Nebraska Public Power District
"Always there when you need us"

Joe L. Citta, Jr.
Director of Corp. Environmental & Water Resources
PH: 402-563-5355

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APR 15 2022

NE Dept Of Environment and Energy
By: DEE#195

April 14, 2022

Mr. Steve Goans
Deputy Director
Nebraska Department of Environment and Energy
245 Fallbrook Blvd.
Lincoln, NE 68521

RE: Submission of the Initial Certification Statement for Sheldon Station under the Effluent Limitation Guidelines Rule
Facility ID# 33563

Dear Mr. Goans:

Pursuant to 40 C.F.R. §423.19(c), Nebraska Public Power District (NPPD) is submitting to the Nebraska Department of Environment and Energy (NDEE) an initial certification statement regarding the high recycle rate system that NPPD will install to limit the discharge of bottom ash transport water (BATW) from NPPD's Sheldon Station (Sheldon).

An overview of the existing BATW system and the planned new configuration of the high recycle rate BATW system for Sheldon Station is provided in Attachment A. This overview is being provided as supplemental information to the attached initial certification statement and intended to assist the NDEE in its evaluation of the high recycle rate BATW system that NPPD plans to install at Sheldon.

NPPD's initial certification statement for Sheldon, which is provided in Attachment B, provides all the technical information specified at §423.19(c)(3) regarding the design and operation of the high recycle rate BATW system for meeting the effluent discharge limitations set for BATW under the Effluent Limitations Guidelines rule and codified at 40 C.F.R. §423.13 (k)(2)(i).

Please let me know if you should have any questions on the information submitted in the attached initial certification statement for Sheldon.

Sincerely,

Joe L. Citta, Jr.

Joe L. Citta, Jr.
Director of Corporate Environmental & Water Resources

Enc.

cc: Shelley Schneider, Permitting and Engineering Division Administrator

Attachment A

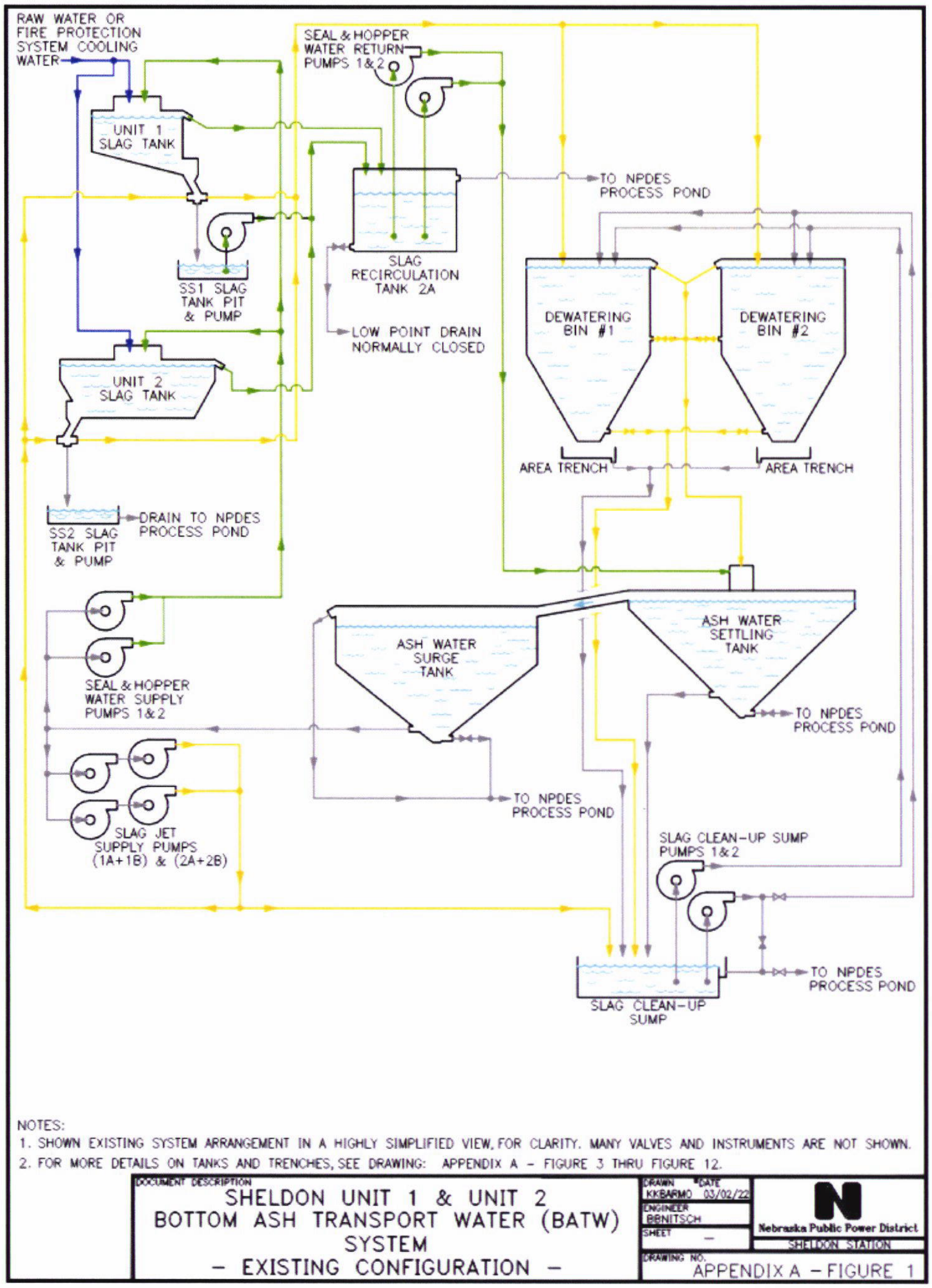
SUPPLEMENTAL TECHNICAL INFORMATION ON THE BOTTOM ASH TRANSPORT WATER SYSTEM FOR SHELDON STATION

The bottom ash transport water (BATW) system currently installed at Sheldon Station (Sheldon) is designed to provide the key design functionality of collecting and cooling bottom ash that is discharged from the Sheldon Unit 1 and 2 boilers into the respective slag tank for each unit and then taking this collected ash in each slag tank and hydraulically transporting it to designed tanks (Dewatering Bins #1 and #2), which hold and collect this ash until it can be safety transported to a 3rd party vendor area or hauled and disposed of in the site's licensed landfill for disposing coal combustion residuals. As the bottom ash flows into in each unit's slag tank that is located under its respective boiler, it is quickly cooled by immersion into a relatively cooler (<140° Fahrenheit) water bath contained within each slag tank.

Immersion into this cool water bath, effectively provides the key design function of shattering the larger bottom ash pieces into smaller, more uniform sizes, which facilitates the ability of the BATW system to transport the bottom ash out of the slag tank (through the use of an eductor) into a grinder (which grinds the broken-up ash into even smaller, more consistently sized particles) and then into the BATW transport piping. The eductor (liquid jet pump) uses the Venturi effect to move the fluid and suspended solids into an enclosed piping system. The eductor has no moving parts but instead relies on only the motive fluid to operate. To facilitate the ability then to transport hydraulically the collected bottom ash in each unit's slag tanks to a selected Dewatering Bin, a collection of tanks, piping, pumps, and controls are utilized for this purpose.

While Sheldon's BATW system was originally designed to facilitate the recycling of a limited portion of the BATW contained within its various system components, it was never designed to function as a high recycle rate, very low discharge system. As a result, the BATW system currently requires the injection of either raw water or fire protection system water to maintain the temperature of the BATW with each unit's boiler slag tank to less than 140° Fahrenheit (OEM recommended value). A high-level general arrangement diagram showing Sheldon's existing BATW system is presented on the following page in Figure 1.

FIGURE 1
EXISTING BATW SYSTEM FOR SHELDON FACILITY



To meet the requirements of the Effluent Limitations Guideline (ELG) rule, NPPD has performed an extensive technical review of Sheldon's existing BATW system. The purpose of that technical review was to identify potential BATW system modifications, evaluate various BATW operating scenarios with respect to the ELG regulatory requirements, and develop high level equipment needs and general arrangement diagrams in order to comply with the discharge limitations and other requirements for BATW under the ELG rule.

Based on the results of this technical review, NPPD is now planning to modify Sheldon's BATW system in order to meet the requirements of the ELG rule. These planned modifications are intended to minimize to the maximum extent practicable the discharge of bottom ash purge water into Sheldon's licensed NPDES discharge structure. These modifications to the current BATW system will also convert the existing BATW system into a high-recycle rate system as described by EPA in the ELG rule. NPPD selected this approach for the following reasons:

- Technical impracticality (if not infeasibility) to convert a wet bottom Sheldon boiler design to a dry bottom design boiler that would be necessary to use a completely dry pneumatic or vacuum based bottom ash conveying technology;

- High technical design and construction difficulties to retrofit and integrate other alternate technologies into the Sheldon wet bottom, pressurized boiler design, such as a mechanical drag chain system; and

- The infeasibility of locating a large enough cooling tank or a secondary cooling system within the confined footprint of each existing individual Sheldon boiler building and surrounding infrastructure.

Under the modified arrangement, the existing Sheldon BATW system will be used in its entirety as it is currently configured with the additions and modifications described below:

- A new Above Ground Cooling (AGC) Tank, as well as appurtenant piping, pumps, and instrumentation, will be added to the system in order to improve the design and support the functionality of the high recycle rate BATW system. The addition of the new AGC Tank is intended to assist in the performance of the following functions:

    - Providing additional cooling of the water that will be recycled to support the operation of the BATW recycle system; and

    - Providing additional volumetric capacity in the BATW recycle system to address key design issues, such as storm events, sediment buildup, BATW working volume, factor of safety, and freeboard.

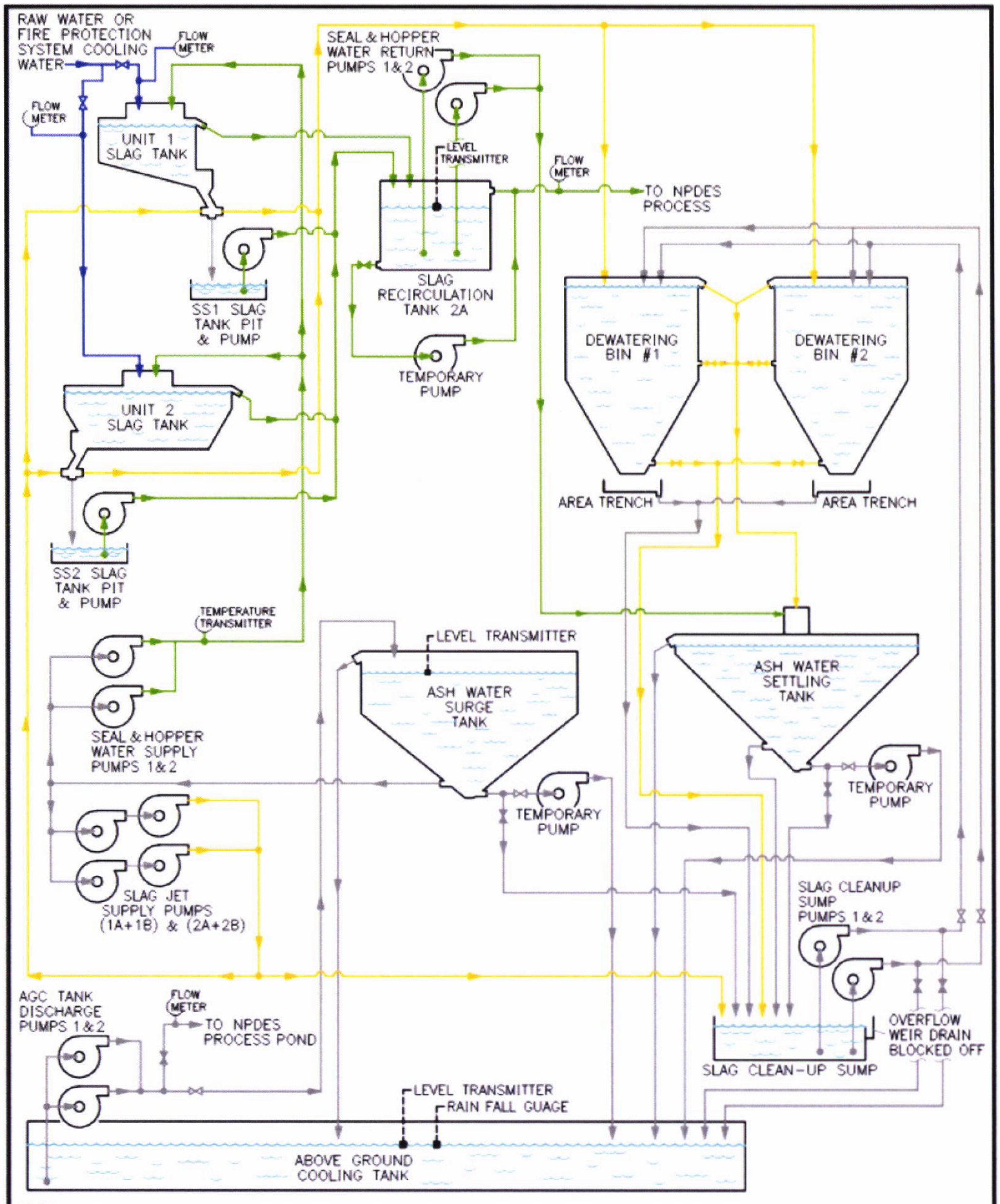
- Flow monitoring from key discharge locations will be added to enhance the monitoring ability and operation of the BATW recycle system.

- Selected portions of existing overflow drain piping associated with the existing BATW system will be modified to facilitate the enhanced recycling capability of the newly reconfigured BATW recycle system.

These planned modifications and the installation of additional equipment will enhance the capability of the existing BATW system to capture and recycle BATW, which would have –

under the existing system – overflowed into the plant drainage system at several points. The planned changes will also increase the cooling capability of the BATW water contained within the system compared to the current BATW system. A high-level general arrangement diagram showing the planned modifications and the installation of additional equipment to Sheldon's existing BATW system is presented on the following page in Figure 2.

FIGURE 2
NEW BATW SYSTEM FOR SHELDON FACILITY



NOTES:

1. SHOWN IS THE NEW BATW SYSTEM ARRANGEMENT IN A HIGHLY SIMPLIFIED VIEW, FOR CLARITY. MANY VALVES AND INSTRUMENTS ARE NOT SHOWN.
2. FOR MORE DETAILS ON TANKS AND TRENCHES, SEE DRAWING: APPENDIX A – FIGURE 3 THRU FIGURE 12.

DOCUMENT DESCRIPTION
SHELDON UNIT 1 & UNIT 2
BOTTOM ASH TRANSPORT WATER (BATW)
SYSTEM
– PROPOSED NEW CONFIGURATION –

DRAWN KKBARMO
DATE 03/18/22
ENGINEER BBNITSCH
SHEET –
Nebraska Public Power District
SHELDON STATION
DRAWING NO. APPENDIX A – FIGURE 2

Attachment B

INITIAL CERTIFICATION STATEMENT

SHELDON STATION
HIGH RECYCLE RATE BOTTOM ASH TRANSPORT SYSTEM

This initial certification statement provides the technical information specified at 40 C.F.R. §423.19(c)(3) regarding the design and operation of the high recycle rate bottom ash transport system that Nebraska Public Power District (NPPD) plans to install at Sheldon Station (Sheldon). Once installed, the high recycle rate system will be used by NPPD to meet the effluent discharge limitations that are set for bottom ash transport water (BATW) under the Effluent Limitations Guidelines (ELG) rule and codified at 40 C.F.R. §423.13 (k)(2)(i).

The initial certification statement below first identifies each of the certification requirements and then provides NPPD's response for that requirement.

1. CERTIFICATION BY LICENSED PROFESSIONAL ENGINEER

REQUIREMENTS:

The initial certification statement must be signed by a licensed professional engineer who confirms he or she is "familiar with regulation requirements" and "familiar with the facility." 40 C.F.R. §423.19(c)(2), (3)(A)-(C).

RESPONSE:

I certify that I am a registered professional engineer under the laws of the State of Nebraska. I further certify that I am familiar with the design and operation of Sheldon Station and the regulatory requirements of the ELG rule, including the requirements for regulation of BATW. Finally, I certify that the information included in this initial certification statement was prepared by me or others under my supervision.

Certified By: Bob B. Nitsch

Bob B. Nitsch
Nebraska P.E. No. E-8267

Date: 4/13/2022

Seal:

BOB B. NITSCH
E-8267

2. PRIMARY ACTIVE WETTED BOTTOM ASH VOLUME

REQUIREMENTS:

The initial certification statement must contain a determination of the primary active wetted bottom ash system volume for the high recycle rate BATW system being installed at the Sheldon Station. 40 C.F.R. §423.19(c)(3)(D).

The owner or operator of the BATW system must provide the material assumptions, information, and calculations used by the certifying professional engineer to determine the primary active wetted bottom ash system volume. 40 C.F.R. §423.19(c)(3)(E).

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." 40 C.F.R. §423.11(aa).

RESPONSE:

Primary Wetted Volume Determination. As noted above, the ELG rule defines the primary wetted volume of a BATW system as the "maximum volumetric capacity of the bottom ash transport water" flowing through the BATW system. One, but not the only, component of the system's maximum volumetric capacity is the working volume of the various non-redundant tanks, bins, sumps, and piping of a BATW System during regular operation. Other components of the system's maximum volumetric capacity include the water volumes of the BATW system that are designed to handle rainfall into the system due to storm events and other system inflows due to various maintenance and operational activities undertaken at Sheldon. In addition, the system's maximum volumetric capacity must reflect the design engineering factors to assure the safe and long-term operation of the planned BATW system. The discussion below provides a detailed technical description of these design factors and operating conditions that NPPD evaluated in developing the high recycle rate BATW system for meeting the requirements of the ELG rule.

Taking all of the design and operating factors noted above into full consideration, NPPD has determined the primary active wetted bottom ash system volume to be 2,102,534 gallons for the high recycle rate BATW system that NPPD plans to install and operate at Sheldon Station. The following table provides a breakdown of the BATW volumes for each component of that planned BATW recycle system that NPPD used for calculating the maximum volumetric capacity of the transport water flowing through the system.

Table 1 - Summary of Primary Wetted Volume of the Sheldon Station Unit 1 and 2 BATW System

1	Description	Volume (Gal)	Additional Information
a.	Unit 1 & 2 wetted volume in equipment, tanks, bins, and sumps during regular frequent and infrequent system operation.	1,117,811	Summation of volumes from Table 2
b.	Unit 1 & 2 wetted volume in system piping during regular frequent and infrequent system operation	13,840	Summation of volumes from Table 3
c.	Additional Unit 1 and 2 system design volume that can be "wetted" volumes of non-redundant Sheldon equipment, tanks, bins, and sumps during regular frequent and infrequent system operation.	970,883	Summation of volumes from Table 4
d.	**Total Primary Wetted Volume of the Sheldon Station Units 1 & 2 BATW System:**	**2,102,534**	

Details are provided in Appendix A regarding how NPPD calculated the volume of the various tanks, bins, and sumps to be utilized for the planned high recycle rate BATW system being installed at Sheldon Station.

<u>Material Assumptions and Information for the Primary Wetted Volume Calculations</u>. Tables 2, 3 and 4 on the following pages describe the material assumptions and other important relevant information on which NPPD relied in performing the primary wetted volume calculations for the planned high recycle rate BATW system being installed at Sheldon Station.

Table 2 - Actual "Wetted" Areas of Sheldon BATW System Including All Non-Redundant Equipment, Tanks, Bins, and Sumps

	Equipment	Qty	Redundant Equipment	Calculated Wetted Volume per tank, Bin, or Sump (ft^3)	Calculated Wetted Volume per Tank Bin or Sump, excluding redundancies (gal)	Material Assumptions
2	**Units 1 & 2**					
a.	Unit 1 Slag Tank	1	0	1,835	13,728	-Volume calculated based on the slag tank operating at the overflow during regular system operation
b.	Unit 2 Slag Tank	1	0	2,165	16,196	-Volume calculated based on the slag tank operating at the overflow during regular system operation
c.	Unit 2 Slag Recirculation Tank	1	0	385	2,880	-Volume during regular system operation considered to be 6" below overflow
d.	#1 & #2 Dewatering Bins	1	1	23,445	175,392	-During regular system operation, only one dewatering bin will be full of water while the other dewatering bin is considered to be dewatered (filled with bottom ash and emptied of water). Therefore, the calculated volume for this dewatering bins is only one dewatering bin, the second dewatering bin is considered redundant. -Volume is calculated assuming the active dewatering bin operates at overflow level during regular system operation.
e.	Ash Water Settling Tank	1	0	28,307	211,765	-Volume at regular system operation is considered to the height of the overflow weir. -Regular operating level of this tank is at a height of the inlet to its overflow trough to the Ash Water Surge Tank.
f.	Ash Water Surge Tank	1	0	34,515	258,207	Volume during regular system operation of this tank is considered to be 12" below the Ash Water Surge Tank overflow. This water level in this tank is the estimated regular operating level that will be maintained with the Above Ground Cooling Tank in Operation.
g.	Units 1 & 2 Slag Clean-up Sump	1	0	223	1,668	Volume of this sump during regular system operation is assumed to be 6" below the outlet to its overflow
h.	Unit 1 Slag Pit Sump	1	0	132	987	-Volume of this sump during regular system operation is assumed to be 24" from the floor of the sump.
i.	Unit 2 Slag Pit Sump	1	0	185	1,384	-Volume of this sump during regular system operation is assumed to be 12" from the floor of the sump. -It is assumed that a new sump pit and pump will be installed with the same dimensions as the Unit 1 pit.
j.	Above Ground Cooling (AGC) Tank					
j.1	Working Volume During Regular System Operation	1	0	58,228	435,604	-The Above Ground Cooling Tank is required for heat rejection in order to maintain the Sheldon Unit 1 and 2 boiler slag tank water bath temperatures at 140 °F while also minimizing the raw water inflow into the system. -The operating level of the Above Ground Cooling Tank will vary depending on precipitation and plant maintenance/operating conditions. However, for the purpose of the primary wetted volume calculation, it is estimated that the regular operating level of the tank is 24 inches per vendor recommended minimum operating depth plus the volume from one dewatering bin to account for both dewatering bins being full of water during various operation and maintenance events (i.e. hydrobin switching when removing bottom ash from a dewatering bin).
j.2	AGC Tank Freeboard			N/A	N/A	Freeboard volume that was included in the AGC Tank design is accounted for in Table 4
j.3	Storm Event Runoff into the BATW System			N/A	N/A	Storm Event Runoff into the BATW System that was included in the AGC Tank design is accounted for in Table 4
j.4	Additional System Volume to Account for Design Factors and Maintenance / Operational Events			N/A	N/A	Additional system volume to account for design factors and maintenance / operational events that was included in the AGC Tank design is accounted for in Table 4
k.	**TOTAL**			149,420	1,117,811	

Table 3 - Actual "Wetted" Areas of Non-Redundant Sheldon BATW System Piping

3	Section of 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)	Material Assumptions
a.	Slag Tank Eductor Lines (10"-785 & 787)	Basalt Lined	10	10	638.30	0.55	348	2,604	Assumed that nominal diameter is the same as internal diameter for basalt lined piping.
b.	Slag Jet Supply (12"-782 & 784)	Sch 40 CS	12	11.938	535.50	0.78	416	3,114	
c.	Seal & Hopper Water Return (8"-815)	Sch 40 CS	8	7.981	4.50	0.35	2	12	
d.	Seal & Hopper Water Return (6"-816 & 818)	Sch 40 CS	6	6.065	458.90	0.20	92	689	
e.	Seal & Hopper Water Supply (10"-802 & 928)	Sch 40 CS	10	10.02	443.60	0.55	243	1,817	
f.	Seal & Hopper Water Supply (6"-928)	Sch 40 CS	6	6.065	56.90	0.20	11	85	
g.	Seal & Hopper Water Supply (6"-807)	Sch 40 CS	6	6.065	37.40	0.20	8	56	
h.	Seal & Hopper Water Supply (8"-807)	Sch 40 CS	8	7.981	9.60	0.35	3	25	
i.	Seal & Hopper Water Supply (6"-929)	Sch 40 CS	6	6.065	28.60	0.20	6	43	
j.	Slag Tank 1 Overflow Line (8"-812)	Sch 40 CS	8	7.981	19.60	0.35	7	51	Assumed 10' elevation change
k.	Slag Tank 1 Overflow Line (10"-812)	Sch 40 CS	10	10.02	142.13	0.55	78	582	
l.	Slag Tank 2 Overflow Line (8"-494)	Sch 40 CS	8	7.981	15.30	0.35	5	40	Assumed 10' elevation change
m.	Ash Water Surge and Ash Water Settling Tank Water Overflow to AGC Tank (future)	Sch 40 CS	16	15	240.00	1.23	295	2,203	
n.	Cooling Water Return (future)	Sch 40 CS	8	7.981	485.00	0.35	168	1,261	
o.	Misc. Secondary Piping						168	1,258	10% of sum of major process piping listed
p.	TOTAL						1,850	13,840	TOTAL VOLUME

Table 4 - Additional System Design Volume That Can Be "Wetted" Areas of Non-Redundant Sheldon Equipment, Tanks, Bins, and Sumps

	Equipment	Additional Available System Volume (ft^3)	Additional Available System Volume (gal)	Material Assumptions
4	**Units 1 & 2**			
a.	Unit 1 Slag Tank	0.0	0	Additional available system volume in the slag tank is 0 since the slag tank is assumed to operate at the overflow.
b.	Unit 2 Slag Tank	0.0	0	Additional available system volume in the slag tank is 0 since the slag tank is assumed to operate at the overflow.
c.	Unit 2 Slag Recirculation Tank	34.0	254	Additional available system volume considered to be the difference between regular operating level in this tank (6" below overflow) up to the overflow level for this tank.
d.	#1 & #2 Dewatering Bins	0.0	0	-It is assumed that there is no additional available system volume in the active dewatering bin since it operates at overflow level.
e.	Ash Water Settling Tank	0.0	0	There is no additional available system volume considered in the Ash Water Setting Tank since it operates at overflow condition to the Above Ground Cooling Tank.
f.	Ash Water Surge Tank	1,963.0	14,685	Additional available system volume considered to be the difference between regular operating level in this tank (12" below overflow) up the the tank overflow
g.	Units 1 & 2 Slag Clean-up Sump	39.0	292	Assume that the regular operating water level in this sump is 6" below overflow, thus the diference between this sumps regular operating level to the top of the sump is considered the additional available system volume.
h.	Unit 1 Slag Pit Sump	171.0	1,279	It is assumed that the regular operating water level in this sump is 24" above the floor of the sump which allows for 24" of elevation to the top of the sump. Thus the diference between the sump's regular operating level to the top of the sump is considered the additional available system volume.
i.	Unit 2 Slag Pit Sump	291.0	2,177	It is assumed that the regular operating water level in this sump is 12" above the floor of the sump which allows for 19.5" of elevation to the top of the sump. Thus the diference between the sump's regular operating level to the top of the sump is considered the additional available system volume.
j.	Above Ground Cooling (AGC) Tank	-	-	The additional available system volume of the AGC Tank is broken into the design considerations as listed in 8.1.4.j1 thru j3.
j.1	Working Volume During Regular System Operation	N/A	N/A	Working volume during regular system operation that was included in the AGC Tank design is accounted for in Table 2
j.2	AGC Tank Freeboard	N/A	N/A	Freeboard is a design volume in the AGC Tank reserved for the vendor recommendation of maintaining a minimum of 12" of airspace measured from the top of the AGC Tank. Thus, this design factor volume was not included as additional system capacity or part of the primary wetted volume since no BATW is intended to be held within this space.
j.3	Storm Event Runoff into the BATW System	36,330	271,781	Design volume in the AGC Tank reserved for the calculated rainfall runoff into the SS BATW system for a 50 year 30-day rain event.
j.4	Additional System Volume to Account for Design Factors and Maintenance / Operational Events	90,952	680,415	Design volume in the AGC Tank reserved to account for design factors such as: a. Sediment b. System Inflows from wastestreams other than BATW c. BATW Movement / Conservation Within the BATW System for Maintenance or Operational Needs d. Factor of Safety
k.	**TOTAL ADDITIONAL AVAILABLE SYSTEM VOLUME**	**129,780**	**970,883**	

3. EXPECTED VOLUME AND FREQUENCY OF DISCHARGE EVENTS

Requirements:

The initial certification statement must provide a list of all potential discharges identified as permissible discharges under the ELG rule, the expected volume of each discharge, and the expected frequency of each discharge. 40 C.F.R. §423.19(c)(3)(F).

The potential discharges permissible under the ELG rule include the following:

- Discharges to maintain system water balance during severe storm events, *see* §423.13(k)(2)(i)(A)(1);
- Discharges to maintain system water balance when regular inflows from other waste streams exceed the system's ability to accept recycled water, *see* §423.13(k)(2)(i)(A)(2);
- Discharges to maintain system water chemistry, *see* §423.13(k)(2)(i)(A)(3); and
- Discharges to conduct maintenance not otherwise described above, *see* §423.13(k)(2)(i)(A)(4).

The owner or operator of the BATW system must provide the material assumptions, information, and calculations used by the certifying professional engineer to determine the expected volume and frequency of each discharge including a narrative discussion of why such discharge cannot be managed within the system and must be discharged. 40 C.F.R. §423.19(c)(3)(G).

Response:

While Sheldon's BATW system was originally designed to facilitate the recycling of a limited portion of the BATW contained within its various system components, it was never designed to function as a high recycle rate, very low discharge system. Sheldon's BATW system currently requires the inflow and use of raw water or fire protection water to maintain the temperature of the water held within each operating unit's boiler slag tank to less than 140° Fahrenheit (OEM recommended value), which – by operational experience – has been confirmed to be a key design factor to ensure safe and effective operation of the system.

Based on the planned modifications and equipment additions to Sheldon's current BATW system, discharges will now be greatly minimized while recycling and conservation of water contained within the various system components will be increased and improved. The increased recycling rate and improved BATW water conservation measures will greatly reduce the discharge of BATW from the system to the station's licensed NPDES discharge structure. Except in the case of a *forced majeure* event, the total volume of the expected discharges in no event shall exceed a 30-day rolling average of ten percent of the primary active wetted bottom ash system volume (primary wetted volume) as outlined in Table 5 on the follow pages.

This section begins by identifying each of the potential discharges from the planned new high recycle rate BATW system. For each type of discharge event listed below, NPPD is providing a summary of the expected volume and frequency of the discharges from the operation of the planned high recycle rate BATW system under foreseeable operating conditions. Finally, this section ends with a summary of the material assumptions and other important relevant information that NPPD used for identifying potential discharge events and the potential amount of discharge from each type of event utilizing reasonable conservative assumptions.

List of Potential Discharges. As a general matter, the planned changes to Sheldon's current BATW system will focus on making improvements to the equipment, process controls, and operational procedures that will reduce, to the maximum extent practicable, the discharges of BATW from the new high recycle rate system. In particular, the following discharges of BATW are expected to occur from the new high recycle rate system once it is properly installed, placed into operation, and maintained:

- Discharges to balance precipitation-related flows when those precipitation-related flows result from storm(s) that result in the exceedance of a 50-year expected frequency and 30-day duration storm rainfall runoff event;

- Discharges to maintain system water balance when regular inflows from wastestreams other than bottom ash transport water exceed the ability of the BATW system to accept recycled water and when segregating these other waste streams is not feasible, including the discharges of wastewater resulting from coal bunker coal removal events at Sheldon Unit 1 and Unit 2[1]:

- Discharges to maintain system water chemistry, including maintaining—
    - The pH of the water contained within the BATW system at levels to avoid conditions causing scaling, and
    - Fine particulates in the water contained within the BATW system below specified targeted levels (specifically, TSS to 0.1wt% or less); and

- Discharges to conduct maintenance not otherwise included in the above discharges, such as those discharges that result from the draining of a significant percentage of Sheldon's high recycle rate BATW system in order to perform major maintenance activities on the new BATW system, including—
    - Complete draining of the AGC Tank;
    - Complete draining of the existing BATW System tanks, bins, sumps and piping;
    - Complete draining of the entire BATW System during a dual unit outage occurring in an extended cold snap; and

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[1] Although not identified as discharge events, this certification statement indicates that substantial wastestream inflows will result from (1) Boiler coal bunker washdowns to remove coal dust at Sheldon Unit 1 and Unit 2 and (2) Boiler hydro-wash events at Sheldon Unit 1 and Unit 2. The ability of the new recycle BATW system to manage these inflows will depend on other inflows into the system at the same time.

- Complete draining of the entire BATW System if at a future date NPPD decides to cease the combustion of coal on both units at the station.

Volume and Frequency of the Discharges. Table 5 on the following pages summarizes the expected volume and frequency of discharges from the operation of the planned high recycle rate BATW system under foreseeable operating conditions and the occurrence of potential events. The frequency of the expected discharge for each evaluated event was classified as frequent or infrequent while the calculated volume of an expected discharge is presented in a manner (potential gallons of discharge over a 30-day averaging period) that reflect the utilization of reasonable assumptions.

A key factor in the evaluation of these operational conditions and events was the expected frequency of how often they might occur. NPPD's evaluation considered frequent events to be those that typically happen at least once or twice per year. Infrequent events were considered to be events that typically occur less than once per year between events.

Table 5 - Expected Volume and Frequency of Discharge Events from Sheldon High Recycle Rate BATW System

Type of Discharge Events	Potential Inflow Into or Within the BATW System (Worst Case)	Frequency of Discharge Event	Volume of Discharge Event (Worst Case)	
			Percent of Primary Wetted Volume over a 30-day Period	Gallons of Primary Wetted Volume
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 as authorized in §423.13(k)(2)(i)(A)(1).				
a. Up to a 10-year, 24-hour storm event	a. ≤82,749 per Storm Event	a. Frequent	a. 0%	a. 0 gallons BATW System Design Accounts for This Event
b. Exceeding a 10-year, 24-hour storm event up to a 50-year, 30-day storm event	b. 82,749 gallons < Storm Event ≤ 271,781 gallons	b. Infrequent	b. 0%	b. 0 gallons BATW System Design Accounts for This Event
c. Exceeding a 50-year, 30-day storm event	c. >271,781 gallons per Storm Event	c. Infrequent	c. *Force Majeure* Event	c. Storm Event minus 271,781 gallons which is accounted for in BATW system design
2. To maintain system water balance when regular inflows from waste streams other than bottom ash transport water exceed the ability of the bottom ash system to accept recycled water and segregating these other waste streams is not feasible as authorized in §423.13(k)(2)(i)(A)(2).				
a. Anticipated other wastestream inflows during regular, frequent, system operations where no inflows will occur from wastestreams other than the regular inflows into bottom ash system.	a. De minimis	a. Frequent	a. 0%	a. 0 gallons BATW system design accounts for this event
b. Anticipated other wastestream inflows occurring during regular, frequently scheduled, system operational events, where inflows into the Sheldon BATW system will occur from wastestreams other than bottom ash system, such as discharges from Sheldon Unit 1 and Unit 2 boiler floor washdowns during boiler hydro-wash events	b. Up to 316,800 gallons per event (Both boiler floors cleaned within a 30-day time period)	b. Frequent	b. 0%	b. 0 gallons BATW system design accounts for this event

Type of Discharge Events	Potential Inflow Into or Within the BATW System (Worst Case)	Frequency of Discharge Event	Volume of Discharge Event (Worst Case)	
			Percent of Primary Wetted Volume over a 30-day Period	Gallons of Primary Wetted Volume
c. Anticipated other wastestream inflows occurring during regular, but infrequently scheduled, operational events, where inflows into the Sheldon BATW system will occur from waste streams other than bottom ash system, such as—				
i. Sheldon Unit 1 and 2 Boiler Coal Bunker(s) Washdown to Remove Coal Dust	c.i. Up to 316,800 gallons per event (All coal bunkers on both units washed down within a 30-day time period)	c.i. Infrequent	c.i. 0%	c.i. 0 gallons BATW system design accounts for this event
ii. Sheldon Unit 1 and 2 Coal Bunker Coal Removal Event	c.ii. Up to 5,392,728 gallons per event if both units are offline Up to 3,480,048 gallons per event if Unit 1 alone Up to 1,912,680 gallons per event if Unit 2 alone	c.ii. Infrequent	c.ii. 7.47%[1] for both units offline 4.44%[2] for Unit 1 alone 1.95%[3] for Unit 2 alone	c.ii. 4,712,444 gallons[2] for both units offline 2,799,764 gallons[3] for Unit 1 alone 1,232,396 gallons[4] for Unit 2 alone
3. To maintain system water chemistry during regular system operation 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, as authorized in §423.13(k)(2)(i)(A)(3).				

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[2] Calculated by taking the worst-case potential inflow into the BATW System due to the event (5,392,728) minus the dedicated additional system volume in the AGC Tank to account for design factors and maintenance / operational events (680,284 gallons) which results in 4,712,444 gallons which may have to be discharged under worst case conditions. Dividing this amount by 30 days and then by the total primary wetted volume of 2,102,534 multiplied by 100 results in a potential discharge rate of 7.47% of the primary wetted volume.

[3] Calculated by taking the worst-case potential inflow into the BATW System due to a Unit 1 event alone (3,480,048) minus the dedicated additional system volume in the AGC Tank to account for design factors and maintenance / operational events (680,284 gallons) which results in 2,799,764 gallons which may have to be discharged under worst case conditions. Dividing this amount by 30 days and then by the total primary wetted volume of 2,102,534 multiplied by 100 results in a potential discharge rate of 4.44% of the primary wetted volume for a Unit 1 alone event.

[4] Calculated by taking the worst-case potential inflow into the BATW System due to a Unit 2 event alone (1,912,680) minus the dedicated additional system volume in the AGC Tank to account for design factors and maintenance / operational events (680,284 gallons) which results in 1,232,396 gallons which may have to be discharged under worst case conditions. Dividing this amount by 30 days and then by the total primary wetted volume of 2,102,314 multiplied by 100 results in a potential discharge rate of 1.95% of the primary wetted volume for a Unit 2 alone event.

Type of Discharge Events	Potential Inflow Into or Within the BATW System (Worst Case)	Frequency of Discharge Event	Volume of Discharge Event (Worst Case)	
			Percent of Primary Wetted Volume over a 30-day Period	Gallons of Primary Wetted Volume
a. Regular scheduled system operation (maintaining system chemistry, pH)	N/A	Frequent	2.33%[5]	49,076.5 gallons per day (~34 gpm)

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[5] Calculated by dividing calculated purge rate (49,076.5 gallons / day) by the totalized PWV (2,102,534 gallons) multiplied by 100 to get percent

Type of Discharge Events	**Potential Inflow Into or Within the BATW System (Worst Case)**	**Frequency of Discharge Event**	**Volume of Discharge Event (Worst Case)**	
			Percent of Primary Wetted Volume over a 30-day Period	**Gallons of Primary Wetted Volume**
4. To conduct maintenance not otherwise included above, as authorized in §423.13(k)(2)(i)(A)(4).				
a. Regular scheduled BATW system maintenance	a. 0 gallons	a. Frequent	a. 0%	a. 0 gallons BATW system design accounts for this event
b. Regular, infrequently scheduled, BATW maintenance				
i. BATW maintenance of draining of the entire existing BATW system into the AGC Tank	b.i. 695,940 gallons of water transferred from the existing BATW System to the AGC Tank when both units are offline	b.i. Infrequent	b.i. 0.02%	b.i. Up to 15,656 gallons[6]
ii. Draining a majority of the Sheldon BATW System such as the AGC Tank back into the existing BATW system	b.ii. 1,387,682 gallons transfer of water from the AGC Tank to the existing BATW System when both units are offline.	b.ii. Infrequent	b.ii. 2.17%	b.ii. Up to 1,368,991 gallons[7]
iii. Draining the entirety of the Sheldon BATW System due to the loss of both units due to a severe cold weather event such as an ice storm followed by and extended cold snap	b.iii. 0 gallons	b.iii. Infrequent	b.iii. *Force Majeure* Event	b.iii. Up to 2,102,534 gallons
iv. Draining the entirety of the Sheldon BATW System due to the decision to cease the combustion of solid fuel (coal) on both Sheldon units.	b.iv. 0 gallons	b.iv. Infrequent	b.iv. 10%	b.iv. Up to 2,102,534 gallons

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[6] Calculated by taking the worst-case potential transfer of water within the BATW System due to the event (695,940 gallons) minus the dedicated additional system volume in the AGC Tank to account for design factors and maintenance / operational events (680,284 gallons) which results in 15,656 gallons which may have to be discharged. Dividing this amount by 30 days and then by the total primary wetted volume of 2,102,534 multiplied by 100 results in a potential discharge rate of 0.02% of the primary wetted volume.

[7] Calculated by taking the worst-case potential transfer of water within the BATW System due to the event (1,387,682 gallons) minus the additional system volume in the existing BATW System tanks, bins, sumps, and piping (18,691 gallons) which results in 1,368,991 gallons which may have to be discharged. Dividing this amount by 30 days and then by the total primary wetted volume of 2,102,534 multiplied by 100 results in a potential discharge rate of 2.17% of the primary wetted volume.

Material Assumptions and Information for Calculating Discharges Due to Storm Events. NPPD evaluated Sheldon's existing BATW system configuration as well as the planned configuration changes to the system. In doing so, the following generalized locations were identified where water inflows from a storm water event could be gathered and directed into the BATW system:

- Ash Water Settling Tank;
- Ash Water Surge Tank;
- Dewatering Bins 1 and 2;
- Above Ground Cooling Tank; and
- An approximate 763 ft^2 area at ground level located between the Ash Water Pump House and Dewatering Bin Unloading Area.

NPPD then evaluated the potential rainfall that could be gathered and directed into the BATW system from the full range of potential storm events. This evaluation included a quantification in gallons of inflows from storm events of varying frequency and duration based on publicly available data from the National Oceanic and Atmospheric Administration and by utilizing the listed amount of rainfall for the event that represents the 95% confidence level that the expected rainfall from a storm of the noted frequency and duration would be less than the amount noted below for each storm event. The amount of stormwater inflows that NPPD calculated for key storm events is presented in Table 6 below.

Table 6 - Amount of Stormwater Inflows Into the BATW System Due to Storm Events[8]

Storm Event	Utilized Inches per Storm Event	Stormwater Inflows
10-year, 24-hour storm event	5.45	82,749 gallons
50-year, 30-day storm event	17.9	271,781 gallons

Notably, NPPD designed the planned new high recycle rate BATW system to install an AGC Tank to have the capacity to accommodate up to an additional 271,781 gallons (See Table 4) for stormwater inflows. As a result, the design of the new recycle system will be able to handle up to a 50-year, 30-day storm event without any discharge of BATW. By contrast, storm events exceeding a 50-year, 30-day storm event will consequently result in additional inflow into the Sheldon BATW system over the allotted design volume of 271,781 gallons.

Due to the possibility that an infrequent storm event exceeding a 50-year, 30-day event might occur, NPPD is proposing to establish a permit provision to address extreme stormwater inflows resulting from such *force majeure* events. This provision would allow Sheldon's new high recycle rate BATW system to discharge stormwater inflows exceeding 50-year, 30-day events even if those discharges were to exceed ten percent of the primary wetted volume averaged over a 30-day period – which is the upper bound discharge limitation for BATW recycle systems under the ELG rule. The discharge of BATW above the ten percent limitation is necessary and

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[8] Further details can be provided upon request regarding the how NPPD calculated the amount of stormwater inflow into the BATW system under these two storm events.

appropriate for several reasons. First, rainfall exceeding a 50-year, 30-year storm event should be considered an Act of God given that stormwater inflows would exceed extreme worst-case conditions for which the new BATW recycle system was designed to accommodate. Second, the discharge of the additional stormwater inflows exceeding such extraordinary unusual and infrequent events is necessary to maintain system integrity and ensure overall safe operation of Sheldon's newly installed BATW system.

Material Assumptions and Information for Calculating Discharges Due to Wastestreams Other Than BATW Flowing into The System. As noted above, NPPD has identified situations in which the inflow of wastestreams other than BATW might exceed the ability of the new high recycle rate system to accept these inflows and when segregating these other waste streams from the recycle system would not be feasible. Those situations involve the potential discharge of wastewater resulting from:

- Boiler floor washdowns occurring near the end of boiler washdown events at Sheldon Unit 1 and Unit 2;
- Boiler coal bunker washdowns to remove coal dust at Sheldon Unit 1 and Unit 2; and
- Boiler coal bunker coal removal events at Sheldon Unit 1 and Unit 2.

Each of these potential discharges could occur as a result of regular maintenance activities undertaken at either Sheldon Unit 1 or Unit 2 individually or both Sheldon units simultaneously. However, only one of these potential discharges would be deemed a frequent occurrence given that they typically occur at least one time per year. This wastewater discharge event would result from the performance of a planned, frequent, maintenance activity of washing down the floor of Sheldon Unit 1 and/or Unit 2 boiler(s) near the end of boiler hydro-wash cleaning(s). The other two types of potential discharges would be expected to occur when it would become necessary for NPPD to perform the infrequent maintenance activities of washing down the coal bunkers to support planned maintenance or operational activities or removing the coal out of the coal bunkers to remove coal dust and raw coal. Notably, NPPD needs to conduct these two infrequent maintenance activities to address potential operational safety issues if one or both units were taken offline for an operational or bulk electrical system reason and then projected to remain offline for an extended period of time.

The discussion below provides NPPD's calculated potential discharge levels of BATW resulting from each of these three regular maintenance activities that are important for the safe and efficient operation of the Sheldon units, along with the assumptions and other relevant information that NPPD used for calculating these potential discharge levels.

Boiler Floor Washdowns. The first type of potential BATW discharges would result from the performance of a planned, and frequent, maintenance activity involving the washing down of the floor of the Sheldon Unit 1 and/or Unit 2 boiler near the end of a boiler hydro-wash cleaning. A boiler hydro-wash cleaning requires the use of specialty cleaning machine(s) that are lowered or pulled through the various parts of the boiler while directing streams of high-pressure water throughout and onto the inner heating surfaces of the boiler in order to dislodge and remove accumulated ash / slag deposits from those boiler heating surfaces. The water and removed slag and fouling deposits resulting from this cleaning eventually flow or fall down to the flat bottom of the individual boiler furnace where the majority of this water and dislodged material flows into the boiler's respective slag tank.[9] This cleaning action helps to improve overall boiler performance. Typically, the individual Sheldon boilers are cleaned by hydro-washing once or twice each year depending on unit operation and slag / fouling conditions in the boiler. Hydro-washing of a boiler is a regular maintenance event that is planned and scheduled collectively by the Sheldon plant's engineering, maintenance, operations, and planning department personnel.

During a boiler hydro-wash event, the high-level overflow flow path from the unit's slag tank that is being cleaned is directed via positioning of installed valving on the discharge piping from the slag tank to allow this water and suspended ash particles in it to flow to the station's NPDES Metal Cleaning Pond. This action is specifically described in the NPDES permit for the Sheldon Station. During most of this maintenance event, no water is flowing into the BATW system from the unit being hydro-washed. Near the end of a boiler hydro-washing event (*i.e.*, the last 12 hours of the maintenance event), plant personnel will use a single firehose to wash down the remaining accumulated dislodged ash and slag particles on the flat bottom boiler floor area from an open boiler cyclone down into the boiler's slag tank. When the wash down of accumulated material on the boiler floor begins near the end of a boiler hydro-wash event, the BATW system is started to support the removal and transport of accumulated slag, ash, and water from the unit's slag tank (accumulated within it from the hydro-washing event) to a selected Dewatering Bin. During this timeframe, a wastestream that is not originally BATW (*i.e.*, water flow from the firehose as well as accumulated slag and ash material in the slag tank) is discharged into the BATW system.

NPPD has determined that the total amount of the wastewater inflows into the BATW recycle system for this maintenance activity is 316,800 gallons. This amount was calculated based on the following reasonable but conservative assumptions: the boilers for the two Sheldon units being hydro-washed within a 30-day time period; the use of a single fire hose and flow control nozzle at maximum output levels; and twelve hours required to complete the wash down of the flat bottom area of a Sheldon boiler during a boiler floor wash down event.[10]

To support the performance of maintenance activities like this, a specific, dedicated additional system volume to account for design factors and maintenance / operational events has been incorporated into the preliminary design for the planned new AGC Tank of 680,284 gallons. This dedicated additional system volume to account for design factors and maintenance / operational events of the AGC Tank encompasses several design factors that must be considered by engineering designers of the system to balance safety, operational, maintenance, and design requirements of the BATW system. As part of the preliminary design for the planned BATW system modifications, the dedicated additional system volume to account for design factors and maintenance / operational events of the AGC Tank encompasses design factors such as:

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[9] Some dislodged slag and ash material accumulates on the flat bottom floor area of the boiler thus necessitating the need for washing down the boiler floor area at the end of the cleaning event.

[10] Additional details regarding the calculations for determining this wastestream inflow into the planned new high recycle rate BATW system are available upon request.

- Sediment buildup in the AGC tank;
- BATW movement / conservation within the BATW System for maintenance or operational needs;
- System inflows from wastestreams other than BATW; and
- Safety Margin

This volume of 680,284 gallons provides sufficient additional volumetric capacity for the planned new high recycle rate BATW system to manage the calculated worst-case inflow from a Sheldon Unit 1 and 2 Boiler Floor Washdown event (316,800 gallons) so long as other potential discharges into the BATW system can be sufficiently managed.[11]

Boiler Coal Bunker(s) Washdown to Remove Coal Dust. Another identified regular maintenance activity resulting in the inflow from wastestreams other than BATW is the washdown of the coal bunkers. The washing down of the coal bunkers is necessary under certain operating or maintenance conditions to remove the coal particles accumulating from the Powder River Basin (PRB) coal being combusted by the two Sheldon units. Although infrequent, this maintenance activity must be performed to ensure the safe and proper operation of each Sheldon unit at those times when significant amounts of the PRB coal particles are left in one or more of a unit's coal bunkers. Removal of the coal dust is critically important because it has the propensity to be very flammable and potentially explosive under certain conditions such as in enclosed spaces or when left unattended for long periods and a localized source of heat potentially comes in contact with this material.

This maintenance activity involves plant personnel using a single fire hose and flow control nozzle to wash out significant amounts of small to very fine PRB coal particles that can accumulate under certain operating or maintenance conditions in one or more of coal bunkers at each Sheldon unit. NPPD has determined that the total amount of wastewater inflows into the planned high rate recycle BATW system for this maintenance activity is 316,800 gallons. This amount was calculated based on the following reasonable, but conservative, assumptions: performing the maintenance on three coal bunkers on each of the two Sheldon units during the same outage during a 30-day time period; use of a single fire hose at maximum output levels; and four hours required to complete the wash down of one coal bunker.[12]

As noted above, the preliminary design allowance for dedicated additional system volume to account for design factors and maintenance / operational events into the planned new AGC Tank of 680,284 gallons volume will provide sufficient volumetric capacity to absorb the wastestream from a Coal Bunker(s) Washdown to Remove Coal Dust Event for Sheldon Unit 1 and Unit 2. This means that there is sufficient capacity for the planned new high recycle rate BATW system

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[11] In the event that NPPD must perform a boiler floor washdown for both Sheldon Unit 1 and Unit 2 at the same time, it may become necessary for NPPD to manage the other potential wastewater inflows into the new high recycle rate BATW system. In particular, NPPD will need to manage proactively all of the wastewater inflows to maintain the proper system water balance while also ensuring the total combined discharges from the BATW recycle system to not exceed a 30-day rolling average of ten percent of the primary active wetted bottom ash system volume during the performance of the boiler floor washdown maintenance activity.

[12] Additional details regarding the calculations for determining this wastestream inflow into the planned new high recycle rate BATW system are available upon request.

(680,284 gallons) to manage the calculated worst-case inflow from such an event for both Sheldon units (316,800 gallons) so long as other potential discharges that inflow into the BATW system can be sufficiently managed.[13]

Coal Bunker Coal Removal. A third maintenance activity identified by NPPD is a coal bunker(s) coal removal event at one or both of the Sheldon units. The need to remove coal out from one or more of the bunkers at the Sheldon units is an infrequent event that NPPD would need to perform if unique operational needs should arise such as when one or both units are forced offline due to an unplanned operational, maintenance, or transmission system event and the units are not foreseen to be able to return to operation for an extended time period.

Similar to the coal bunker washing event, coal removal from a Sheldon unit's coal bunker(s) when one or both units have been forced offline for projected extended time periods encompasses plant personnel utilizing a single fire hose to help remove coal as it is fed at a minimal rate out of the bunker's respective coal feeder and into one or more of the boiler's cyclone(s). Once the water fluidized coal is fed into the cyclone that the bunker is designed to feed, it continues to flow out of the cyclone to the floor area of the boiler and then into the boiler's slag tank. Removing the remaining coal from a coal bunker when a unit has been forced offline for a projected extended time period minimizes the operational risk (*e.g.*, spontaneous combustion) of PRB coal particles and raw coal remaining in one or more bunkers for an extended time period.

NPPD has determined that the total amount of the wastewater inflows into the BATW recycle system for this maintenance activity is 5,392,728 gallons. This amount was calculated based on the following reasonable but conservative assumptions: the removal of coal from three completely full coal bunkers on each of the two Sheldon units within a 30-day time period; the use of a single fire hose at maximum output levels; and 52 hours required to empty each bunker at Sheldon Unit 1 and 35 hours to empty each bunker on Sheldon Unit 2.[14]

Identical to the Sheldon Unit 1 and 2 Boiler Coal Bunker(s) Washdown to Remove Coal Dust event, a preliminary design allowance for dedicated additional system volume to account for design factors and maintenance / operational events in the planned new AGC Tank of 680,284 gallons provides some additional volumetric capacity where the wastestream from the coal bunker coal removal event could be absorbed. However, there would be insufficient capacity for the planned new high recycle rate BATW system (680,284 gallons) to manage the calculated worse-case inflows into the Sheldon BATW system from a Sheldon Unit 1 and 2 Boiler Coal Bunker(s) Coal Removal event. As a result, NPPD would have to implement other measures to assure that this infrequent maintenance event that is important for the safe operation of the Sheldon facility would not result in an exceedance of applicable ELG discharge limitation(s)

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[13] In the event that NPPD must perform an infrequent coal bunker washdown for both Sheldon units at the same time under a worse-case scenario, it may become necessary for NPPD to manage the other potential wastewater inflows into the new high recycle rate BATW system. In particular, NPPD will need to manage proactively all of the wastewater inflows to maintain the proper system water balance while also ensuring the total combined discharges from the BATW recycle system to not exceed a 30-day rolling average of ten percent of the primary active wetted bottom ash system volume during the performance of the boiler floor washdown maintenance activity.

[14] Additional details regarding the calculations for determining this wastestream inflow into the planned new high recycle rate BATW system are available upon request.

(specifically the 30-day rolling average limitation of ten percent of the primary active wetted bottom ash system volume) during the performances of this type of coal bunker emptying activity.

Material Assumptions and Information for Calculating Discharges to Maintain System Water Chemistry. NPPD evaluated the expected chemistry and operating parameters for the planned new high recycle rate BATW system. A key design parameter that was considered as part of this evaluation was the potential buildup of ash fines in the recirculating bottom ash system and how to control them to prevent damage to pumping equipment that is required for the safe and effective operation of the BATW recycle system. In particular, the amount of ash fines smaller than 300 microns was of concern because industry operating experience has found that ash particles smaller in size than this level are not as effectively removed from the dewatering equipment (*i.e.*, the dewatering bins) that would be used by the Sheldon BATW system.

As part of this evaluation, NPPD reviewed the EPA's published report, EPA-600/7-80-067, which studied the behavior of coal ash particles in water.[15] The report addressed the following six major areas of concern in wet ash disposal: (1) the characteristics of ashes and ash pond effluents; (2) the effects of ash and raw water characteristics on the pH of ash pond water; (3) the methods for pH adjustment of ash pond effluents; (4) the settling characteristics of both fly ash and bottom ash; (5) the leaching of minerals from ashes; and (6) the relationship of trace metals to pH and concentration of suspended solids in ash pond effluents.

The primary system chemistry concern is the buildup of bottom ash fines in the recirculating transport water. Particles smaller in diameter than 75 µm are considered fines. Fines enter the BATW system with other, larger, particles of ash falling into each boiler's slag tank and occasionally from fracturing of the larger particles of ash due to the thermal shock of entering the water contained in the slag tanks. The ash in the dewatering bin(s) acts as a filter which removes particles above 300 µm in size based on input from the original equipment manufacturer recommendations for the system installed at Sheldon. A small percentage of fines will exit the BATW system through entrainment in bottom ash purge water and the ash unloaded into the trucks. which haul it to the 3rd party ash handling vendor or to the site's licensed coal combustion residuals landfill. The remaining fines will concentrate in the BATW system until the mass flow rate of fines into the system is equal to that exiting. To mitigate erosion and reduce maintenance impacts due to the concentration of fines within the BATW system, the system needs an amount of purge to maintain a concentration < 0.1% or 1000 mg/L.[16]

Another major BATW system chemistry concern is the scaling or corrosivity of the bottom ash transport water in high-recycle BATW systems. To estimate the pH of the high-recycle BATW system, NPPD used the chart provided in the same EPA report noted above (EPA-600/7-80-067, at page 17) coupled with provided analysis of the Sheldon fuel ash quality. Table 5 below relates the ratio of ash calcium oxide and magnesium oxide concentrations to the ash sulfur trioxide concentration. The units at Sheldon burn a blend of Belle Ayr Mine and North Antelope PRB

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[15] This EPA Report, entitled "*Behavior of Coal Ash Particles in Water: Trace Metal Leaching and Ash Settling*, is available at here.

[16] Additional details regarding NPPD's evaluation of bottom ash purge water suspended estimate are available upon request.

fuel. To cover the range of possible future fuel blends, the EPA analysis was applied to 100 percent of each constituent of the fuels. The results of these analyses are shown in Table 7 below].

Table 7 - Estimate of Bottom Ash Transport Water System Equilibrium pH

Fuel Supplier	Fuel Ash Calcium Oxide (%)	Fuel Ash Magnesium Oxide (%)	Fuel Ash Sulfur Tri-Oxide (%)	Ratio of (CaO+MgO) to SO_3	Estimated pH
Belle Ayr Mine	25.83	4.80	10.69	2.87	~3 (acidic)
Rochelle / North Antelope	24.7	5.8	8.7	3.5	~3 (acidic)

The predicted acidic chemistry of the BATW system will occur at system chemical equilibrium, which takes time to achieve. To prevent the system from reaching chemical equilibrium, a certain amount of the BATW contained in the system should be continuously discharged and made-up with fresh utility, service water, or rainfall collected in the system. A limited purge water rate to maintain TSS levels, as discussed above, should provide sufficient protection from constituents in the ash creating acidic water in the system.

When the system modifications to maximize BATW recirculation are implemented, water chemistry issues such as total suspended solids and pH are foreseen to become challenging, based on industry experience. Again, utilizing the information contained in the same EPA published report (EPA-600/7-80-067), the completed scaling and corrosivity analysis, original equipment manufacturer industry experience, and industry's prior project design experience with ash handling systems similar to that of Sheldon's, a maximum total suspended solids concentration of 0.10% wt. was selected as a key design point to help prevent degradation of erosion resistant pump materials.

Utilizing the selected design point to maintain TSS levels at or below as well as conservative assumptions (*e.g.*, two Sheldon units in operation with a maximum bottom ash make-up rate), calculated inputs (*e.g.*, calculated amount of fines present in the system <300 microns in size), and industry research and operational experience (*e.g.*, EPA Report 600/7-80-067 and Ash Handling Vendor Input), the completed calculation for how much water would have to be continuously purged from the Sheldon BATW system to maintain the total suspended solids level under 0.10% wt. was calculated to be 49,076.5 gallons per day (~34 gpm).[17]

Material Assumptions and Information for Calculating Discharges to Conduct Maintenance Not Otherwise Described Above. NPPD evaluated other regular maintenance needs that are required by the BATW system. Specifically, the maintenance needs identified by NPPD would require the complete or partial draining of the BATW system were evaluated.

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[17] Additional details regarding the calculations that were completed to compile this BATW system discharge rate are available upon request.

A key input to this evaluation was the recognition again of the preliminary design allowance for dedicated additional system volume to account for design factors and maintenance / operational events in the planned new AGC Tank of 680,284 gallons for which BATW movement / conservation within the BATW system for maintenance or operational needs can be accounted. This design allowance capacity within the entirety of the planned new high rate recycle BATW system will allow BATW to be moved and conserved within other portions of the BATW system while other portions of the system can be drained to support maintenance needs if necessary.

However, four (4) maintenance events were identified where the ability to support BATW movement / conservation within the BATW system would be exceeded.

- The first identified maintenance event would occur when the entire volume of the installed AGC Tank must be drained back into the existing BATW system to support potential maintenance activity(ies) on this tank.

  Under this type of event and a worst-case condition of the AGC Tank's working volume, storm event volume, and additional system volume were all being utilized to hold BATW generated from other events identified above, a calculated potential volume of ~1,387,682 gallons would need to be transferred back into the existing BATW components. As noted previously in this document, the non-redundant potions of the existing BATW system have a limited available additional system volume of 18,691 gallons to utilize for this type of event (not counting the 175,369 gallons in the second redundant Dewatering Bin).

  This means that there would be insufficient capacity in the existing BATW components to account for the planned draining of the AGC Tank (1,387,682 gallons). As a result, NPPD would have to implement other measures to assure that this infrequent maintenance event would not result in an exceedance of applicable ELG discharge limitation (specifically the 30-day rolling average limitation of ten percent of the primary active wetted bottom ash system volume).

- The second identified maintenance event would occur when the entirety of the existing installed BATW tanks, bins, sumps, and piping must be drained into the AGC Tank to support potential maintenance activity(ies) on the existing BATW System components.

  Under this type of event and utilizing the regular working volumes of the existing BATW's tanks, bins, sumps, and piping holding BATW, a calculated potential volume of ~695,940 gallons would need to be transferred into the AGC Tank.

  This means that there would be insufficient capacity in the AGC Tank (680,284 gallons) to account for the planned draining of the existing BATW System components (695,940 gallons). As a result, NPPD would have to implement other measures to assure that this infrequent maintenance event would not result in an exceedance of applicable ELG discharge limitation (specifically the 30-day rolling average limitation of ten percent of the primary active wetted bottom ash system volume).

- The third identified event would occur due to a *force majeure* event. One such example is an Act of God winter storm event – such as a severe ice storm and a following extended extreme cold snap was to move through the area and knock both units offline due to damage to either the plants electrical distribution system or the bulk electrical system as a whole. Under this extreme winter event situation, there would be no ability to maintain sufficient heat levels in the BATW system over the long term to keep the system from freezing up and thereby potentially causing serious physical harm to the system as whole.

  Under this type of *force majeure* event, the entirety of the BATW System would likely need to be drained to prevent significant damage to the components of the system. A worst-case evaluation of this event would require the NPPD to discharge the entirety of the BATW System water to the station's NPDES system in a controlled manner before the system would freeze to a point where damage could occur.

- The fourth identified event would occur if NPPD was to decide at some future date to cease the combustion of solid fuel (coal) at both Sheldon facilities. Under this scenario, the BATW system would not be required anymore since no coal and thus no bottom ash would be generated. Under this scenario, NPPD would be required to drain the entirety of the BATW System to the station's NPDES system in a controlled manner in order to allow as needed changes to the plant infrastructure to be made to transform it to other generational means or alternative uses.

4. WASTEWATER TREATMENT SYSTEMS

Requirements:
The initial certification statement must provide "a list of all wastewater treatment systems at the facility, currently or otherwise required by a date certain under this section.
40 C.F.R. §423.19(c)(3)(H).

The initial certification statement also must provide "a narrative discussion of each treatment system including the system type, design capacity, and current or expected operation."
40 C.F.R. §423.19(c)(3)(I).

Response:
Sheldon wastewater is treated in various settling ponds, one of which, the coal pile runoff pond (SPD-1), will not treat bottom ash purge water[18]. The following ponds will receive some bottom ash purge water:

- Process Pond (SPD-2);

---

[18] See Appendix B – Sheldon Water Discharge System Diagram, WB-1

- Metal Cleaning Waste Pond (SPD-3); and
- Blue River Surge Pond (SPD-4).

Non-Bottom Ash Treatment Discharges
Rainfall that falls upon Sheldon Station's coal pile passes through the pile and may carry some suspended coal fines. This runoff flow is collected in the Coal Pile Runoff Pond (SPD-1) along with coal equipment washdown water.

Bottom Ash Treatment Discharges
The Process Pond (SPD-2) is a settling pond with gaseous carbon dioxide injection equipment to control pH of the pond discharge. This settling pond removes suspended solids from a combination of bottom ash purge water, boiler tube side blowdown, floor drain water from plant buildings and equipment, boiler make-up water preparation wastewater, combustion turbine drain water, buildings and grounds yard and roof drain water, and small amounts of fire side boiler tube cleaning water and air heater cleaning water for Sheldon Unit 1 and Unit 2. The Process Pond is the primary treatment pond for bottom ash discharge water. The Process Pond discharges through PP01 to the Blue River Surge Pond. According to WB-1 (Appendix B), the Sheldon Water Discharge System diagram, the Process Pond is designed with 262.6 gallons per minute (gpm) discharge flow rate capacity into the Blue River Surge Pond (SPD-4). When installed, the bottom ash transport system modifications are expected to reduce this discharge flow.

The Metal Cleaning Waste Pond (SPD-3) is a settling pond. This settling pond collects a combination of metal cleaning wastewaters, primarily fire side boiler tube cleaning water and Unit 1 & 2 air heater cleaning water. The suspended iron and copper contained in the cleaning water settles in the pond. Dissolved iron and copper particles present in the cleaning water are given sufficient time to naturally oxidize and precipitate so that they also settle in the pond. The Metal Cleaning Waste Pond discharges through MC1 and MC2 to the Blue River Surge Pond. According to WB-1 (Appendix B), the Sheldon Water Discharge System diagram, the Metal Cleaning Waste Pond is designed to discharge to the Blue River Surge Pond in batches at a rate of 13.7 gpm. This flow rate is not expected to change in the future.

The Blue River Surge Pond (SPD-4) is a settling pond with gaseous carbon dioxide injection equipment to control pH of the pond discharge. This Surge Pond removes suspended solids from a combination of Units 1 and 2 cooling tower blowdown, Process Pond effluent, Metal Cleaning Waste Pond effluent, and Coal Yard Runoff Pond effluent. The Blue River Surge Pond discharges through NDPES Outfall 004 to the Blue River. The Blue River Surge Pond is designed with 800 gpm capacity (Appendix B); however, the pumping structure is configured with two large capacity pumps, each sized for 1,200 gpm to accommodate high water level events. When installed, the BATW system modifications are expected to reduce discharge flow through the Blue River Surge Pond.

Appendix A

Bottom Ash Generation Volume Calculation

Table 1: Unit Make-Rate Calculation

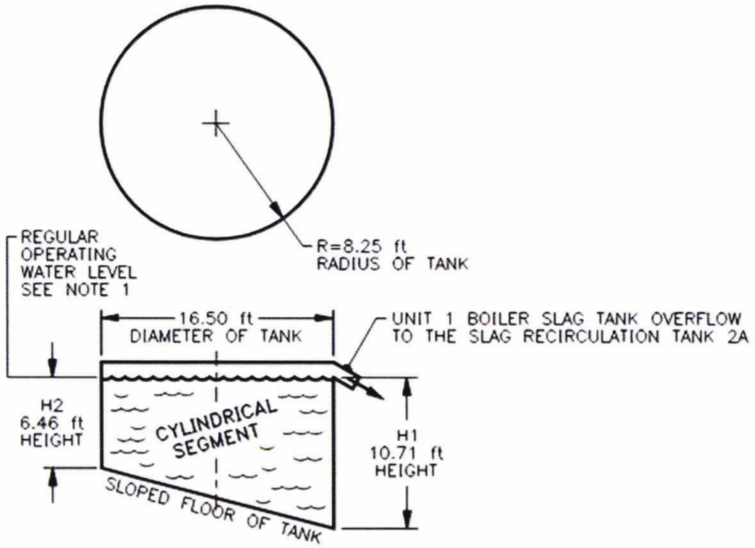
Plant-Unit	Unit type	Gross MW Rating (MW)	Gross Heat Rate[1] (Btu/kWh)	Btu Value[1] (Btu/lb)	Total Coal Burned (tons/hr)	Ash %[1]	Total Ash (tph)	Bottom Ash Percentage	Bottom Ash (tph)
Sheldon U1	Cyclone	116	10,428	8,603	70.30	4.42%	3.11	65.6%	2.04
Sheldon U2	Cyclone	128	10,505	8,603	78.15	4.42%	3.45	65.6%	2.27

Notes

1) Inputs provided by NPPD - Averge of annual values 2017 - 2021

Source: Sheldon Annual Station Report, Sheldon Ash Report

Sheldon Unit 1 Slag Tank Volume Calculations



NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON UNIT 1 SLAG TANK USED FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM: ALLEN SHERMAN HOFF COMPANY DWG# 5048-13 (NPPD DIR# 403108237)

VOLUME OF CYLINDRICAL SEGMENT = $1/2 \times \pi \times R^2 \times (H1 + H2)$

VOLUME OF CYLINDRICAL SEGMENT = $0.5 \times 3.14 \times 8.25^2 \times (10.71 + 6.46)$

VOLUME OF CYLINDRICAL SEGMENT = 1,835 cubic feet

CUBIC FEET x 7.481 = GALLONS

REGULAR SYSTEM SLAG TANK VOLUME = **1,835 cubic feet**
13,728 gallons
CYLINDRICAL SEGMENT

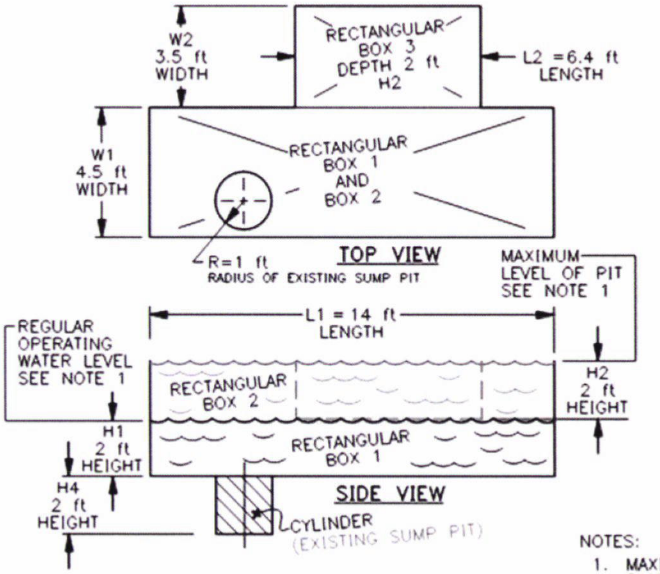
ADDITIONAL TANK CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = **0 cubic feet**
0 gallons
NONE

TOTAL PRIMARY WETTED VOLUME SLAG TANK = **1,835 cubic feet**
13,728 gallons
REGULAR SYSTEM TANK VOLUME PLUS ADDITIONAL TANK CAPACITY

DOCUMENT DESCRIPTION
SHELDON
UNIT 1
SLAG TANK
VOLUME CALCULATIONS

DRAWN KKBARMO DATE 03/02/22
ENGINEER BBNITSCH
SHEET –
Nebraska Public Power District
SHELDON STATION
DRAWING NO. APPENDIX A – FIGURE 3

Sheldon Unit 1 Slag Pit Sump Calculations



NOTES:

1. MAXIMUM WATER LEVEL IN THE SHELDON UNIT 1 SLAG TANK SUMP PIT USED FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM: STEARNS & ROGER SHEET# C2-1 & C7-1 (NPPD DIR# 404039389 & 404039396)

VOLUME OF RECTANGULAR BOX 1 (REGULAR OPERATING WATER LEVEL)

VOLUME OF RECTANGULAR BOX = $L1 \times W1 \times H1$

VOLUME OF RECTANGULAR BOX = $14 \times 4.5 \times 2$

VOLUME OF RECTANGULAR BOX = $126\ ft^3$

VOLUME OF RECTANGULAR BOX 2 (ADDITIONAL TANK CAPACITY)

VOLUME OF RECTANGULAR BOX = $L1 \times W1 \times H2$

VOLUME OF RECTANGULAR BOX = $14 \times 4.5 \times 2$

VOLUME OF RECTANGULAR BOX = $126\ ft^3$

VOLUME OF RECTANGULAR BOX 3 (ADDITIONAL TANK CAPACITY)

VOLUME OF RECTANGULAR BOX = $L2 \times W2 \times H2$

VOLUME OF RECTANGULAR BOX = $6.4 \times 3.5 \times 2$

VOLUME OF RECTANGULAR BOX = $44.8\ ft^3$

VOLUME OF CYLINDER

VOLUME OF CYLINDER = $\pi \times R^2 \times H3$

VOLUME OF CYLINDER = $\pi \times 1^2 \times 2$

VOLUME OF CYLINDER = $6.3\ ft^3$

CUBIC FEET x 7.481 = GALLONS

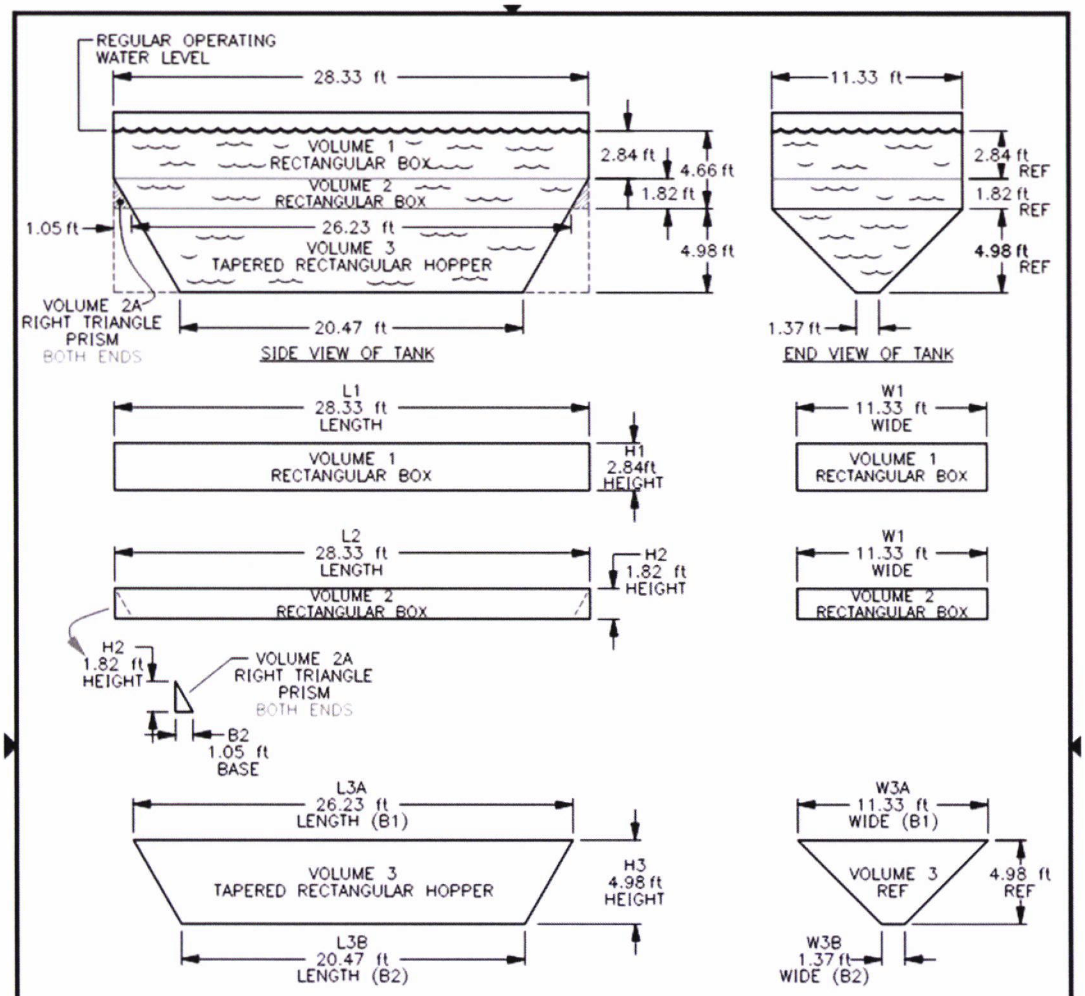
REGULAR SYSTEM SLAG PIT SUMP VOLUME = 132 cubic feet
987 gallons
RECT BOX 1 PLUS CYLINDER VOLUME

ADDITIONAL SUMP CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = 171 cubic feet
1,279 gallons
RECT BOX 2 PLUS RECT BOX 3 VOLUME

TOTAL PRIMARY WETTED VOLUME SLAG PIT SLUMP = 303 cubic feet
2,266 gallons
REGULAR SYSTEM PIT VOLUME PLUS ADDITIONAL PIT CAPACITY

DOCUMENT DESCRIPTION		
SHELDON UNIT 1 SLAG PIT SUMP VOLUME CALCULATIONS	DRAWN KKBARMO DATE 03/02/22 ENGINEER BBNITSCH SHEET – DRAWING NO. APPENDIX A – FIGURE 4	Nebraska Public Power District SHELDON STATION

Sheet 1 of 2 - Sheldon Unit 2 Slag Tank Volume Calculations



CUBIC FEET x 7.481 = GALLONS

SEE SHEET 2 FOR CALCULATIONS

REGULAR SYSTEM SLAG PIT SUMP VOLUME = 2,165 cubic feet
16,196 gallons
RECT BOX 1 + RECT BOX 2 + TAPERED RECT HOPPER MINUS TWO [2] RIGHT TRIANGLE PRISMS

ADDITIONAL CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = 0 cubic feet
0 gallons
NONE

TOTAL PRIMARY WETTED VOLUME SLAG TANK = 2,165 cubic feet
16,196 gallons
REGULAR SYSTEM TANK VOLUME PLUS ADDITIONAL TANK CAPACITY

NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON UNIT 2 BOILER SLAG TANK USED FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM:
   UNITED CONVEYOR CORPORATION
   DWG# 527-55193-1
   (NPPD DIR# 404081868)

8½"x11"

DOCUMENT DESCRIPTION
SHELDON
UNIT 2
SLAG TANK
VOLUME CALCULATIONS

DRAWN KKBARMO DATE 03/02/22
ENGINEER BBNITSC
SHEET 1 of 2
DRAWING NO. APPENDIX A – FIGURE 5

Nebraska Public Power District
SHELDON STATION

Sheet 2 of 2 - Sheldon Unit 2 Slag Tank Volume Calculations

REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX 1
REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX = L1 × W1 × H1
VOLUME OF RECTANGULAR BOX = 28.33 × 11.33 × 2.84
VOLUME OF RECTANGULAR BOX = 912 ft^3

VOLUME OF RECTANGULAR BOX 2
REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX = L2 × W2 × H1
VOLUME OF RECTANGULAR BOX = 28.33 × 11.33 × 1.82
VOLUME OF RECTANGULAR BOX = 584 ft^3

VOLUME 2A OF RIGHT TRIANGLE PRISM
REGULAR OPERATING WATER LEVEL

VOLUME OF RIGHT TRIANGLE PRISM = 1/2 × B × H × LENGTH
VOLUME OF RIGHT TRIANGLE PRISM = 1/2 × 1.05 × 1.82 × 11.33
VOLUME OF RIGHT TRIANGLE PRISM = 11 ft^3

VOLUME 3 OF TAPERED RECTANGULAR HOPPER
REGULAR OPERATING WATER LEVEL

VOLUME OF TAPERED RECTANGULAR HOPPER = $(H3 \div 3) \times (B1 + B2 + \sqrt{B1 \times B2})$
VOLUME OF TAPERED RECTANGULAR HOPPER = $(4.98 \div 3) \times (297 + 28 + \sqrt{297 \times 28})$
VOLUME OF TAPERED RECTANGULAR HOPPER = 691 ft^3

AREA OF B1 = L3A × W3A
AREA OF B1 = 26.23 × 11.33
AREA OF B1 = 297 ft^2

AREA OF B2 = L3B × W3B
AREA OF B1 = 20.47 × 1.37
AREA OF B1 = 28 ft^2

VOLUMES

RECT BOX 1 + RECT BOX 2 + TAPERED RECT HOPPER − RIGHT TRIANGLE PRISM − RIGHT TRIANGLE PRISM = 2,165 ft^3

VOLUME AT REGULAR OPERATING WATER LEVEL

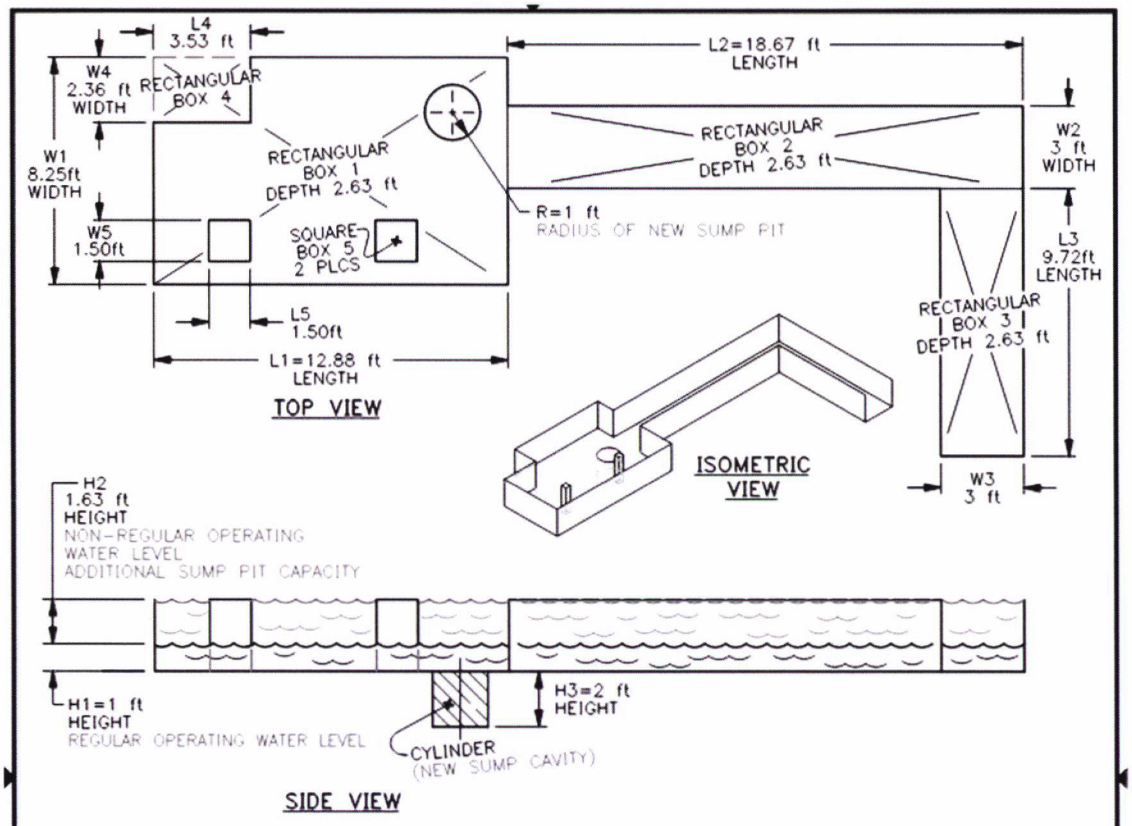
NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON UNIT 2 BOILER SLAG TANK USED FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM:
   UNITED CONVEYOR CORPORATION
   DWG# 527-55193-1
   (NPPD DIR# 404081868)

SEE SHEET 1 FOR SLAG TANK DIMENSIONS

8 1/2"x11"	DOCUMENT DESCRIPTION SHELDON UNIT 2 SLAG TANK VOLUME CALCULATIONS	DRAWN KKBARMO DATE 03/02/22 ENGINEER BBNITSCH SHEET 2 of 2 Nebraska Public Power District SHELDON STATION DRAWING NO. APPENDIX A – FIGURE 5

Sheet 1 of 3 - Sheldon Unit 2 Slag Pit Sump Volume Calculations



NOTES:

1. MAXIMUM WATER LEVEL IN THE SHELDON UNIT 2 SLAG TANK SUMP PIT USED FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM: STEARNS & ROGERS SHEET# C1-2 & C2-3 (NPPD DIR# 404040588 & 404040603)

CUBIC FEET x 7.481 = GALLONS

SEE SHEET 2 & 3
FOR CALCULATIONS

REGULAR SYSTEM SLAG PIT SUMP VOLUME = **185 cubic feet**
1,384 gallons
SEE SHEET 1 & 2

ADDITIONAL CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = **291 cubic feet**
2,177 gallons
SEE SHEET 1 & 3

TOTAL PRIMARY WETTED VOLUME SLAG PIT SUMP = **476 cubic feet**
3,561 gallons
REGULAR SYSTEM PIT VOLUME PLUS ADDITIONAL PIT CAPACITY

DOCUMENT DESCRIPTION
SHELDON
UNIT 2
SLAG PIT SUMP
VOLUME CALCULATIONS

DRAWN KKBARMO
DATE 03/02/22
ENGINEER BBNITSC
SHEET 1 of 3
Nebraska Public Power District
SHELDON STATION
DRAWING NO. APPENDIX A – FIGURE 6

Sheet 2 of 3 - Sheldon Unit 2 Slag Pit Sump Volume Calculations

REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX 1 REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX $= L1 \times W1 \times H1$

VOLUME OF RECTANGULAR BOX $= 12.88 \times 8.25 \times 1$

VOLUME OF RECTANGULAR BOX $= 106\ \text{ft}^3$

VOLUME OF RECTANGULAR BOX 2 REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX $= L2 \times W2 \times H1$

VOLUME OF RECTANGULAR BOX $= 18.67 \times 3 \times 1$

VOLUME OF RECTANGULAR BOX $= 56\ \text{ft}^3$

VOLUME OF RECTANGULAR BOX 3 REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX $= L3 \times W3 \times H1$

VOLUME OF RECTANGULAR BOX $= 9.72 \times 3 \times 1$

VOLUME OF RECTANGULAR BOX $= 29\ \text{ft}^3$

VOLUME OF RECTANGULAR BOX 4 REGULAR OPERATING WATER LEVEL

VOLUME OF RECTANGULAR BOX $= L4 \times W4 \times H1$

VOLUME OF RECTANGULAR BOX $= 3.53 \times 2.36 \times 1$

VOLUME OF RECTANGULAR BOX $= 8\ \text{ft}^3$

VOLUME OF SQUARE BOX 5 REGULAR OPERATING WATER LEVEL

VOLUME OF SQUARE BOX $= L5 \times W5 \times H1$

VOLUME OF SQUARE BOX $= 1.5 \times 1.5 \times 1$

VOLUME OF SQUARE BOX $= 2.25\ \text{ft}^3$

VOLUME OF CYLINDER NEW SUMP CAVITY

VOLUME OF CYLINDER $= \pi \times R^2 \times H3$

VOLUME OF CYLINDER $= \pi \times 1^2 \times 2$

VOLUME OF CYLINDER $= 6.3\ \text{ft}^3$

VOLUMES OF REGULAR OPERATING WATER LEVEL

$$\text{RECT BOX 1} + \text{RECT BOX 2} + \text{RECT BOX 3} + \text{CYLINDER} - \text{RECT BOX 4} - \text{SQUARE BOX 5} - \text{SQUARE BOX 5} = 185\ \text{ft}^3$$

VOLUME AT REGULAR OPERATING WATER LEVEL

SEE SHEET 1 FOR PIT DIMENSIONS
SEE SHEET 3 FOR MORE CALCULATIONS

DOCUMENT DESCRIPTION
SHELDON
UNIT 2
SLAG PIT SUMP
VOLUME CALCULATIONS

DRAWN KKBARMO DATE 03/02/22
ENGINEER BBNITSC
SHEET 2 of 3
DRAWING NO. APPENDIX A – FIGURE 6

Nebraska Public Power District
SHELDON STATION

Sheet 3 of 3 - Sheldon Unit 2 Slag Pit Sump Volume Calculations

ADDITIONAL PIT CAPACITY WATER LEVEL

VOLUME OF RECTANGULAR BOX 1 ADDITIONAL PIT CAPACITY
VOLUME OF RECTANGULAR BOX = L1 x W1 x H2
VOLUME OF RECTANGULAR BOX = 12.88 x 8.25 x 1.63
VOLUME OF RECTANGULAR BOX = 173 ft^3

VOLUME OF RECTANGULAR BOX 2 ADDITIONAL PIT CAPACITY
VOLUME OF RECTANGULAR BOX = L2 x W2 x H2
VOLUME OF RECTANGULAR BOX = 18.67 x 3 x 1.63
VOLUME OF RECTANGULAR BOX = 91 ft^3

VOLUME OF RECTANGULAR BOX 3 ADDITIONAL PIT CAPACITY
VOLUME OF RECTANGULAR BOX = L3 x W3 x H2
VOLUME OF RECTANGULAR BOX = 9.72 x 3 x 1.63
VOLUME OF RECTANGULAR BOX = 47.5 ft^3

VOLUME OF RECTANGULAR BOX 4 ADDITIONAL PIT CAPACITY
VOLUME OF RECTANGULAR BOX = L4 x W4 x H2
VOLUME OF RECTANGULAR BOX = 3.53 x 2.36 x 1.63
VOLUME OF RECTANGULAR BOX = 13.5 ft^3

VOLUME OF SQUARE BOX 5 ADDITIONAL PIT CAPACITY
VOLUME OF SQUARE BOX = L5 x W5 x H2
VOLUME OF SQUARE BOX = 1.5 x 1.5 x 1.63
VOLUME OF SQUARE BOX = 3.7 ft^3

VOLUMES OF ADDITIONAL PIT CAPACITY

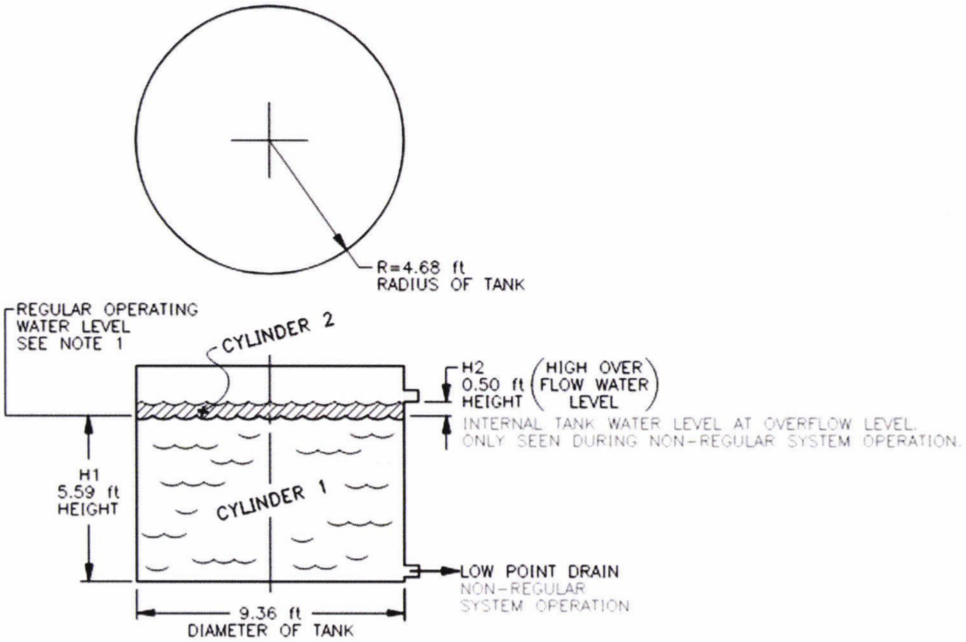
RECT BOX 1 + RECT BOX 2 + RECT BOX 3 − RECT BOX 4 − SQUARE BOX 5 − SQUARE BOX 5 = 291 ft^3

ADDITIONAL PIT CAPACITY

SEE SHEET 1 FOR PIT DIMENSIONS
SEE SHEET 2 FOR MORE CALCULATIONS

DOCUMENT DESCRIPTION		
SHELDON UNIT 2 SLAG PIT SUMP VOLUME CALCULATIONS	DRAWN KKBARMO DATE 03/02/22 ENGINEER BBNITSC SHEET 3 of 3	Nebraska Public Power District SHELDON STATION
	DRAWING NO. APPENDIX A – FIGURE 6	

Sheldon Unit 2 Slag Recirculation Return Tank 2A Volume Calculations



NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON SLAG RECIRCULATION RETURN TANK WAS CONSIDERED TO BE AT A LEVEL OF 6 INCHES (0.5 ft) BELOW THE HIGH OVERFLOW LEVEL FOR THIS TANK.
2. INFORMATION FOR THIS DRAWING CAME FROM: TANK CONNECTION AFFILIATE GROUP DWG# BCL0090071702001 (NPPD DIR# 403134841)

VOLUME OF CYLINDER 1

VOLUME OF CYLINDER = $\pi \times R^2 \times H1$

VOLUME OF CYLINDER = $3.14 \times 4.68^2 \times 5.59$

VOLUME OF CYLINDER = $385\ \text{ft}^3$

VOLUME OF CYLINDER 2

VOLUME OF CYLINDER = $\pi \times R^2 \times H2$

VOLUME OF CYLINDER = $3.14 \times 4.68^2 \times 0.50$

VOLUME OF CYLINDER = $34\ \text{ft}^3$

CUBIC FEET x 7.481 = GALLONS

REGULAR SYSTEM TANK VOLUME = **385 cubic feet**
2,880 gallons
CYLINDER 1

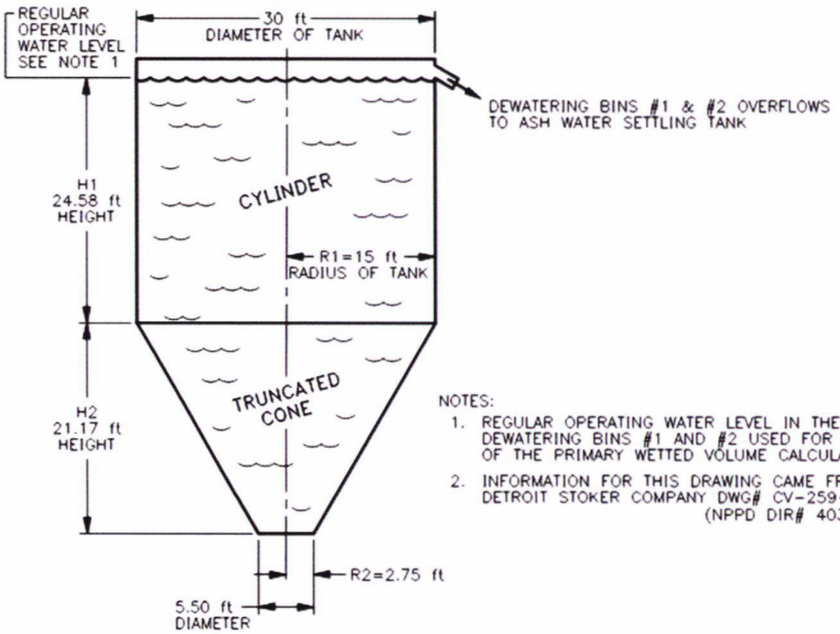
ADDITIONAL TANK CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = **34 cubic feet**
254 gallons
CYLINDER 2

TOTAL PRIMARY WETTED VOLUME OF THIS TANK = **419 cubic feet**
3,135 gallons
REGULAR SYSTEM TANK VOLUME PLUS ADDITIONAL TANK CAPACITY

DOCUMENT DESCRIPTION
SHELDON
SLAG RECIRCULATION
RETURN TANK 2A
VOLUME CALCULATIONS

DRAWN KKBARMO DATE 03/18/22
ENGINEER BBNITSCH
SHEET –
DRAWING NO. APPENDIX A – FIGURE 7
Nebraska Public Power District
SHELDON STATION

Sheldon Dewatering Bins #1 and #2 Volume Calculations



NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON DEWATERING BINS #1 AND #2 USED FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM: DETROIT STOKER COMPANY DWG# CV-259-D4-6L (NPPD DIR# 403076491)

VOLUME OF CYLINDER $= \pi \times R1^2 \times H1$

VOLUME OF CYLINDER $= 3.14 \times 15^2 \times 24.58$

VOLUME OF CYLINDER $= 17{,}375\ ft^3$

VOLUME OF TRUNCATED CONE $= (\pi \times H2 \div 3) \times (R1^2 + R1 \times R2 + R2^2)$

VOLUME OF TRUNCATED CONE $= (3.14 \times 21.17 \div 3) \times (15^2 + 15 \times 2.75 + 2.75^2)$

VOLUME OF TRUNCATED CONE $= 6{,}070\ ft^3$

CUBIC FEET x 7.481 = GALLONS

REGULAR SYSTEM TANK VOLUME = **23,445 cubic feet**
175,392 gallons
CYLINDER PLUS TRUNCATED CONE

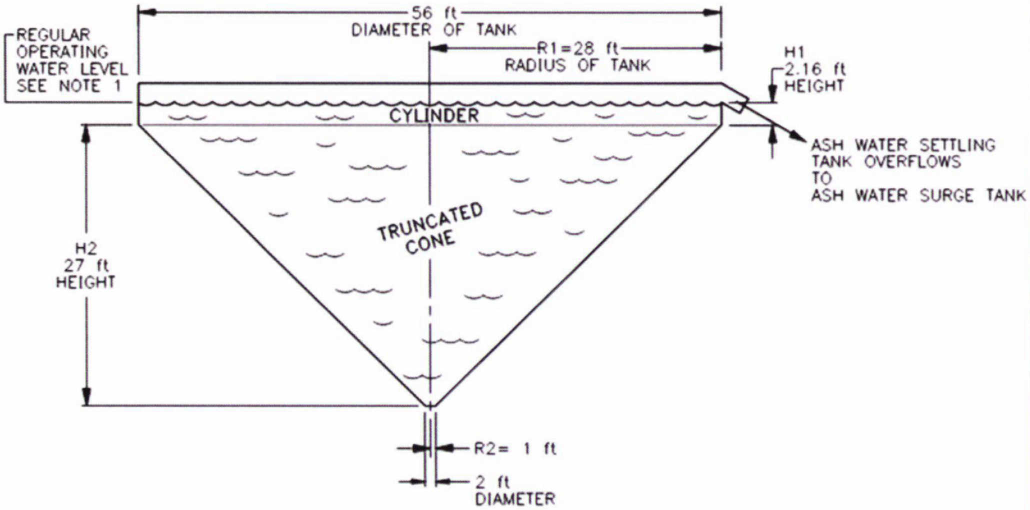
ADDITIONAL TANK CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = **0 cubic feet**
0 gallons
NO HIGH LEVEL ON THIS TANK

TOTAL PRIMARY WETTED VOLUME OF ONE DEWATERING BIN = **23,445 cubic feet**
175,392 gallons
REGULAR SYSTEM TANK VOLUME PLUS ADDITIONAL TANK CAPACITY

DOCUMENT DESCRIPTION
SHELDON DEWATERING BINS
#1 & #2
VOLUME CALCULATIONS
REGULAR OPERATION

DRAWN KKBARMO *DATE 03/02/22
ENGINEER BBNITSCH
SHEET –
Nebraska Public Power District
SHELDON STATION
DRAWING NO. APPENDIX A – FIGURE 8

Sheldon Ash Water Settling Tank Volume Calculations



NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON ASH WATER SETTLING TANK USED FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM: DETROIT STOKER COMPANY DWG# CV259D2-5L (NPPD DIR# 403076479)

$$\text{VOLUME OF CYLINDER} = \pi \times R^2 \times H1$$

$$\text{VOLUME OF CYLINDER} = 3.14 \times 28^2 \times 2.16$$

$$\text{VOLUME OF CYLINDER} = 5{,}320 \text{ ft}^3$$

$$\text{VOLUME OF TRUNCATED CONE} = (\pi \times H2 \div 3) \times (R1^2 + R1 \times R2 + R2^2)$$

$$\text{VOLUME OF TRUNCATED CONE} = (3.14 \times 27 \div 3) \times (28^2 + 28 \times 1 + 1^2)$$

$$\text{VOLUME OF TRUNCATED CONE} = 22{,}987 \text{ ft}^3$$

<u>CUBIC FEET x 7.481 = GALLONS</u>

REGULAR SYSTEM TANK VOLUME = **28,307 cubic feet**
211,765 gallons
CYLINDER PLUS TRUNCATED CONE

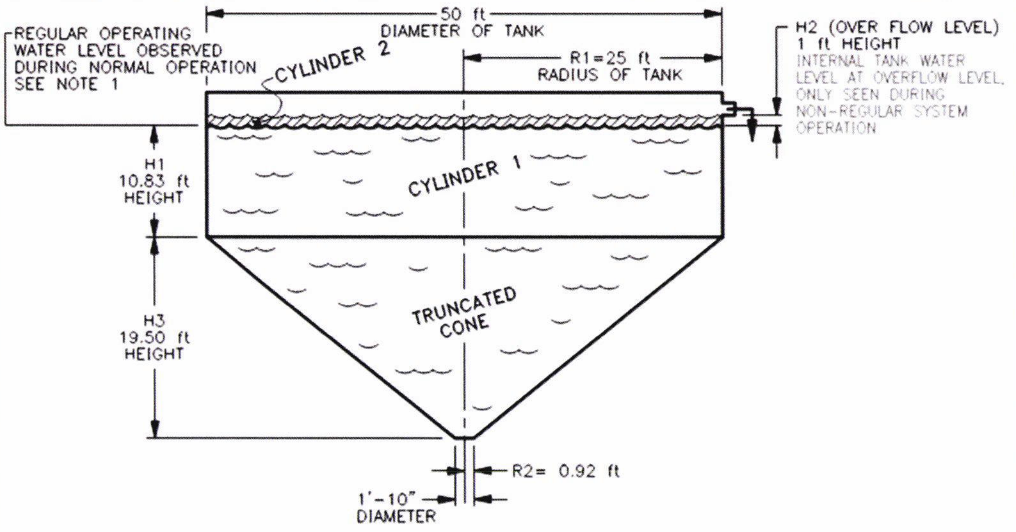
ADDITIONAL TANK CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = **0 cubic feet**
0 gallons
NO HIGH LEVEL ON THIS TANK

TOTAL PRIMARY WETTED VOLUME OF THIS TANK = **28,307 cubic feet**
211,765 gallons
REGULAR SYSTEM TANK VOLUME PLUS ADDITIONAL TANK CAPACITY

DOCUMENT DESCRIPTION
SHELDON
ASH WATER
SETTLING TANK
VOLUME CALCULATIONS

DRAWN KKBARMO DATE 03/02/22
ENGINEER BBNITSCH
SHEET —
Nebraska Public Power District
SHELDON STATION
DRAWING NO. APPENDIX A – FIGURE 9

Sheldon Ash Water Surge Tank Volume Calculations



NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON ASH WATER SURGE TANK WAS CONSIDERED TO BE AT A LEVEL OF 12 INCHES (1 FT) BELOW THE HIGH OVERFLOW LEVEL FOR THIS TANK.
2. INFORMATION FOR THIS DRAWING CAME FROM: DETROIT STOKER COMPANY DWG# CV259D3-5L (NPPD DIR# 403076483)

VOLUME OF CYLINDER 1

$$\text{VOLUME OF CYLINDER} = \pi \times R^2 \times H1$$
$$\text{VOLUME OF CYLINDER} = 3.14 \times 25^2 \times 10.83$$
$$\text{VOLUME OF CYLINDER} = 21{,}265\ \text{ft}^3$$

VOLUME OF CYLINDER 2

$$\text{VOLUME OF CYLINDER} = \pi \times R^2 \times H2$$
$$\text{VOLUME OF CYLINDER} = 3.14 \times 25^2 \times 1$$
$$\text{VOLUME OF CYLINDER} = 1{,}963\ \text{ft}^3$$

$$\text{VOLUME OF TRUNCATED CONE} = (\pi \times H3 \div 3) \times (R1^2 + R1 \times R2 + R2^2)$$
$$\text{VOLUME OF TRUNCATED CONE} = (3.14 \times 19.5 \div 3) \times (25^2 + 25 \times 0.92 + 0.92^2)$$
$$\text{VOLUME OF TRUNCATED CONE} = 13{,}250\ \text{ft}^3$$

<u>CUBIC FEET x 7.481 = GALLONS</u>

REGULAR SYSTEM TANK VOLUME = 34,515 cubic feet
258,207 gallons
CYLINDER 1 PLUS TRUNCATED CONE

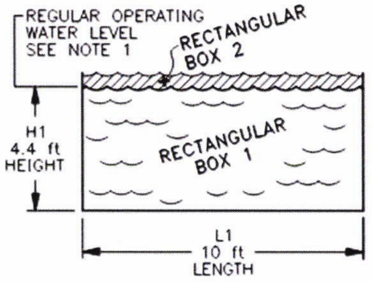
ADDITIONAL TANK CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = 1,963 cubic feet
14,685 gallons
CYLINDER 2

TOTAL PRIMARY WETTED VOLUME OF THIS TANK = 36,478 cubic feet
272,892 gallons
REGULAR SYSTEM TANK VOLUME PLUS ADDITIONAL TANK CAPACITY

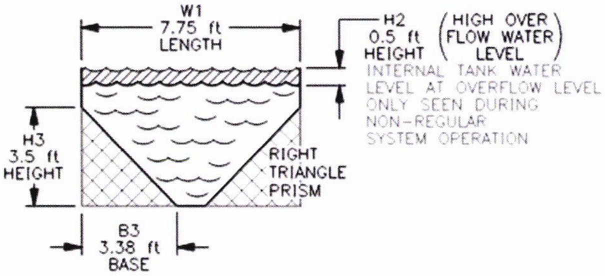
DOCUMENT DESCRIPTION
SHELDON
ASH WATER SURGE TANK
VOLUME CALCULATIONS

DRAWN KKBARMO DATE 03/18/22
ENGINEER BBNITSCH
SHEET –
Nebraska Public Power District
SHELDON STATION
DRAWING NO. APPENDIX A – FIGURE 10

Sheldon Unit 1 and 2 Slag Clean-Up Sump Volume Calculations



SIDE VIEW



END VIEW

NOTES:

1. REGULAR OPERATING WATER LEVEL IN THE SHELDON SLAG CLEANUP SUMP WAS CONSIDERED TO BE AT A LEVEL OF 6 INCHES (0.5 FT) BELOW THE HIGH OVERFLOW LEVEL FOR PURPOSES OF THE PRIMARY WETTED VOLUME CALCULATIONS.
2. INFORMATION FOR THIS DRAWING CAME FROM: TANK CONNECTION AFFILIATE GROUP DWG# BCL0090071702001 (NPPD DIR# 403134841)

VOLUME OF RECTANGULAR BOX 1

VOLUME OF RECTANGULAR BOX = L1 x W1 x H1

VOLUME OF RECTANGULAR BOX = 10 x 7.75 x 4.4

VOLUME OF RECTANGULAR BOX = 341 ft^3

VOLUME OF RECTANGULAR BOX 2

VOLUME OF RECTANGULAR BOX = L1 x W1 x H2

VOLUME OF RECTANGULAR BOX = 10 x 7.75 x 0.5

VOLUME OF RECTANGULAR BOX = 39 ft^3

$$\text{RECTANGULAR BOX 1} - 2\left(\text{RIGHT TRIANGLE PRISM}\right) = 223\ ft^3$$

VOLUME OF RIGHT TRIANGLE PRISM = 1/2 x B3 x H3 x L1

VOLUME OF RIGHT TRIANGLE PRISM = 0.5 x 3.38 x 3.5 x 10

VOLUME OF RIGHT TRIANGLE PRISM = 59 ft^3

<u>CUBIC FEET x 7.481 = GALLONS</u>

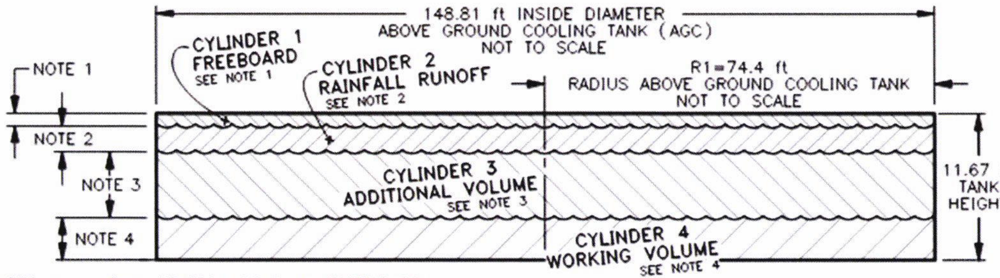
REGULAR SYSTEM TANK VOLUME = **223 cubic feet**
1,668 gallons
RECTANGULAR BOX 1 MINUS TWO [2] RIGHT TRIANGLES

ADDITIONAL SUMP CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = **39 cubic feet**
292 gallons
RECTANGULAR BOX 2

TOTAL PRIMARY WETTED VOLUME SLAG CLEAN-UP SUMP = **262 cubic feet**
1,960 gallons
REGULAR SYSTEM TANK VOLUME PLUS ADDITIONAL TANK CAPACITY

DOCUMENT DESCRIPTION		
SHELDON UNIT 1 & UNIT 2 SLAG CLEAN-UP SUMP VOLUME CALCULATIONS	DRAWN KKBARMO DATE 03/02/22 ENGINEER BBNITSCH SHEET –	Nebraska Public Power District SHELDON STATION
	DRAWING NO. APPENDIX A – FIGURE 11	

Sheet 1 of 2 - Sheldon Above Ground Cooling Tank Volume Calculations



NOTE 1: ALLOWANCE FOR AGC TANK FREEBOARD.

NOTE 2: ALLOWANCE FOR THE CALCULATED RAINFALL RUNOFF INTO THE ENTIRE BATW SYSTEM FROM A 50 YEAR, 30 DAY RAINFALL STORM EVENT.

NOTE 3: ALLOWANCE FOR ADDITIONAL BATW SYSTEM VOLUME TO ACCOUNT FOR THE FOLLOWING BATW SYSTEM DESIGN FACTORS AND MAINTENANCE/OPERATIONAL EVENTS.

- A. ALLOWANCE FOR SEDIMENT ACCUMULATION IN THE ABOVE GROUND COOLING TANK
- B. ALLOWANCE FOR INFLOWS INTO THE BATW SYSTEM FROM WASTE STREAMS OTHER THAN BATW.
- C. ALLOWANCE FOR BATW MOVEMENT/CONSERVATION WITHIN THE OVERALL BATW SYSTEM FOR MAINTENANCE OR OPERATIONAL NEEDS.
- D. ALLOWANCE FOR SAFETY.

NOTE 4: ALLOWANCE FOR WORKING VOLUME OF THE AGC TANK TO ACCOUNT FOR THE FOLLOWING BATW SYSTEM DESIGN FACTORS.

- A. ALLOWANCE FOR NET POSITIVE SUCTION (NPSH) PUMPING REQUIREMENTS FOR NEW PUMPS THAT WILL BE USED TO TRANSFER WATER OUT OF THE AGC TANK BACK TO THE ASH WATER SURGE TANK
- B. ALLOWANCE FOR ONE [1] DEWATERING BIN VOLUME FOR INITIAL BATW SYSTEM FILL.

AGC TANK LAYER CATEGORY	APPROXIMATE DEPTH OF LAYER	USEABLE VOLUME VOLUME (FT^3)	USEABLE VOLUME VOLUME (GALLONS)	COMMENTS
AGC TANK FREEBOARD -SEE NOTE 1-	1.00 FT -SEE NOTE 5-	17,392*	130,106*	NOT INCLUDED IN CALCULATED PRIMARY WETTED VOLUME
RAINFALL RUNOFF -SEE NOTE 2-	2.09 FT*	36,330*	271,781 -SEE NOTE 6-	INCLUDED IN CALCULATED PRIMARY WETTED VOLUME
ADDITIONAL BATW SYSTEM VOLUME TO ACCOUNT FOR DESIGN FACTORS AND MAINTENANCE AND OPERATIONAL EVENTS -SEE NOTE 3-	5.23 FT*	90,952*	680,415 -SEE NOTE 7-	INCLUDED IN CALCULATED PRIMARY WETTED VOLUME
WORKING VOLUME -SEE NOTE 4-	3.35 FT*	58,228*	435,604 -SEE NOTE 8-	INCLUDED IN CALCULATED PRIMARY WETTED VOLUME

* LISTED NUMBERS MAY VARY SLIGHTLY DEPENDING ON UTILIZED NUMBER OF DIGITS FOR MULTIPLICATION FACTORS SUCH AS (π) PI AND WHEN CONVERTING CUBIC FEET TO GALLONS AND WHEN ROUNDING TO A SELECT NUMBER OF SIGNIFICANT DIGITS.

EXAMPLE

VOLUME OF CYLINDER 4 WORKING VOLUME

VOLUME OF CYLINDER $= \pi \times R^2 \times H1$

VOLUME OF CYLINDER $= \pi \times 74.4^2 \times 3.35$ ft

VOLUME OF CYLINDER $= 58{,}228$ ft^3

CUBIC FEET x 7.481 = GALLONS

VOLUME OF CYLINDER (IN GALLONS) $= 58{,}228$ $ft^3 \times 7.481 = 435{,}604$ GALLONS

SEE SHEET 2
FOR MORE NOTES
AND VOLUME TOTALS

DOCUMENT DESCRIPTION	SHELDON ABOVE GROUND COOLING (AGC) TANK VOLUME CALCULATIONS
DRAWN	KKRARMO
*DATE	4/11/22
ENGINEER	BBNITSCH
SHEET	1 of 2
	Nebraska Public Power District SHELDON STATION
DRAWING NO.	APPENDIX A - FIGURE 12

Sheet 2 of 2 - Sheldon Above Ground Cooling Tank Volume Calculations

NOTE 5: SPECIFIED DESIGN NUMBER FROM THE AGC TANK OEM.

NOTE 6: CALCULATED VOLUME DESIGNED FOR A STORM EVENT AS SPECIFIED IN NOTE 2, FOR AN AGC TANK OF THE NOTED INSIDE DIAMETER.

NOTE 7: CALCULATED VOLUME TO ACCOUNT FOR ISSUES LISTED IN NOTE 3, FOR AN AGC TANK OF THE NOTED INSIDE DIAMETER.

NOTE 8: CALCULATED VOLUME TO ACCOUNT FOR ISSUES LISTED IN NOTE 4, FOR AN AGC TANK OF THE NOTED INSIDE DIAMETER.

REGULAR (WORKING) OPERATION AGC TANK VOLUME = 58,228 cubic feet
435,604 gallons

CYLINDER 4, WORKING VOLUME

ADDITIONAL AGC TANK CAPACITY ABOVE REGULAR OPERATION WATER LEVEL = 127,281 cubic feet
952,196 gallons

CYLINDER 2 PLUS CYLINDER 3, RAINFALL RUNOFF PLUS ADDITIONAL VOLUME

TOTAL PRIMARY WETTED VOLUME AGC TANK = 185,509 cubic feet
1,387,800 gallons

REGULAR OPERATION AGC TANK PLUS ADDITIONAL AGC TANK VOLUME

DOCUMENT DESCRIPTION
SHELDON
ABOVE GROUND
COOLING (AGC) TANK
VOLUME CALCULATIONS

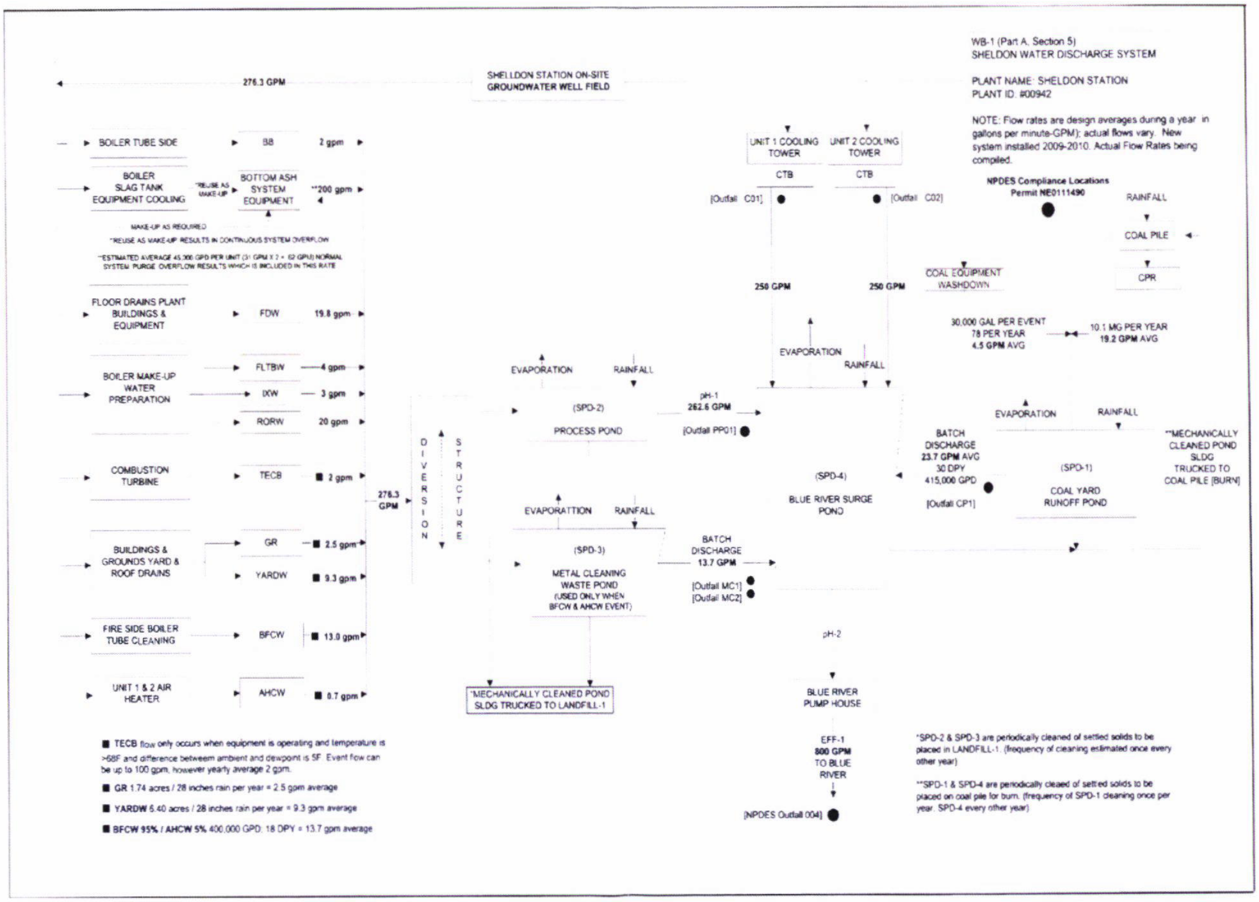
DRAWN KKBARMO DATE 03/22/22
ENGINEER BBNITSCH
SHEET 2 of 2
DRAWING NO. APPENDIX A – FIGURE 12

Nebraska Public Power District
SHELDON STATION

APPENDIX B

SHELDON WATER DISCHARGE SYSTEM DIAGRAM, WB-1

(FROM SHELDON 2021 NPDES PERMIT)



NOTE: Flow rates are design averages during a year in gallons per minute-GPM); actual flows vary. New system installed 2009-2010. Actual Flow Rates being compiled.

*REUSE AS MAKE-UP RESULTS IN CONTINUOUS SYSTEM OVERFLOW

**ESTIMATED AVERAGE 45,300 GPD PER UNIT (31 GPM X 2 = 62 GPM) NORMAL SYSTEM PURGE OVERFLOW RESULTS WHICH IS INCLUDED IN THIS RATE

■ **TECB** flow only occurs when equipment is operating and temperature is >68F and difference betweem ambient and dewpoint is 5F. Event flow can be up to 100 gpm, however yearly average 2 gpm.

■ **GR** 1.74 acres / 28 inches rain per year = 2.5 gpm average

■ **YARDW** 6.40 acres / 28 inches rain per year = 9.3 gpm average

■ **BFCW 95% / AHCW 5%** 400,000 GPD: 18 DPY = 13.7 gpm average

*SPD-2 & SPD-3 are periodically cleaned of settled solids to be placed in LANDFILL-1. (frequency of cleaning estimated once every other year)

**SPD-1 & SPD-4 are periodically cleaed of settled solids to be placed on coal pile for burn. (frequency of SPD-1 cleaning once per year. SPD-4 every other year)