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ELG Implications for Bottom Ash Transport Water

Prepared for: WPCA / FirstEnergy Seminar
Proposed Revisions to ELG Guidelines Seminar
Presented By: Kevin L. McDonough
19 February 2020

Safety Moment

Discussion Overview

- Overview of Proposed Regulatory Changes
- High Recycle Rate Bottom Ash Systems
- Low Profile Bottom Ash Conveyors
- Project Planning Considerations

Discussion Overview

- **Overview of Proposed Regulatory Changes**
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Effluent Limitations Guidelines (ELG)

April 2013	Proposed Rule Issued
November 03, 2015	CFR Publication
2018-2023	Original Compliance Dates *Depending on NPDES permit renewal dates*
March-April, 2017	Utility Water Act Group (UWAG) and The Small Business Administration Office of Advocacy Petitions for Reconsideration of the Rule.
April 12, 2017	EPA issues a stay of certain compliance deadlines for the Final ELG Rule.
August 11, 2017	EPA announces that it will conduct a rulemaking to potentially revise portions of the Final Rule, specifically those related to **bottom ash transport water** and **flue gas desulfurization wastewater**.
November 4, 2019	EPA proposed revisions to the ELG for public comment.
January 21, 2020	End of 60-day Public Comment Period.
TBD	Final Rule CFR Publication

Bottom Ash Transport Water

ELG Proposed Rule Revisions

Specialized Definitions

- **Ash Transport Water**
  - The term transport water means any wastewater that is used to convey fly ash, bottom ash, or economizer ash from the ash collection or storage equipment, or boiler, and has direct contact with the ash.
  - Transport water *does not include* low volume, short duration discharges of wastewater from minor leaks (e.g., leaks from valve packing, pipe flanges, or piping), minor maintenance events (e.g., replacement of valves or pipe sections), cleaning FGD paste transportation piping, wastewater present in equipment when a facility is retired from service, or *maintenance purge water*.

ELG Update

For Bottom Ash Transport Water

Presentation Prepared For:

WPCA

- **EPA evaluated 4 options for revised ELG (Bottom Ash)**
- **EPA is proposing Option 2**

Wastestream	Subcategory	Technology Basis for the BAT/PSES Regulatory Options			
		1	2	3	4
Bottom Ash Transport Water	N/A	Dry handling or High Recycle Rate Systems	**Dry handling or High Recycle Rate Systems**	Dry handling or High Recycle Rate Systems	Dry handling or High Recycle Rate Systems
	Low Utilization Boilers	(NS) Not Subcategorized	**Surface Impoundments + BMP Plan**	(NS) Not Subcategorized	(NS) Not Subcategorized
	Boilers Retiring by 2028	Surface Impoundments	**Surface Impoundments**	Surface Impoundments	Surface Impoundments

Note: The table above does not present existing subcategories included in the 2015 rule as the EPA is not proposing any changes to the existing subcategorization of oil-fired units or units with a nameplate capacity of 50 MW or less.

Source: Effluent Limitations Guidelines and Standards for the Steam Electric Power Generating Point Source Category; Proposed Rule (Pre-publication version,11/4/2019) - Page 38 of 198

ELG Proposed Rule Revisions

Bottom Ash Transport Water Best Available Technology Economically Achievable (BAT)

- **Bottom Ash Transport Water BAT**
  - **High Recycle Rate Systems**
  - Would allow facilities with a wet transport system, on an *"as needed" basis, to discharge up to 10 percent of the system volume* per day on a 30-day rolling average to account for the operational challenges, including *infrequent large precipitation and maintenance events*.
  - This does not mean that the EPA expects all facilities to discharge up to 10 percent on a regular basis, rather this option is designed to provide flexibility *if and when needed* to address site-specific challenges of operating the recirculating ash system.

ELG Proposed Rule Revisions

Bottom Ash Transport Water Best Available Technology Economically Achievable (BAT)

- **Bottom Ash Transport Water BAT**
  - **High Recycle Rate Systems (continued)**
  - Under such an alternative, each facility operating a high recycle rate system would take proactive measures *(e.g., acid or caustic addition for pH control, chemical addition to control alkalinity, polymer addition to remove fines)* to maintain system water chemistry within control limitations established by the facility in a BMP plan similar to that proposed for low utilization unit.
  - Under this approach, when reasonable active measures are insufficient to maintain system water chemistry or water balance within acceptable limitations, or to facilitate maintenance and repairs of the BA system, *the facility would be authorized to purge a portion of the system volume.*
  - The purge volume would be determined based on plant-specific information and would be minimized to the extent feasible and *limited to a maximum of 10 percent of the total system volume.*

ELG Proposed Rule Revisions

Bottom Ash Transport Water Best Available Technology Economically Achievable (BAT)

- **Bottom Ash Transport Water BAT**
  - **High Recycle Rate Systems (continued)**
  - The EPA proposes that BAT limitations for any wastewater that is purged from a high recycle rate system and then discharged be established by the permitting authority *on a case-by-case basis using BPJ*.
  - In most cases, the BPJ for any discharged water would be a *surface impoundment with discharge limitations on TSS, pH and Oil/Grease* (similar to typical NPDES BPT requirements for Low Volume Wastewater)

ELG Proposed Rule Revisions

Bottom Ash Transport Water Best Available Technology Economically Achievable (BAT)

- **Bottom Ash Transport Water BAT**
  - **High Recycle Rate Systems – Reporting & Recordkeeping Requirements**
  - Facilities submit the calculation of the primary active wetted BA system volume, which means the maximum volumetric capacity of BA transport water in all piping (including recirculation piping) and primary tanks of a wet bottom ash system, excluding the volumes of installed spares, redundancies, maintenance tanks, other secondary bottom ash system equipment, and non-bottom ash transport systems that may direct process water to the bottom ash system.
  - This ensures that the permitting authority can verify the volume of discharge allowed for a high recycle rate system.

Compliance Deadlines

ELG Proposed Rule Revisions

Availability Timing of New Requirements

- **Initial Compliance Date (for both Bottom Ash & FGD WWT)**
  - BAT limitations apply from a date determined by the permitting authority that is "as soon as possible" *beginning November 1, 2020*
- **Final Compliance Dates**
  - Bottom Ash Transport Water = *No Later than 12/31/2023*
  - FGD Wastewater = *No later than 12/31/2025*
  - FGD Wastewater VIP = *No later than 12/31/2028*

CCR & ELG

Regulatory Timelines

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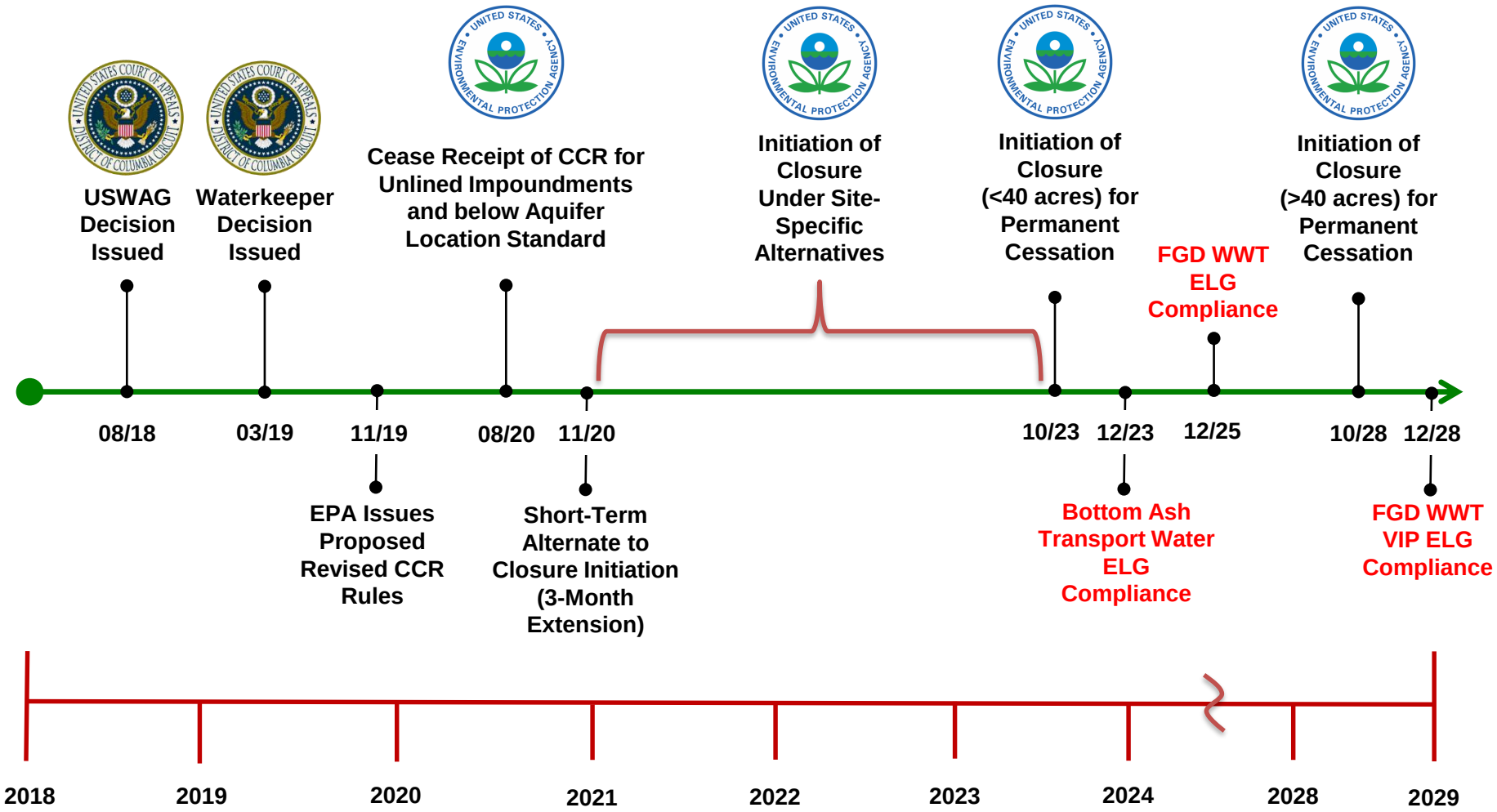

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Bottom Ash Transport Water Management

Technical Options

- **Dry Bottom Ash Handling System**
  - Submerged Drag Chain System (Traditional)
  - Submerged Drag Chain System (Low Profile)
  - Dry Pneumatic System
  - Dry Mechanical System
- **High Recycle Rate Bottom Ash Systems**
  - Conventional Dewatering Bin / Settling / Surge Tanks
  - Continuous Dewatering & Recirculation System with Remotely-located Submerged Flight Conveyors (CDR)
  - Dewatering Basin/Tank Recirculation System

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Bottom Ash WTD Conversion Alternatives

High Recycle Rate Bottom Ash System with Remote SFC's (CDR)

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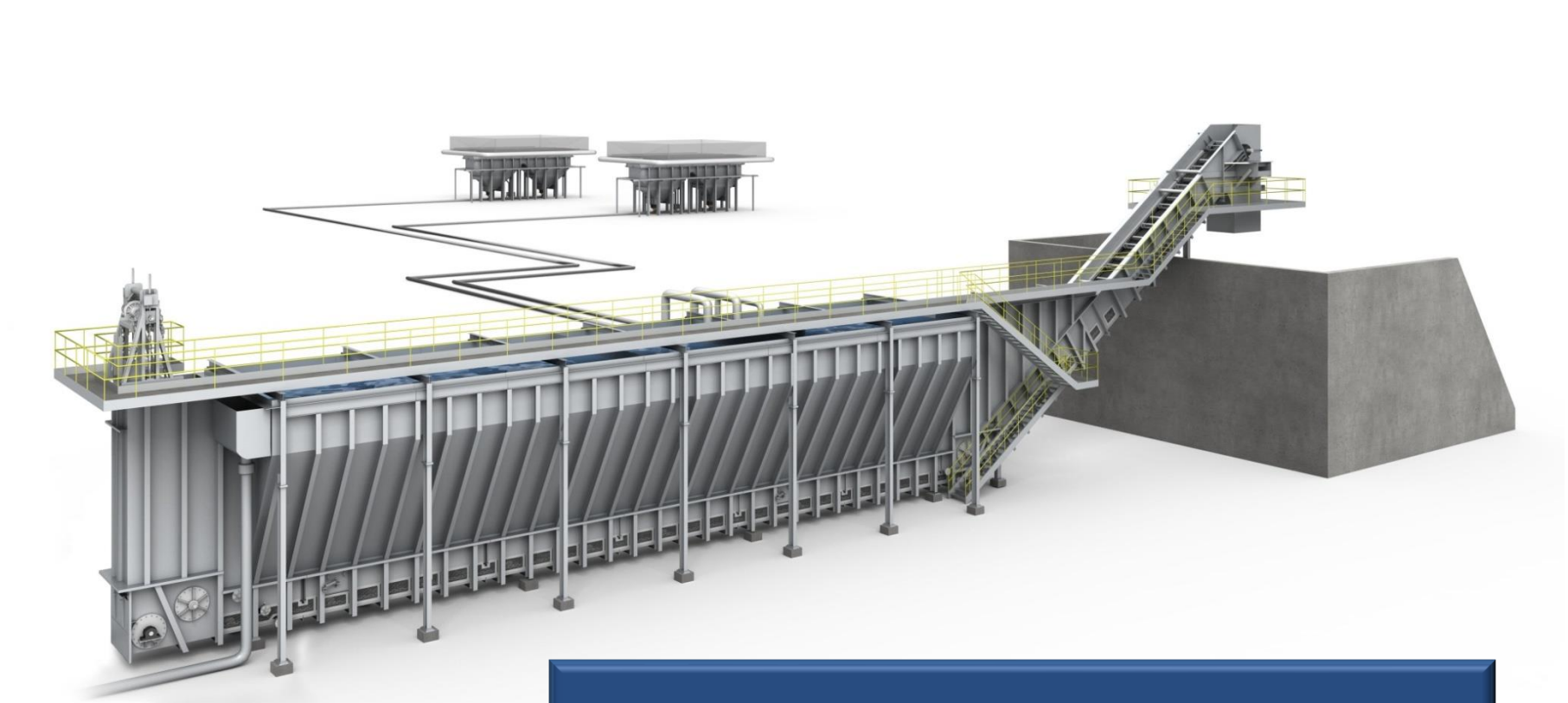

- CDR System with Remote SFC's
- Combines SFC Technology with Conventional Recirculation System

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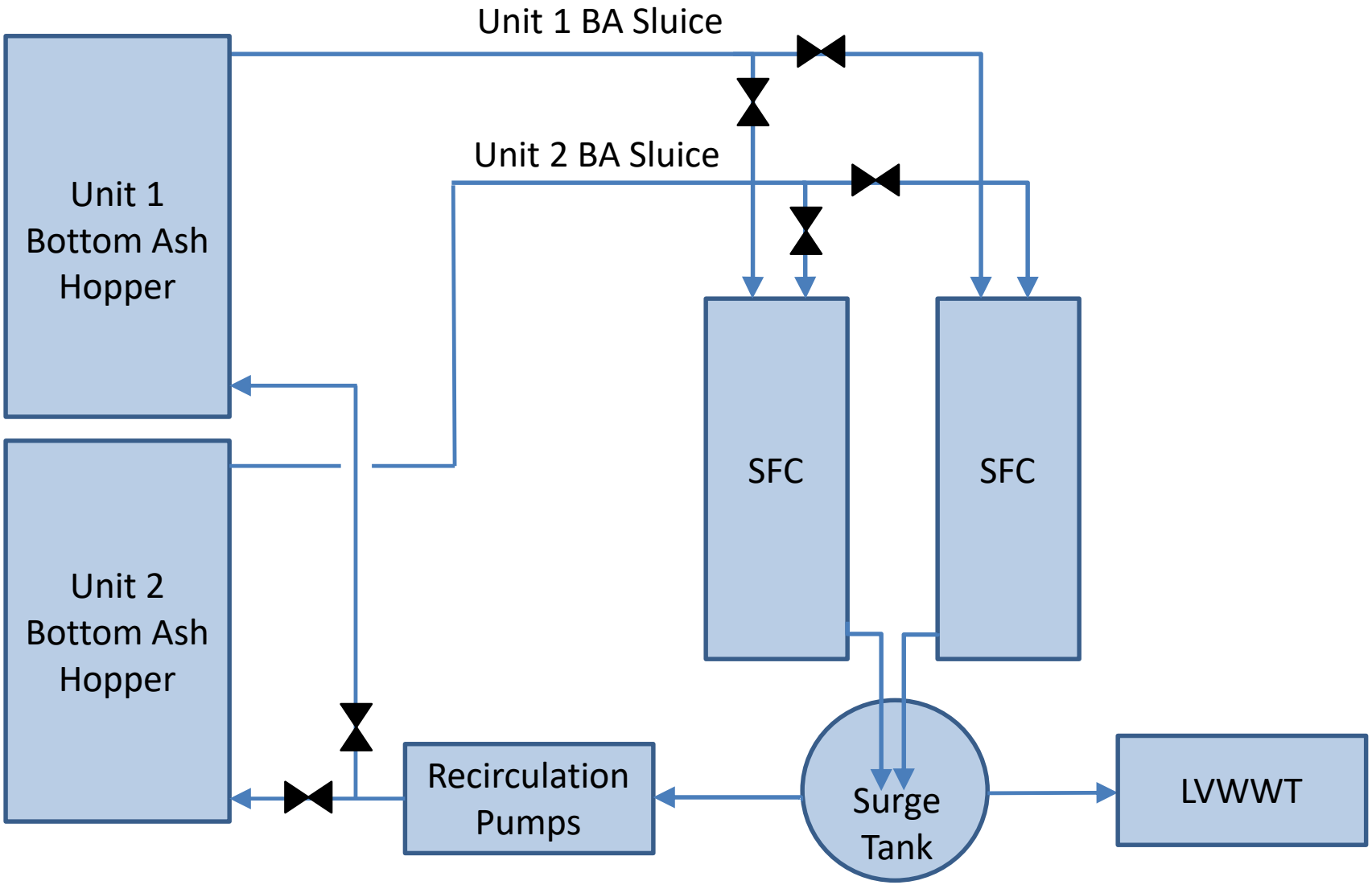
Design Basis Requirements

High Recycle Rate Bottom Ash System with Remote SFC's (100% Redundancy)



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High Recycle Rate Bottom Ash System

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High Recycle Rate Bottom Ash System

High Recycle Rate Bottom Ash System

High Recycle Rate Bottom Ash System

High Recycle Rate Bottom Ash System

Design Basis Requirements

Bottom Ash Sluice Water Demands for High Recycle Rate Systems

Typical Water Requirements:

- Bottom Ash Sluice Conveying Water = 2,500-3,500 gpm
- Low Pressure Cooling Water/Seal Trough Flushing/Make-Up Water Supply = 150-300 gpm/unit
- Pyrites Sluice Conveying Water = 500-3,500 gpm

High Recycle Rate Bottom Ash System

Water Balance Design: Typical Water Usage Chart

Presentation Prepared For:

EQUIPMENT	USE DESCRIPTION	FLOW RATE GPM	SUPPLY PRESSURE				OPERATION CONTINUOUS OR INTERMITTENT	
			UNIT 1 LOW	UNIT 1 HIGH	UNIT 2 LOW	UNIT 2 HIGH	CONT	INT
UNIT 1	SEAL TROUGH COOLING	50	X				X	
BOTTOM ASH HOPPER	SEAL TROUGH FLUSHING (ADDITIONAL)	950	X					X
	WALL COOLING	450	X				X	
	WALL COOLING FLUSH (ADDITIONAL)	1050	X					X
	HOPPER COOLING	200	X				X	
	DOOR NOZZLES (2 @ 155 GPM EACH)	310		X				X
	LOWER SLOPE NOZZLES (3 @ 155 GPM EACH)	465		X				X
	UPPER SLOPE NOZZLES (5 @ 155 GPM EACH)	775		X				X
	OBSERVATION WINDOWS (12 @ 2 GPM EACH)	24	X				X	
	OBSERVATION WINDOWS (WHILE CONVEYING)	36	X					X
	DILUTION SPRAY	100		X				X
	JETPULSION PUMP (CONVEYING)	2049		X				X
* (AS REQUIRED)	SLUICE DOOR WINDOW (6 @ 2 GPM EACH)	12	X					X
* (AS REQUIRED)	EMERGENCY JETTING NOZZLES	155		X				X
	HOPPER MAKE-UP WATER	1232	X					X
	LP MINIMUM FLOW	2000	X				X	
	JETPULSION PUMP (BYPASS)	2049		X				X
UNIT 1	AGITATING NOZZLES (NOTE 2)	100	X				X	
BOTTOM ASH HOPPER SUMP								
UNIT 1	JETPULSION PUMP (A-D)	370		X				X
PYRITES HOPPERS	TRANSPORT ELBOW	30		X				X
	JETPULSION PUMP (E-H)	370		X				X
	TRANSPORT ELBOW	30		X				X
UNIT 1	JETPULSION PUMP	1990		X				X
PYRITES TRANSFER	TRANSPORT NOZZLE	300		X				X
TANK	TANK MAKE-UP WATER	200	X					X
UNIT 1	AGITATING NOZZLES (NOTE 1)	200	X				X	
SURGE TANK								
UNIT 1	AGITATING NOZZLES (NOTE 2)	100	X					X
EQUIPMENT AREA SUMP								
UNIT 1	AGITATING NOZZLES (NOTE 2)	100	X					X
BUNKER AREA SUMP								
SUBMERGED	CHAIN SPRAY	10	X					X
FLIGHT CONVEYOR	LOWER TROUGH SPRAY	5	X					X
	RAMP AGITATING NOZZLES	90	X					X
	BENT SECTION AGITATION NOZZLES	250	X					X

HOURS

MINUTES: 0 5 10 15 20 25 30 35 40 45 50 55 | 1: 0 5 10 15 20 25 30 35 40 45 50 55 | 2: 0 5 10 15 20 25 30

CONSUMPTION TOTALS FOR UNIT 1 LOW PRESSURE WATER SUPPLY	5874 5874 5874 6029 6029 6029 6339 6339 6339 6339 7106 7106 7106 6029 6029 6029 6029 6339 6339 6339 6339 7106 7106 7106 6029 6029 6029 6339 6249 6249 7370 7270 6601 6069
CONSUMPTION TOTALS FOR UNIT 1 HIGH PRESSURE WATER SUPPLY	2459 2459 2459 2614 2614 2614 2924 2924 2924 2924 2459 2459 2459 2614 2614 2614 2614 2924 2924 2924 2924 2459 2459 2459 2614 2614 2614 2924 2924 2924 2049 2049 1990 2690

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Water Balance/Wastewater Considerations

Bottom Ash Sluice Water Demands for High Recycle Rate Systems

Water Balance Key Considerations

- **Losses**
  - Evaporation
  - Water Retention in Ash
  - Hopper/Pipe Leakage
  - Seal Trough Flushing (if included in balance)
- **Gains**
  - Chain Sprays – SFC (for CDR System)
  - Seal Water from Pumps (if not mechanical)
  - Rain
- **Typically will have net loss of water from system**
- **Water Balance can be complex**

Design Basis Requirements

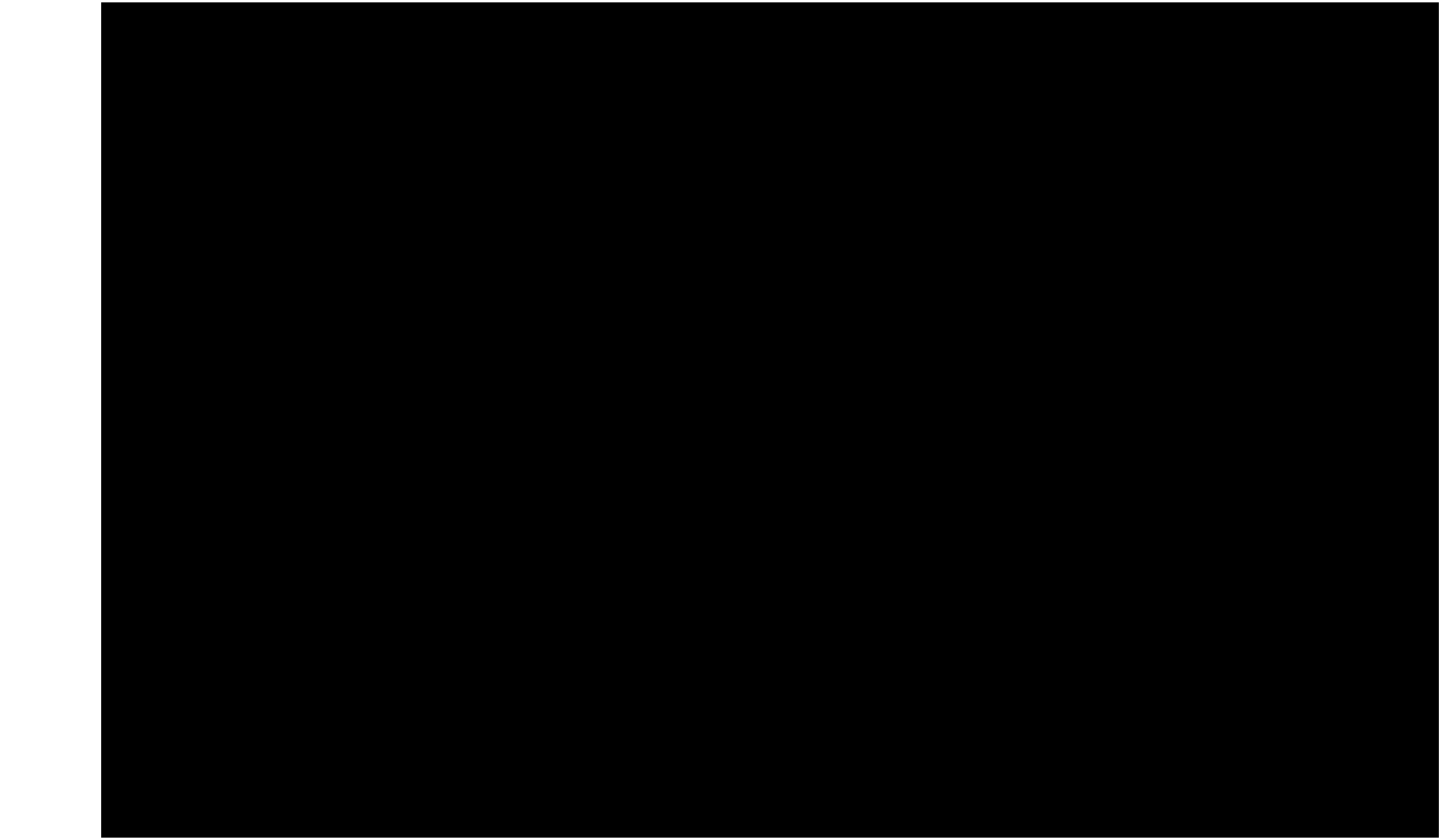
Typical Performance Guarantees for High Recycle Rate Systems

Parameter	Performance Requirement
TSS (in R-SFC Overflow)	400 ppm (24-hour average)
Moisture % (Bottom Ash)	20% in bunker after 24 hours or Paint Filter Test

Bottom Ash Transport Water TSS Control

Lamella Packs

Presentation Prepared For:



High Recycle Rate Bottom Ash System

TSS Control: Lamella Design

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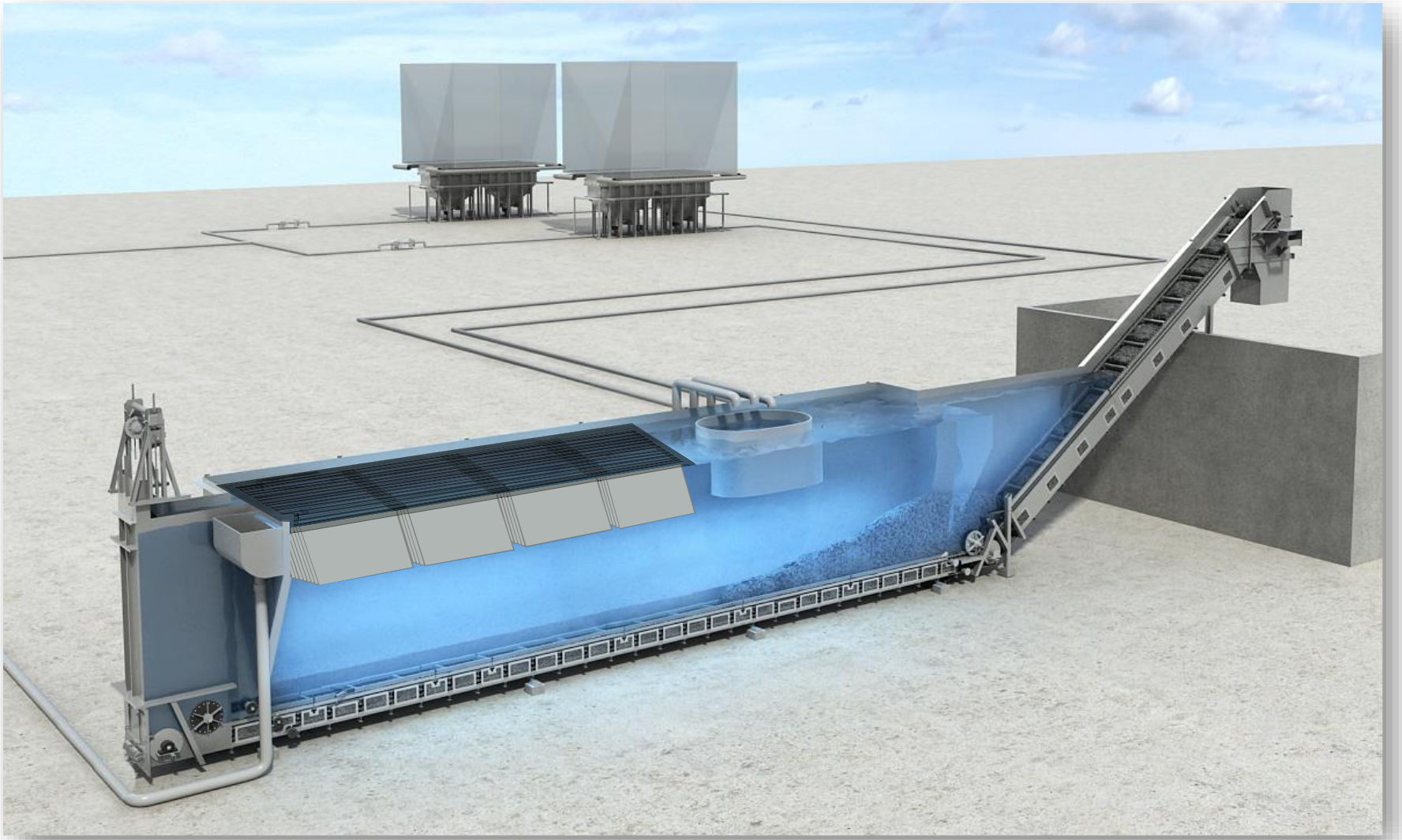

High Recycle Rate Bottom Ash System

TSS Control: Lamella Design

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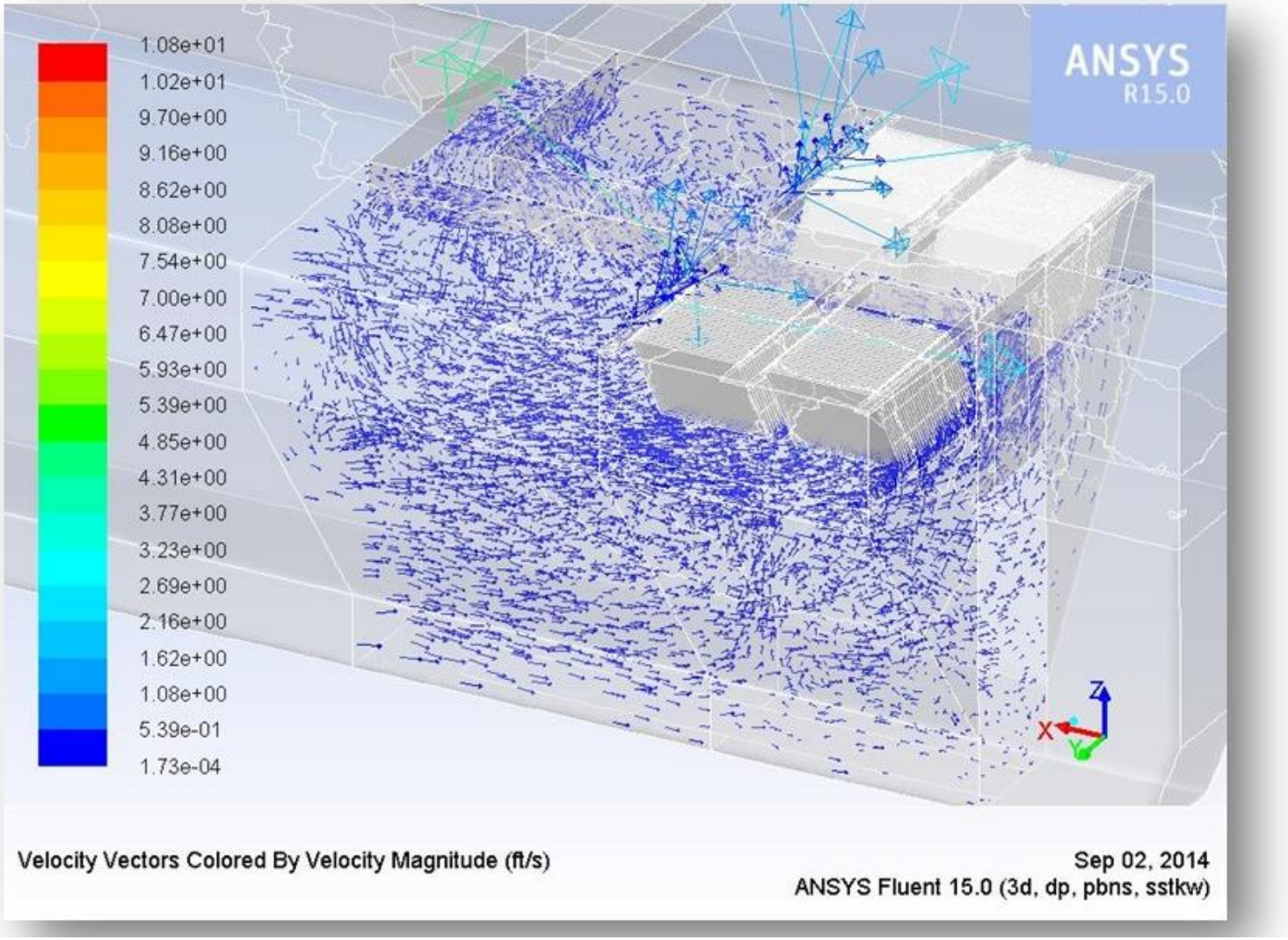

High Recycle Rate Bottom Ash System

TSS Control: Lamella Design

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High Recycle Rate Bottom Ash System

TSS Control: Lamella Design

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High Recycle Rate Bottom Ash System

For Bottom Ash Transport Water Treatment

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Water Balance/Wastewater Considerations

Bottom Ash Sluice Water Quality and Chemistry

- **Water Quality/Chemistry Concerns**
  - Acidity/Alkalinity Cycling
  - Heavy Metals Cycling
  - TSS Cycling
- **pH Control Measures:**
  - Measure pH at Bottom Ash Hopper Overflow and Dewatering Area
  - Caustic Addition for Acidic Conditions (NaOH)
  - Acid Addition for Alkaline Conditions (HCl to mitigate scaling risk)
- **Additional TSS Control Measures:**
  - Coagulant Injection (Particle Neutralizing)
  - Flocculent Injection (Enhanced Particulate Settling)

Existing System Retrofits for Outage Wash Operations

Existing System Outage Wash Capability

Current and Potential Arrangement

- **Typical Outage Wash Operations**
  - Non-Chemical and Chemical Water Outage Wash of Boiler, Air Preheater, and ESPs
  - Outage Wash Wastewater Stream Directed to Low Volume Waste or Pond Systems
- **Potential Arrangement for Outage Wash Water**
  - Provide WWT to Mitigate TSS, Iron, and Copper
  - Utilize Existing Bottom Ash Dewatering System Equipment
  - Leverage R-SFC / Clarifier to capture Fine Particulate from Outage Wash Operations
  - Minimize the Requirement for additional WWT Equipment
  - Augment with additional Chemical Injection Equipment if necessary

High Recycle Rate Bottom Ash System

For Bottom Ash Transport Water Treatment

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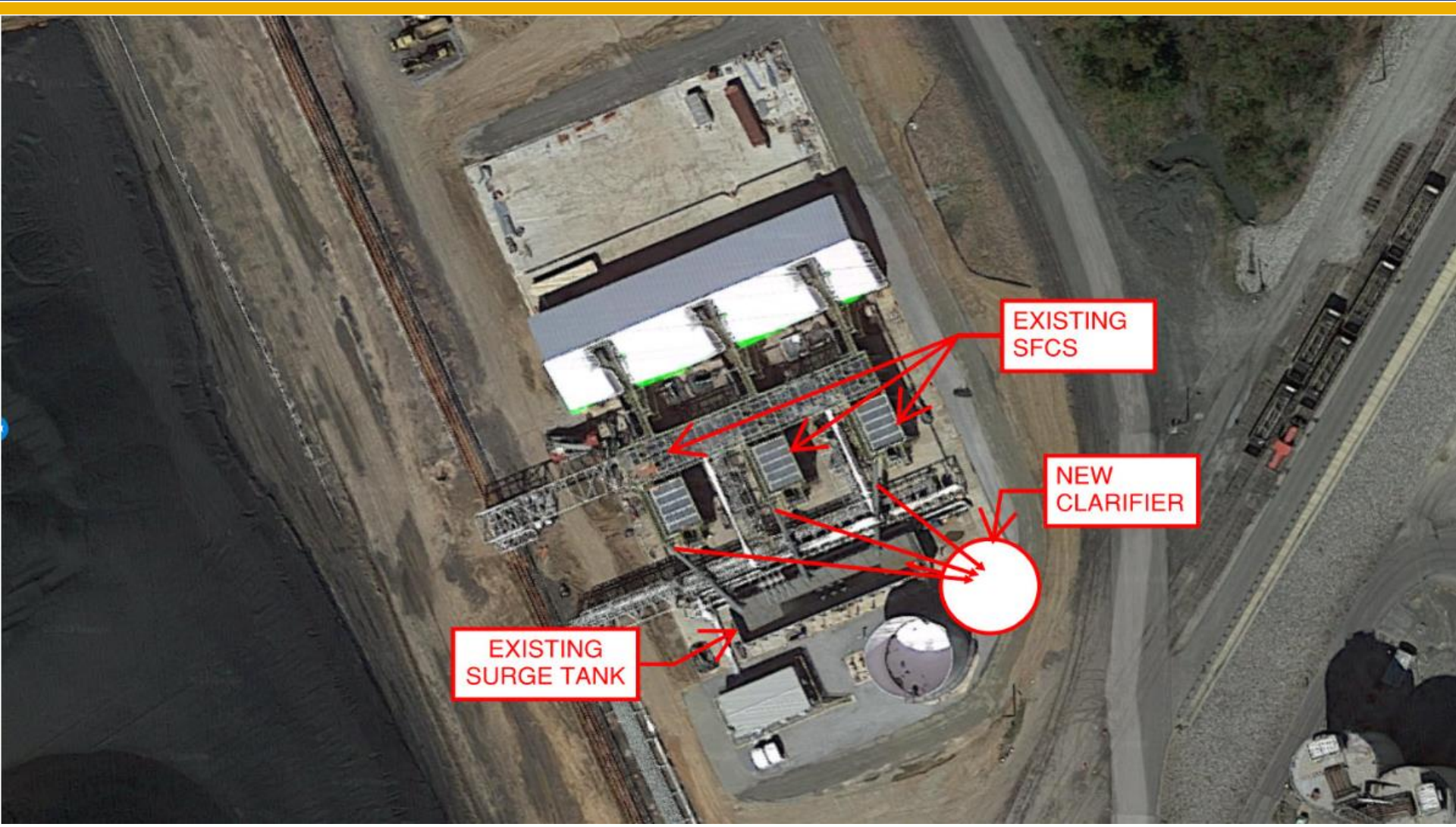

Clarifier addition augments existing assets for outage wash treatment

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- **Low Profile Bottom Ash Conveyors**
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Bottom Ash Submerged Drag Chain Conveyor

Low Profile Design

UCC MAX™-LP System

Bottom Ash Submerged Drag Chain Conveyor

Low Profile Design

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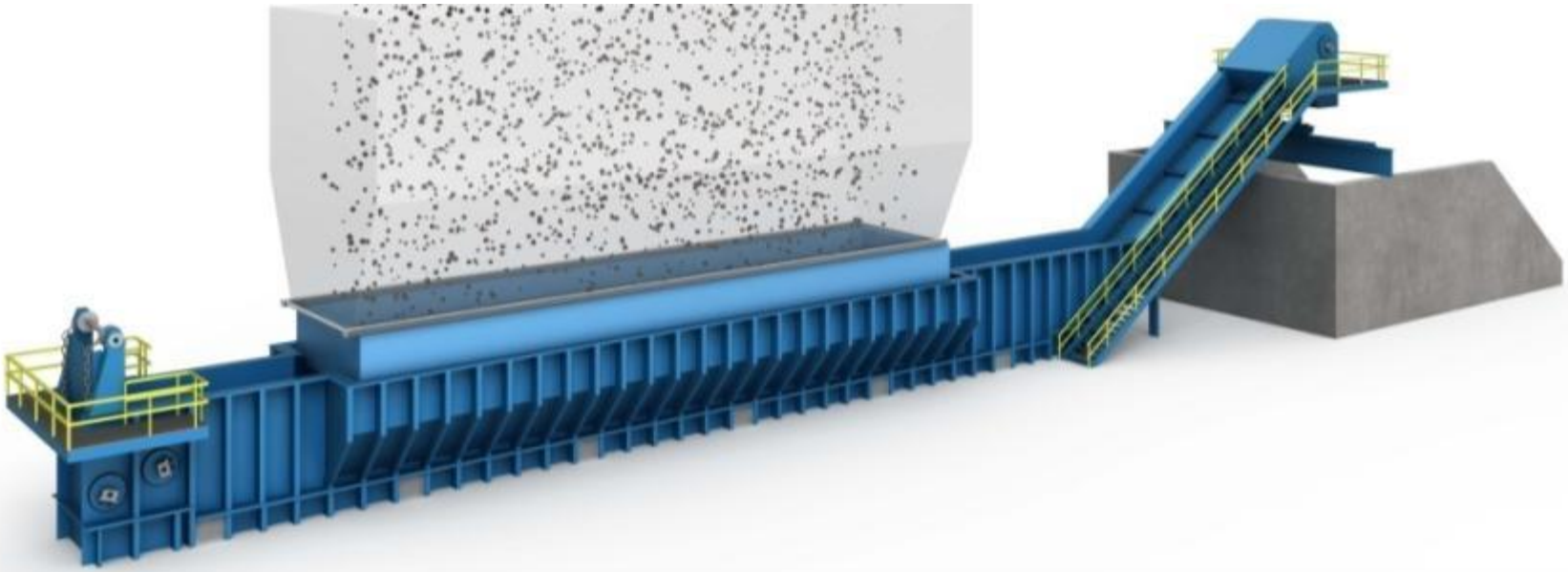
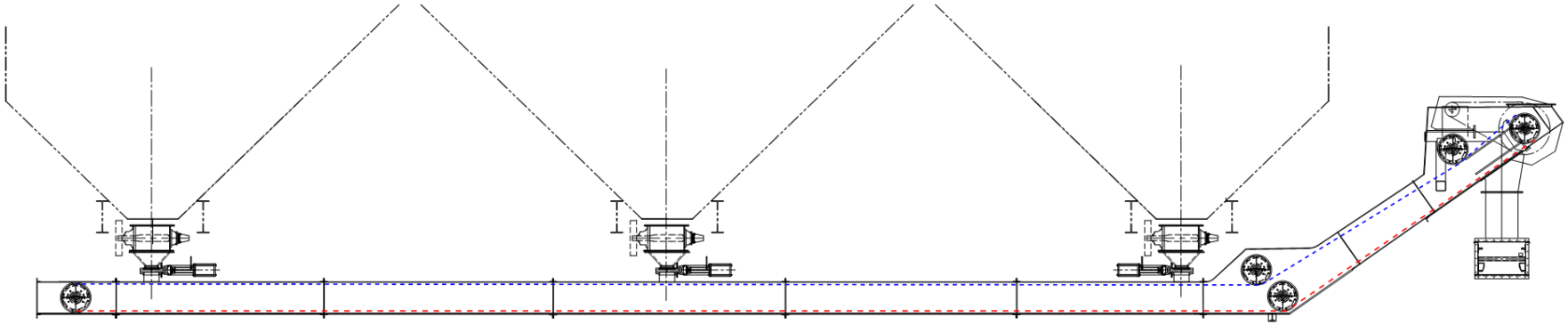


Bottom Ash Submerged Drag Chain Conveyor

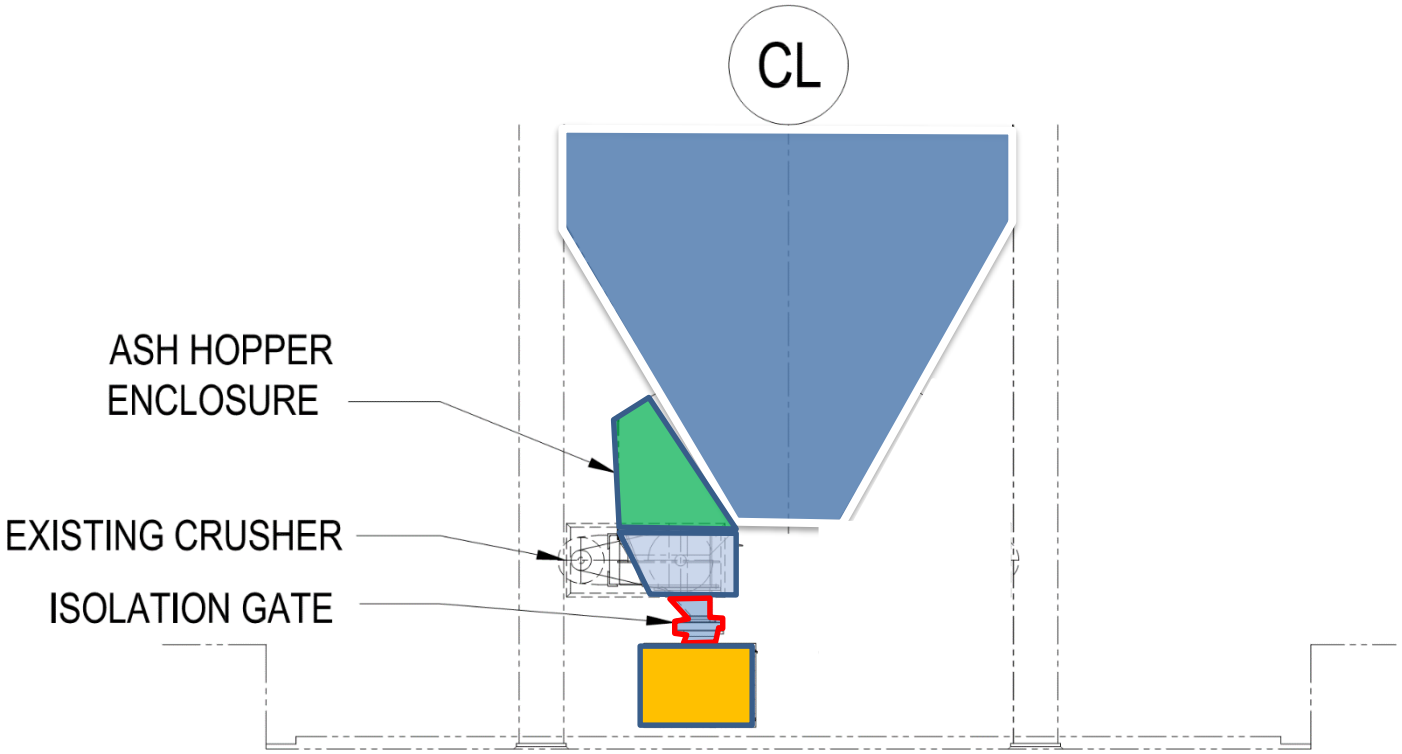
General Arrangement – Elevation



Typical Elevation View

Conveyor Arrangement (Single Outlet)

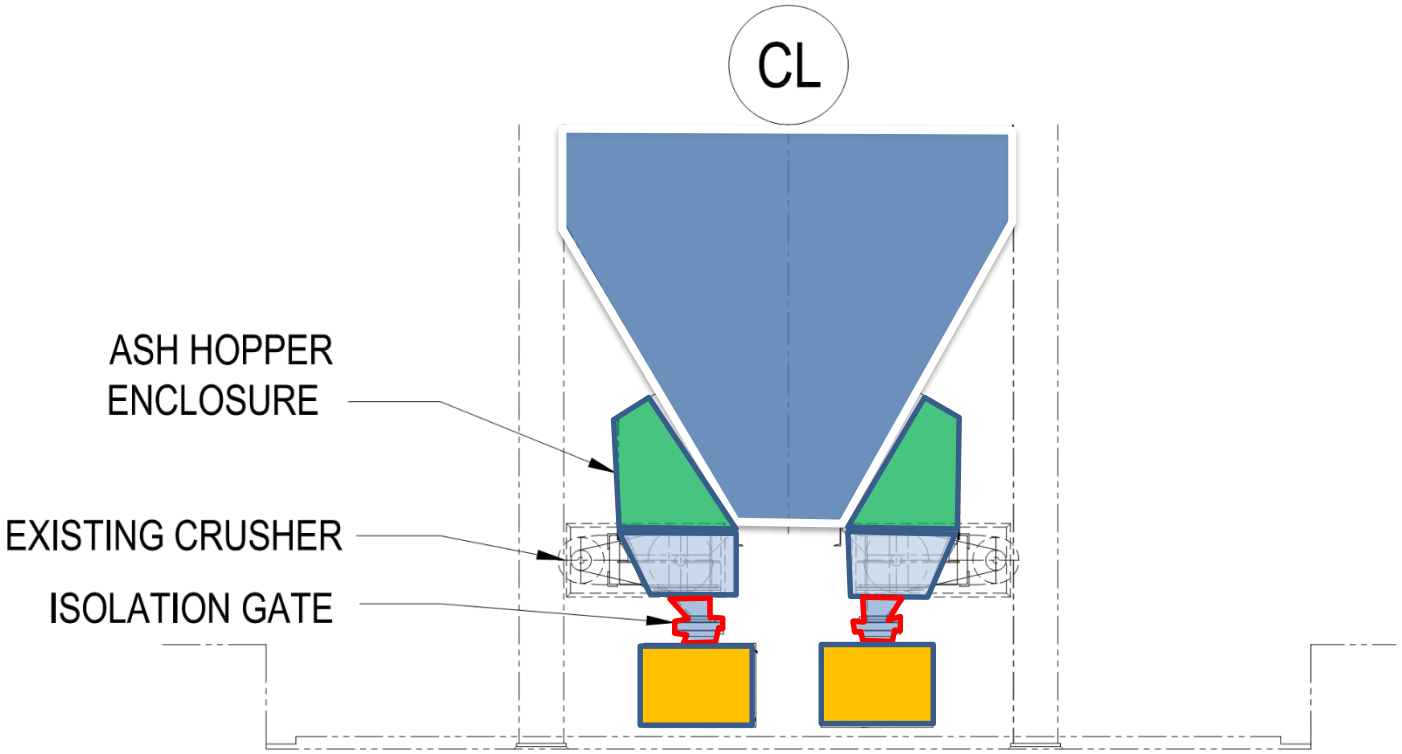
Structural General Arrangement – Section



Conveyor Arrangement (Dual Outlet)

Structural General Arrangement – Section

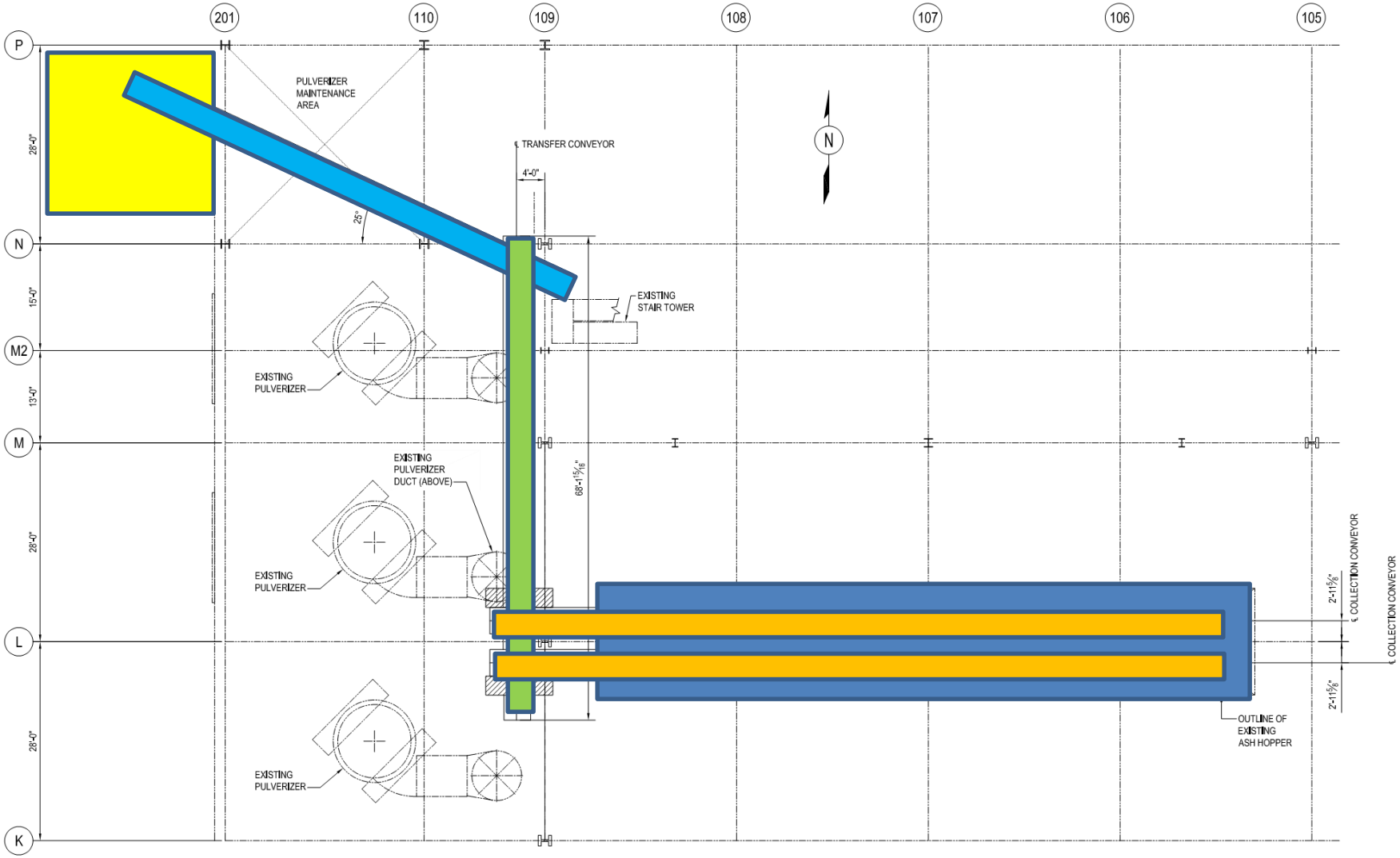
Presentation Prepared For:



Conveyor Arrangement (Dual Outlet)

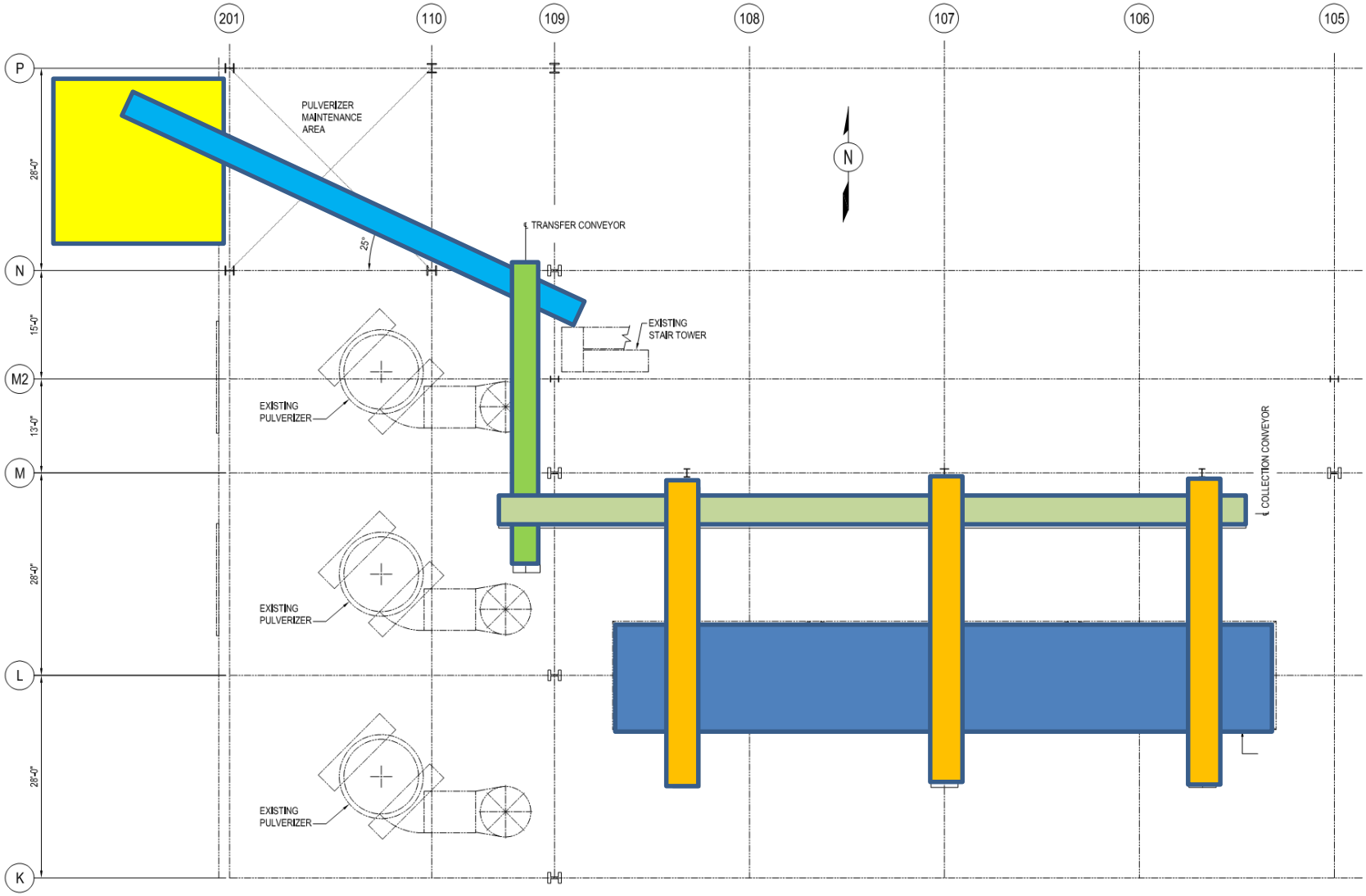
Structural General Arrangement – Plan View

Presentation Prepared For:



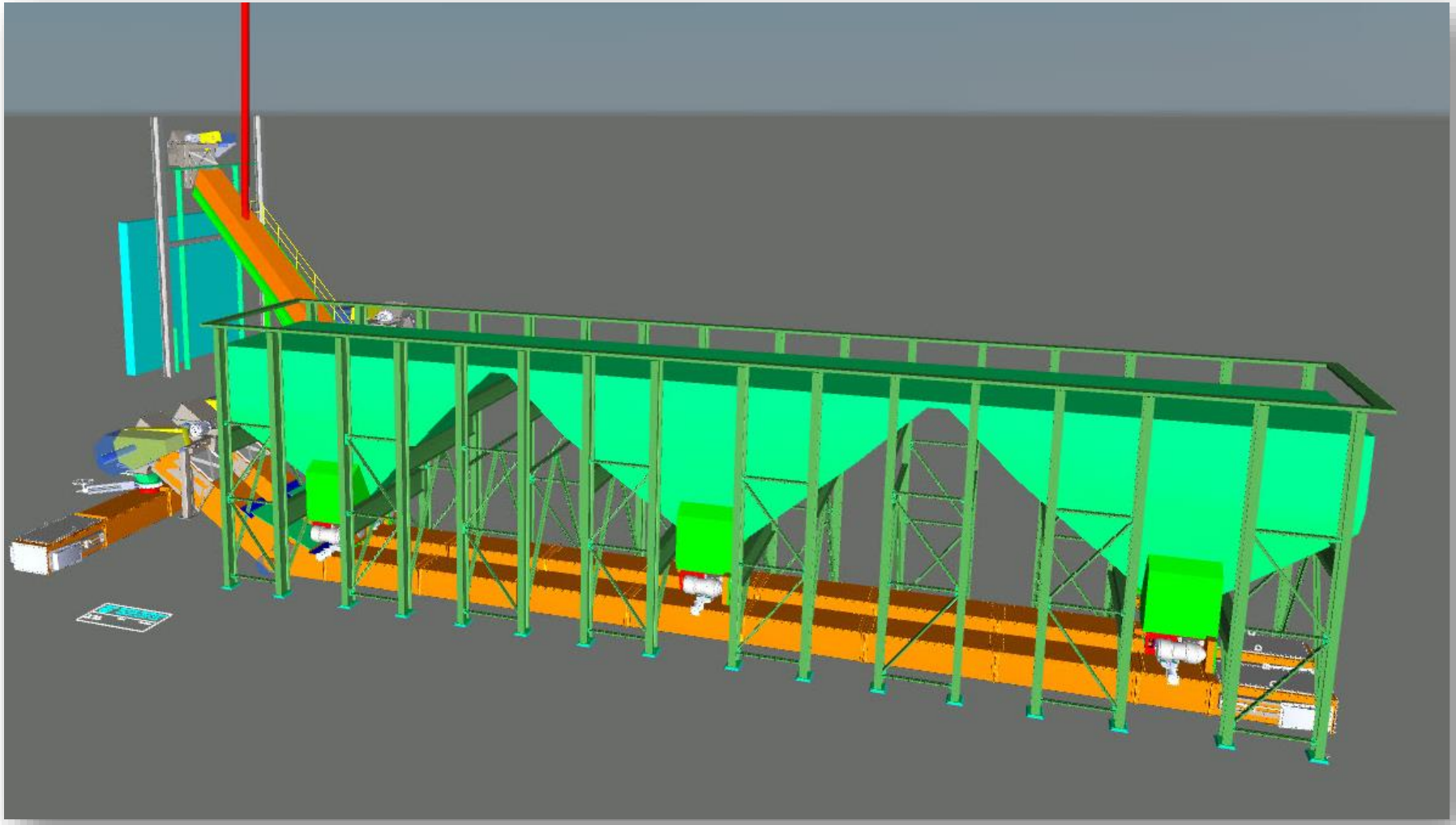
Conveyor Arrangement (Perpendicular)

Structural General Arrangement



Bottom Ash Submerged Drag Chain Conveyor

3-D Model Design



Bottom Ash Submerged Drag Chain Conveyor

3-D Model Design

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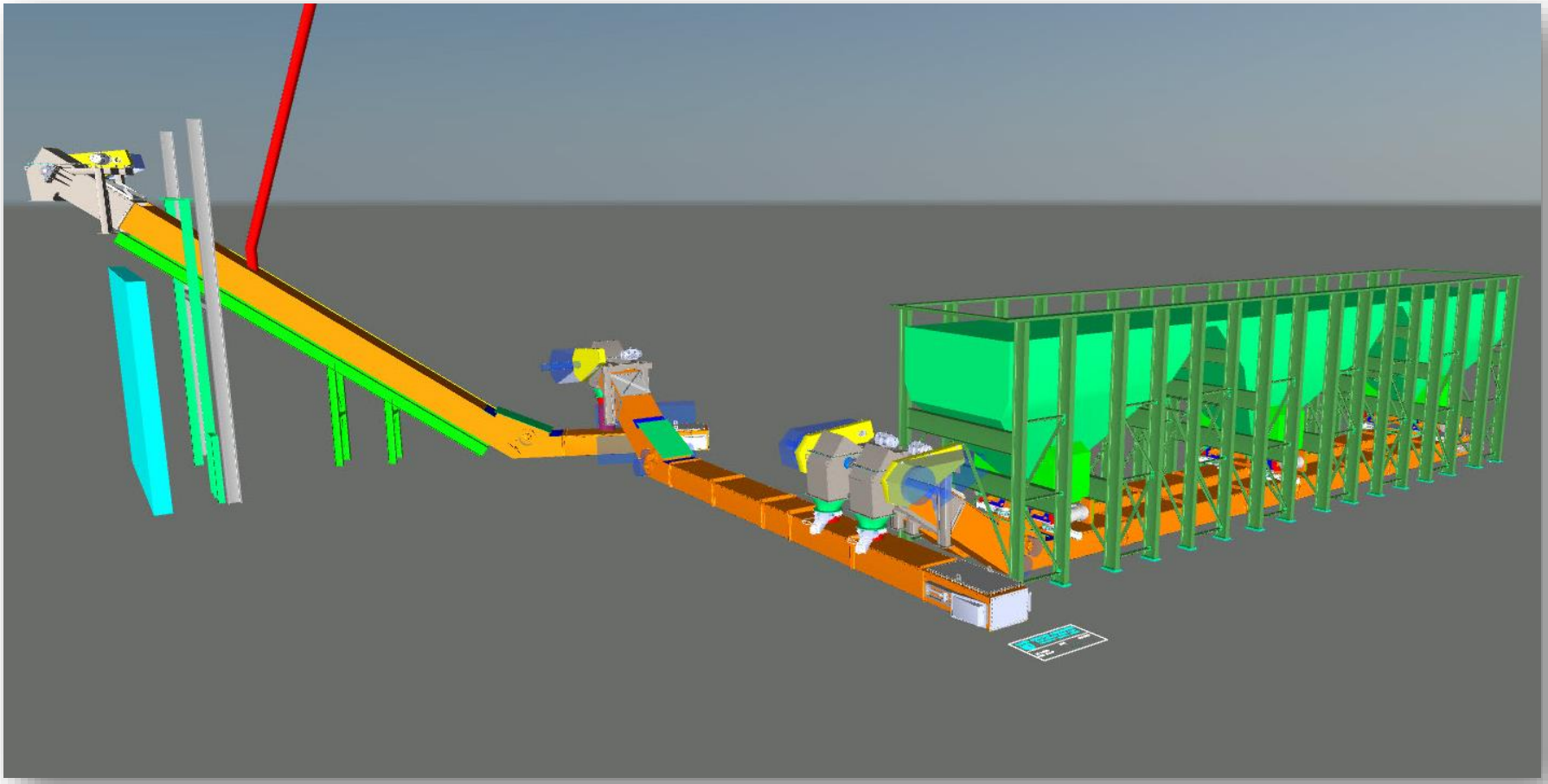

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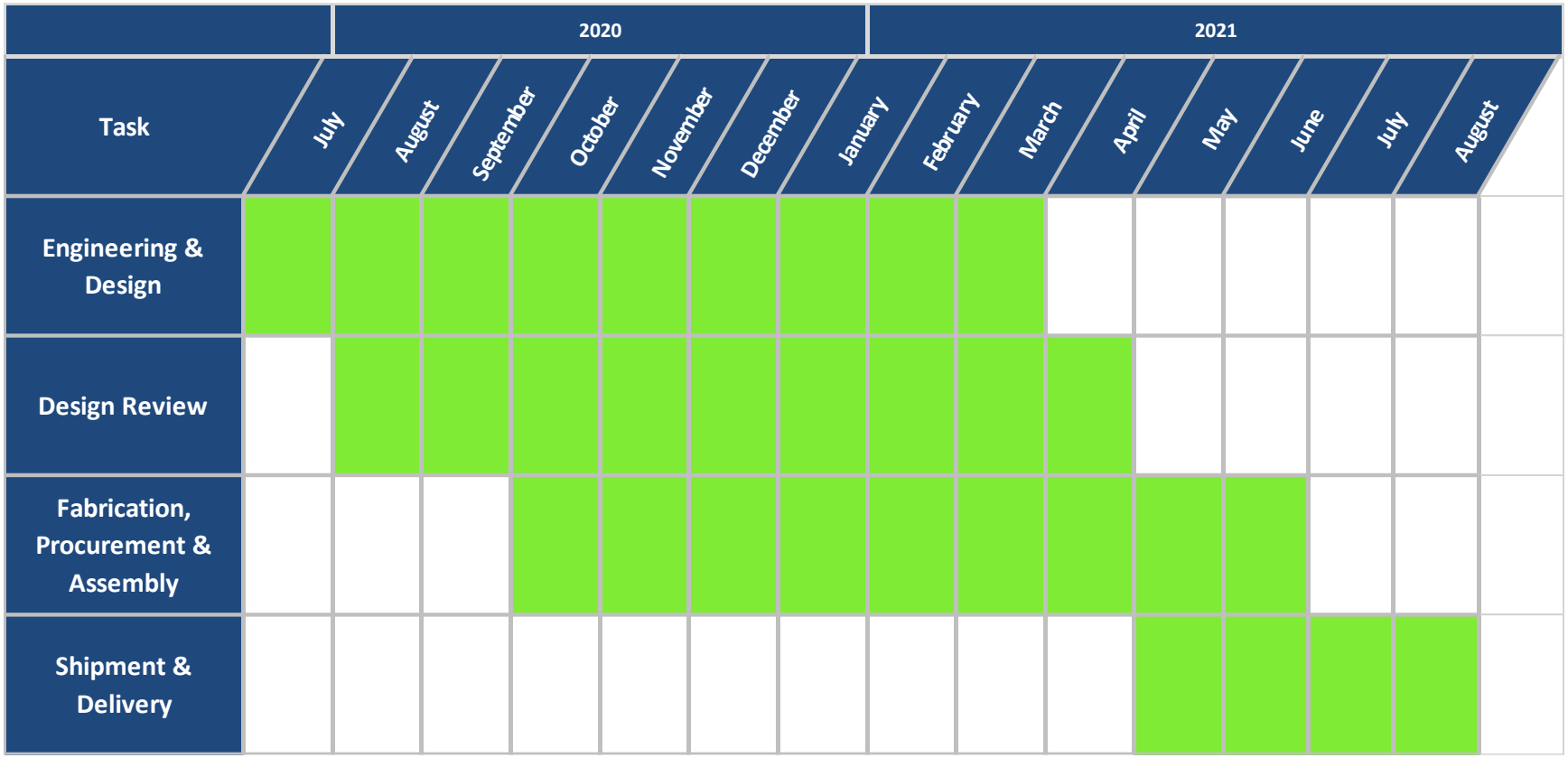
Presentation Prepared For:

Typical Bottom Ash WTD Project Schedule

Technology/Equipment Design & Supply



Typical Design & Supply Duration Ranges from 8-14 Months, Depending on Technology Selection & Project Scope/Complexity

UCC Dry Ash Conversion Projects

Typical Lead Times

Bottom Ash Wet-to-Dry Conversion Project Lead Times by Technology

System/Technology	Time Between Initial Request for Proposal and Award (months)	Time Between Award and Delivery (months)	Time Between Delivery and Installation Completion (months)	Time Between Installation Completion and Operational (months)	Total Months	Total Years
Under-Boiler SFC	4	10-12	1.5-2.5	0.5-1	16-19.5	1.3-1.6
Under BA Hopper SFC (MAX-LP Low Profile)	4	8-10	1.5-2.5	0.5-1	14-17.5	1.2-1.5
Remote SFC and Clarifier	4	12-14	6-12	1-2	23-32	1.9-2.7
Remote SFC & Closed-Loop Recirculation (CDR)	4	12-14	6-12	1-2	23-32	1.9-2.7
Dry Pneumatic (PAX)	4	12-14	6-12	1-2	23-32	1.9-2.7
Dry Mechanical (DAX)	4	10-12	1.5-2.5	1-2	16.5-20.5	1.4-1.7
Range	**4**	**10-14**	**1.5-12**	**0.5-2**	**14-32**	**1.2-2.7**

Bottom Ash WTD Conversion Alternatives

Risk Analysis – Schedule/Critical Path

Project Critical Path Items

- Permitting
- Site Surveys & Laser Scans
- Major Equipment Locations & Foundations
- Geotechnical Study
- Electrical Load Study
- Power Supply & Distribution Equipment
- DCS Interface Requirements
- Outage Tie-In Plans
- Environmental Compliance Dates

Questions ?