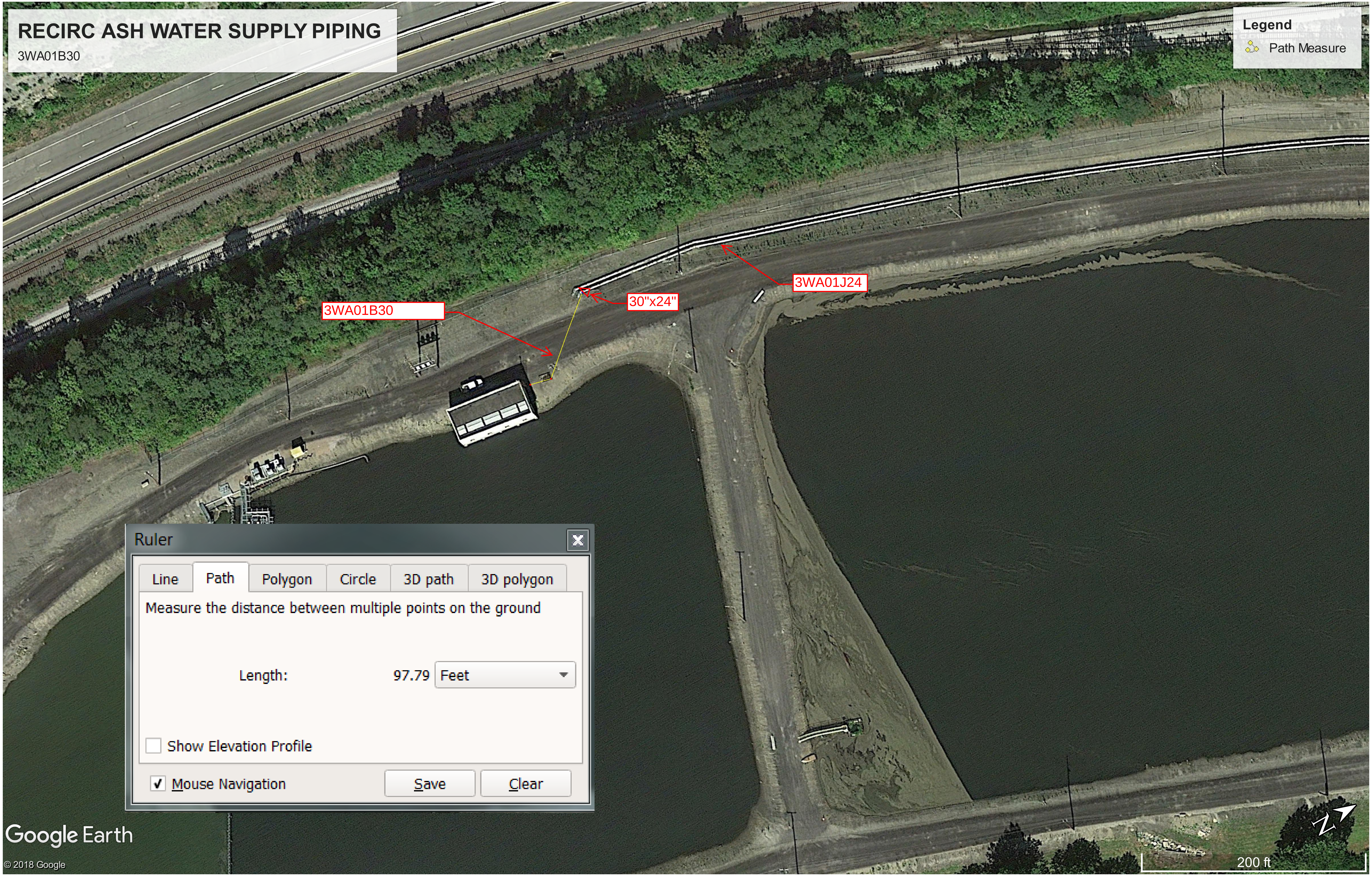
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

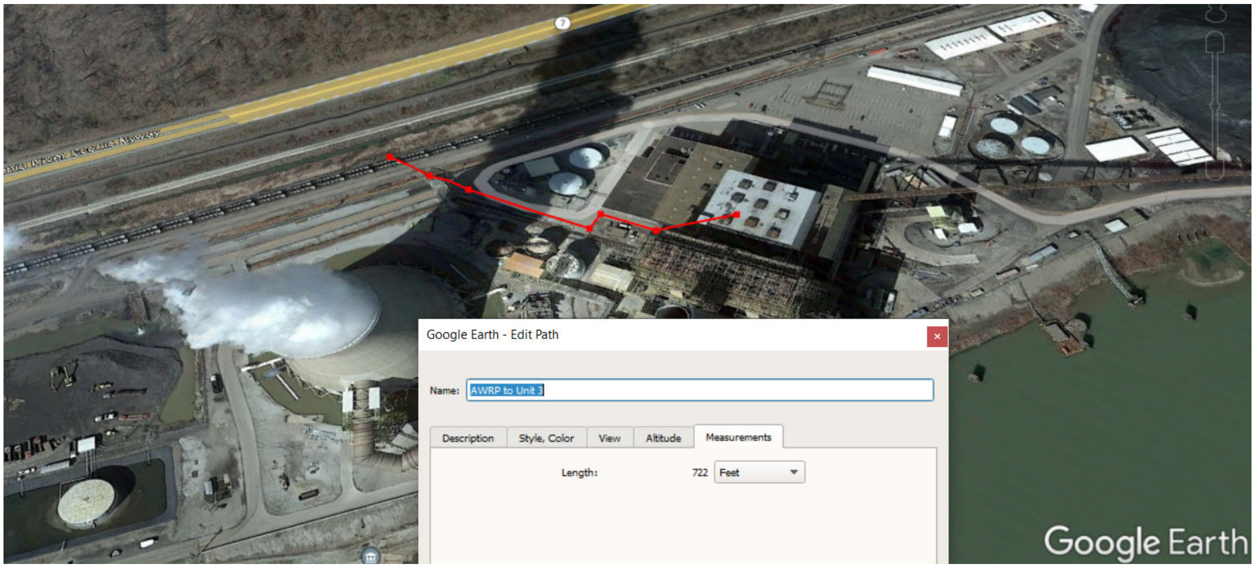
PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

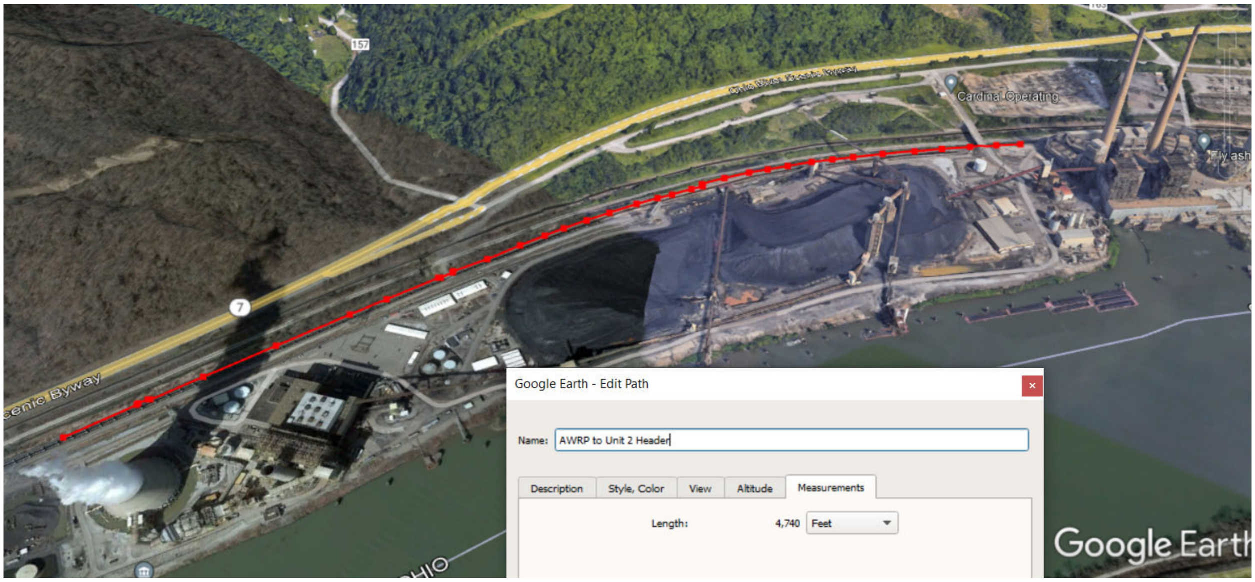

RECIRC ASH WATER SUPPLY PIPING
3WA01B30
Legend
Path Measure
3WA01B30
30"x24"
3WA01J24
Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the distance between multiple points on the ground
Length: 97.79 Feet
Show Elevation Profile
Mouse Navigation
Save
Clear
Google Earth
© 2018 Google
200 ft

RECIRC ASH WATER SUPPLY PIPING
3WA01G24
Legend
Path Measure
3WA01G24
Ruler
Line
Path
Polygon
Circle
3D path
3D polygon
Measure the distance between multiple points on the ground
Length: 2,522.41 Feet
Show Elevation Profile
Mouse Navigation
Save
Clear
Google Earth
© 2018 Google
700 ft
N

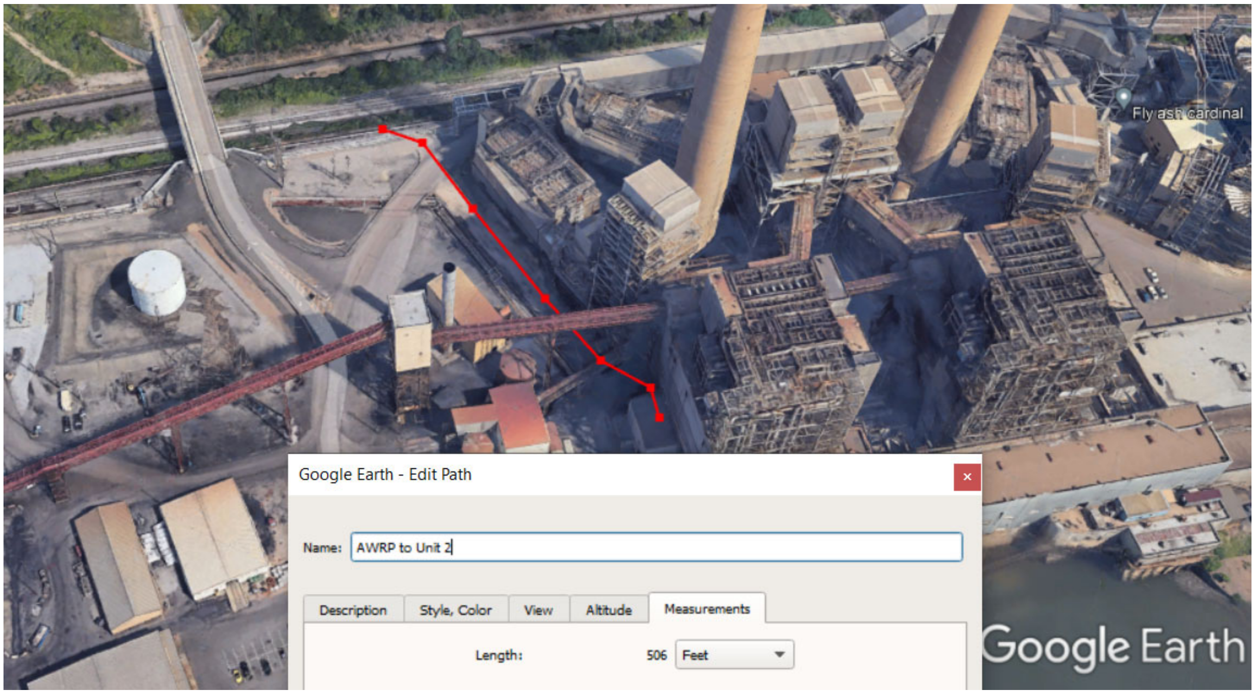
AWRP Discharge dedicated line to Unit 3 Bottom Ash Pump



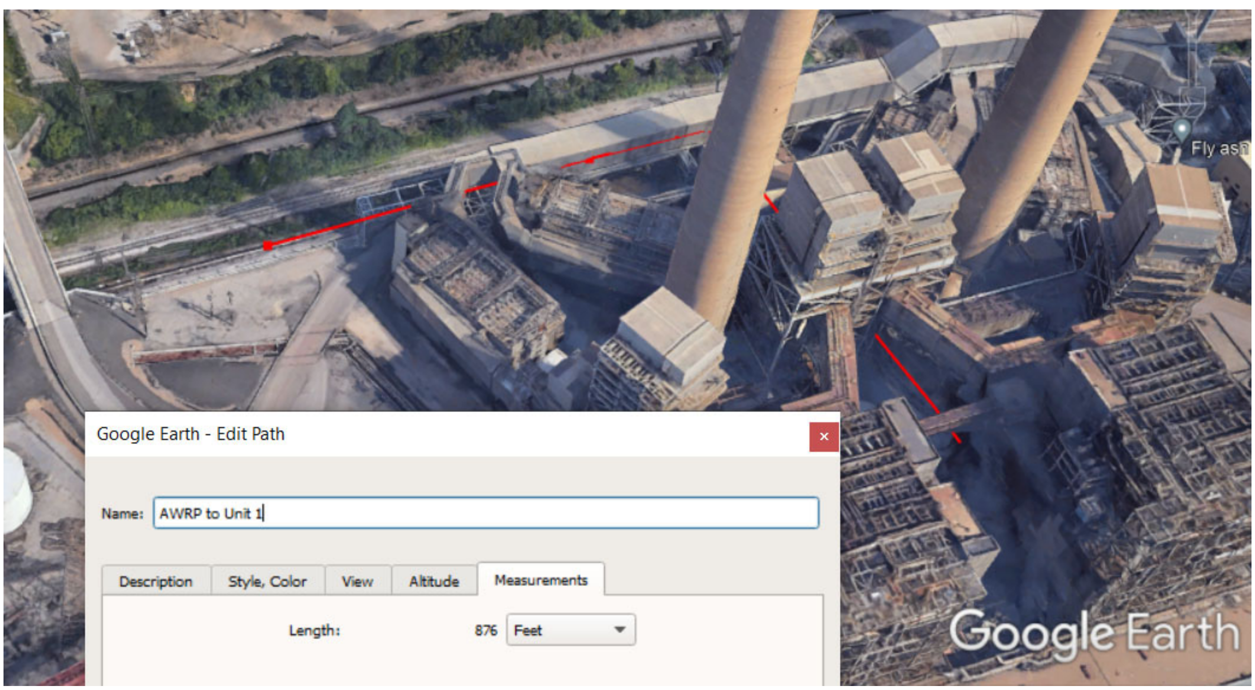
AWRP Common Header to Unit 2



AWRP Discharge dedicated line to Unit 2 Bottom Ash Pump



AWRP Discharge dedicated line to Unit 1 Bottom Ash Pump



8.08
Excel Formulas

=Cover!A21

1	**PURPOSE AND SCOPE:**				
1.01	The Cardinal power station consists of three (3) units. Project 13770.006 includes the lining and closure of the existing bottom ash ponds for each units.				
1.02	The purpose of this calculation is to determine the primary active wetted volume of the revised bottom ash system in accordance with ELG regulations in order to estimate the allowance of purge (10% of the primary active wetted bottom ash volume).				

Item	Description	Reference	Unit of Measure	Data Value	Input (V/UV/EJ)
2	**DESIGN INPUTS:**				
=B10+0.01	ELG Proposed Rule Section 423.11(aa), Specialized Definitions, is provided below for basis of included equipment: *The term "primary active wetted bottom ash system volume" means the maximum volumetric capacity of bottom ash transport water in all non-redundant piping (including recirculation piping) and primary bottom ash collection and recirculation loop tanks (e.g., bins, troughs, clarifiers, and hoppers) of a wet bottom ash system, excluding the volumes of surface impoundments, secondary bottom ash system equipment (e.g., installed spares, redundancies, and maintenance tanks), and non-bottom ash transport systems that may direct process water to the bottom ash .*				**V**
=B11+0.01	The specific gravity of the water is 1.00 and the density is 62.4 lb/ft3.				**EJ**
=B12+0.01	Units 1 & 2 Ash Hopper and Seal Trough volumes are determined per drawings in Attachment 8.02.				**V**
=B13+0.01	Units 1 & 2 Boiler Room Sump volume is determined per drawings in Attachment 8.03.				**V**
=B14+0.01	The pipe length for Units 1 & 2 overflow piping to the Boiler Room Sump is determined per Attachment 8.06.				**V**
=B15+0.01	Unit 3 Ash Hopper and Seal Trough volumes are determined per drawings in Attachment 8.05.				**V**
=B16+0.01	Unit 3 Ash Hopper Pit Sump volume is determined per drawings in Attachment 8.09.				**V**
=B17+0.01	Ash Water Recirculation Pump (AWRP) Pipe lengths were determined using drawings and Google Earth images shown in Attachment 8.07.				**EJ**
=B18+0.01	Units 1, 2 & 3 Bottom Ash water piping volume is determined per the Bill of Materials in Attachment 8.04.				**V**
=B19+0.01	Routing for the piping from the Units 1 & 2 Bottom Ash Pumps to Jet Pumps is determined using Attachment 8.10.				**V**
=B20+0.01	Routing for the piping from the Unit 3 Bottom Ash Pumps to Jet Pumps is determined using Attachment 8.11.				**V**

Item	Description	Reference	Unit of Measure	Data Value	
3	**ASSUMPTIONS:**				
=B23+0.01	Unit 3 overflow piping to the Ash Hopper Pit Sump is assumed the same length as the Units 1 & 2 overflow piping to the Boiler Room Sump.				**EJ**
=B24+0.01	For all three (3) Units, bottom ash hopper surge volume was taken at high water level, 6" above normal operating level.				**EJ**
=B25+0.01	Seal Trough is assumed to be 6" deep and extends 6" around the ash hoppers.				**EJ**
=B26+0.01	The South Pond was not considered part of the primary wetted volume, however, it is considered part of the surge volume. The South Pond has 5 feet freeboard so an assumed depth of 5 ft is used based on total pond volume for a total of 33.9 acre-feet (based on an average pond area of 6.78 acres).				**EJ**
=B27+0.01	It is assumed that the last 50 ft of piping for the AWRP discharge lines for each Unit is the lower diameter piping (14" nominal for Unit 3 and 12" nominal for Units 1 and 2).				**EJ**

Item	Description	Variables	Data Value
4	**METHODOLOGY & ACCEPTANCE CRITERIA:**		
=B30+0.01	The methodology for performing the calculations involves the following principal steps: • Identify all equipment and piping expected to contain ash water during normal plant operation and ash handling processes. • Determine the volume of all identified equipment and piping that is applicable		
=B31+0.01	Volume of Rectangular Prism	V = Volume [ft3] l = Length (ft) w = Width (ft) h = Height (ft)	$V = lwh$
=B32+0.01	Volume of Triangular Prism	V = Volume [ft3] l = Length (ft) w = Width (ft) h = Height (ft)	$V = lwh\left(\frac{1}{2}\right)$
=B33+0.01	Volume of Trapezoidal Prism	V = Volume [ft3] B1 = Base 1 (ft) B2 = Base 2 (ft) h = Height (ft) d = Depth (ft)	$V = \left(\frac{B_1 + B_2}{2}\right)hd$
=B34+0.01	Volume of Pyramid	V = Volume [ft^3] h = Height (ft) l = Length (ft) w = Width (ft)	$V = \left(\frac{lwh}{3}\right)$
=B35+0.01	Volume of a pipe	V = Volume [ft3] π = Constant {3.14} r = Internal Pipe Radius (ft) L = Length (ft)	$V = \pi r^2 \mathrm{L}$

=Cover!A21

Item	Description	Reference	Unit of Measure	Equation	
5	**CALCULATIONS:**				
5.01	See Attachment 8.01 for wetted volume summary breakdown				
Item	**Description**	**Reference**	**Unit of Measure**	**Value**	**Accept (Y/N)**
6	**RESULTS:**				
6.01	Wetted volume of equipment and piping				
=B43+0.01	Units 1 & 2 Ash Hoppers	Attachment 8.02	gal	=Equipment!I9*2	Y
=B44+0.01	Units 1 & 2 Seal Trough	Assumption 3.05	gal	=Equipment!I10*2	Y
=B45+0.01	Units 1 & 2 Overflow Piping	Attachment 8.06	gal	=Equipment!I12*2	Y
=B46+0.01	Units 1 & 2 Boiler Room Sump	Attachment 8.03	gal	=2*Equipment!I13	Y
=B47+0.01	Unit 3 Ash Hoppers	Attachment 8.05	gal	=Equipment!I23	Y
=B48+0.01	Unit 3 Seal Trough	Assumption 3.05	gal	=Equipment!I24	Y
=B49+0.01	Unit 3 Overflow Piping	Assumption 3.01	gal	=Equipment!I26	Y
=B50+0.01	Unit 3 Ash Hopper Pit Sump	Attachment 8.09	gal	=Equipment!I27	Y
=B51+0.01	AWRP Piping	Attachment 8.07	gal	=SUM(Piping!I9:I18)-Piping!I11	Y
=B52+0.01	Piping from Bottom Ash Pump to Jet Pump	Assumption 3.04	gal	=SUM(Piping!I20:I21)	Y
=B53+0.01	Piping from Jet Pumps to South Pond	Attachment 8.08	gal	=SUM(Piping!I23:I25)	Y
=B54+0.01	Boiler Room Sump and Bottom Ash Hopper Pit Sump Discharge lines to Crossover	Attachments 8.03 and 8.13	gal	=SUM(Piping!I27:I29)	Y
=B55+0.01	Units 1 and 2 Boiler Room Sump Crossover Piping to South Pond	Attachment 8.12	gal	=Piping!I30	Y
=B56+0.01	Unit 3 Ash Hopper Pit Sump Crossover Piping to South Pond	Attachment 8.12	gal	=Piping!I31	Y
	TOTAL WETTED VOLUME UNITS 1, 2 & 3		**gal**	**=SUM(F44:F57)**	**Y**
	Estimated Max Daily Blowdown based on 10% wetted volume over a 30-day rolling average		**gpm**	**=F58*0.1/(60*24)**	**Y**
=B57+0.01	**TOTAL VOLUME UNITS 1, 2 & 3**		**gal**	**=Equipment!I30+Piping!I32**	**Y**
=B60+0.01	Units 1 & 2 Boiler Room Sump Surge Volume	Attachment 8.03	gal	=2*Equipment!I14	Y
=B61+0.01	Units 3 Ash Hopper Pit Sump Surge Volume	Attachment 8.09	gal	=Equipment!I28	Y
=B62+0.01	Units 1 & 2 Ash Hopper Surge Volume	Attachment 8.02	gal	=Equipment!I11*2	Y
=B63+0.01	Unit 3 Ash Hopper Surge Volume	Attachment 8.05	gal	=Equipment!I25	Y
=B64+0.01	Surge Volume of South Pond	Assumption 3.04	gal	=Equipment!I29	Y
7	**REFERENCES:**				
=B67+0.01	N/A				
8	**ATTACHMENTS:**				
8.01	Wetted Ash Volume Calculation Summary				
=B71+0.01	U1 & U2 Bottom Ash Hopper Volume				
=B72+0.01	U1 & U2 Boiler Room Sump				
=B73+0.01	U1, U2 & U3 Bottom Ash Piping Isometrics				
=B74+0.01	U3 Bottom Ash Hopper Volume				
=B75+0.01	U1 & U2 Bottom Ash Hopper Overflow Pipe				
=B76+0.01	AWRP Piping drawings and images				
=B77+0.01	Excel Formulas				
=B78+0.01	U3 Ash Hopper Pit Sump				
=B79+0.01	U1 and U2 Bottom Ash Pumps to Jet Pumps				
=B80+0.01	U3 Bottom Ash Pumps to Jet Pumps				
=B81+0.01	U1 and U2 Bottom Ash Sump Pump Piping and U3 Ash Hopper Pit Sump Piping from Crossover to South Pond				
=B82+0.01	U3 Ash Hopper Pit Sump Discharge pipe to Crossover				

WETTED ASH VOLUME CALCULATION - EQUIPMENT

Piping	Pipe schedule	Pipe nominal dia (in)	Pipe Inner dia (in)	Pipe length (ft)	Pipe Cross Sectional area (ft^2)	Volume (ft^3)	Volume (gal)	Notes
1. Unit 1 Bottom Ash Hopper								
1-01 - Hopper Volume	N/A	N/A	N/A	N/A	N/A	N/A	61870	
1-02 - Seal Trough (if applicable)	N/A	N/A	N/A	N/A	N/A	=((64.71+1)*(7.79+1)-(7.79*64.71))*0.5	=H10*62.4*0.12	
1-03 - Surge Capacity (assume water level to be at emergency overflow level for hopper)	N/A	N/A	N/A	N/A	N/A	249.28	=H11*62.4*0.12	
1-04 - Overflow piping to Boiler Room Sump	STD	12	12	27	=(PI()*E12^2)/(4*144)	=F12*G12	=H12*62.4*0.12	
1-05 - Boiler Room Sump	N/A	N/A	N/A	N/A	N/A	=(666-654)*20*8	=H13*62.4*0.12	First Pump Start level at 666' is used
1-06 - Boiler Room Sump Surge Volume	N/A	N/A	N/A	N/A	N/A	=(667.167-666)*20*8	=H14*62.4*0.12	Extreme High level alarm at 667'-2" is used
2. Unit 2 Bottom Ash Hopper								
2-01 - Hopper Volume	N/A	N/A	N/A	N/A	N/A	N/A	61870	
2-02 - Seal Trough (if applicable)	N/A	N/A	N/A	N/A	N/A	=((64.71+1)*(7.79+1)-(7.79*64.71))*0.5	=H17*62.4*0.12	
2-03 - Surge Capacity (assume water level to be at emergency overflow level for hopper)	N/A	N/A	N/A	N/A	N/A	249.28	=H18*62.4*0.12	
2-04 - Overflow piping to Boiler Room Sump	STD	12	12	27	=(PI()*E19^2)/(4*144)	=F19*G19	=H19*62.4*0.12	
2-05 - Boiler Room Sump	N/A	N/A	N/A	N/A	N/A	=(666-654)*20*8	=H20*62.4*0.12	First Pump Start level at 666'" is used
2-06 - Boiler Room Sump Surge Volume	N/A	N/A	N/A	N/A	N/A	=(667.167-666)*20*8	=H21*62.4*0.12	Extreme High level alarm at 667'-2" is used
3. Unit 3 Bottom Ash Hopper								
3-01 - Hopper Volume	N/A	N/A	N/A	N/A	N/A	9640.42	=H23*62.4*0.12	
3-02 - Seal Trough (if applicable)	N/A	N/A	N/A	N/A	N/A	=((61.75+1)*(10.5+1)-(10.5*61.75))*0.5	=H24*62.4*0.12	
3-03 - Surge Capacity (assume water level to be at emergency overflow level for hopper)	N/A	N/A	N/A	N/A	N/A	366.81	=H25*62.4*0.12	
3-04 - Overflow piping to Ash Hopper Pit Sump	STD	12	12	27	=(PI()*E26^2)/(4*144)	=F26*G26	=H26*62.4*0.12	
3-05 - Ash Hopper Pit Sump	N/A	N/A	N/A	N/A	N/A	=(80-77)*15.33*6.5	=H27*62.4*0.12	First Pump Start level at 80' is used
3-06 - Ash Hopper Pit Sump Surge Volume	N/A	N/A	N/A	N/A	N/A	=(82-80)*15.33*6.5	=H28*62.4*0.12	Third Pump Start level at 82' is used
4. Surge Volume of South Pond	N/A	N/A	N/A	N/A	N/A	=33.9*43559.9	=H29*62.4*0.12	
5. Total Volume of Equipment							=SUM(I9:I28)	The sum of all volumes above except the Surge Volume of the South P

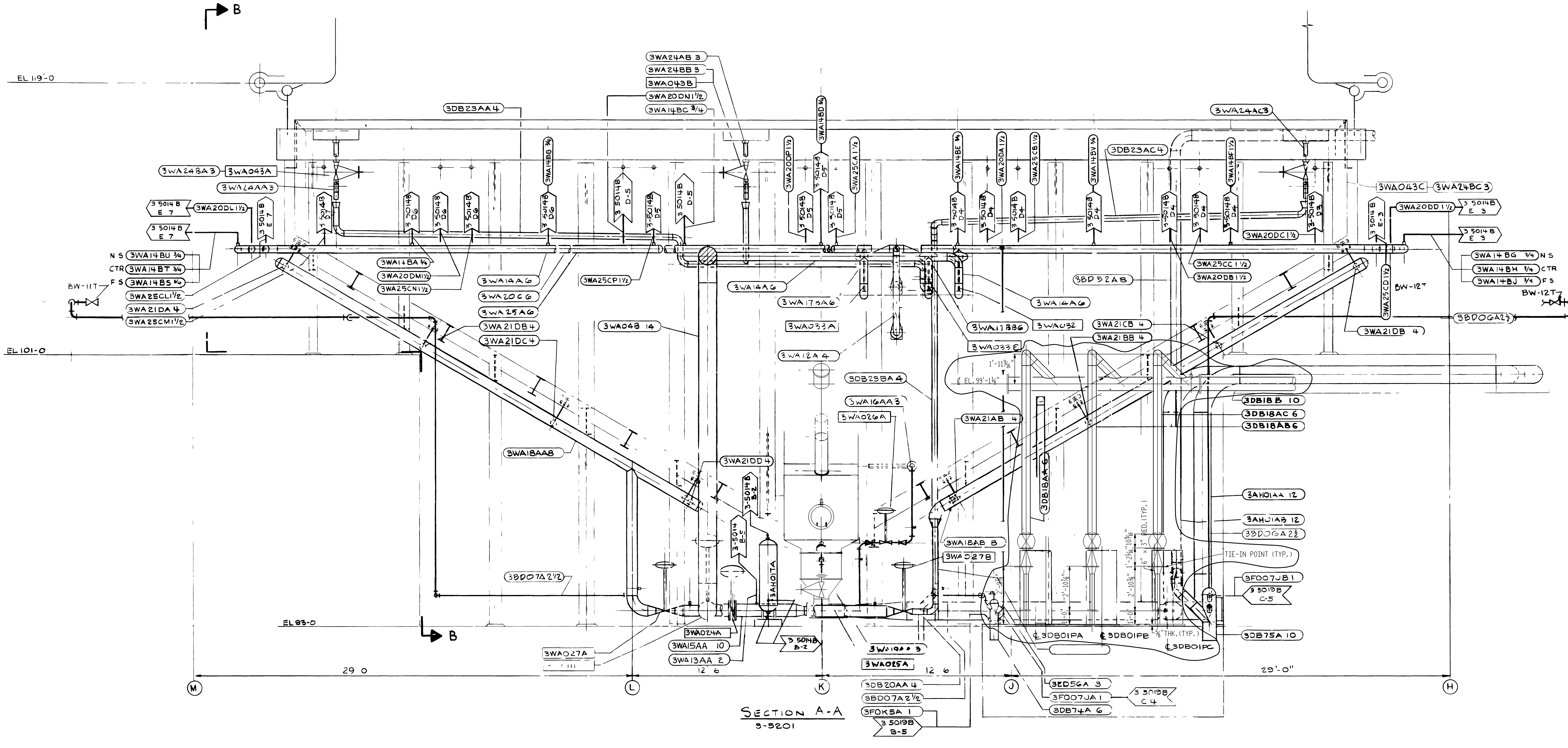
WETTED ASH VOLUME CALCULATION - PIPING

Piping	Pipe schedule	Pipe nominal dia (in)	Pipe Inner dia (in)	Pipe length (ft)	Pipe Cross Sectional area (ft^2)	Volume (ft^3)	Volume (gal)	Notes
1. Piping from Ash Water Recirculation Pump (AWRP) Loop to Units 1, 2, and 3								
1-01a - AWRP Discharge Common Header up to Unit 3	STD	30	29.25	98	=(PI()*E9^2)/(4*144)	=F9*G9	=H9*62.4*0.12	
1-01b - AWRP Discharge Common Header up to Unit 3	STD (20)	24	23.25	2522	=(PI()*E10^2)/(4*144)	=F10*G10	=H10*62.4*0.12	
1-01c - Redundant AWRP Discharge Pipe	STD (20)	24	23.25	2522	=(PI()*E11^2)/(4*144)	=F11*G11	=H11*62.4*0.12	Redundant AWRP pipe for the discharge common header up to Unit 3
1-02a - AWRP Discharge Dedicated line to Unit 3 Bottom Ash Pump	STD	18	17.25	672	=(PI()*E12^2)/(4*144)	=F12*G12	=H12*62.4*0.12	
1-02b - AWRP Discharge Dedicated line to Unit 3 Bottom Ash Pump	STD (30)	14	13.25	50	=(PI()*E13^2)/(4*144)	=F13*G13	=H13*62.4*0.12	Assumed 14" nominal piping extend 50 ft to Bottom Ash Pump
1-03 - AWRP Discharge Common Header up to Unit 2	STD (20)	24	23.25	4740	=(PI()*E14^2)/(4*144)	=F14*G14	=H14*62.4*0.12	
1-04a - AWRP Discharge Dedicated line to Unit 2 Bottom Ash Pump	STD (30)	16	15.25	456	=(PI()*E15^2)/(4*144)	=F15*G15	=H15*62.4*0.12	
1-04b - AWRP Discharge Dedicated line to Unit 2 Bottom Ash Pump	STD	12	12	50	=(PI()*E16^2)/(4*144)	=F16*G16	=H16*62.4*0.12	Assumed 12" nominal piping extend 50 ft to Bottom Ash Pump
1-05a - AWRP Discharge Dedicated line to Unit 1 Bottom Ash Pump	STD (30)	16	15.25	826	=(PI()*E17^2)/(4*144)	=F17*G17	=H17*62.4*0.12	
1-05b - AWRP Discharge Dedicated line to Unit 1 Bottom Ash Pump	STD	12	12	50	=(PI()*E18^2)/(4*144)	=F18*G18	=H18*62.4*0.12	Assumed 12" nominal piping extend 50 ft to Bottom Ash Pump
2. Piping from Bottom Ash Pump to Jet Pump								
2-01 - Unit 1 and Unit 2 Common Bottom Ash Pump to Jet Pump	STD	12	12	=204.4167+2*48.4167+249.	=(PI()*E20^2)/(4*144)	=F20*G20	=H20*62.4*0.12	Conservatively used just the lengths of pipe from Att. 8.10 and assumed all pi
2-02 - Unit 3 Bottom Ash Pump to Jet Pump	STD	12	12	200.9	=(PI()*E21^2)/(4*144)	=F21*G21	=H21*62.4*0.12	Conservatively used just the lengths of pipe from Att. 8.11 and assumed all pi
3. Piping from Jet Pump to South Pond								
3-01 - Unit 1 Jet Pump to South Pond	HDPE / Basalt Lined	12	11.8	=1.6*5280	=(PI()*E23^2)/(4*144)	=F23*G23	=H23*62.4*0.12	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and a lined CS (ID 11.93") so 11.8" is used for conservatism
3-02 - Unit 2 Jet Pump to South Pond	HDPE / Basalt Lined	12	11.8	=1.58*5280	=(PI()*E24^2)/(4*144)	=F24*G24	=H24*62.4*0.12	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and a lined CS (ID 11.93") so 11.8" is used for conservatism
3-03 - Unit 3 Jet Pump to South Pond	HDPE / Basalt Lined	12	11.8	4239.73	=(PI()*E25^2)/(4*144)	=F25*G25	=H25*62.4*0.12	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and a lined CS (ID 11.93") so 11.8" is used for conservatism
4. Boiler Room Sump Discharge to the Crossover								
4-01 - Unit 1 Boiler Room Sump Discharge to Crossover	CS Polyurethane-lined pipe (assumed STD)	12	12	=108+350+278.5+19	=(PI()*E27^2)/(4*144)	=F27*G27	=H27*62.4*0.12	Assumed the same ID as Carbon Steel STD pipe
4-02 - Unit 2 Boiler Room Sump Discharge to Crossover	CS Polyurethane-lined pipe (assumed STD)	12	12	=350+111+19	=(PI()*E28^2)/(4*144)	=F28*G28	=H28*62.4*0.12	Assumed the same ID as Carbon Steel STD pipe
4-03 - Unit 3 Ash Hopper Pit Sump Discharge to Crossover	Sch. 40	10	10.02	52.5	=(PI()*E29^2)/(4*144)	=F29*G29	=H29*62.4*0.12	
4-04 - Units 1 and 2 Boiler Room Sump Crossover Piping to South Pond	HDPE / Basalt Lined	12	11.8	=4995+389+2746	=(PI()*E30^2)/(4*144)	=2*F30*G30	=H30*62.4*0.12	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and a lined CS (ID 11.93") so 11.8" is used for conservatism
4-05 - Unit 3 Ash Hopper Pit Sump Crossover Piping to South Pond	HDPE / Basalt Lined	12	11.8	=794+2746	=(PI()*E31^2)/(4*144)	=F31*G31	=H31*62.4*0.12	ID from CBP doc, A portion of the pipe is 14" (SDR 13.5) HDPE (ID 11.8") and a lined CS (ID 11.93") so 11.8" is used for conservatism
5. Total Volume of Piping							=SUM(I9:I31)	The sum of all volumes above

8.09
U3 Ash Hopper Pit Sump

3-5201
BOILER ROOM PIPING PLAN
ASH HOPPER PIT
BUCKEYE POWER, INC.
CARDINAL PLANT UNIT 3
BRILLIANT
OHIO
SARGENT & LUNDY ENGINEERS CHICAGO
DRAWING. NO.
3-5201-4
SCALE 3/8"=1'-0"
THIS DRAWING HAS BEEN ELECTRONICALLY SCANNED. SEE MICROFILM RECORDS FOR HISTORY & SIGNATURES. DRAWING REVISION 3
THIS DWG.HAS BEEN CERTIFIED BY "GEORGE C. KUHLMAN", REGISTERED PROF. ENGINEER IN THE STATE OF "OHIO", No. "E-38354", "FOR CONSTRUCTION" ISSUE. FOR ORIGINAL CERTIFICATION STAMP AND SIGNATURE, SEE MICROFILM RECORD FOR REF'D. REV. 3
2/25/97
4
PER PTS-97746: REPLACED (3) ASH PIT SUMP PUMPS.(E4).PER AS-BUILT COND'S. REROUTED DISCH.PIPE FROM SAME PUMPS (E4). DR
JDB
DATE
NO.
DESCRIPTION
APPD.
REVISIONS
/usr6/mech/cardinal/u3_piping/5201.300
/usr6/mech/cardinal/u3_piping/5201.cit
SYSTEM DATE-26-FEB-1997
SYSTEM TIME-14:38
PLOT DATE- 1/28/97
PLOTTED BY-D.ROSE
KEY PLAN
NORTH
WATER TREATING
SERVICE BLDG
TURBINE ROOM
BOILER ROOM
ELEC. ROOM
AUX BOILER
ASH PIT
ASH HOPPER PIT EL 583-0
3WA21DR4
3AH01AA12
3AH01AB12
3WA21CB4
3DB75A 10
3DB18AC6
3DB002C
3DB18B10
3DB18AB6
3DB002B
3DB18AA6
3DB002A
3DB01PC
3DB01PB
3DB01PA
3ED56A 3 (TOP)
3F007JA 1 (BOT)
3DB74A 6
3F0K5A 1 (BOT)
3F007JB 1
3DB52A 8
3WA21BB4
3DB21A 12
3WA21AB4
3DB20AB4
3WA16AB3
3WA026B
3WA025B
3WA15AB3
3AH01TB
3WA15A310
3WA024B
3WA21AA4
3WA21BA4
3WA21CA4
3WA21DA4
3WA18C4
3WA027B
3WA16AA3
3WA026A
3WA025A
3WA19AA3
3AH01TA
3WA15AA10
3WA024A
3WA04B14
3WA027A
3WA18AA8
3DB07A2½
1½"CPL'G.(PLUG)
90°ELL.45° ROLL (TYP.)
10"B.F.

3-5457



THIS DWG.HAS BEEN CERTIFIED BY "GEORGE C. KUHLMAN", REGISTERED PROF. ENGINEER IN THE STATE OF "OHIO", No. "E-38354", "FOR CONSTRUCTION" ISSUE. FOR ORIGINAL CERTIFICATION STAMP AND SIGNATURE, SEE MICROFILM RECORD FOR REF'D. REV. _2_

DATE	NO.	DESCRIPTION	APPD.
2 / 25/ 97	3	PER PTS-97746: REPLACED (3) ASH PIT SUMP PUMPS.(C3).(B3) PER AS-BUILT COND'S. REROUTED DISCH.PIPE FROM SAME PUMPS (C3). DR	JDB

REVISIONS

ASH HOPPER-WET "SECTION A-A"

BUCKEYE POWER, INC.

CARDINAL PLANT UNIT 3

BRILLIANT OHIO

SCALE 3/8"=1'-0"

THIS DRAWING HAS BEEN ELECTRONICALLY SCANNED. SEE MICROFILM RECORDS FOR HISTORY & SIGNATURES. DRAWING REVISION 2

/usr6/mech/cardinal/u3_piping/5457.300

/usr6/mech/cardinal/u3_piping/5457.cit

SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING. NO.

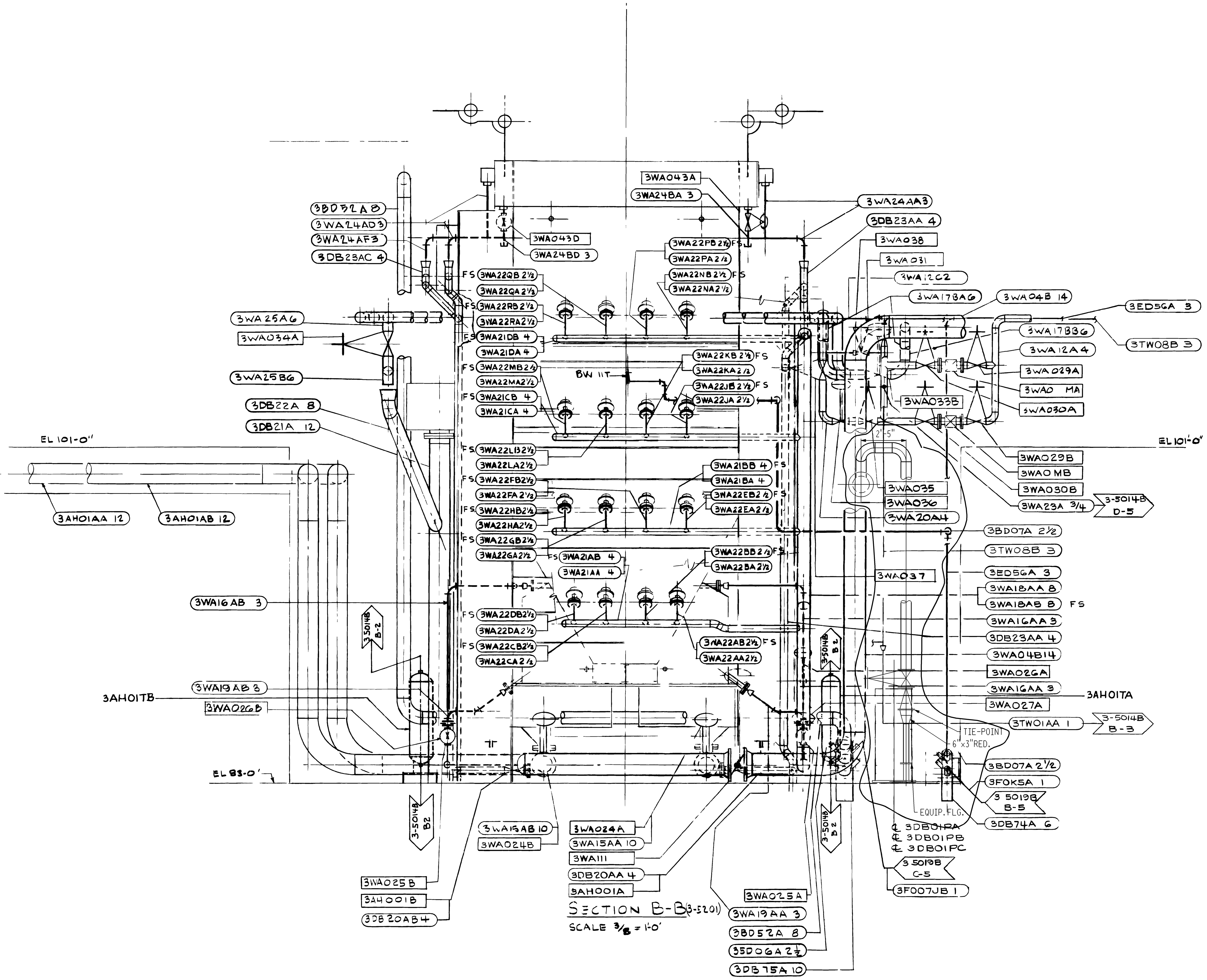
3-5457-3

Q.C.-2 /24/97 Q.C. BY-D.ROSE

SYSTEM DATE-26-FEB-1997
SYSTEM TIME-14:44

PLOT DATE- 1/27/97
PLOTTED BY-D.ROSE

3-5458



STATE OF OHIO
GEORGE C KUHLMAN
E 38354
REGISTERED PROFESSIONAL ENGINEER

DATE	NO.	DESCRIPTION	APPD.
2/25/97	3	PER PTS-97746: REPLACED (3) ASH PIT SUMP PUMPS.(C3),(B3) PER AS-BUILT COND'S. REROUTED DISCH.PIPE FROM SAME PUMPS (C3). DR	JDB

REVISIONS

ASH HOPPER-WET SECTION "B-B"

BUCKEYE POWER, INC.

CARDINAL PLANT UNIT 3

BRILLIANT — OHIO

SCALE 3/8"=1'-0"

THIS DRAWING HAS BEEN ELECTRONICALLY SCANNED. SEE MICROFILM RECORDS FOR HISTORY & SIGNATURES. DRAWING REVISION 2

SARGENT & LUNDY ENGINEERS CHICAGO

/usr6/mech/cardinal/u3_piping/5458.300

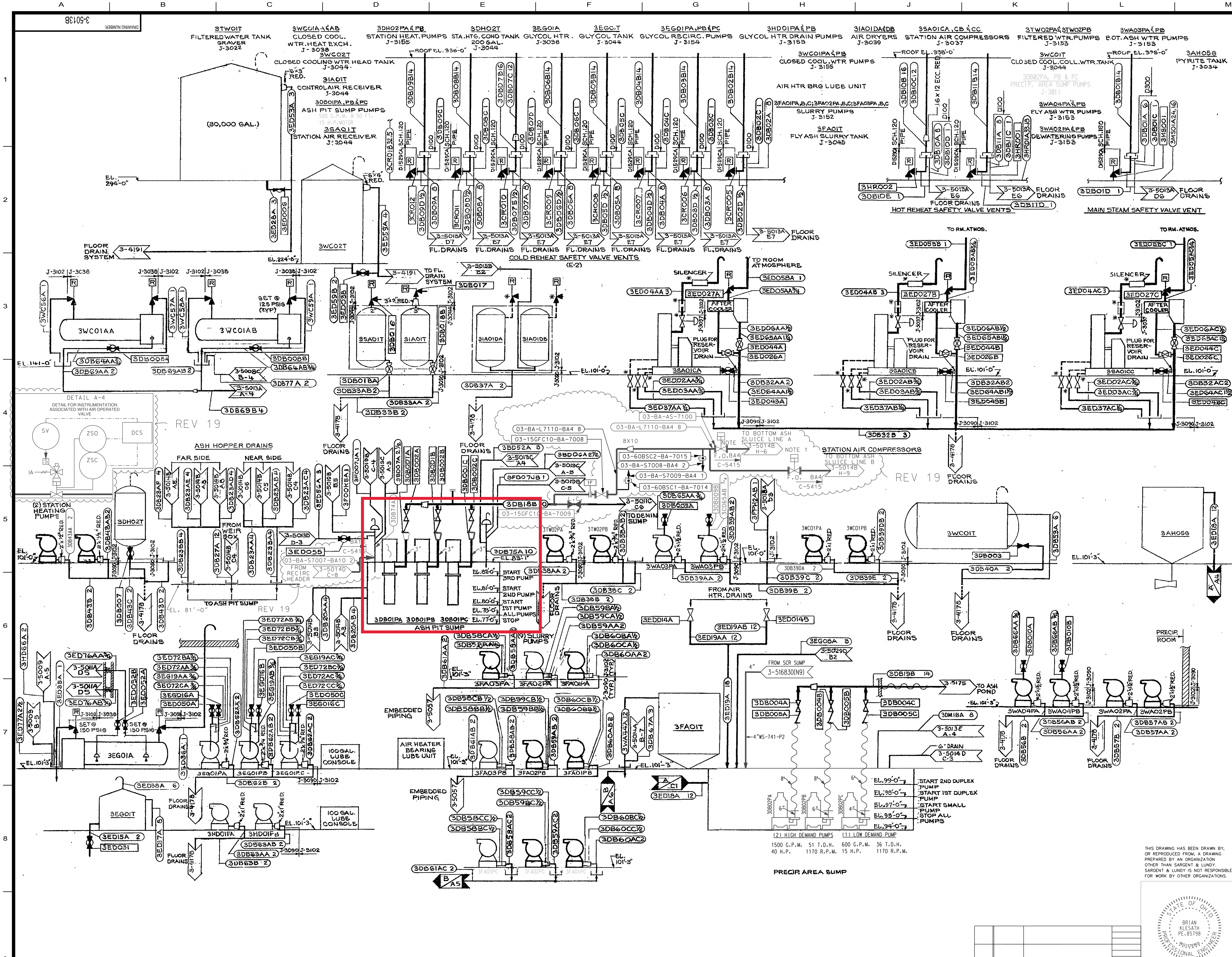
/usr6/mech/cardinal/u3_piping/5458.clt

DRAWING NO.

3-5458-3

SYSTEM DATE-26-FEB-1997
SYSTEM TIME-14:48

PLOT DATE- 1/28/97
PLOTTED BY-D.ROSE



PDC NUMBER	DESIGN PRESSURE (psig)	DESIGN TEMP. (DEG. F)	MAX OPER. PRESSURE (psig)	MAX OPER. TEMP. (DEG. F)	PIPING CODE	PDT	INSTR. PIPE CODE	INSTR. PDT	INSULATION TYPE	FIELD TEST PRESSURE (psig)	REMARKS
BA10	120	110	110	100	B31.1 NBEP	S&L 0105	B31.1 NBEP	S&L 0659	N	IN SERVICE	CS A106 OR A53
BA4	110	110	100	100	B31.1 NBEP	S&L 0105	B31.1 NBEP	S&L 0659	N	165	CS A53 GR B ERW
BA9	110	110	100	100	B31.1 NBEP	S&L 0150	B31.1 NBEP	S&L 0659	N	IN SERVICE	316 SS

REV 19

GENERAL NOTES

1. SEE DETAIL "A-4" OF THIS DRAWING FOR INSTRUMENTATION FOR AIR OPERATED VALVES.
2. NEW PIPING IS PER PDC NUMBER BA4 UNLESS OTHERWISE INDICATED.

REV 19

REFERENCE DRAWINGS

3-5014B FLOW DIAGRAM P&ID BOTTOM ASH WATER

REV 19

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

FLOW DIAGRAM
P. & I.D.-BOILER ROOM VENTS & DRAINS

UNIT: 3 | DRAWING NUMBER: 3-5013B | REV: 19

SCALE: N/A | ENGINEERING DIVISION

DR. BY / CH. CHKD / SUP. APPD / ENG. ENG / DATE: DATE

THIS DRAWING HAS BEEN DRAWN BY, OR REPRODUCED FROM, A DRAWING PREPARED BY AN ORGANIZATION OTHER THAN SARGENT & LUNDY. SARGENT & LUNDY IS NOT RESPONSIBLE FOR WORK BY OTHER ORGANIZATIONS.

STATE OF OHIO — BRIAN KLESATH PE.85798 — REGISTERED PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

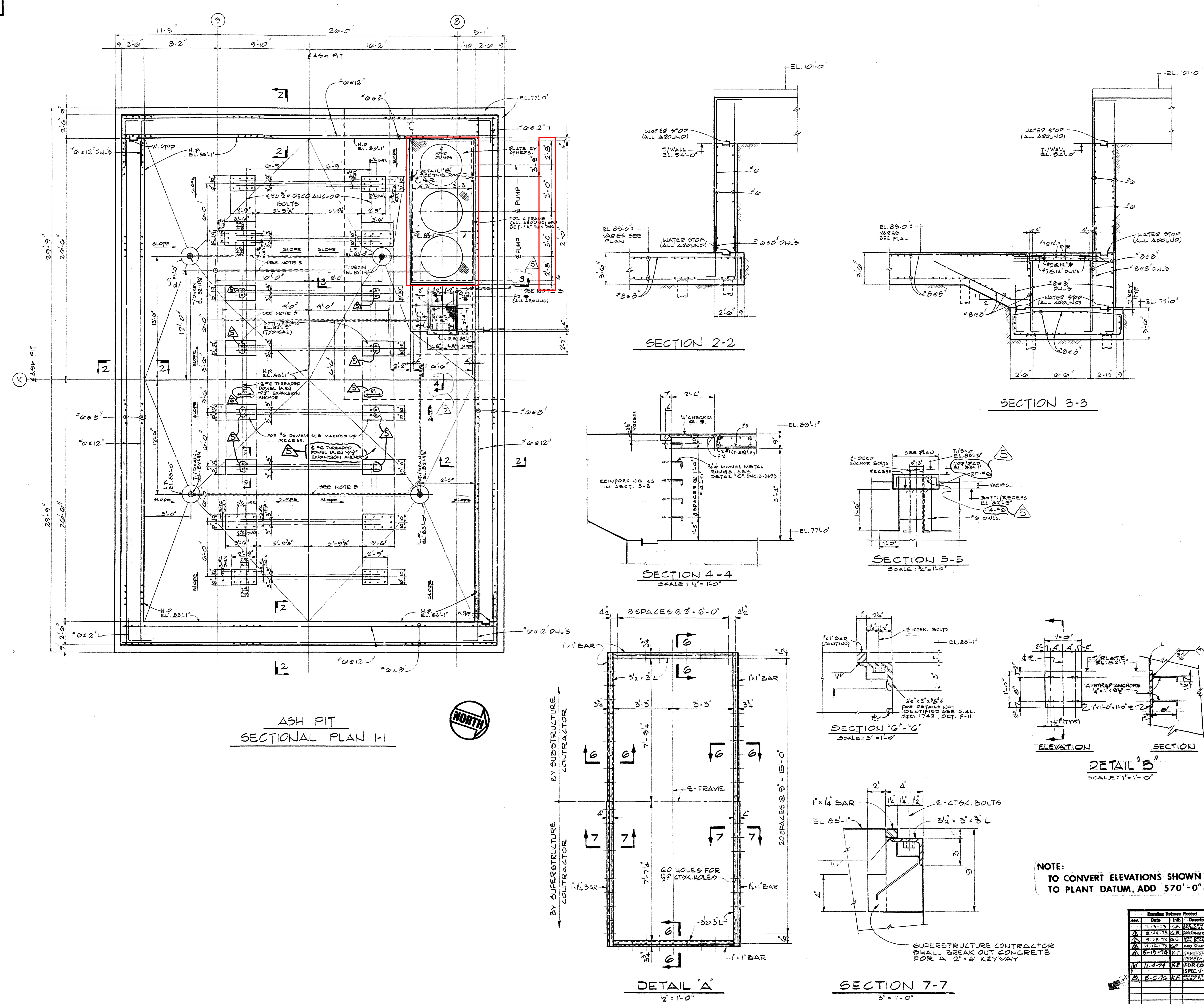
Sargent & Lundy

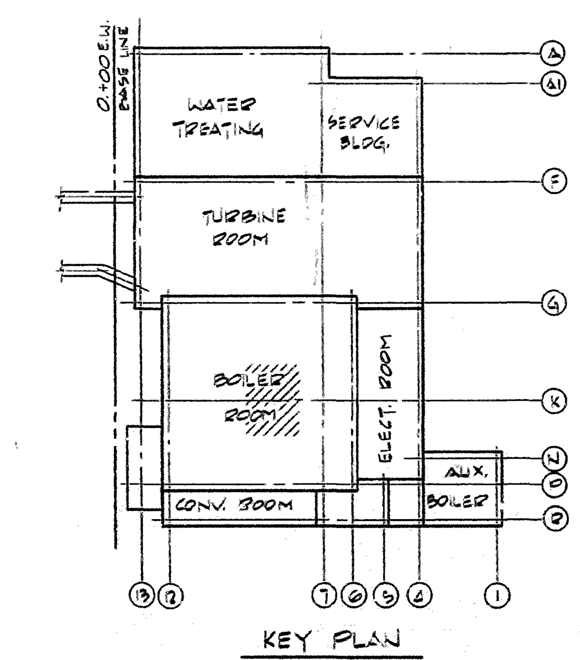
REV	DATE RELEASED	PURPOSE	
19	03-17-2021	ISSUE FOR CONSTRUCTION SPEC C-5415	D. WU PREPARED / B. KLESATH REVIEWED / B. KLESATH APPROVED

DRAWING RELEASE RECORD

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913





NOTE:
TO CONVERT ELEVATIONS SHOWN TO PLANT DATUM, ADD 570'-0"

NOTES

1. FOR GENERAL NOTES SEE DWG. 3-3391
2. * INDICATES WORK FURNISHED & INSTALLED BY SUPER-STRUCTURE CONTRACTOR.
3. FOR PLUMBING IN ASH PIT FOUNDATION SEE DWG. 3-4178

REFERENCE DRAWINGS

3-3055	PILING PLAN BOILER ROOM
3-3393	INTAKE & DISCHARGE TUNNELS SECTIONS & DETAILS
3-4178	PLUMBING BOILER ROOM GROUND FLOOR

ALL WORK PERFORMED BY SARGENT & LUNDY ON THIS DRAWING WAS COMPLETED WITH REVISION 5 DATED 8-5-76 AND THE DRAWING ORIGINAL WAS TRANSMITTED TO AMERICAN ELECTRIC POWER SERVICE CORPORATION

STATE OF OHIO — M. ZAR — E-1[illegible] — REGISTERED PROFESSIONAL ENGINEER

Drawing Release Record

Rev.	Date	Init.	Description
	7-13-73	G.E.	FOR REINFORCE DETAILING ONLY
1	8-24-73	G.E.	FOR CONSTRUCTION
2	9-28-73	GE	ADD DETAIL REV. SLAB ELEV.
3	11-16-73	GE	ADD PLUMBING
4	5-13-74	K.F.	SUPERST. BIDS SPEC-3082
W	11-4-74	K.F.	FOR CONST. SPEC. J-3082
5	8-5-76	K.F.	REV. PAD & SECT. PLAN 1-1

BOILER RM. ASH PIT FOUNDATION
PLAN SECTIONS & DETAILS

CARDINAL PLANT UNIT 3
BUCKEYE POWER, INC.
BRILLIANT, OHIO

SCALE ¼"=1'-0" U.N.
DRAWN D. J. BEDAR 7-10-73
CHECKED [signature] 8-24-73
ENGINEER R. [signature] Smith 8-29-73
APPROVED [signature] 8-30-73
JOB NO. 4642

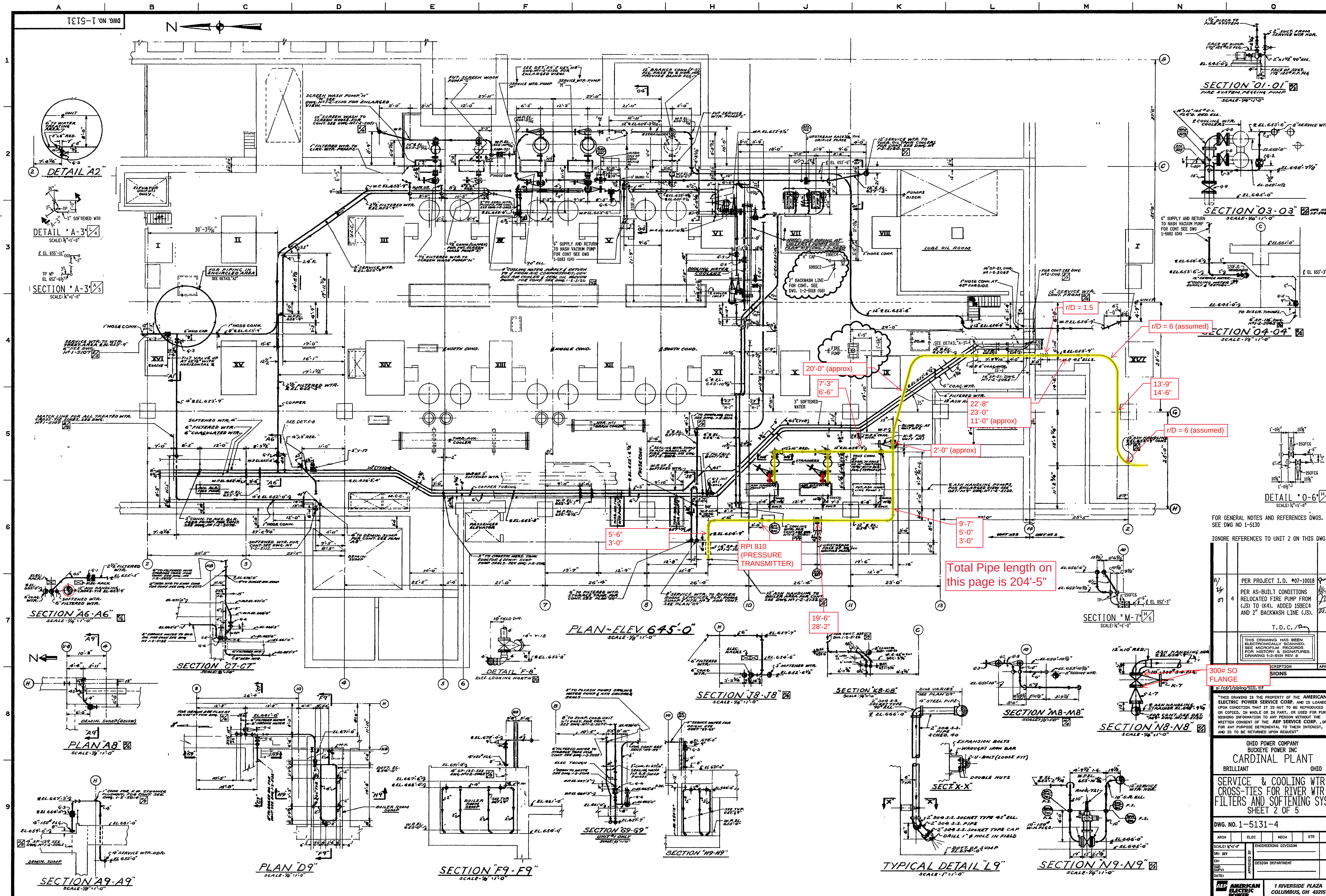
SARGENT & LUNDY ENGINEERS CHICAGO

DRAWING NO. 3-3340-5

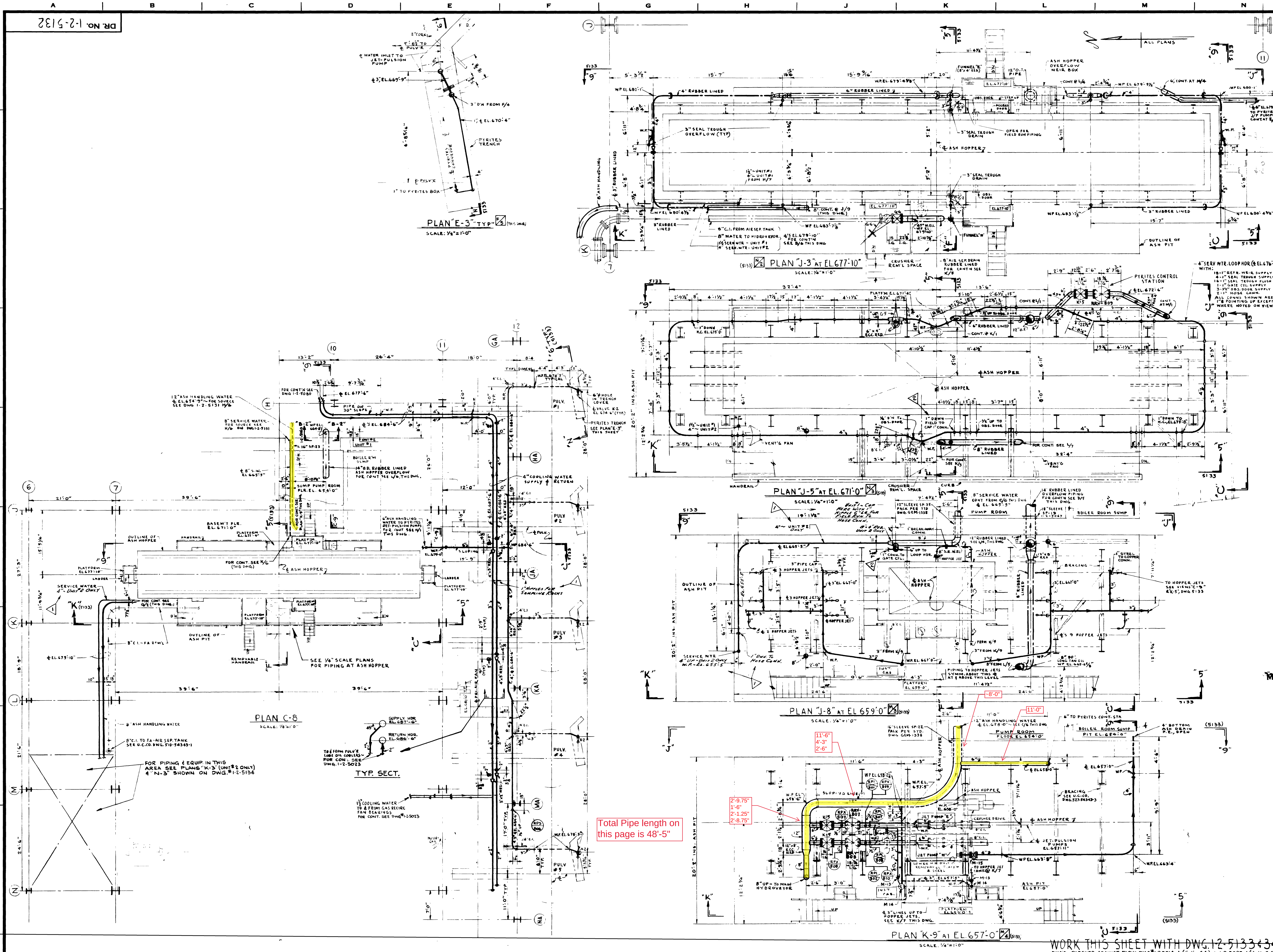
8.10
U1 and U2 Bottom Ash Pumps to Jet Pumps

Pump Suction

Pump Discharge



DR. No. 1-2-5132



WORK THIS SHEET WITH DWG. 1-2-5133 & 34
DWGS. CHECKED AGAINST FLOW DWG. 1-2-5014-1 (11-11-64) & 1-2-5023-1 (11-11-64)

GENERAL NOTES

2½" PIPE & OVER TO BE SHOP FABRICATED; 2" PIPE & UNDER TO BE FIELD RUN.

TERMINAL CONN'S. ON RUBBER LINED PIPE TO BE FLAT FACED FLGS.

ALL INTERMEDIATE JOINTS. ON RUBBER LINED PIPE (AS REQ'D. FOR INSTALL. OF LINING) TO BE VICTAULIC CPLG'S. THE NUMBER & LOCATION OF THESE CPLG'S. TO BE DETERMINED BY P.C. IN ACCORDANCE WITH STD. PRACTICE FOR RUBBER LINED PIPE.

FOR DIMENS AT RUBBER LINED FLG. JOINTS SEE NOTE ON DWG. #1-2-5060.

FOR ADD'L. GEN'L. NOTES SEE DWG. #1-2-5130

SYMBOLS:

LINED PIPING
V.C. = VICTAULIC COUPLING
P.C. = PIPING CONTRACTOR
O.F = OVERFLOW PIPING
I.G. = INCLUDING GASKET
F.A. = FLY ASH

REFERENCE DRAWINGS

A.E.P. SERVICE CORP

BOILER DRAIN PIPING	1-2-5204
BOTTOM ASH PIPING	1-2-5219
FLOOR & WALL SLEEVES	1-2-5065
STATION DRAINAGE	1-2-5060
FLY ASH SLURRY PIPING	1-2-5216
FLOW DIAGRAM ~ SERVICE WATER & ASH HANDLING	1-2-5014
FLOW DIAGRAM — COOLING WATER	1-2-5023
FLY ASH SLURRY TK. (UNIT #2)	1-2-5073
DET. OF PIPE PENETRATION THRU EXTER. SIDING	GE-A-4081
SPECS. FOR SURFACE PROTECTION - STL. PIPE	GEM-1245
TYP. DET FOR SEALING PIPE IN WALL SLEEVE	GEM-1338

UNITED CONVEYOR CORP.:

DESIGN OF ASH HOPPER	527-54343-1, 2 & 3
PYRITES JET-PULSION CONV'R	510-54343-2
FLY ASH CONV'R	510-54343-1
8" JET-PULSION PUMP (BOTT ASH)	3-1602-105
4" JET PULSION PUMP (PYRITES)	3-1602-99
6" HYDROVEYOR (FLY ASH)	3-1601-3
6" JET-PULS. PUMP FOR F.A, UNIT #1	PD-1615
FLY ASH VACUUM TANK	3-2611-73A
FLY ASH-AIR SEP. TANK	3-2611-72A

B. & W. Co:

LUBE OIL COOLER FOR PULV'R	106982E

REVISIONS

DATE		DESCRIPTION	APPD.
10-6-66	2	RELOCATED 1" CONN. TO GATE CYL. FROM RING HDR. K/5 TO UPSTREAM OF G-5 VA. K/6 PER W.R. 364/66 J.S.	WG
1-14-65	1	DELETED 1½" TO F.A. VAC TANK (UNIT 1) IN PLAN C-8 & J-8, ADDED HOSE CONNS. PLAN J-8, ADDED 1" CONNS FOR SAMPLE RACKS @ F/7. CORRECT PER LATEST FLOW DIAGRS. F.S.J.	WG

CARDINAL PLANT
OHIO POWER COMPANY
BUCKEYE POWER, INC.
BRILLIANT, OHIO

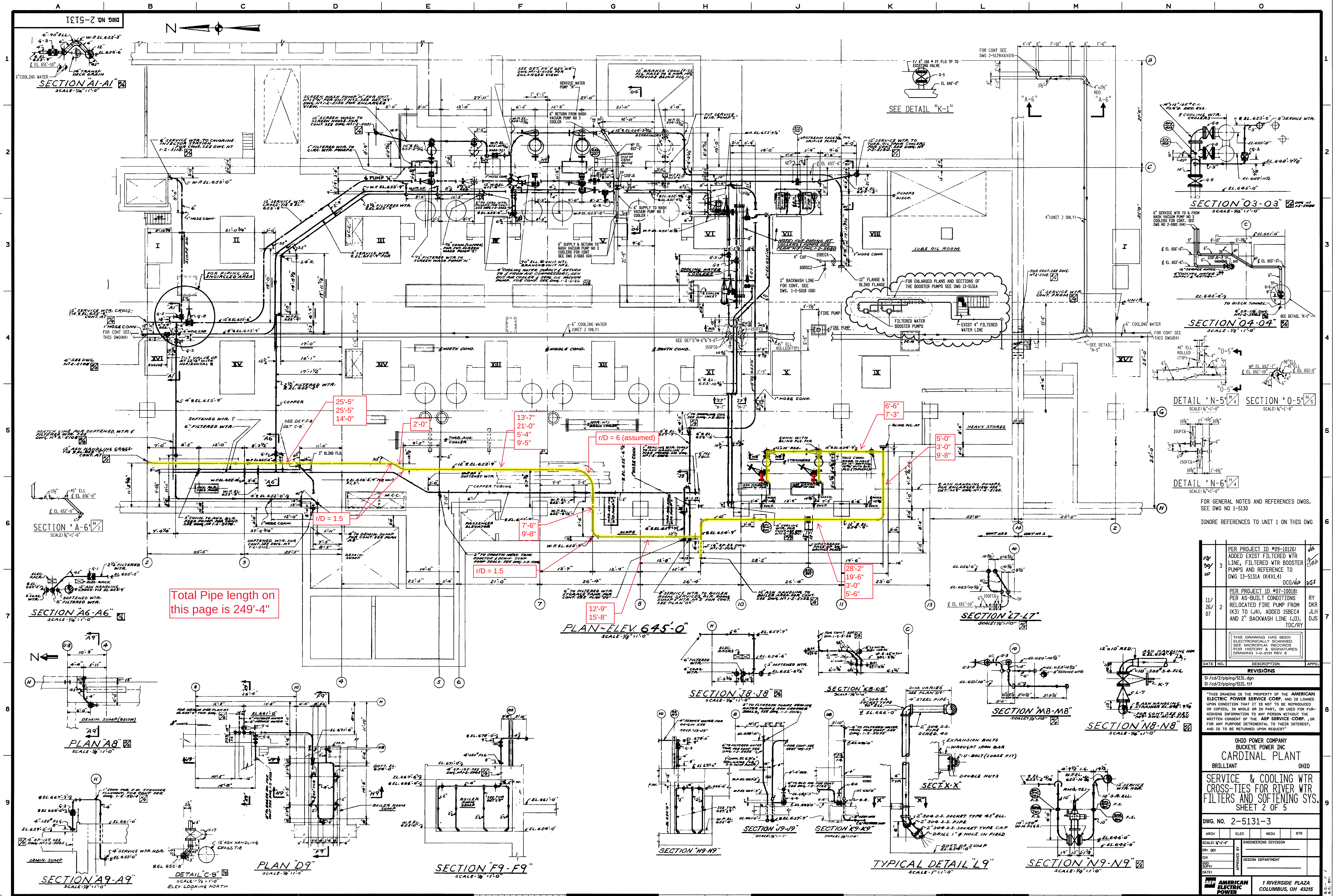
SERV. & COOLING WATER PIPING
BOILER ROOM ~ PLANS
UNITS 1 & 2 SHEET #3 OF 5

EXCEPTIONS ARE NOTED

DR. No. 1-2-5132-2

ARCH. — ELEC. MECH. STR.
SCALE: AS NOTED
DR.
CH. J.S.
SQ. LDR. F.S.J.
DATE: 9-30-64
APPROVED BY ENGINEERING DIV. DESIGN DIV. J. E. Dolan

AMERICAN ELECTRIC POWER SERVICE CORP.
2 BROADWAY NEW YORK


DWG NO. 2-5131
Total Pipe length on this page is 249'-4"
r/D = 6 (assumed)
r/D = 1.5
r/D = 1.5
25'-5"
25'-5"
14'-0"
2'-0"
13'-7"
21'-0"
5'-4"
9'-5"
6'-6"
7'-3"
5'-0"
3'-0"
9'-8"
7'-6"
9'-8"
12'-9"
15'-8"
28'-2"
19'-6"
3'-0"
5'-6"
PLAN~ELEV 645'-0"
SCALE-1/8"=1'-0"
SECTION "A1-A1"
SECTION "A-6"
SECTION "A6-A6"
PLAN "A8"
SECTION "A9-A9"
DETAIL "C-9"
PLAN "D9"
SECTION "F9-F9"
SECTION "H9-H9"
SECTION "J8-J8"
SECTION "J9-J9"
SECTION "K8-K8"
SECTION "K9-K9"
TYPICAL DETAIL "L9"
SECT. X-X
SECTION "L7-L7"
SECTION "M8-M8"
SECTION "N8-N8"
SECTION "N9-N9"
SECTION "O3-O3"
SECTION "O4-O4"
DETAIL "N-5"
SECTION "O-5"
DETAIL "N-6"
SEE DETAIL "K-1"
FOR ENLARGED PLANS AND SECTIONS OF THE BOOSTER PUMPS SEE DWG 13-5131A
FILTERED WATER BOOSTER PUMPS
EXIST 4" FILTERED WATER LINE
LUBE OIL ROOM
HEAVY STORES
FOR GENERAL NOTES AND REFERENCES DWGS. SEE DWG NO 1-5130
IGNORE REFERENCES TO UNIT 1 ON THIS DWG
PER PROJECT ID #09-10126: ADDED EXIST FILTERED WTR LINE, FILTERED WTR BOOSTER PUMPS AND REFERENCE TO DWG 13-5131A (K4XL4)
PER PROJECT ID #07-10018: PER AS-BUILT CONDITIONS RELOCATED FIRE PUMP FROM (K3) TO (J4). ADDED 15BEC4 AND 2" BACKWASH LINE (J3).
THIS DRAWING HAS BEEN ELECTRONICALLY SCANNED. SEE MICROFILM RECORDS FOR HISTORY & SIGNATURES. DRAWING 1-2-5131 REV 6
DATE NO. DESCRIPTION APPD.
REVISIONS
S:/cd/2/piping/5131.dgn
S:/cd/2/piping/5131.tif
"THIS DRAWING IS THE PROPERTY OF THE AMERICAN ELECTRIC POWER SERVICE CORP. AND IS LOANED UPON CONDITION THAT IT IS NOT TO BE REPRODUCED OR COPIED, IN WHOLE OR IN PART, OR USED FOR FURNISHING INFORMATION TO ANY PERSON WITHOUT THE WRITTEN CONSENT OF THE AEP SERVICE CORP., OR FOR ANY PURPOSE DETRIMENTAL TO THEIR INTEREST, AND IS TO BE RETURNED UPON REQUEST"
OHIO POWER COMPANY
BUCKEYE POWER INC
CARDINAL PLANT
BRILLIANT OHIO
SERVICE & COOLING WTR CROSS-TIES FOR RIVER WTR FILTERS AND SOFTENING SYS.
SHEET 2 OF 5
DWG. NO. 2-5131-3
ENGINEERING DIVISION
DESIGN DEPARTMENT
AMERICAN ELECTRIC POWER
1 RIVERSIDE PLAZA COLUMBUS, OH 43215
SYSTEM DATE-3/25/2010
IGS1092

8.11
U3 Bottom Ash Pumps to Jet Pumps

⊛ DENOTES INFORMATION GIVEN BY TELEPHONE TO FABRICATOR

NOTE:
TO CONVERT ELEVATIONS SHOWN TO PLANT DATUM, ADD 570'-0"

RECIRCULATING ASH WATER, BOTTOM ASH WATER & PYRITES PIPING

CARDINAL PLANT UNIT 3
BUCKEYE POWER, INC
BRILLIANT, OHIO

DRAWN J. CAIN 11-13-74

SARGENT & LUNDY ENGINEERS CHICAGO

JOB NO. 4642

DRAWING NO. 3-5348-13-SHT.1 OF 2

3-5348-1 SH.2 OF 2
ASH PIT
CAPPED
ENLARGED PLAN "2"
SCALE: 1/4" = 1'-0"
FOR CONT. SEE DWG. 3-5374-1 (D-2)
℄ EL. 129'-0"
℄ EL. 134'-3"
℄ EL. 115'-6"
W.P. 45° ELL.
90° ELL. TURN 45°
3WA012
3WA09B10
3WA09A10
3WA04B14
FOR CONT. SEE DWG. 3-5348 SHT. 1 OF 2 (E-5)
Total Length of Pipe is 200.9'
PLAN
SCALE 1/8" = 1'-0"
MEZZ. EL. 121'-0"
FLR. EL. 101'-0"
3WA08M
SECTION "J-J"
SCALE: 1/8" = 1'-0" (F-4)
SECTION "K-K"
SCALE 1/8" = 1'-0" (F-2)
SECTION "L-L"
SCALE 1/8" = 1'-0" (E-1)
℄ EL. 131'-0"
SECTION "H-H"
SCALE 1/8" = 1'-0" (F-5)
NOTE:
TO CONVERT ELEVATIONS SHOWN TO PLANT DATUM, ADD 570'-0"
ALL WORK PERFORMED BY SARGENT & LUNDY ON THIS DRAWING WAS COMPLETED WITH REVISION 4 DATED 3-25-77 AND THE DRAWING ORIGINAL WAS TRANSMITTED TO AMERICAN ELECTRIC POWER SERVICE CORPORATION
RECIRC. ASH WATER, BOTTOM ASH WATER & PYRITES PIPING
CARDINAL PLANT UNIT 3
BUCKEYE POWER, INC.
BRILLIANT, OHIO
SCALE AS NOTED
DRAWN J. CAIN 11-13-74
CHECKED 11-14-74
SARGENT & LUNDY ENGINEERS CHICAGO
JOB NO. 4642
DRAWING NO.
3-5348-4-SH. 2 OF 2
STATE OF OHIO GEORGE C. KUHLMAN E-38354 REGISTERED PROFESSIONAL ENGINEER
NORTH

8.12
U1 and U2 Bottom Ash Sump Pump Piping and U3 Ash Hopper Pit Sump Piping

UNIT 1 & 2 BOILER ROOM SUMPS

RED = OUTDOOR PIPE FROM UNIT 1 & 2 BOILER ROOM SUMP PUMPS. GOOGLE EARTH APPOXIMATES IT AT 389 FEET OF PIPE. USE 12" POLYURETHANE LINED PIPE.

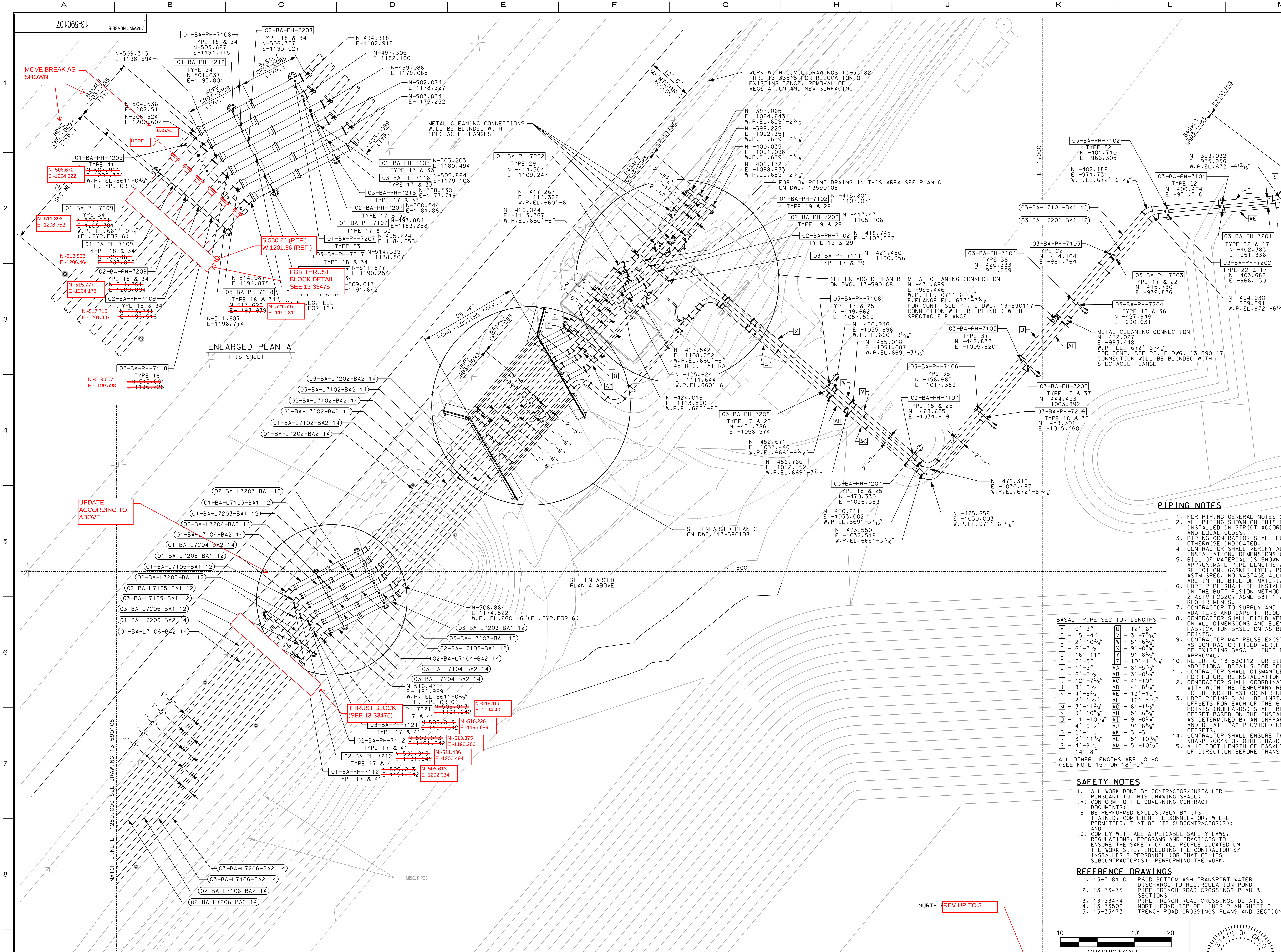
YELLOW = EXISTING OUTDOOR PIPE IS USED FOR BOILER ROOM SUMP PUMPS. GOOGLE EARTH APPOXIMATES IT AT 4,995 FEET OF PIPE. USE 11.8" BASALT PIPE.

BLUE = NEW PIPE INSTALLED AS PART OF BOTTOM ASH PROJECT REFER TO DWGS IN EMAIL. GOOGLE EARTH APPROXIMATES IT AT 2,746 FEET OF PIPE. USE HDPE PIPE PER DRAWING.

UNIT 3 BOTTOM ASH HOPPER PIT SUMP

YELLOW = EXISTING OUTDOOR PIPE IS USED FOR ASH HOPPER PIT SUMP PUMP DISCHARGE. GOOGLE EARTH APPOXIMATES IT AT 794 FEET OF PIPE. USE 11.8" BASALT PIPE.

BLUE = NEW PIPE INSTALLED AS PART OF BOTTOM ASH PROJECT REFER TO DWGS IN EMAIL. GOOGLE EARTH APPROXIMATES IT AT 2,746 FEET OF PIPE. USE HDPE PIPE PER DRAWING.



BASALT PIPE SECTION LENGTHS

A - 6'-9"	U - 12'-6"
B - 15'-4"	V - 3'-7 5/16"
C - 2'-10 3/4"	W - 5'-6 5/8"
D - 6'-7 1/2"	X - 9'-0 5/8"
E - 16'-11"	Y - 9'-8 5/8"
F - 7'-3"	Z - 10'-11 3/16"
G - 1'-5"	AA - 8'-5 7/8"
H - 6'-7 1/2"	AB - 3'-0 1/2"
I - 12'-7 5/8"	AC - 4'-10"
J - 8'-6 1/4"	AD - 4'-8 1/8"
K - 4'-6 3/4"	AE - 13'-10"
L - 2'-1 1/4"	AF - 16'-5 1/2"
M - 3'-11 3/4"	AG - 6'-1 1/2"
N - 9'-10 5/8"	AH - 5'-6 5/8"
O - 11'-10 1/4"	AI - 9'-0 5/8"
P - 4'-6 3/4"	AJ - 9'-8 5/8"
Q - 2'-1 1/4"	AK - 3'-3"
R - 3'-11 3/4"	AL - 5'-10 3/4"
S - 4'-8 1/4"	AM - 5'-10 7/8"
T - 14'-8"	

ALL OTHER LENGTHS ARE 10'-0" (SEE NOTE 15) OR 18'-0"

PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BA-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL DISMANTLE EXISTING METAL CLEANING WASTE PIPES FOR FUTURE REINSTALLATION IN ACCORDANCE WITH DRAWING 13-590117.
12. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
13. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
14. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.
15. A 10 FOOT LENGTH OF BASALT PIPE IS REQUIRED AFTER EACH CHANGE OF DIRECTION BEFORE TRANSITIONING TO HDPE PIPING.

SAFETY NOTES

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(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33473 PIPE TRENCH ROAD CROSSINGS PLAN & SECTIONS
3. 13-33474 PIPE TRENCH ROAD CROSSINGS DETAILS
4. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2
5. 13-33473 TRENCH ROAD CROSSINGS PLANS AND SECTIONS

10' 10' 20'
GRAPHIC SCALE
SCALE:1"=10'

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS, SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO BRIAN KLESATH PE.85798 REGISTERED PROFESSIONAL ENGINEER
PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT REV UP TO 3 OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

UNIT: 13 | DRAWING NUMBER: 13-590107 | REV: 2

SCALE: 1" = 10'-0" | ENGINEERING DIVISION

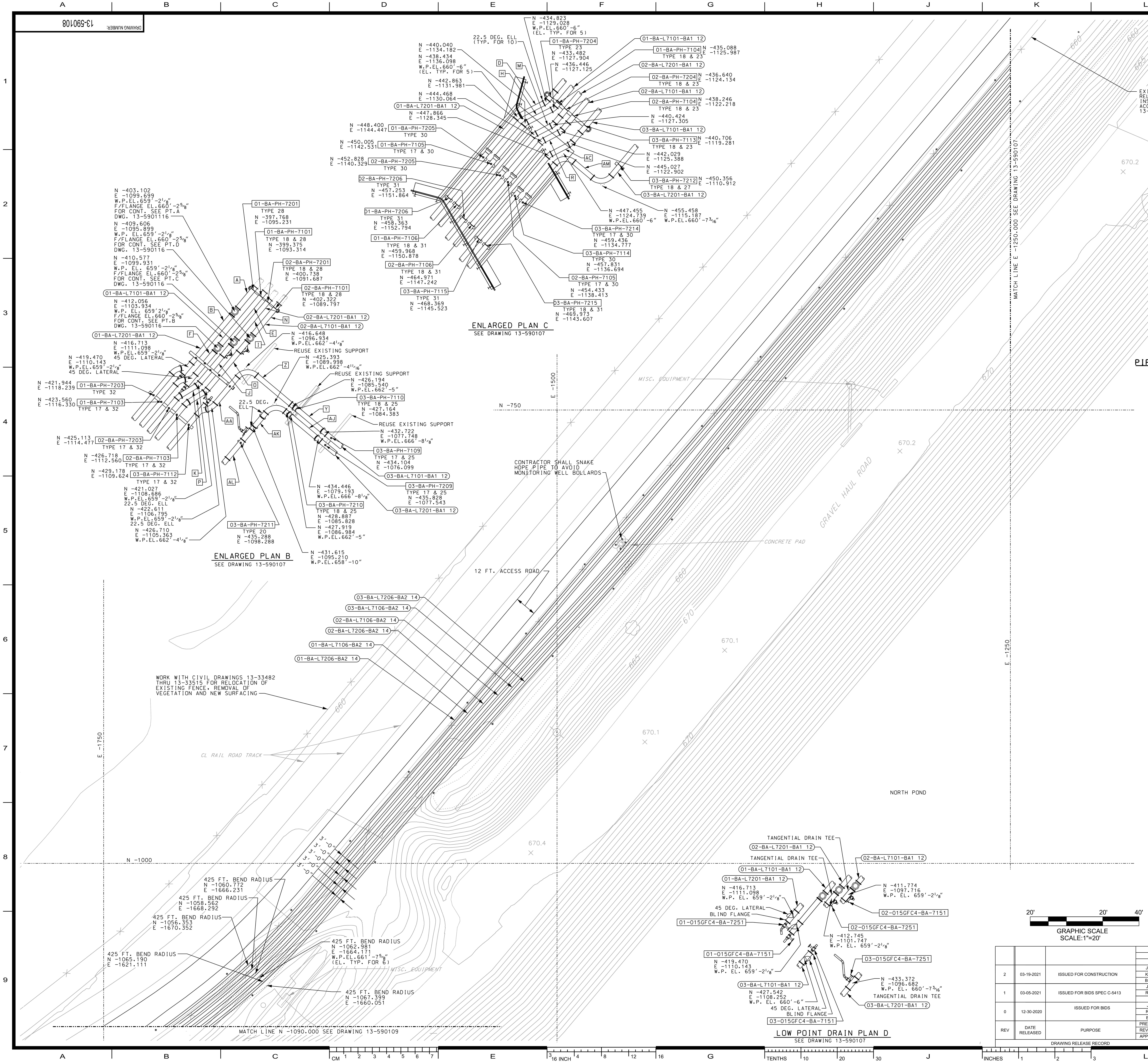
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:



PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BS-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL DISMANTLE EXISTING METAL CLEANING WASTE PIPES FOR FUTURE REINSTALLATION IN ACCORDANCE WITH DRAWING 13-590117.
12. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
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14. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.
15. A 10 FOOT LENGTH OF BASALT PIPE IS REQUIRED AFTER EACH CHANGE OF DIRECTION AND BEFORE TRANSITIONING TO HDPE PIPING.

SAFETY NOTES

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(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
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REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33505 NORTH POND-TOP OF LINER PLAN-SHEET 1
3. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2

18°30'00"
PLANT NORTH UNIT 3
NAD 27 GRID NORTH

20' 20' 40'
GRAPHIC SCALE
SCALE:1"=20'

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO
BRIAN KLESATH PE.85798
REGISTERED
PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

UNIT: 13 | DRAWING NUMBER: 13-590108 | REV: 2

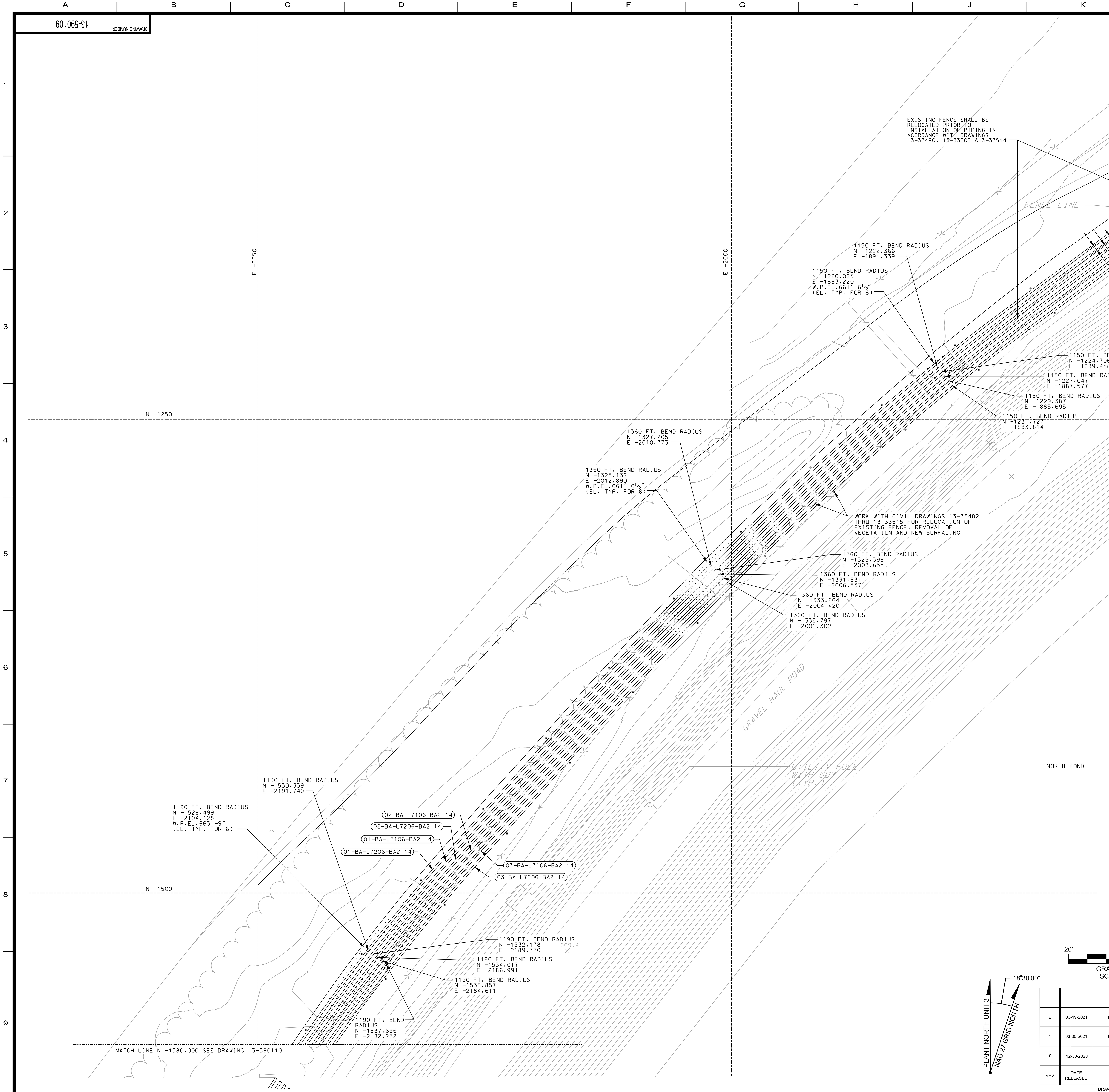
SCALE: 1"=20'
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

**CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913**

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:



PIPING NOTES

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11. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
12. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
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REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33505 NORTH POND-TOP OF LINER PLAN-SHEET 1
3. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2

20' 20' 40'
GRAPHIC SCALE
SCALE:1"=20'

18°30'00"
PLANT NORTH UNIT 3
NAD 27 GRID NORTH

REV	DATE RELEASED	PURPOSE	
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK
REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED

DRAWING RELEASE RECORD

STATE OF OHIO · BRIAN KLESATH PE.85798 · REGISTERED · PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOMASH CLOSURE AND LINING PROJECT

BOTTOM ASH TRANSFER

PIPING COMPOSITE

UNIT: 13	DRAWING NUMBER: 13-590109	REV: 2

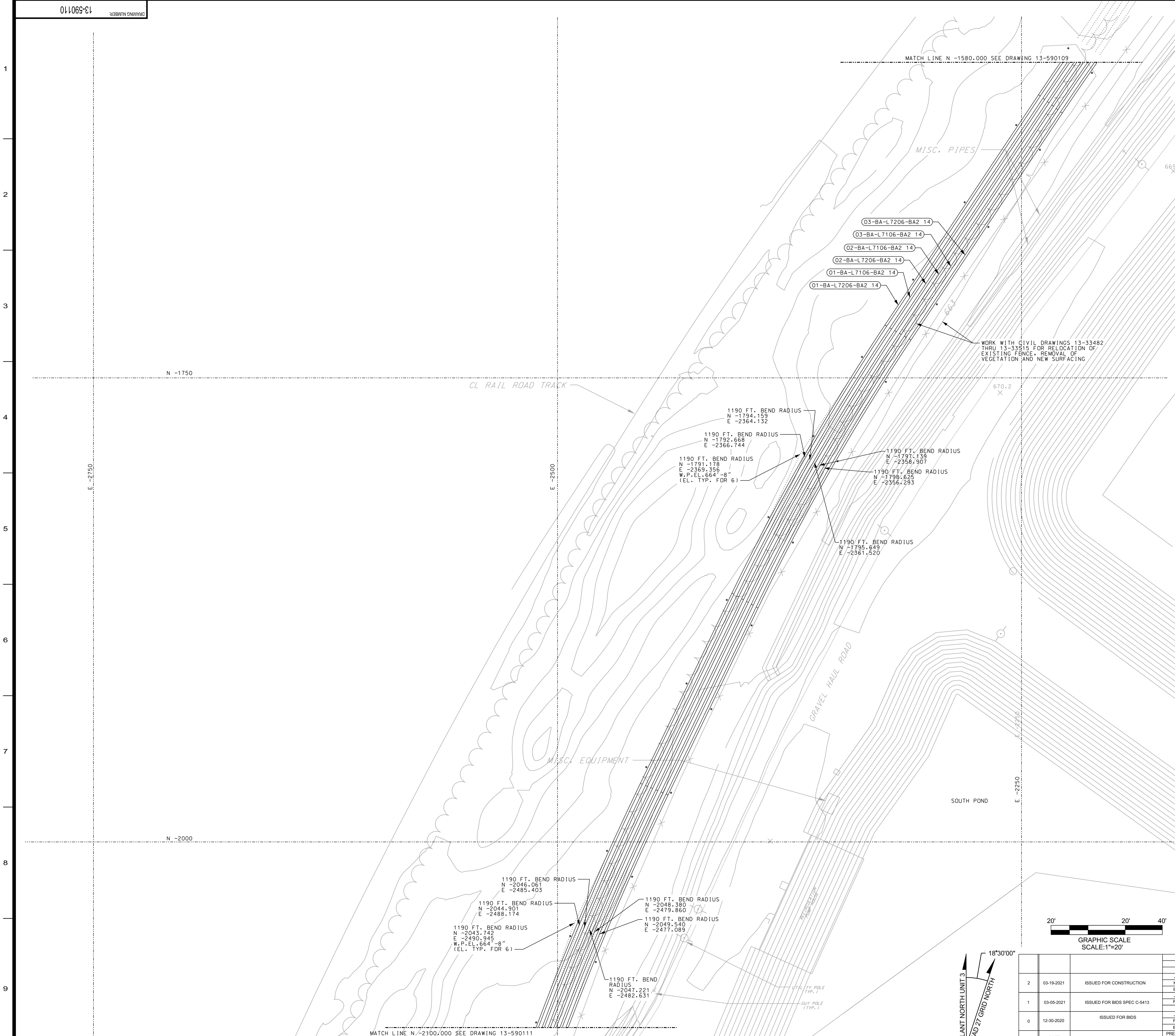
SCALE: 1"=20'
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:



PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BA-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
12. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
13. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33488 SOUTH POND-EXCAVATION-PLAN
3. 13-33489 SOUTH POND-EXCAVATION-SECTION VIEWS
4. 13-33490 SOUTH POND-TOP OF LINER PROTECTION-PLAN
5. 13-33505 NORTH POND-TOP OF LINER PLAN-SHEET 1
6. 13-33506 NORTH POND-TOP OF LINER PLAN-SHEET 2

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO
BRIAN KLESATH PE.85798
REGISTERED
PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS CONTRACTOR(S) PERFORMING THE WORK

UNIT:	DRAWING NUMBER:	REV:
13	13-590110	2

SCALE: 1" = 20'-0"
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

DRAWING NUMBER: 13-590110

CROSS REFS:

PIPING NOTES

1. FOR PIPING GENERAL NOTES SEE DRAWING 13-590106.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DEMENSIONS GIVEN ARE FOR DESIGN.
5. BILL OF MATERIAL IS SHOWN FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTION, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONGS OR WELD GAPS ARE IN THE BILL OF MATERIAL.
6. HDPE PIPE SHALL BE INSTALLED BY PERSONNEL EXPERIENCED IN THE BUTT FUSION METHOD IN ACCORDANCE WITH PROCEDURE 2 ASTM F2620, ASME B31.1 APPENDIX N, AND THE MANUFACTURER'S REQUIREMENTS.
7. CONTRACTOR TO SUPPLY AND INSTALL BLIND FLANGES, FLANGE ADAPTERS AND CAPS IF REQUIRED.
8. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATIONS AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.
9. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPING SO LONG AS CONTRACTOR FIELD VERIFIES THE INTEGRITY AND WALL THICKNESS OF EXISTING BASALT LINED PIPING AND RECEIVES ENGINEER APPROVAL.
10. REFER TO 13-590112 FOR BILL OF MATERIAL AND 13-BA-PH-008 FOR ADDITIONAL DETAILS FOR BOLLARDS AND THRUST BLOCKS.
11. CONTRACTOR SHALL COORDINATE ISTALLATION OF PIPING SHOWN HEREIN WITH WITH THE TEMPORARY REROUTE OF THE LOW VOLUME WASTE PIPING TO THE NORTHEAST CORNER OF THE NORTH POND.
12. HDPE PIPING SHALL BE INSTALLED IN A SNAKING PATTERN WITH SIMILAR OFFSETS FOR EACH OF THE 6 LINES. THE LOCATION OF INFLECTION POINTS (BOLLARDS) SHALL BE 50 FEET APART WITH THE INSTALLATION OFFSET BASED ON THE INSTALLATION TEMPERATURE OF THE PIPE MATERIAL AS DETERMINED BY AN INFRARED SURFACE PYROMETER. REFER TO TABLE "A" AND DETAIL "A" PROVIDED ON DRAWING 13-BA-PH-008 FOR INSTALLATION OFFSETS.
13. CONTRACTOR SHALL ENSURE THAT HDPE PIPE BE LAID ON GRADE FREE OF SHARP ROCKS OR OTHER HARD OBJECTS.
14. A 10 FOOT LENGTH OF BASALT PIPE IS REQUIRED AFTER EACH CHANGE OF DIRECTION AND BEFORE TRANSITIONING TO HDPE PIPING.

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

REFERENCE DRAWINGS

1. 13-518110 P&ID BOTTOM ASH TRANSPORT WATER DISCHARGE TO RECIRCULATION POND
2. 13-33488 SOUTH POND-EXCAVATION PLAN
3. 13-33489 SOUTH POND-SECTION VIEWS
4. 13-33490 SOUTH POND-TOP OF LINER PROTECTION-PLAN
5. 13-33473 PIPE TRENCH ROAD CROSSINGS PLANS AND SECTIONS
6. 13-33475 BOTTOM ASH PIPE DISCHARGE SUPPORT PLANS SECTIONS AND DETAILS

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
BOTTOM ASH TRANSFER
PIPING COMPOSITE

20' 20' 40'
GRAPHIC SCALE
SCALE:1"=20'

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5413	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO — BRIAN KLESATH PE.85798 — REGISTERED PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

UNIT:	DRAWING NUMBER:	REV:
13	13-590111	2

SCALE: 1" = 20'-0"
DR: J. HIBBARD
CH: R. MILLER
SUP: B. KLESATH
ENG: D.WU
DATE: 12-30-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

CROSS REFS:

DRAWING NUMBER 13-590112

BILL OF MATERIALS
UNIT 1 BOTTOM ASH TRANSFER-HDPE

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
14	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5201 FT	14 IN	CRD30099	B31.1 NBEP	PIPE (BEND LENGTHS INCLUDED) SEE NOTE 3
14	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS
UNIT 1 BOTTOM ASH TRANSFER-BASALT

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
8	12 IN	CRD30085	B31.1 NBEP	22.5 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	45 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	45 DEG LATERAL
2	12 IN	CRD30085	B31.1 NBEP	90 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	BLIND FLANGE
171 FT	12 IN	CRD30085	B31.1 NBEP	PIPE *
2	12 IN	CRD30085	B31.1 NBEP	TEE
1	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	4 IN	S&L0105	B31.1 NBEP	PIPE
2 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	S&L0105	B31.1 NBEP	FF WELD NECK FLANGE (CLASS 150)
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	14 IN	———	———	SPECTACLE FLANGE
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS
UNIT 3 PYRITES HANDLING (TEMPORARY ROUTE)

REV 2

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	14 IN	S&L0105	B31.1 NBEP	45 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
1	14 IN	S&L0105	B31.1 NBEP	90 DEG LR ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
27 FT	14 IN	S&L0105	B31.1 NBEP	PIPE
622 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
2	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150) **
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
UNIT 3 SLURRY HOUSE (TEMPORARY ROUTE)

REV 2

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	14 IN	S&L0105	B31.1 NBEP	45 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
2	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
1	14 IN	S&L0105	B31.1 NBEP	90 DEG LR ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
39 FT	14 IN	S&L0105	B31.1 NBEP	PIPE
616 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
2	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
1	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
1	14 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)

BILL OF MATERIALS
UNIT 3 DEMIN. SUMP (TEMPORARY ROUTE)

REV 2

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	22 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
4	22 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	22 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
2	22 IN	CRD30099	B31.1 NBEP	FF FLANGE (SDR 11)
638 FT	22 IN	CRD30099	B31.1 NBEP	PIPE

BILL OF MATERIALS
UNIT 1&2 BOILER ROOM SUMP/SOUTH COAL PILE/BOTTOM ASH SUMP DISCHARGE (TEMPORARY ROUTE)

REV 2

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	24 X 16 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	24 X 14 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	24 X 10 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
2	24 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	24 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
3	24 IN	CRD30099	B31.1 NBEP	45 DEG LATERAL
1	24 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
600 FT	24 IN	CRD30099	B31.1 NBEP	PIPE
2	16 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	16 IN	CRD30099	B31.1 NBEP	90 DEG FABRICATED ELBOW
12	16 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
31 FT	16 IN	CRD30099	B31.1 NBEP	PIPE
1	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
6	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
26 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
1	10 X 8 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	10 X 6 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	10 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
92 FT	10 IN	CRD30099	B31.1 NBEP	PIPE
1	8 X 4 IN	CRD30099	B31.1 NBEP	CONCENTRIC REDUCER
1	8 X 4 IN	CRD30099	B31.1 NBEP	REDUCING TEE
10 FT	8 IN	CRD30099	B31.1 NBEP	PIPE
2	6 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	6 IN	CRD30096	B31.1 NBEP	FF FRP FLANGE
5	6 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	6 IN	CRD30099	B31.1 NBEP	PIPE
6	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
3	4 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
7 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
4	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2	4 IN	CRD30099	B31.1 NBEP	RF FLANGE ADAPTER (SDR 11)
2	4 IN	S&L0105	B31.1 NBEP	RF SLIP-ON FLANGE (CLASS 150)
12	16 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
6	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
5	6 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
6	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-5901113 AND 13-5901114				

BILL OF MATERIALS
UNIT 2 BOTTOM ASH TRANSFER-HDPE

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
14	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5166 FT	14 IN	CRD30099	B31.1 NBEP	PIPE (BEND LENGTHS INCLUDED) SEE NOTE 3
14	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS
UNIT 2 BOTTOM ASH TRANSFER-BASALT

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	12 X 4 IN	CRD30085	B31.1 NBEP	TANGENTIAL DRAIN TEE
12	12 IN	CRD30085	B31.1 NBEP	22.5 DEG ELBOW MEDIUM
2	12 IN	CRD30085	B31.1 NBEP	90 DEG ELBOW MEDIUM
170 FT	12 IN	CRD30085	B31.1 NBEP	PIPE *
2	12 IN	CRD30085	B31.1 NBEP	TEE
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
1 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	14 IN	———	———	SPECTACLE FLANGE
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS
UNIT 3 PYRITES HANDLING (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	12 IN	CRD30085	B31.1 NBEP	45 DEG ELBOW MEDIUM
1	12 IN	CRD30085	B31.1 NBEP	45 DEG LATERAL
123 FT	12 IN	CRD30085	B31.1 NBEP	PIPE
1	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
1 FT	4 IN	S&L0105	B31.1 NBEP	PIPE
1 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
1	4 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
1	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
UNIT 3 SLURRY HOUSE (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	14 X 4 IN	CRD30099	B31.1 NBEP	REDUCING TEE
3	14 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
126 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
1	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
UNIT 3 DEMIN. SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	22 X 6 IN	CRD30099	B31.1 NBEP	REDUCING TEE
3	22 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	22 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
125 FT	22 IN	CRD30099	B31.1 NBEP	PIPE
1	6 X 4 IN	CRD30099	B31.1 NBEP	REDUCER
1	6 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	4 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
UNIT 1 BOILER ROOM SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	16 X 2 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	16 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
103 FT	16 IN	CRD30099	B31.1 NBEP	PIPE
2	2 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
2 FT	2 IN	CRD30099	B31.1 NBEP	PIPE
1	2 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	2 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
UNIT 2 BOILER ROOM SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	16 X 2 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	16 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
95 FT	16 IN	CRD30099	B31.1 NBEP	PIPE
2	2 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
4 FT	2 IN	CRD30099	B31.1 NBEP	PIPE
1	2 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	16 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	2 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
SOUTH COAL PILE RUNOFF (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	14 X 2 IN	CRD30099	B31.1 NBEP	REDUCING TEE
2	14 IN	CRD30099	B31.1 NBEP	22.5 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
88 FT	14 IN	CRD30099	B31.1 NBEP	PIPE
2	2 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
6 FT	2 IN	CRD30099	B31.1 NBEP	PIPE
1	2 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	2 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
DSI ISLAND SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	6 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	6 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
41 FT	6 IN	CRD30099	B31.1 NBEP	PIPE
1	6 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING

BILL OF MATERIALS
BOTTOM ASH POND LOW POINT SUMP (PERMANENT ROUTE)

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
2	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
2	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
63 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
2	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWING 13-590115				

BILL OF MATERIALS
UNIT 3 BOTTOM ASH TRANSFER-HDPE

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
14	14 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5131 FT	14 IN	CRD30099	B31.1 NBEP	PIPE (BEND LENGTHS INCLUDED) SEE NOTE 3
14	14 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS
UNIT 3 BOTTOM ASH TRANSFER-BASALT

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
1	12 X 4 IN	CRD30085	B31.1 NBEP	TANGENTIAL DRAIN TEE
16	12 IN	CRD30085	B31.1 NBEP	22.5 DEG ELBOW MEDIUM
5	12 IN	CRD30085	B31.1 NBEP	45 DEG ELBOW MEDIUM
1	12 IN	CRD30085	B31.1 NBEP	45 DEG LATERAL
2	12 IN	CRD30085	B31.1 NBEP	60 DEG ELBOW MEDIUM
8	12 IN	CRD30085	B31.1 NBEP	90 DEG ELBOW MEDIUM
517 FT	12 IN	CRD30085	B31.1 NBEP	PIPE *
2	12 IN	CRD30085	B31.1 NBEP	TEE
2	4 IN	CRD30099	B31.1 NBEP	45 DEG ELBOW
1	4 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
5 FT	4 IN	CRD30099	B31.1 NBEP	PIPE
1	4 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
2	14 IN	———	———	SPECTACLE FLANGE
WORK WITH DRAWINGS 13-590107 THRU 13-590111				

BILL OF MATERIALS
METAL CLEANING

QTY.	SIZE	PDT NUMBER	PIPING CODE	DESCRIPTION
4	12 IN	S&L0105	B31.1 NBEP	22.5 DEG LR ELBOW (2) 90 DEG ELBOWS CUT TO SUIT
2	12 IN	S&L0105	B31.1 NBEP	45 DEG ELBOW
3	12 IN	CRD30099	B31.1 NBEP	90 DEG ELBOW
11	12 IN	S&L0105	B31.1 NBEP	90 DEG LR ELBOW
1	12 IN	CRD30099	B31.1 NBEP	FF FLANGE ADAPTER (SDR 11)
241 FT	12 IN	S&L0105	B31.1 NBEP	PIPE
397 FT	12 IN	CRD30099	B31.1 NBEP	PIPE
1	12 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150)
6	12 IN	S&L0105	B31.1 NBEP	RF WELD NECK FLANGE (CLASS 150) *
5	12 IN	S&L0105	B31.1 NBEP	TEE
1	12 IN	CRD30099	B31.1 NBEP	DUCTILE IRON BACK-UP RING
WORK WITH DRAWING 13-590117				

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THAT OF ITS SUBCONTRACTOR(S); AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S)) PERFORMING THE WORK.

NOTES

1. BILL OF MATERIAL LISTINGS ARE SHOWN SOLELY FOR CONTRACTOR'S BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND DOES NOT ACCOUNT FOR ADDITIONAL LENGTH OF PIPE REQUIRED TO INSTALL SNAKED PIPING. CONTRACTOR SHALL ACCOUNT FOR ADDITIONAL LENGTHS (ADD LONGS, WASTAGE ALLOWANCES).
2. NUTS, BOLTS, AND GASKETS SHALL BE SUPPLIED BY CONTRACTOR AND ARE NOT LISTED IN THE BILL OF MATERIALS.
3. BILL OF MATERIAL DOES NOT INCLUDE ADDITIONAL PIPE REQUIRED FOR SNAKING PROCEDURE FOR HDPE PIPING INSTALLATION. CONTRACTOR SHALL ACCOUNT FOR ADDITIONAL PIPING NEEDED TO INSTALL HDPE PIPING IN ACCORDANCE WITH DETAIL A & B FROM DRAWING 13-BA-PH-008.
4. CONTRACTOR MAY REUSE EXISTING BASALT LINED PIPE, BLIND STECTACLES, CARBON STEEL PIPE FROM UNIT 1, 2 AND 3 BOTTOM ASH PIPING AND METAL CLEANING WASTE DEMOLITION SCOPE. ANY REUSED MATERIALS SHALL BE THOROUGHLY CLEANED BY CONTRACTOR BOTH INSIDE AND OUTSIDE AND ALL WORKING PARTS OF VALVES AND OTHER APPURTENANCES SHALL BE CHECKED BY THE CONTRACTOR FOR PROPER FUCTIONING BEFORE THEY ARE INSTALLED. ANY MALFUNCTIONS SHALL BE REPORTED TO OWNER'S REPRESENTATIVE.

* SPECIAL FLANGES ON NEW BASALT LINED PIPE WILL BE USED TO MATE WITH EXISTING BASALT LINED PIPES AT TIE IN POINTS FOR UNITS 1 AND 2. (2) 45 DEGREE ELBOWS WITH SPECIAL FLANGES AT ONE END WILL BE USED FOR UNIT 3 TO MATE WITH EXISTING BASALT LINED PIPE. CONTRACTOR SHALL MATCH DRILLING TEMPLATE OF EXISTING BASALT LINED PIPE FLANGE WHICH IS 19$\frac{1}{4}$" OD X 12" ID X $\frac{3}{4}$" THK. CI GASKET W/12 HOLES $\frac{7}{8}$" DIA. ON A 17$\frac{1}{2}$" BCD.

** SPECIAL CARBON STEEL WELD NECK FLANGE SHALL BE USED TO MATE TO EXISTING BASALT LINED PIPE FLANGE. CONTRACTOR SHALL MATCH DRILLING TEMPLATE OF EXISTING BASALT LINED PIPE FLANGE WHICH IS 19$\frac{1}{4}$" OD X 12" ID X $\frac{3}{4}$" THK. CI GASKET W/12 HOLES $\frac{7}{8}$" DIA. ON A 17$\frac{1}{2}$" BCD.

NEW BASALT PIPE FLANGES SHALL MATCH DRILLING TEMPLATE OF NEW ASME B16.5 NPS 14" CLASS 150 FLANGE WHICH IS 12 HOLES 1$\frac{1}{8}$" DIA. ON A 18$\frac{3}{4}$" BCD.

FOR BASALT LINED PIPE FITTINGS, CONTRACTOR SHALL ENSURE THAT FLANGED ENDS ARE SUITABLE FOR FIT UP (I.E. LOOSE FLANGES).

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
POND PIPING
BILL OF MATERIALS

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
2	03-19-2021	ISSUED FOR CONSTRUCTION	JEH / KAR / BMK
1	03-05-2021	ISSUED FOR BIDS SPEC C-5314	JEH / RAM / -
0	12-30-2020	ISSUED FOR BIDS	JEH / RAM / BMK

DRAWING RELEASE RECORD

STATE OF OHIO
BRIAN KLESATH
PE.85798
REGISTERED
PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/ INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

UNIT:	DRAWING NUMBER:	REV:
13	13-590112	2

SCALE: NONE
DR: J. HIBBARD
CH: R. MILLER
SUP: B.KLESATH
ENG: D. WU
DATE: 12-30-2020
APPROVED BY

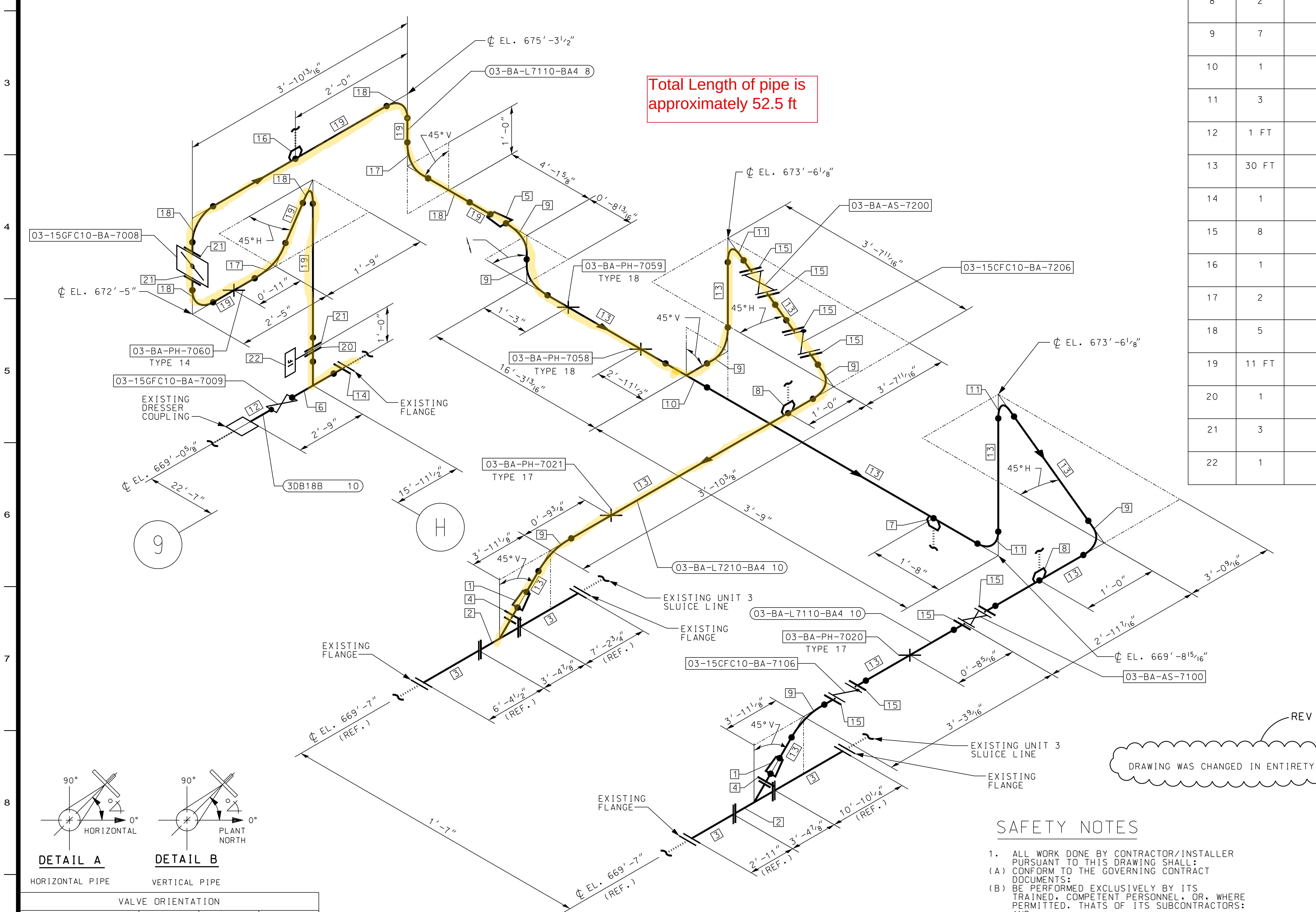
CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

8.13
U3 Ash Hopper Pit Sump Discharge pipe to Crossover



DETAIL A
HORIZONTAL PIPE

DETAIL B
VERTICAL PIPE

VALVE ORIENTATION			
VALVE NUMBER	DETAIL	VIEWED LOOKING	ANGLE
03-15CFC10-BA-7106	A	EAST	90
03-15CFC10-BA-7206	A	NORTHEAST	90
03-15GFC10-BA-7008	B	DOWN	90
03-15GFC10-BA-7009	A	EAST	90
03-BA-AS-7100	A	EAST	90
03-BA-AS-7200	A	NORTHEAST	90

BILL OF MATERIALS

ITEM NO.	QTY.	SIZE	SCHEDULE/ RATING	PIPING CODE	DESCRIPTION
1	2	12 X 10 IN	STD	B31.1 NBEP	CONCENTRIC REDUCER ASTM A234 GRADE WPB, ASME B16.9
2	2	12 IN	150 WP	B31.1 NBEP	45 DEG LATERAL CBP, CBP
3	28 FT	12 IN	150 WP	B31.1 NBEP	PIPE CBP, CBP
4	2	12 IN	CLASS 150	B31.1 NBEP	RF WELD NECK FLANGE ASTM A105, ASME B16.5
5	1	10 X 8 IN	40	B31.1 NBEP	CONCENTRIC REDUCER ASTM A234 GRADE WPB, ASME B16.9
6	1	10 X 8 IN	40S	B31.1 NBEP	REDUCING TEE ASTM A 403 GRADE WP316, ASME B16.9
7	1	10 X 2 IN	CLASS 3000	B31.1 NBEP	SOCKOLET, RUN NPS 10, SCH 40 ASTM A105, MSS SP-97
8	2	10 X 1 IN	CLASS 3000	B31.1 NBEP	SOCKOLET, RUN NPS 10, SCH 40 ASTM A105, MSS SP-97
9	7	10 IN	40	B31.1 NBEP	45 DEG ELBOW ASTM A234 GRADE WPB, ASME B16.9
10	1	10 IN	40	B31.1 NBEP	45 DEG LATERAL ASTM A234 GRADE WPB, ASME B16.9
11	3	10 IN	40	B31.1 NBEP	90 DEG LR ELBOW ASTM A234 GRADE WPB, ASME B16.9
12	1 FT	10 IN	40S	B31.1 NBEP	PIPE ASTM A 312 GRADE TP316, ASME B36.19M
13	30 FT	10 IN	40	B31.1 NBEP	PIPE ASTM A106 GRADE B, ASME B36.10M
14	1	10 IN	CLASS 150	B31.1 NBEP	RF WELD NECK FLANGE ASTM A 182 GRADE F316, ASME B16.5
15	8	10 IN	CLASS 150	B31.1 NBEP	RF WELD NECK FLANGE ASTM A105, ASME B16.5
16	1	8 X 1 IN	CLASS 3000	B31.1 NBEP	SOCKOLET, RUN NPS 8, SCH 40 ASTM A105, MSS SP-97
17	2	8 IN	40	B31.1 NBEP	45 DEG ELBOW ASTM A234 GRADE WPB, ASME B16.9
18	5	8 IN	40	B31.1 NBEP	90 DEG LR ELBOW ASTM A234 GRADE WPB, ASME B16.9
19	11 FT	8 IN	40	B31.1 NBEP	PIPE ASTM A106 GRADE B, ASME B36.10M
20	1	8 IN	CLASS 150	B31.1 NBEP	RF WELD NECK FLANGE ASTM A 182 GRADE F316, ASME B16.5
21	3	8 IN	CLASS 150	B31.1 NBEP	RF WELD NECK FLANGE ASTM A105, ASME B16.5
22	1	8 IN	40	-	INSULATING FLANGE KIT

NOTES

1. FOR PIPING GENERAL NOTES AND DETAILS SEE DRAWING 13-590100A THRU D.
2. ALL PIPING SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED IN STRICT ACCORDANCE WITH SPEC. C-5415 AND ALL STATE AND LOCAL CODES.
3. PIPING CONTRACTOR SHALL FURNISH ALL PIPING UNLESS OTHERWISE INDICATED.
4. CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO INSTALLATION. DIMENSIONS GIVEN ARE DESIGN DIMENSIONS AND MAKE NO ALLOWANCES FOR CUTS, WELDS, MAKE LONG, AND WELD CAPS.
5. BILL OF MATERIAL IS SHOWN SOLELY FOR BENEFIT TO ESTABLISH APPROXIMATE PIPE LENGTHS AND FITTING COUNTS, FITTING SELECTIONS, GASKET TYPE, BOLT DETAILS, ETC. PER APPROPRIATE ASTM SPEC. NO WASTAGE ALLOWANCES, ADD-LONG OR WELD GAPS ARE INCLUDED IN THE BILL OF MATERIAL.
6. X DENOTES PIPE SUPPORT LOCATION.
7. AA-BB-CC-DDDD DENOTES PIPE SUPPORT TAG.
8. ALL SEAM WELDS SHALL BE LOCATED ON THE TOP/UPPER QUADRANT OF THE PIPING SYSTEM TO MINIMIZE CORROSION EFFECTS ON THE SEAM.
9. CONTRACTOR SHALL FIELD VERIFY AND MAKE ANY ADJUSTMENTS ON ALL DIMENSIONS AND ELEVATION AS REQUIRED, PRIOR TO FABRICATION BASED ON AS-BUILT COORDINATES FOR INTERFACE POINTS.

SAFETY NOTES

1. ALL WORK DONE BY CONTRACTOR/INSTALLER PURSUANT TO THIS DRAWING SHALL:
(A) CONFORM TO THE GOVERNING CONTRACT DOCUMENTS;
(B) BE PERFORMED EXCLUSIVELY BY ITS TRAINED, COMPETENT PERSONNEL, OR, WHERE PERMITTED, THATS OF ITS SUBCONTRACTORS; AND
(C) COMPLY WITH ALL APPLICABLE SAFETY LAWS, REGULATIONS, PROGRAMS AND PRACTICES TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING THE CONTRACTORS/INSTALLERS PERSONNEL (OR THAT OF ITS SUBCONTRACTORS PERFORMING WORK.

REFERENCE DRAWINGS

1. 3-5013B FLOW DIAGRAM BOILER ROOM VENTS & DRAINS
2. 13BA-PH-001 TO 004 BOTTOM ASH SYSTEM PIPE SUPPORTS

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
1	03-19-2021	ISSUED FOR CONSTRUCTION SPEC. C-5415	C.TORRES / J.HIBBARD / B.KLESATH
0	02/02/2021	ISSUED FOR BIDS, SPEC C-5415	C.TORRES / - / -

DRAWING RELEASE RECORD

STATE OF OHIO BRIAN KLESATH PE.85798 REGISTERED PROFESSIONAL ENGINEER

PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUBCONTRACTOR(S) PERFORMING THE WORK

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
LOW PRESSURE RECIRCULATION WATER SUPPLY
TO ASH HOPPER MODIFICATIONS
PIPING ISOMETRIC

UNIT: 3 | DRAWING NUMBER: CD3-BA-001 | REV: 1

SCALE: NONE | ENGINEERING DIVISION
DR: C.TORRES
CH: -
SUP: -
ENG: D.WU
DATE: 12-18-2020
APPROVED BY

CARDINAL OPERATING COMPANY

CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

PLOT DATE: DD-MMM-YYYY
PLOT TIME: HOUR:MINUTE
BY: USERPLOT

CROSS REFS:

APPENDIX B.

BOTTOM ASH SYSTEM RAINFALL ESTIMATE

Sargent & Lundy

ISSUE SUMMARY

Form SOP-0402-07, Revision 13

DESIGN CONTROL SUMMARY

CLIENT: Cardinal Operating Company UNIT NO.: 1,2 & 3 PAGE NO.: 1

PROJECT NAME: Cardinal Plant

PROJECT NO.: A13770-006

CALC. NO..: 2023-02951

S&L NUCLEAR QA PROGRAM APPLICABLE ☐ YES ☒ NO

TITLE: South Bottom Ash Pond Stormwater Runoff Analysis

EQUIPMENT NO.: N/A

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

Main Calculation: 7 Pages
Attachments (6): 6 Pages
Total: 13 Pages

INPUTS/ ASSUMPTIONS
☒ VERIFIED
☐ UNVERIFIED

REVIEW METHOD: Detailed REV.: 0

STATUS: ☒ APPROVED ☐ SUPERSEDED BY CALCULATION NO. ☐ VOID DATE FOR REV.: 8/18/2023

ISSUE DESCRIPTION: For use

PREPARER: Nikhil Patel Nikhil Patel Digitally signed by Nikhil Patel DATE: 8/18/2023

REVIEWER: Vasudev Patel Vasudev Patel Digitally signed by Vasudev Patel Date: 2023.08.18 15:45:54 -05'00' DATE: 8/18/2023

APPROVER: Darrel Packard Darrel Packard 2023.08.18 16:17:28 -05'00' DATE: 8/18/2023

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☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD: REV.:

STATUS: ☐ APPROVED ☐ SUPERSEDED BY CALCULATION NO. ☐ VOID DATE FOR REV.:

ISSUE

PREPARER: DATE:

REVIEWER: DATE:

APPROVER: DATE:

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

INPUTS/ ASSUMPTIONS
☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD: REV.:

STATUS: ☐ APPROVED ☐ SUPERSEDED BY CALCULATION NO. ☐ VOID DATE FOR REV.:

ISSUE

PREPARER: DATE:

REVIEWER: DATE:

APPROVER: DATE:

TABLE OF CONTENTS

ATTACHMENTS

1.0 PURPOSE AND SCOPE

The EPA published a new revision of the 40 CFR 423 Effluent Limitations Guidelines (ELG) on December 31, 2020. This updated revision changed the total volume of bottom ash transport water that is allowed to be discharged from a steam electric generating plant from 0 percent to allowing up to 10 percent of the primary active wetted bottom ash system volume per day considering a 30-day rolling average per 40 CFR 423 (k)(2)(i)(A).

The purpose of this calculation is to determine stormwater rainfall contribution inflow into the South Bottom Ash Pond (BAP) through direct rainfall or onto surfaces that drain into the bottom ash transport water system for Units 1, 2, and 3 at Cardinal at Brilliant, Ohio. This information will be used to assess in part, in a separate calculation, the potential stormwater rainfall contribution to the BAP and how much BAP can be discharged, due to this type of event(s) while satisfying 40 CFR 423.

2.0 DESIGN INPUT

2.1 Rainfall Data

In 40 CFR 423.13(k)(2)(i)(A), the rule states that to discharge south BAP the Plant must "maintain system water balance when precipitation-related inflows are generated from storm events exceeding a 10-year storm event of 24-hour or longer duration (e.g., 30-day storm event) and cannot be managed by installed spares, redundancies, maintenance tanks, and other secondary bottom ash system equipment. Therefore, the quote above, the 10-year, 24-hour storm is to be evaluated, however the longer duration implies that an upper boundary should be considered when evaluating the bottom ash transport water volume. To develop an upper boundary for this calculation, in the 40 CFR 423 Preamble it states that if there is a rare precipitation event like the 100-year storm, the NPDES is more flexible to allow a bypass higher than 10% - based on this input it is reasonable to establish the upper boundary as a 50-year event, and as a result this calculation evaluates the stormwater runoff volume for rainfall events between 10-year and 50-years, and for durations of each event from 6 hours to 30 days were analyzed and included in Attachments 3 and 4 to identify sensitivity with respect to duration and storm frequency. The rainfall depths used are the high, average, and low depths as published by NOAA in Attachment 1. The high and low depth are estimates as the upper and lower bounds, respectively, of the 90% confidence interval. The probability that the rainfall depths will be greater than the upper bound or less than the lower bound is 5 percent, as stated by NOAA in Note 1 on Attachment 1.

This calculation presents in Section 6 the detailed steps to determine the runoff volume for the 10-year, 24-hour depth to outline the process used to calculate the runoff volume for each storm event and duration. For the Cardinal Plant, the 10-year, 24-hour rainfall depth value is 3.38 inches per NOAA Atlas 14 (Reference 1). Rainfall depths from NOAA Atlas 14 are included as Attachment 1 from Reference 1.

2.2 Drainage Areas

There are two separate drainage areas that comprises the BAP (Reference 2). Topographic surveying for the site was provided by Labella in August 2020. As per the as-built documents, the top of dike for BAP is set at 670.0 ft and the normal water elevation is at 665.0 ft. The south pond area is approximately 6.9 acres, and the pond bottom elevation is at 652.0 feet. Water is pumped out of the South Pond through the recirculation Pumphouse. As indicated in Reference 2, the drainage areas accounted for the calculation is the perimeter dike road around the site. This area equated to 2.1 ac.

2.3 All elevations in this analysis reference to National Geodetic Vertical Datum of 1929 (NGVD 29) (Reference 3)

3.0 ASSUMPTIONS

Following conservative assumptions are made in the analysis:

3.1 A runoff coefficient of 1.0 was utilized to calculate the runoff volumes for both areas (direct rainfall, and the perimeter dike) into the Bottom Ash Pond (BAP) System. This runoff coefficient assumes that there are no losses or infiltration of collected rainfall.

4.0 METHODOLOGY

Utilizing the existing Plant drawings and information used in Reference 2, the two contributing drainage areas were determined. Area 1 is considered the Bottom Ash Pond, Area 2 the perimeter dike road around the site.

Once the contributing equipment of the Plant's bottom ash system is understood, the area is calculated as shown in Section 2.2. At this point the runoff volume could be calculated using the 10-year, 24-hour rainfall depth, as shown in Attachment 1, and the selected runoff coefficient.

5.0 ACCEPTANCE CRITERIA

There are no acceptance criteria for this calculation.

6.0 CALCULATIONS

The equation utilized to calculate the runoff volume from each area is shown below. Design inputs for this section are from Section 2.

$$\text{Runoff Volume } V = C * d * A$$

Where:

V= Runoff Volume (ac-ft)

C= Runoff Coefficient (as listed in Assumption 3.1)

d= Storm depth as shown on Attachment 1

A= Drainage Area (ac)

6.1 Area 1 Runoff Volume

Area 1 consists of south Bottom Ash Pond (BAP) with drainage area of 6.9 acres

A = 6.9 acres

10-Year, 24-hour rainfall from Attachment 1, average d = 3.38 inches

Note: lower bound is 3.14 inches and upper bound is 3.64 inches

Runoff coefficient C =1.0

Average rainfall Runoff volume V =1.0 x 3.38/12 x 6.9 = 1.944 ac-ft

Lower bound rainfall Runoff volume V =1.0 x 3.14/12 x 6.9 = 1.806 ac-ft

Upper bound rainfall Runoff volume V =1.0 x 3.64/12 x 6.9 = 2.093 ac-ft

Runoff volume for different durations is presented in Attachment 3.

6.2 Area 2 Runoff Volume

Area 2 consists of perimeter dike road with drainage area of 2.1 acres

A = 2.1 acres

10-Year, 24-hour rainfall from Attachment 1, average d = 3.38 inches

Note: lower bound is 3.14 inches and upper bound is 3.64 inches

Runoff coefficient c =1.0

Average rainfall Runoff volume V =1.0 x 3.38/12 x 2.1 = 0.592 ac-ft

Lower bound rainfall Runoff volume V =1.0 x 3.14/12 x 2.1 = 0.550 ac-ft

Upper bound rainfall Runoff volume V =1.0 x 3.64/12 x 2.1 = 0.637 ac-ft

Runoff volume for different durations for 50-year storm event is presented in Attachment 4.

7.0 RESULTS

Combined Runoff Volume for South BAP is summarized below:

Storm Duration		Volume (ac-ft)					
Duration Hr / Day	Days	10-Year			50-Year		
		Average	Upper Bound	Lower Bound	Average	Upper Bound	Lower Bound
6-hour	0.25	1.890	2.146	1.680	2.566	2.902	2.258
12-hour	0.50	2.182	2.430	1.958	2.970	3.278	2.640
24-hour	1.00	2.536	2.730	2.356	3.382	3.622	3.112
2-day	2.00	2.926	3.136	2.722	3.832	4.096	3.548
3-day	3.00	3.090	3.300	2.896	4.012	4.276	3.736
4-day	4.00	3.262	3.466	3.068	4.200	4.462	3.930
7-day	7.00	3.832	4.058	3.622	4.852	5.130	4.560
10-day	10.00	4.328	4.568	4.110	5.408	5.700	5.108
20-day	20.00	5.910	6.210	5.626	7.222	7.508	6.856
30-day	30.00	7.282	7.650	6.922	8.776	9.226	8.326

Graphs for 10-year and 50-year storm events are presented in Attachments 5 and 6 respectively.

8.0 CONCLUSIONS

As stated above, the volumes calculated in Sections 6.1 and 6.2 were for the 10-Year, 24-hour storm duration with an average depth. The same process shown within the calculation was used to calculate various durations ranging from 6 hours to 30 days for the 10- and 50-year storm events. A table outlining these volumes for 10- and 50-year storm durations can be found in Attachments 3 and 4. Graphs outlining calculated rainfall volumes into the BAP for the high, average, and low depths of the rainfall amounts for each of the storm durations are shown in Attachment 5 and 6 for the 10- and 50-year storm events, respectively.

As shown on Attachments 3 and 4, the largest storm event evaluated within Section 2.1 per 40 CFR 423.13(k)(2)(i)(A) was the 50-year, 30-day storm. This storm event was then used along with the surface areas that contribute to the south BAP to calculate the runoff volume for the 50-year, 30-day storm event. The south BAP was sized to contain a 1/2-PMP (Probable Maximum Precipitation) event of 16.5 inches within 24 hours to meet State of Ohio regulatory requirements for earthen dams and that volume envelopes the runoff volume generated during this 50-year, 30-day storm event, which would allow the Plant to not discharge from the south BAP during each of the stormwater events evaluated up to the 50-year, 30-day event.

9.0 REFERENCES

1 National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 2, Version 3, Point Frequency Data Server, Location name: Brilliant, Ohio, USA.

2 Cardinal Operating Company, Cardinal Plant, Calculation No. CRD-BAP-C-002, Revision 0, Hydrology and Hydraulics Calculation for South Pond.

3 Cardinal Operating Company, Drawing No 301008, Revision A, FARI Cover and Stormwater Pond Projects, Civil General Notes, and Symbols.

NOAA Atlas 14, Volume 2, Version 3
Location name: Brilliant, Ohio, USA*
Latitude: 40.2527°, Longitude: -80.6526°
Elevation: 729.28 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

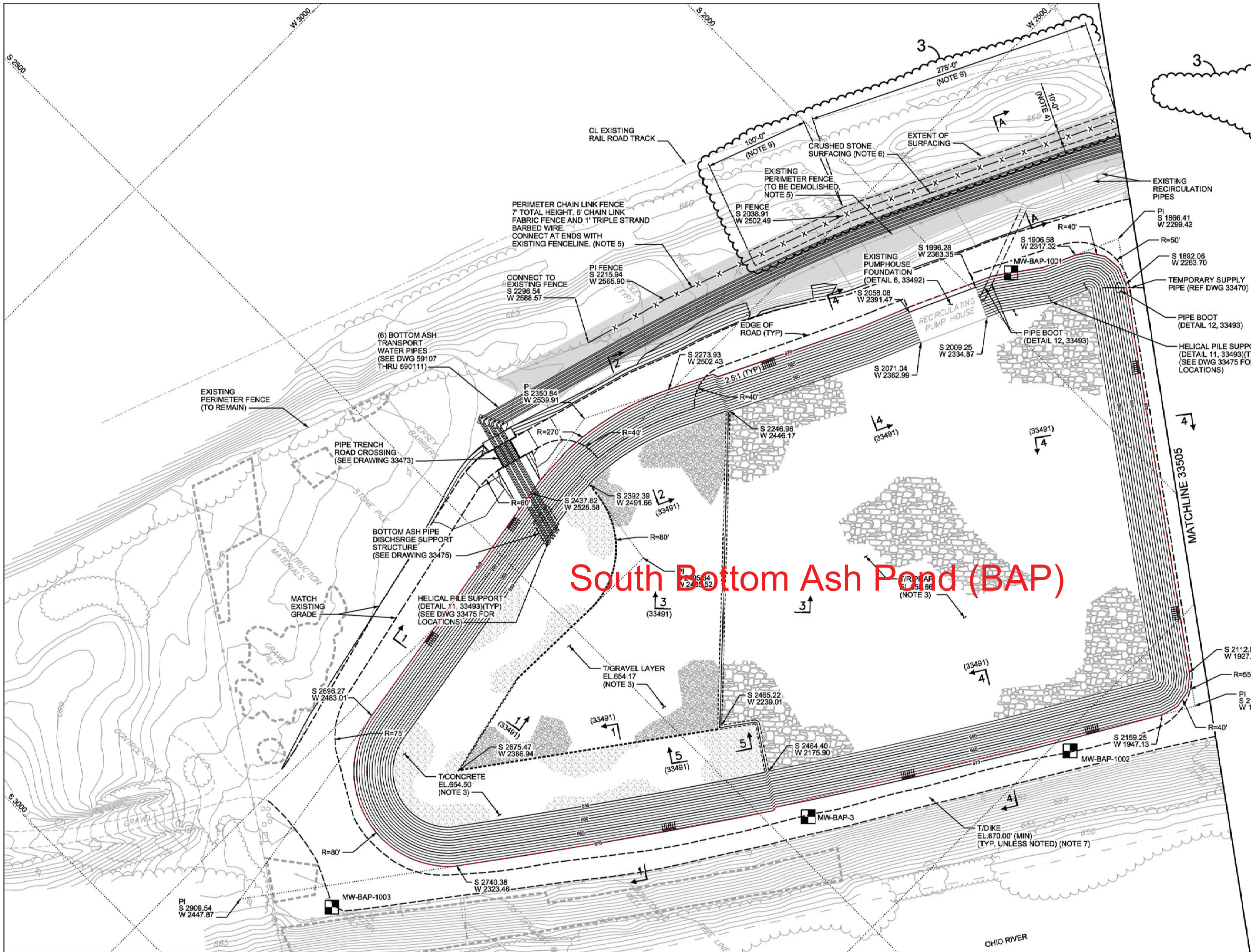
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.320 (0.284-0.363)	0.382 (0.339-0.434)	0.463 (0.410-0.524)	0.524 (0.462-0.592)	0.603 (0.531-0.681)	0.663 (0.582-0.747)	0.720 (0.629-0.811)	0.779 (0.679-0.878)	0.858 (0.743-0.965)	0.915 (0.789-1.03)
10-min	0.497 (0.441-0.564)	0.597 (0.529-0.677)	0.719 (0.637-0.814)	0.808 (0.714-0.914)	0.922 (0.812-1.04)	1.00 (0.882-1.13)	1.08 (0.947-1.22)	1.16 (1.01-1.31)	1.26 (1.09-1.42)	1.33 (1.15-1.50)
15-min	0.610 (0.540-0.691)	0.730 (0.647-0.828)	0.883 (0.782-1.00)	0.994 (0.878-1.13)	1.14 (1.00-1.29)	1.24 (1.09-1.40)	1.35 (1.18-1.52)	1.45 (1.26-1.63)	1.57 (1.36-1.77)	1.67 (1.44-1.87)
30-min	0.807 (0.715-0.914)	0.977 (0.866-1.11)	1.21 (1.07-1.37)	1.38 (1.22-1.56)	1.61 (1.42-1.82)	1.78 (1.56-2.01)	1.94 (1.70-2.19)	2.11 (1.84-2.38)	2.33 (2.02-2.62)	2.50 (2.15-2.81)
60-min	0.985 (0.873-1.12)	1.20 (1.06-1.36)	1.52 (1.34-1.72)	1.76 (1.55-1.99)	2.09 (1.84-2.36)	2.34 (2.06-2.64)	2.60 (2.27-2.93)	2.87 (2.50-3.23)	3.23 (2.79-3.63)	3.51 (3.02-3.94)
2-hr	1.13 (0.995-1.30)	1.37 (1.21-1.58)	1.74 (1.52-1.99)	2.02 (1.77-2.31)	2.41 (2.10-2.75)	2.72 (2.37-3.11)	3.05 (2.64-3.46)	3.38 (2.92-3.84)	3.85 (3.29-4.36)	4.21 (3.58-4.78)
3-hr	1.20 (1.07-1.40)	1.46 (1.29-1.69)	1.84 (1.63-2.13)	2.14 (1.89-2.47)	2.56 (2.25-2.95)	2.90 (2.54-3.33)	3.25 (2.83-3.73)	3.63 (3.13-4.15)	4.14 (3.55-4.74)	4.55 (3.88-5.21)
6-hr	1.44 (1.29-1.64)	1.73 (1.54-1.97)	2.16 (1.93-2.46)	2.52 (2.24-2.86)	3.02 (2.67-3.42)	3.42 (3.01-3.87)	3.85 (3.37-4.35)	4.31 (3.75-4.85)	4.95 (4.26-5.56)	5.47 (4.67-6.13)
12-hr	1.70 (1.53-1.90)	2.03 (1.83-2.27)	2.52 (2.26-2.81)	2.91 (2.61-3.24)	3.49 (3.11-3.86)	3.96 (3.52-4.37)	4.47 (3.94-4.91)	5.00 (4.39-5.49)	5.77 (5.01-6.32)	6.40 (5.51-6.97)
24-hr	2.01 (1.88-2.18)	2.41 (2.24-2.60)	2.94 (2.74-3.18)	3.38 (3.14-3.64)	4.00 (3.70-4.30)	4.51 (4.15-4.83)	5.03 (4.62-5.39)	5.58 (5.10-5.97)	6.36 (5.77-6.79)	6.98 (6.30-7.44)
2-day	2.37 (2.21-2.54)	2.82 (2.63-3.03)	3.41 (3.19-3.67)	3.90 (3.63-4.18)	4.56 (4.24-4.89)	5.11 (4.73-5.46)	5.66 (5.23-6.05)	6.24 (5.73-6.65)	7.03 (6.42-7.49)	7.65 (6.95-8.15)
3-day	2.53 (2.38-2.71)	3.01 (2.83-3.22)	3.62 (3.40-3.87)	4.12 (3.86-4.40)	4.81 (4.49-5.12)	5.35 (4.98-5.70)	5.92 (5.49-6.30)	6.49 (6.00-6.90)	7.29 (6.69-7.74)	7.91 (7.22-8.40)
4-day	2.70 (2.55-2.87)	3.20 (3.02-3.41)	3.84 (3.61-4.08)	4.35 (4.09-4.62)	5.05 (4.73-5.36)	5.60 (5.24-5.95)	6.17 (5.75-6.55)	6.75 (6.27-7.16)	7.55 (6.96-7.99)	8.16 (7.49-8.66)
7-day	3.24 (3.07-3.43)	3.84 (3.63-4.06)	4.55 (4.30-4.82)	5.11 (4.83-5.41)	5.88 (5.54-6.21)	6.47 (6.08-6.84)	7.08 (6.64-7.48)	7.69 (7.18-8.12)	8.50 (7.90-8.98)	9.12 (8.44-9.64)
10-day	3.74 (3.55-3.94)	4.41 (4.18-4.66)	5.17 (4.91-5.46)	5.77 (5.48-6.09)	6.58 (6.23-6.94)	7.21 (6.81-7.60)	7.83 (7.38-8.26)	8.46 (7.95-8.92)	9.27 (8.67-9.78)	9.89 (9.21-10.4)
20-day	5.24 (4.99-5.50)	6.15 (5.86-6.48)	7.12 (6.78-7.49)	7.88 (7.50-8.28)	8.88 (8.43-9.32)	9.63 (9.14-10.1)	10.4 (9.81-10.9)	11.1 (10.5-11.7)	12.0 (11.3-12.6)	12.7 (11.9-13.4)
30-day	6.57 (6.26-6.92)	7.69 (7.32-8.11)	8.82 (8.40-9.29)	9.71 (9.23-10.2)	10.9 (10.3-11.4)	11.7 (11.1-12.3)	12.6 (11.9-13.2)	13.4 (12.6-14.1)	14.4 (13.6-15.2)	15.2 (14.2-16.0)
45-day	8.41 (8.03-8.80)	9.81 (9.37-10.3)	11.1 (10.6-11.6)	12.1 (11.6-12.7)	13.4 (12.8-14.0)	14.3 (13.7-15.0)	15.2 (14.5-15.9)	16.1 (15.3-16.8)	17.1 (16.2-18.0)	17.8 (16.9-18.7)
60-day	10.1 (9.72-10.6)	11.8 (11.3-12.3)	13.2 (12.7-13.8)	14.3 (13.7-15.0)	15.7 (15.1-16.4)	16.7 (16.0-17.5)	17.7 (16.9-18.4)	18.5 (17.7-19.3)	19.6 (18.6-20.4)	20.3 (19.3-21.2)

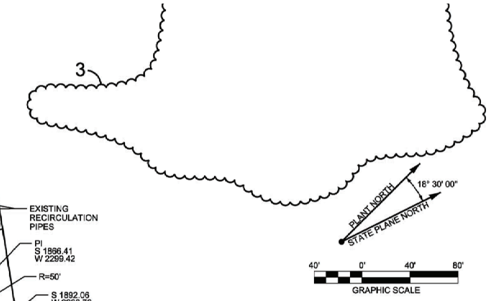
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top





NOTES

1. FOR CIVIL GENERAL NOTES, ABBREVIATIONS, AND SYMBOLS, SEE DRAWING 33483.
2. ALL WORK SHOWN ON THIS DRAWING SHALL BE FURNISHED AND INSTALLED BY SPECIFICATION C-5413 UNLESS NOTED OTHERWISE.
3. CONTOURS SHOWN REPRESENT THE TOP OF THE UPPERMOST LINER PROTECTION LAYER OF THE CCR RULE - COMPLIANT LINER SYSTEM; GRAVEL, CONCRETE, OR RIPRAP RESPECTIVELY. SEE SECTION VIEWS AND LINER DETAILS FOR INFORMATION REGARDING THE LINER SYSTEMS FOR EACH AREA OF THE POND.
4. A 10'-0" WIDE GRAVEL PATH SHALL BE PROVIDED WEST OF THE NEW PERIMETER FENCE.
5. SEE DEMOLITION DRAWING 15301-DEMO. CONTRACTOR SHALL INSTALL NEW PERIMETER FENCE AND OBTAIN WRITTEN APPROVAL FROM THE OWNER PRIOR TO COMMENCING DEMOLITION OF THE EXISTING PERIMETER FENCE AND ASSOCIATED GATES.
6. CONTRACTOR SHALL REGRADE AREA (CUT) AND PROVIDE FILL IN LOCALIZED AREAS AS SHOWN ON PLAN TO LOCATE HIGH POINT AT FENCE LINE AND PROVIDE POSITIVE DRAINAGE ON EITHER SIDE OF NEW PERIMETER FENCE AS SHOWN IN SECTION A.
7. WHERE REQUIRED, CONTRACTOR SHALL PROVIDE CRUSHED STONE TO RAISE PERIMETER TOP OF DIKE ELEVATIONS TO EL. 670.00 AND COMPACT PER THE SPECIFICATION. NO GRADING IS REQUIRED FOR EXISTING AREAS AT EL. 670.00 OR ABOVE.
8. REGRADED AREA AND NEW FILL SHALL BE COMPACTED TO 90% ASTM D1557 AT OPTIMUM MOISTURE CONTENT ±3% AND THEN PROOFROLLED TO DETERMINE SUITABILITY OF THE SUBGRADE. SOFT AREAS SHALL BE ADDRESSED PER SPECIFICATION REQUIREMENTS PRIOR TO PLACEMENT OF TOP SURFACING MATERIAL.
9. FILL MATERIAL IS ANTICIPATED TO BE REQUIRED IN THIS AREA TO PROVIDE POSITIVE DRAINAGE ON EITHER SIDE OF NEW PERIMETER FENCE AS SHOWN IN SECTION A.

REFERENCE DRAWINGS

33470	PIPE SUPPORT LOCATION PLAN
33473	PIPE TRENCH ROAD CROSSINGS PLANS AND SECTIONS
33475	BOTTOM ASH PIPE DISCHARGE SUPPORT PLAN, SECTIONS, AND DETAILS
33491	SOUTH POND - TOP OF LINER PROTECTION - SECTION VIEWS
33492	SOUTH POND - TOP OF LINER PROTECTION - SECTIONS AND DETAILS - SHEET 1
33493	SOUTH POND - TOP OF LINER PROTECTION - SECTIONS AND DETAILS - SHEET 2
33494	SOUTH POND - BOTTOM ASH DEWATERING AND STAGING AREA - PLAN VIEW
33514	NORTH AND SOUTH POND - CHAIN LINK FENCE DETAILS

UNDERGROUND OR EMBEDDED UTILITIES MAY BE LOCATED WITHIN OR ADJACENT TO THE AREA IN WHICH EXCAVATION, DEMOLITION, FOUNDATION, OR MODIFICATION WORK IS TO BE PERFORMED.

REFERENCES RELATING TO THE UNDERGROUND OR EMBEDDED UTILITIES ARE PROVIDED TO ASSIST THE CONTRACTOR/INSTALLER IN THE FIELD LOCATING THOSE UTILITIES AND OTHER POSSIBLE UNDERGROUND OR EMBEDDED INTERFERENCES WITH THE WORK.

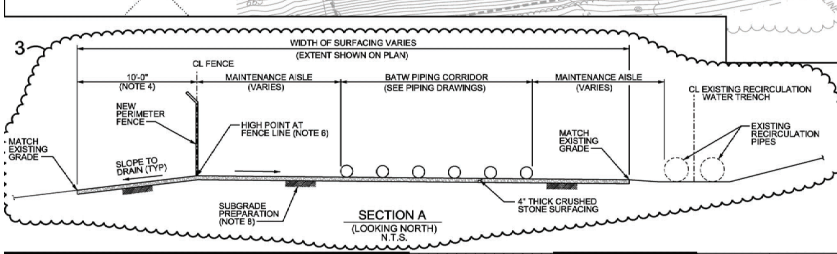
THE CONTRACTOR/INSTALLER SHALL EXERCISE DUE CAUTION DURING ALL EXCAVATION/FOUNDATION/DEMOLITION WORK.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

REFERENCE CARDINAL OPERATING CO. INFORMATION SECURITY POLICY



SECTION A
(LOOKING NORTH)
N.T.S.

SOUTH POND - TOP OF LINER PROTECTION PLAN

REV	DATE RELEASED	PURPOSE	PREPARED / REVIEWED / APPROVED
3	02-25-2021	ISSUED FOR CONSTRUCTION	MR / JF / JC
2	12-30-2020	ISSUED FOR BIDS AND FOR PERMIT REVIEW	JF / AP / JC
1	11-16-2020	ISSUE FOR INFORMATION	AP / JF / DP
0	10-19-2020	ISSUE FOR PERMIT REVIEW	AP / JF / JC

DRAWING RELEASE RECORD

STATE OF OHIO
JOSEPH P. CHARLES
PE 80489
REGISTERED PROFESSIONAL ENGINEER
25-Feb-2021
PROFESSIONAL ENGINEER'S STAMP

Sargent & Lundy

CARDINAL OPERATING COMPANY

CARDINAL PLANT

BRILLIANT OHIO

BOTTOM ASH CLOSURE AND LINING PROJECT
SOUTH POND
TOP OF LINER PROTECTION PLAN
CARDINAL PLANT
BUCKEYE POWER INC.

UNIT	DRAWING NUMBER	REV.
13	33490	3

SCALE: NONE — ENGINEERING DIVISION
DR: AP
CH: JF
S.P.: --
ENG: --
DATE: 10-19-2020
APPROVED BY

CARDINAL OPERATING COMPANY
CARDINAL OPERATING CO.
306 COUNTY ROAD 7E
BRILLIANT, OH 43913

Attachment 3: Runoff Volume (ac-ft) For 10-Year Storm Event South BAP

Description	Drainage Area (ac) (A)	Runoff Coefficient (c)	Rainfall Bound	10-Year Rainfall Depth (d) Inches									
				6-Hour	12-Hour	24-Hour	2-day	3-day	4-day	7-day	10-day	20-day	30-day
Rainfall			Average	2.52	2.91	3.38	3.90	4.12	4.35	5.11	5.77	7.88	9.71
			High	2.86	3.24	3.64	4.18	4.40	4.62	5.41	6.09	8.28	10.20
			Low	2.24	2.61	3.14	3.63	3.86	4.09	4.83	5.48	7.50	9.23
Area 1: South Bottom Ash Pond	6.90	1.00	Average	1.449	1.673	1.944	2.243	2.369	2.501	2.938	3.318	4.531	5.583
			High	1.645	1.863	2.093	2.404	2.530	2.657	3.111	3.502	4.761	5.865
			Low	1.288	1.501	1.806	2.087	2.220	2.352	2.777	3.151	4.313	5.307
Area 2: Peripheral Road to South BAP	2.10	1.00	Average	0.441	0.509	0.592	0.683	0.721	0.761	0.894	1.010	1.379	1.699
			High	0.501	0.567	0.637	0.732	0.770	0.809	0.947	1.066	1.449	1.785
			Low	0.392	0.457	0.550	0.635	0.676	0.716	0.845	0.959	1.313	1.615
Total South BAP	9.00	1.000	Average	1.890	2.182	2.536	2.926	3.090	3.262	3.832	4.328	5.910	7.282
			High	2.146	2.430	2.730	3.136	3.300	3.466	4.058	4.568	6.210	7.650
			Low	1.680	1.958	2.356	2.722	2.896	3.068	3.622	4.110	5.626	6.922

Note:

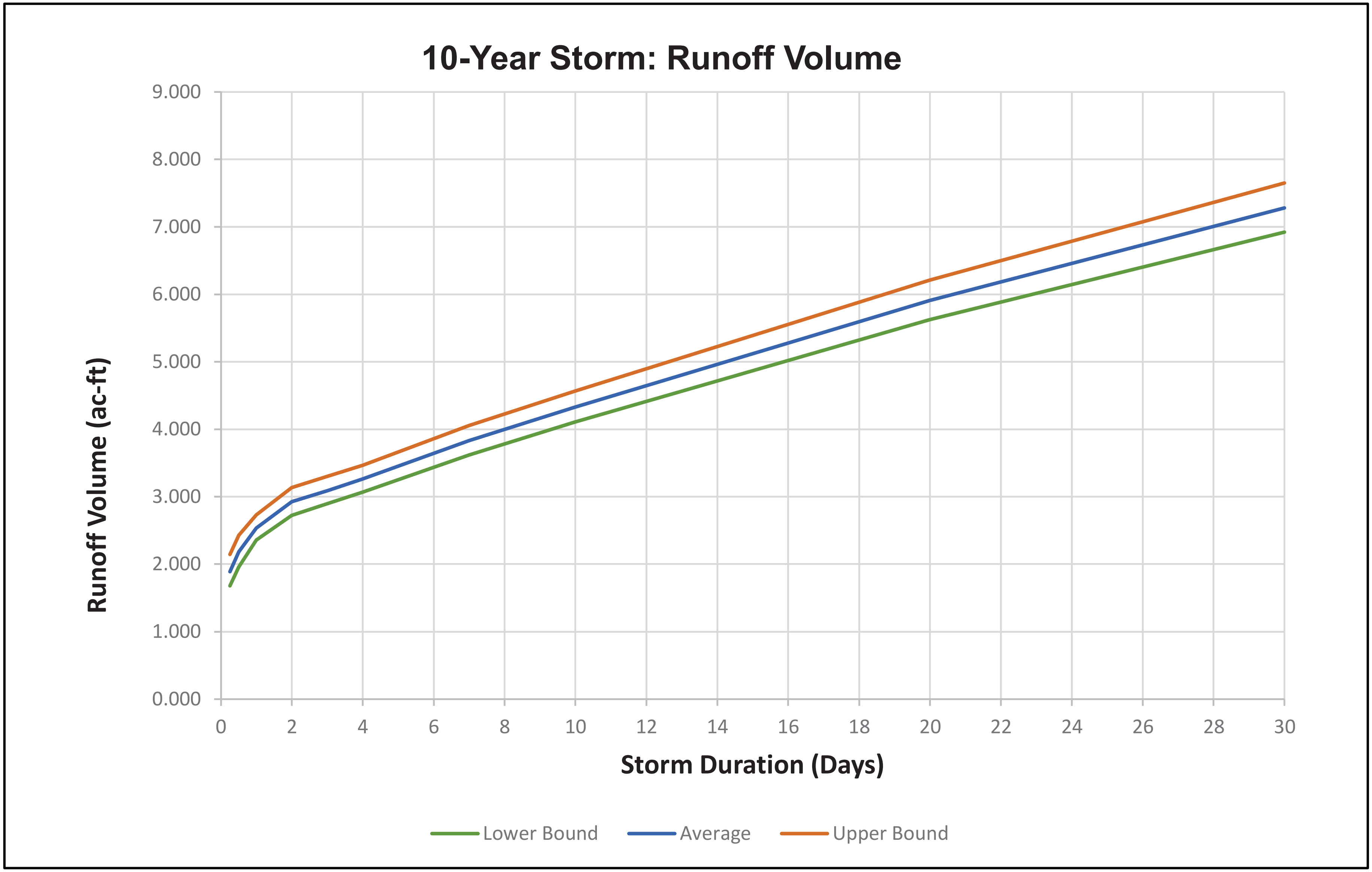
Runoff Volumes in ac-ft and rounded to three decimal

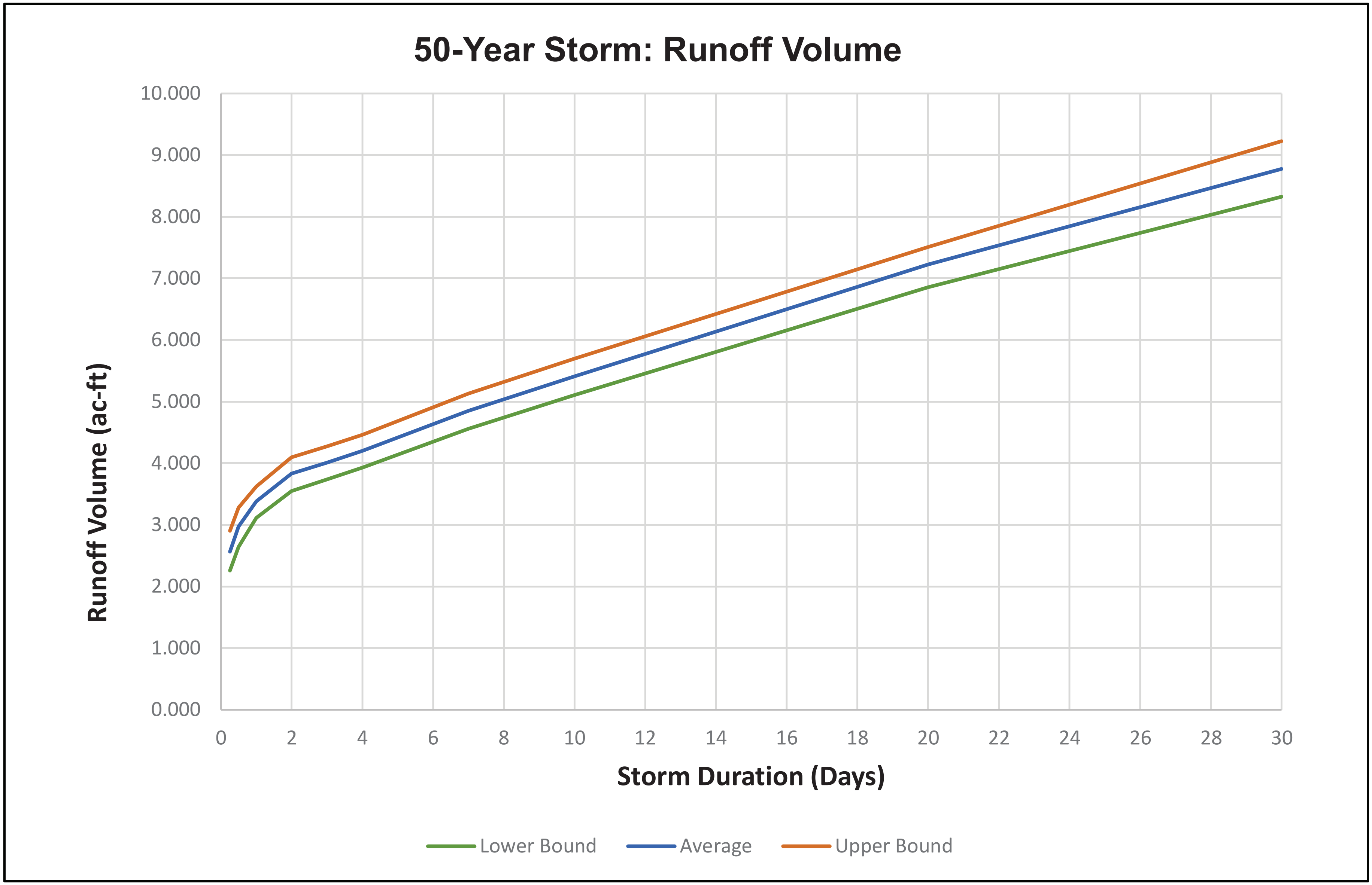
Attachment 4: Runoff Volume (ac-ft) For 50-Year Storm Event South BAP

Description	Drainage Area (ac) (A)	Runoff Coefficient (c)	Rainfall Bound	10-Year Rainfall Depth (d) Inches									
				6-Hour	12-Hour	24-Hour	2-day	3-day	4-day	7-day	10-day	20-day	30-day
Rainfall			Average	3.42	3.96	4.51	5.11	5.35	5.60	6.47	7.21	9.63	11.70
			High	3.87	4.37	4.83	5.46	5.70	5.95	6.84	7.60	10.01	12.30
			Low	3.01	3.52	4.15	4.73	4.98	5.24	6.08	6.81	9.14	11.10
Area 1: South Bottom Ash Pond	6.90	1.00	Average	1.967	2.277	2.593	2.938	3.076	3.220	3.720	4.146	5.537	6.728
			High	2.225	2.513	2.777	3.140	3.278	3.421	3.933	4.370	5.756	7.073
			Low	1.731	2.024	2.386	2.720	2.864	3.013	3.496	3.916	5.256	6.383
Area 2: Peripheral Road to South BAP	2.10	1.00	Average	0.599	0.693	0.789	0.894	0.936	0.980	1.132	1.262	1.685	2.048
			High	0.677	0.765	0.845	0.956	0.998	1.041	1.197	1.330	1.752	2.153
			Low	0.527	0.616	0.726	0.828	0.872	0.917	1.064	1.192	1.600	1.943
Total South BAP	9.00	1.000	Average	2.566	2.970	3.382	3.832	4.012	4.200	4.852	5.408	7.222	8.776
			High	2.902	3.278	3.622	4.096	4.276	4.462	5.130	5.700	7.508	9.226
			Low	2.258	2.640	3.112	3.548	3.736	3.930	4.560	5.108	6.856	8.326

Note:

Runoff Volumes in ac-ft and rounded to three decimal


10-Year Storm: Runoff Volume
Runoff Volume (ac-ft)
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Storm Duration (Days)
Lower Bound
Average
Upper Bound


50-Year Storm: Runoff Volume
Runoff Volume (ac-ft)
10.000
9.000
8.000
7.000
6.000
5.000
4.000
3.000
2.000
1.000
0.000
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
Storm Duration (Days)
Lower Bound
Average
Upper Bound

APPENDIX C.

BOTTOM ASH PURGE WATER SUSPENDED SOLIDS ESTIMATE

Buckeye Power Cooperative

Cardinal Generating Station, Unit 1,2,&3

Document Number: 2023-02785
Bottom Ash Purge Water Suspended Solids Estimate

Rev. 0
August 15, 2023

Sargent & Lundy

ISSUE SUMMARY

Form SOP-0402-07, Revision 15

DESIGN CONTROL SUMMARY

CLIENT:	Buckeye Power Cooperative	UNIT & NO.: 1,2,&3	Page No.: 2
PROJECT NAME:	Cardinal Generating Station		
PROJECT NO.:	13770-006	☐ NUCLEAR SAFETY RELATED ☑ NOT NUCLEAR SAFETY RELATED	
CALC. NO.:	2023-02785		
TITLE:	Bottom Ash Purge Water Suspended Solids Estimate		
EQUIPMENT NO.:			

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

For Comment

Inputs/ Assumptions ☐ VERIFIED ☑ UNVERIFIED

REVIEW METHOD:	Detailed	REV.	0
STATUS:	APPROVED ☐ SUPERSEEDED BY CALC NO. ☐ VOID ☐	DATE FOR REV.:	15-Aug-23
PREPARER	M. Heermann Matthew Heermann (Matthew Heermann 2023.08.16 09:15:02 -05'00')	DATE:	15-Aug-23
REVIEWER	M. Rosen (Michael Rosen — Digitally signed by Michael Rosen Date: 2023.08.16 [illegible])	DATE:	15-Aug-23
APPROVER	D. Wu (Digitally signed by David Wu Date: 2023.10.06 11:25:01 -05'00')	DATE:	15-Aug-23

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REVIEW METHOD:		REV.	
STATUS:	APPROVED ☐ SUPERSEEDED BY CALC NO. ☐ VOID ☐	DATE FOR REV.:	
PREPARER		DATE:	
REVIEWER		DATE:	
APPROVER		DATE:	

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

Inputs/ Assumptions ☐ VERIFIED ☐ UNVERIFIED

REVIEW METHOD:		REV.	
STATUS:	APPROVED ☐ SUPERSEEDED BY CALC NO. ☐ VOID ☐	DATE FOR REV.:	
PREPARER		DATE:	
REVIEWER		DATE:	
APPROVER		DATE:	

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

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Bottom Ash Purge Water Suspended Solids Estimate

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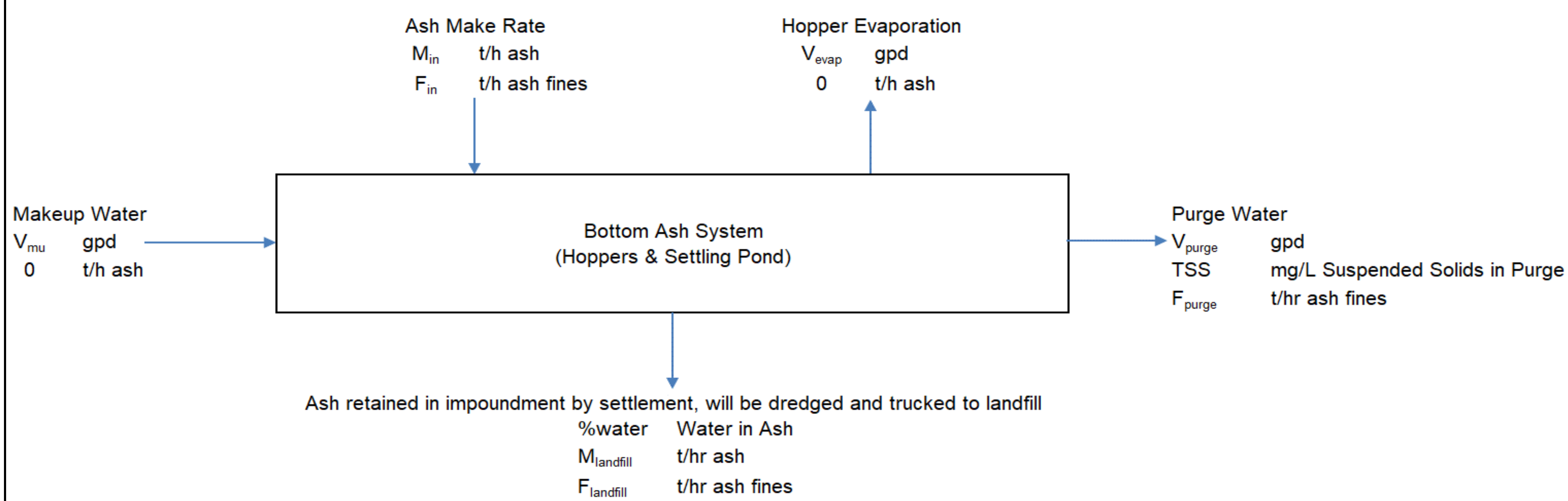
Bottom Ash Purge Water Suspended Solids Estimate

1.00	**PURPOSE AND SCOPE:**				
1.01	The Cardinal Generating Station is a coal fired unit located in Brilliant, OH				
1.02	This calculation was performed to estimate the bottom ash purge water discharge to maintain TSS concentration of 30 mg/L or less to protect bottom ash system pumps from excessive abrasion damage based upon ash water recirculation pump discharge TSS samples. TSS concentration will be maintained at or below the 99% confidence interval of recent TSS concentration analyses.				
Item	**Description**	**Reference**	**Unit of Measure**	**Data Value**	**Input (V/UV/ EJ)**
2.0	**DESIGN INPUTS:**				
2.1	Bottom Ash Handling System Inputs				
2.1.a	Unit 1 ash make rate, M_{in1}	Bottom Ash Closure and Lining Project Design Basis, CAR-DB-0002, Rev 0	t/hr	4.2	**UV**
2.1.b	Unit 2 ash make rate, M_{in2}		t/hr	4.2	**UV**
2.1.c	Unit 3 ash make rate, M_{in3}		t/hr	4.8	**UV**
2.1.d	Primary Active Wetted Bottom Ash System Volume, V	2020-03682, Wetted Bottom Ash Transport Water Volume Estimate	gallons	657,345	**V**
2.3	Bottom Ash Particle Size Distribution				
2.3.a	Fraction of bottom ash particles <75 μm, %fines	EPA-600/7-80-067, Table 8, pg 38	%wt	1.8%	**UV**
2.4	Bottom Ash System Purge Water Total Suspended Solids Concentration Limit				
2.4.a	Fines concentration to protect bottom ash system pumps from excessive abrasion damage based upon ash water recirculation pump discharge TSS samples, TSS	99% confidence interval of Ash Water Recycle Pump Discharge Water Quality total suspended solids data, October 25, 2022 through July 19, 2023.	mg/L	19.7	**UV**
Item	**Description**	**Reference**	**Unit of Measure**	**Data Value**	
3.0	**ASSUMPTIONS:**				
3.1	Particles <75μm are considered fines and the fraction settled in the settlement pond is assumed based upon removal fraction required to protect the ash water recirculation pumps, %removed		%	99.95%	**EJ**
3.2	No ash is present in the makeup water, V_{mu}, and water evaporated from the hopper and dewatering bins, V_{evap}				**EJ**
3.3	Evaporation from hopper and bottom ash pond based on previous project experience prorated by unit nameplate MW, V_{evap}	N/A	gpd	2995	**EJ**
3.4	Water will be entrained in the ash when it is dredged from the ash south pond. This amount of water, when averaged over the life of the plant, is considered negligible.				**EJ**
3.5	All particles other than fines are completely removed by settlement in the bottom ash pond				**EJ**

Bottom Ash Purge Water Suspended Solids Estimate

Item	Description	Variables	Data Value
4.0	**METHODOLOGY & ACCEPTANCE CRITERIA:**		
4.1	The methodology for performing this calculation involves completing the following mass balance for all bottom ash handling systems on site:		



Item	Description	Variables	Data Value
4.2	This calculation is acceptable if the resultant concentration of total suspended solids, TSS, is less than or equal to the value in 3.6.a.		

Bottom Ash Purge Water Suspended Solids Estimate

Item	Description	Reference	Unit of Measure	Equation	
5.0	**CALCULATIONS:**				
5.1	Input of ash into system, M_{in}		t/hr	$M_{in} = (M_{in1} + M_{in2} + M_{in3})$	
	Cardinal Units 1, 2, & 3		t/hr	13.2	
5.2	Input of fines into system, F_{in}		t/hr	$F_{in} = M_{in}$ x %fines	
	Cardinal Units 1, 2, & 3		t/hr	0.24	
5.3	Fines included in the bottom ash purge water, F_{purge}		t/hr	$F_{purge} = F_{in}$ x (1-%removed)	
	Cardinal Units 1, 2, & 3		t/hr	0.00012	
5.4	Concentration of suspended solids in bottom ash purge water, recirculating water, and water entrained in ash to landfill, TSS.		mg/L	$TSS = F_{purge} / (V_{purge} / (2000 \times 24) \times 8.338) \times 1{,}000{,}000$	
	Cardinal Units 1, 2, & 3		mg/L	20	
5.5	Bottom ash purge water flow, V_{purge}		gpd	$V_{purge} = (F_{purge} / TSS) \times 10^6 \times 2000 \times 24 / 8.338$	
	Cardinal Units 1, 2, & 3		gpd	34690.4	
5.6	Average fraction of primary wetted volume discharged per day, %PVW		%	$\%PVW = V_{purge} / V$	
	Cardinal Units 1, 2, & 3		%	5.3%	
Item	**Description**	**Reference**	**Unit of Measure**	**Equation**	**Accept (Y/N)**
6.0	**RESULTS:**				
6.1	30-day rolling average discharge of bottom ash purge water from bottom ash system required to control fines concentration in Combined Unit 6 bottom ash system, %PWV		%PWV/day	5.3%	**YES**
7.0	**REFERENCES:**				
7.1	Program No. 03.2.435-16.0, Microsoft Excel for Office 365				
7.2	Bottom Ash Volume Calculation, 2021-03195				
7.3	EPA Report, EPA-600/7-80-067, Behavior of Coal Ash Particles in Water: Trace Metal Leaching and Ash Settling				
7.4	Bottom Ash Closure and Lining Project Design Basis, CAR-DB-0002, Rev 0				
8.0	**ATTACHMENTS:**				
8.1	AWRP discharge water quality data, October 25, 2022 through July 19, 2023.				

Bottom Ash Purge Water Suspended Solids Estimate

Attachment 8.1:

Ash Water Recirculation Pump Water Quality Data

Date	TSS
10/25/2022	10
11/15/2022	10
11/29/2022	21.5
12/14/2022	19
12/21/2022	12
1/5/2023	7.5
1/9/2023	4
1/16/2023	11.5
1/23/2023	8
2/1/2023	7
2/9/2023	4.5
2/16/2023	6
2/22/2023	7.5
3/2/2023	8.5
3/8/2023	3.5
3/16/2023	5.5
3/23/2023	12
4/3/2023	13
5/2/2023	9
6/2/2023	7.5
7/19/2023	5.5
Min	3.5
Average	9.2
Max	21.5
99% CL	19.7

APPENDIX D.

CHART FROM EPA "BEHAVIOUR OF COAL ASH PARTICLES IN WATER: TRACE METAL LEACHING AND ASH SETTLING"

EPA-600/7-80-067, MARCH 1980, PG 17

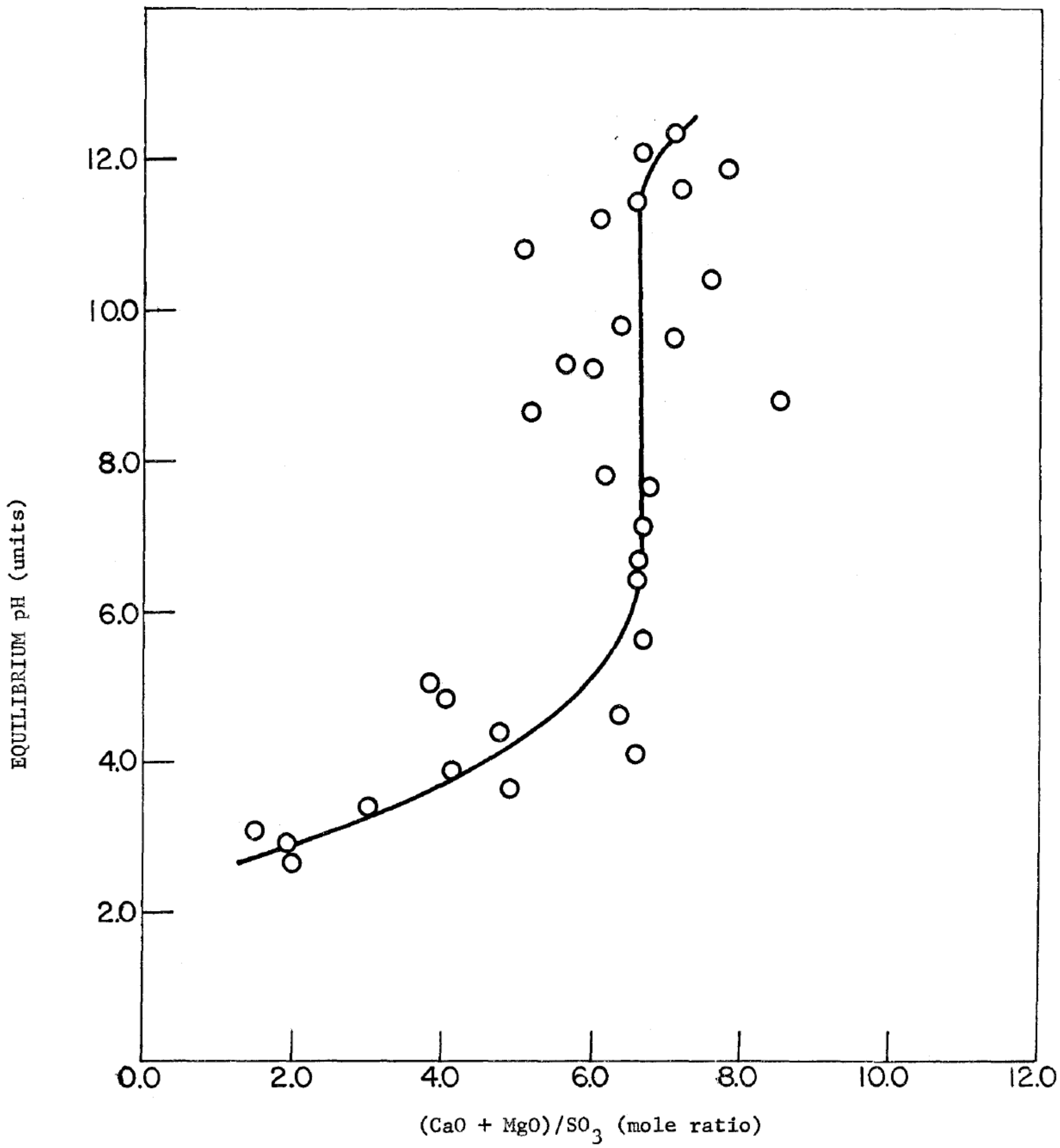


Figure 2. Relationship between the equilibrium pH of ash/water mixture and the mole ratio of CaO plus MgO to SO_3 contained in dry fly ashes.