

Conference :- Heat Rate Efficiency Summit 2023

Topic :
**HEAT RATE TO CHP-COAL
REQUIREMENT & DESIGN OF
CHP & AHP**

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Council of Enviro Excellence

**3RD HEAT RATE
EFFICIENCY
SUMMIT 2023**



HEAT RATE
TO
CHP –COAL REQUIREMENT
&
DESIGN OF CHP & AHP

**SixD Engineering
Solutions Pvt. Ltd**



COO –Six D ,
40+ years in
Thermal,
Renewable &
GH2



Professional with national and international experience in the power sector, holds expertise in thermal, solar PV and Green Hydrogen .Prior to Six D worked with BHEL ,STEAG, TRACTEBEL-ENGIE,TUV-SUD.

Solution Provider for Owners Engineering for Power , Renewables and GH2



Heat rate of a power plant is a quantity that reflects the amount of fuel required to generate one unit of electrical energy.

SYSTEM & EQUIPMENT CALCULATION

SYSTEM CALCULATION

TG Heat rate = 1850 Kcal/kWh (As per CEA guidelines)

Boiler Efficiency = 85%

Plant Heat rate = $1850 / 0.85 = 2176$ Kcal/kWh

GCV of Coal = 3400 Kcal/kg

Specific coal consumption = $2176 / 3400 = 0.64$ kg / kWh.

Hourly coal consumption per 660 MW unit at MCR condition = 422 Tonnes (660×0.64)

Daily coal consumption = 10128 Tonnes





Coal requirement / day for 3 units = 30384 Tonnes.

Considering 14 hours working time in a day, capacity of CHP shall be $(30384/14) = 2170$ TPH. Considering the design margin of 10% Design capacity of CHP system comes to 2400 TPH(rounded off from 2387)

Rake requirement/day for 3 units = $30384/3600=9$ nos.

SYSTEM OVERVIEW-



UNLOADING

RAKES REQUIRED - 9 RAKES PER DAY

WAGON TIPPLER REQUIREMENT-4(3W+1S)

- WT CAPACITY-20 TIPPLING/HR/WT
- TIME REQD FOR UNLOADING OF 1RAKE-3 Hrs. (Theoretical)
- TIME REQD FOR UNLOADING OF 1RAKE-5 Hrs. (Actual operating)
- TIME REQD FOR UNLOADING OF 9RAKE-45 Hrs.
- Hence 3Nos. WT have been selected based on 14hrs operation of one WT and CHP system have been designed for 14Hrs. Operation per day.

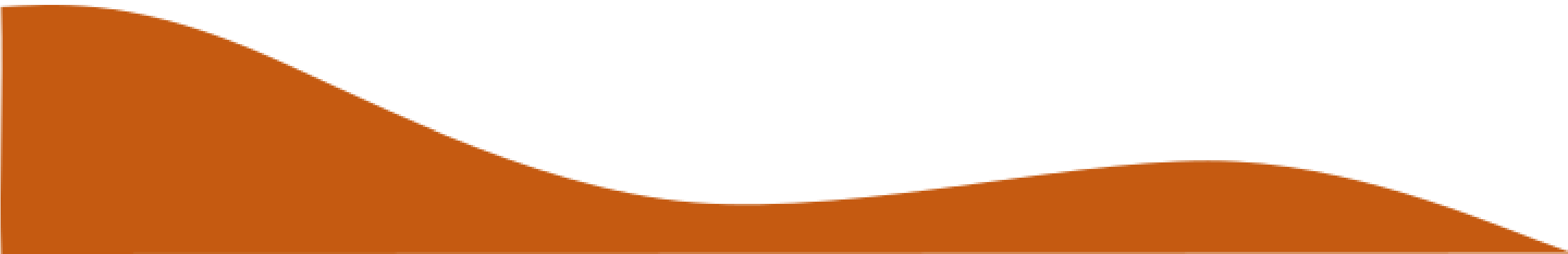
TRACK HOPPER -1

TRACK HOPPER CAPACITY-TO ACCOMMODATE 20 WAGONS



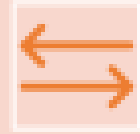
SYSTEM OVERVIEW-CRUSHING & SCREENING

- CRUSHER TYPE-RING GRANULATOR
- QTY -4 CAPACITY-
- 1200TPH EACH
- REDUNDANCY- 2W+2S
- EACH CRUSHER CAPABLE OF FEEDING TO BOTH CONVEYORS.
- SCREEN LOCATION-BEFORE CRUSHER
- SCREENING CAPABILITY-300MM TO (-)20MM





SYSTEM OVERVIEW- CONVEYING



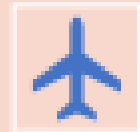
CONVEYOR STREAMS –2NOS.



REDUNDANCY –1W + 1S



CONVEYOR CAPACITY-2400TPH



BELT WIDTH-1600MM@3.2m/sec



CONVEYING & STACKING ROUTE-CHP LAYOUT AND FLOW SCHEME



SYSTEM OVERVIEW- STORAGE

STOCKPILE CAPACITY –20 DAYS STORAGE

STOCKPILE SIZE (LxBxH) –600x38x10

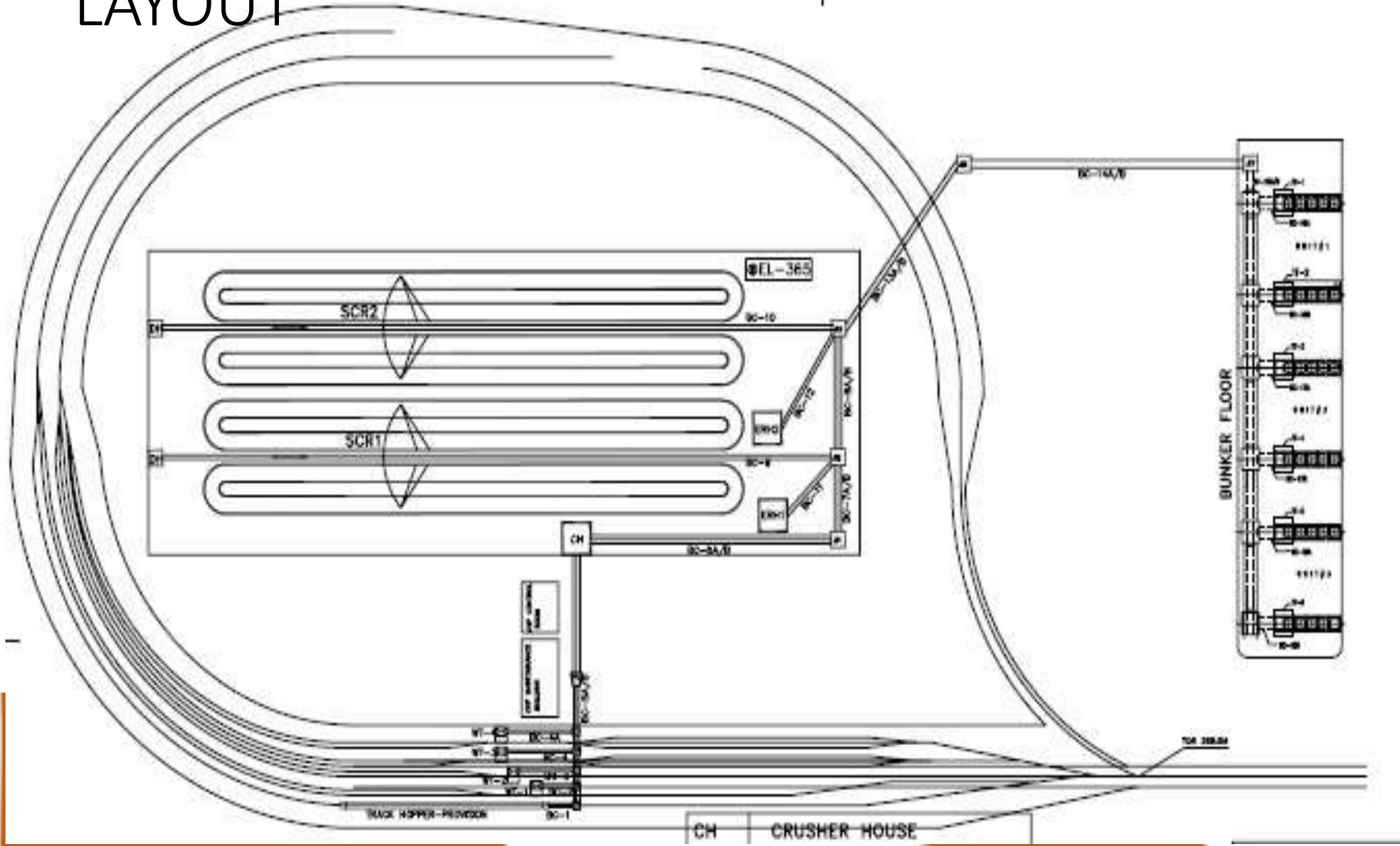
NO -4

REVERSIBLE STACKER CUM RECLAIMER QTY-2

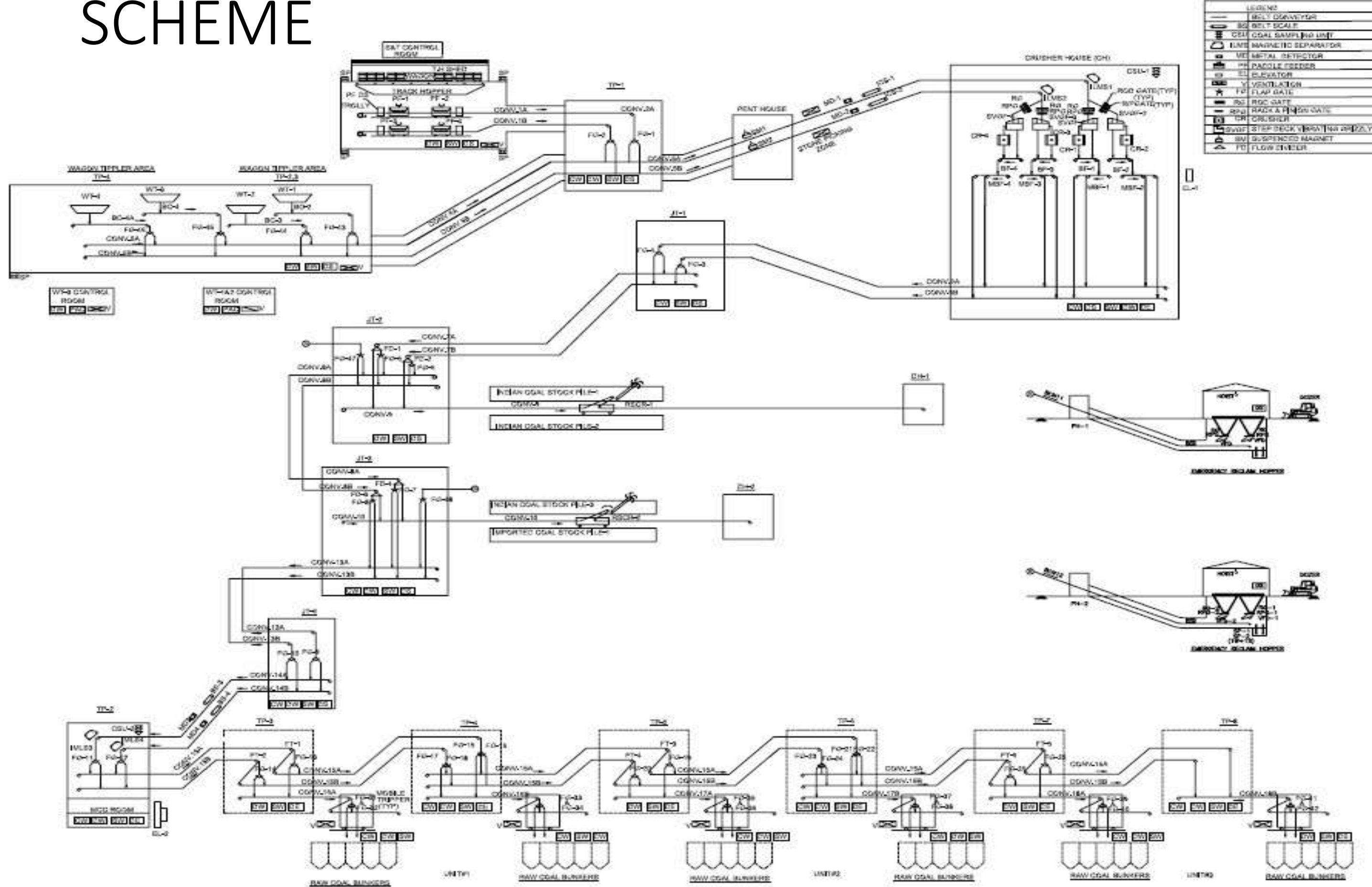
CAPACITY-2400TPH

FOR EMERGENCY RECLAIMING & COAL BLENDING 2Nos. OF EMERGENCY RECLAIM HOPPERS (ERH)HAVE BEEN PROVIDED WITH 5Nos. DOZERS.

CHP LAYOUT



FLOW SCHEME





ASH HANDLING SYSTEM
DESIGN & SYSTEM CALCULATION-660 MW
SYSTEM
MW



DESIGN



CRITERIA

ASH GENERATION RATES	
Bottom ash	30 percent of total ash generation with design
Economizer ash	5 percent of total ash generation with design coal.
Air preheater ash	5 percent of total ash generation with design coal
Fly ash generation (ESP)	90 percent of total ash generation with design coal
Duct hopper	0.5% of total ash generation with design coal.

coal.



DESIGN

CRITERIA	
ASH REMOVAL TIME	
Bottom ash removal	2.30 hours for ash collected in an 8-hour shift.
Fly ash removal	5 hours for ash collected in an 8-hour shift.



DESIGN CRITERIA



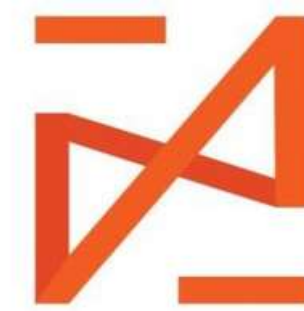
DENSITY / CONCENTRATION OF ASH	
Density of bottom ash for volumetric sizing	650 kg/m ³
Density of economizer ash/air preheater ash for volumetric sizing	750 kg/m ³
Density of fly ash for volumetric sizing	750 kg/m ³
Concentration of ash slurry for bottom ash and fly ash slurry lines	Up to 28 percent (w/w)

DESIGN CRITERIA



SYSTEM	
System	CAPACITY
	Evacuation /Conveying time in 8 hrs shift for each Unit
Bottom + Eco. Ash	150 min
Fly ash vacuum conveying	300 min
Fly ash pressure conveying	300 min
Silo Unloading System	2x150 TPH dry unloading, 2x150 TPH semi dry unloading

SYSTEM



BOTTOM ASH AND ECONOMIZER ASH HANDLING CAPACITY

Bottomash generated, TPH 57	
Economizerash generated, TPH 10	
Bottom ash generated in 8 hours, 456 tons	
Economizer ash generated in 8 hours, tons	8
Eight hours' storage considered for bottom ash hopper, tons	0 53
Assuming 650 kg/m ³ as bottom ash bulk density, volumetric capacity of bottom ash hopper, m ³	6 82 5

SYSTEM



CALCULATION

FLY ASH HANDLING CAPACITY	
	Fly ash generated, TPH186
Total ash generated in 8 hours shift, tons	1488
Number of fly ash extraction streams	6
Fly ash de-ashingtime, hours	5
Fly ash removal capacity, TPH	49.
Selected fly ash removal capacity, TPH	6
	5
	0



SYSTEM OVERVIEW

Alt.1

Bottom Ash –Jet Pump System up to Slurry Sump

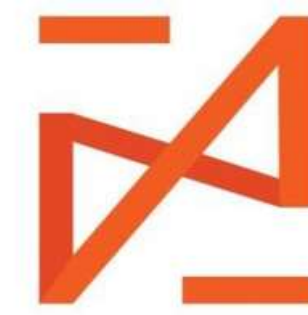
Fly Ash-Vacuum + Pressure (wet +dry)

Lean Slurry disposal

Ash water recovery system

Merits –less space for jet pump, less space for installation of vacuum system below ESP

Demerits-water requirement is high, wear tear is high, civil cost is high



SYSTEM OVERVIEW

Alt.2

Bottom ash-Scraper chain conveyor and belt conveyor up to intermediate hopper

Fly ash-Pressure+ Pressure (ESP-ISH-FA Silo)

HCSD (BA + FA)

Merits-less water, less power and less wear and tear.

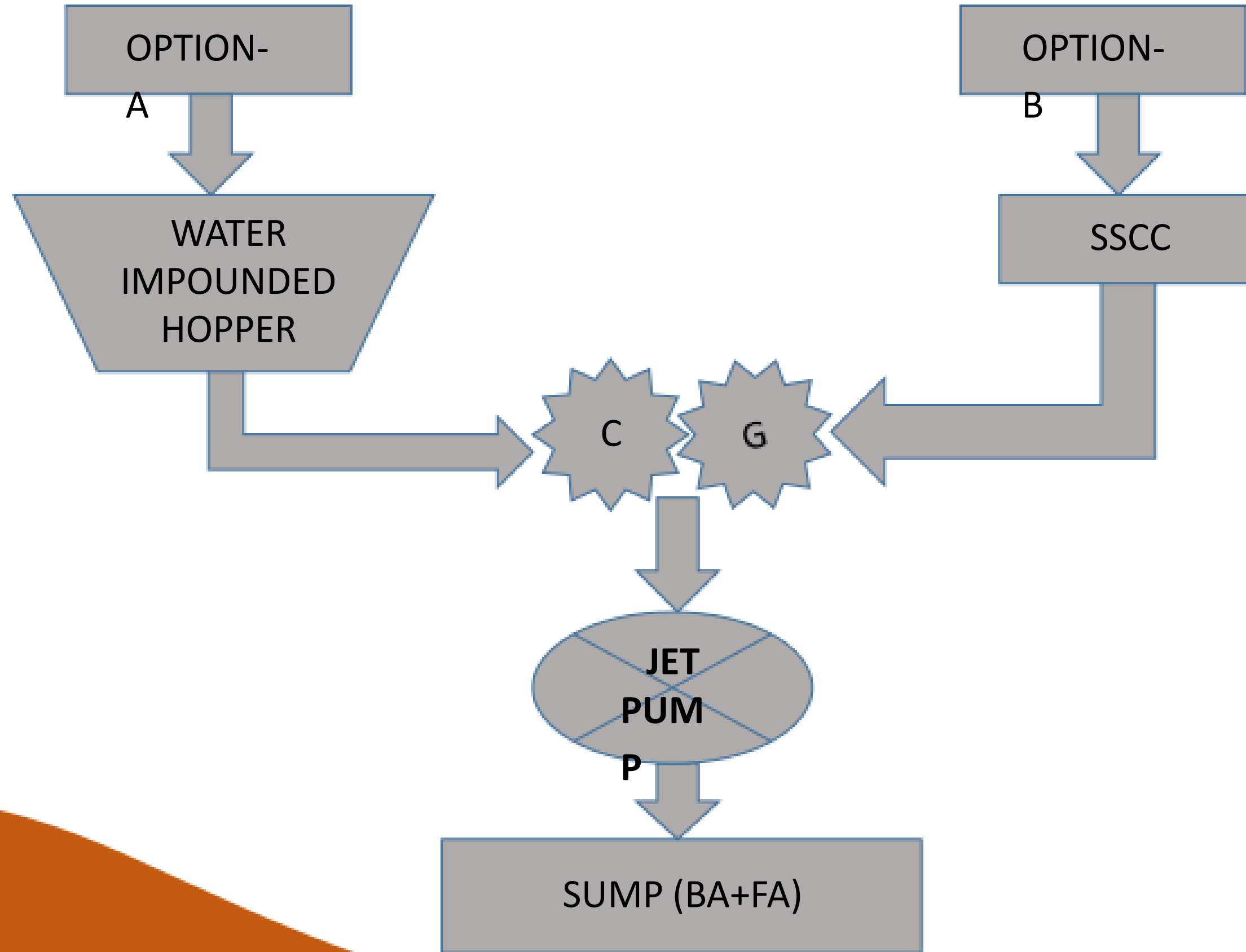


COMPARISON &

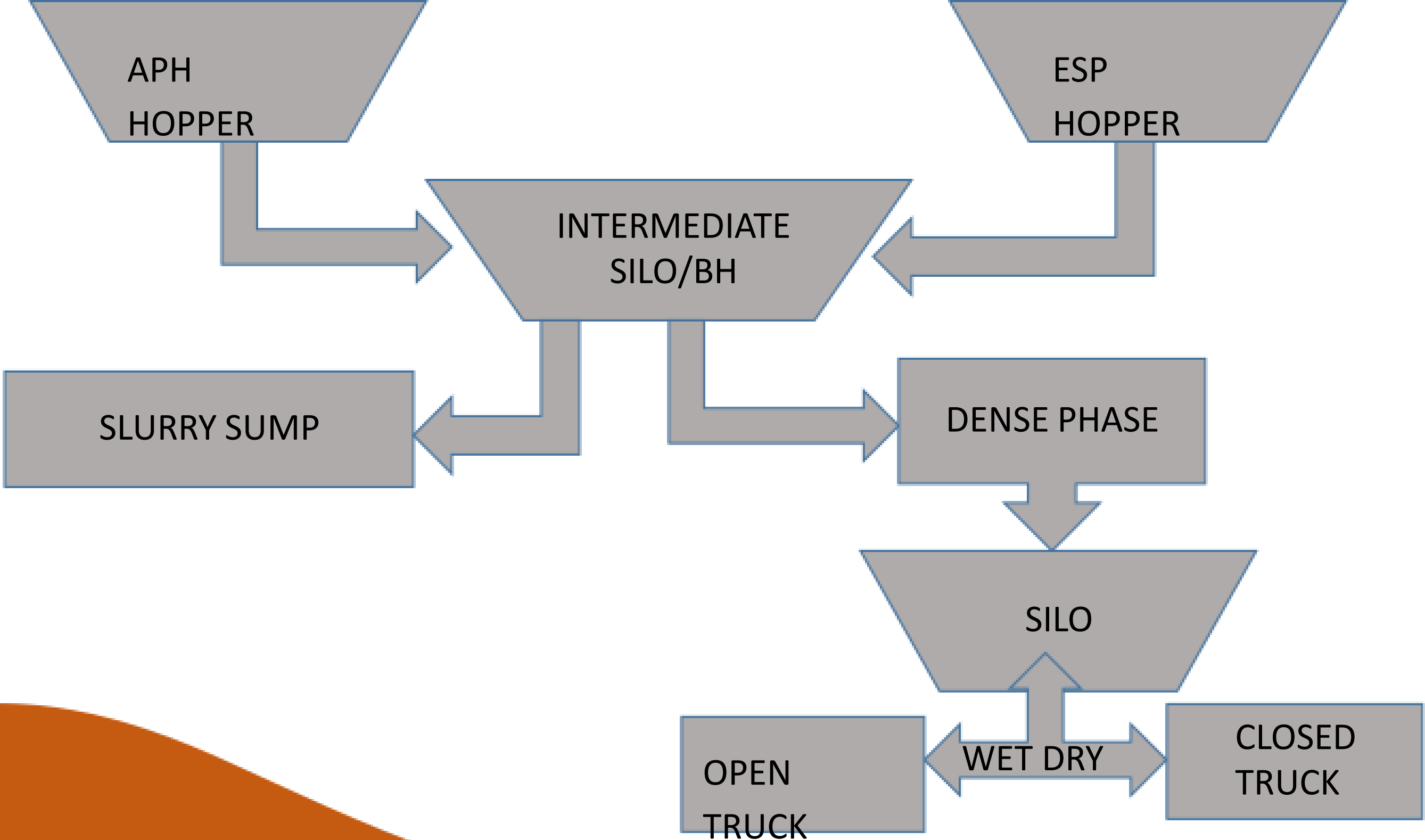
CONCLUSION

	ALTERNATIVE-1	ALTERNATIVE-2
POWER CONSUMPTION	6000 KW	5750 KW
WATER CONSUMPTION	A. WITH RECOVERY-900CUM/HR. B. WITHOUT RECOVERY-2900CUM/HR	400CUM/H R
DISPOSAL AREA	----LESS THAN 70% OF Alt.1	
CONCLUSIO N	Alt.2IS BETTER OPTION BECAUSE OF LESS WATER AND AREA REQUIREMENT FOR ASH POND. OVERALL OPERATION AND MAINTENANCE COST OF Alt.2 IS ON LOWER SIDE.	

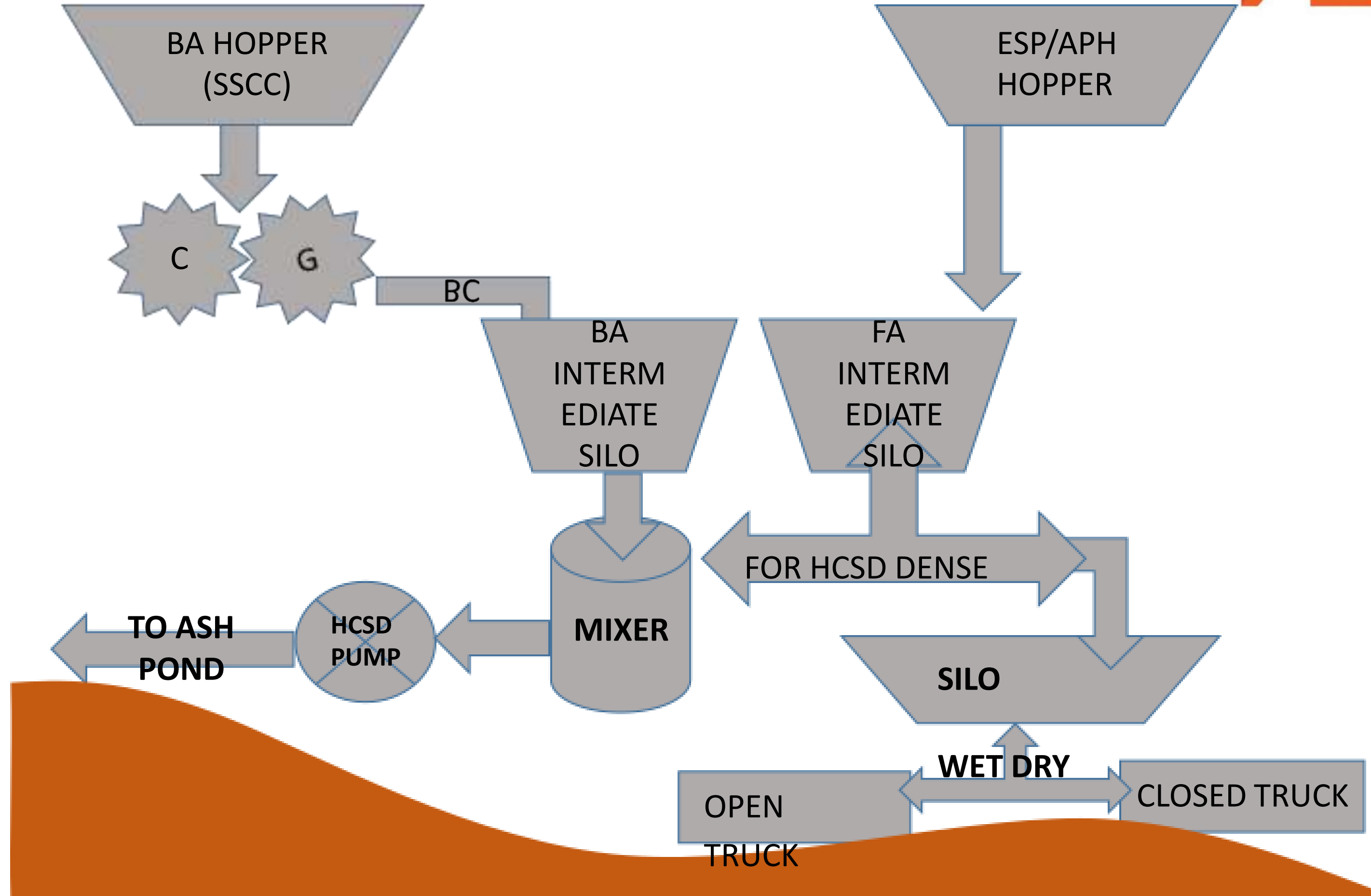
BA HANDLING-ALT.1



FA HANDLING-ALT.1



ASH HANDLING-ALT.2



Thank you!!

Thanking You
on Behalf of!



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