

PROCESS & SYSTEM DESCRIPTION

I. PROCESS GOAL

The purpose of the WTE (Waste to Energy) Plant is to dispose of wood flour and carpet waste by a staged combustion process resulting in hot clean waste gases, which are then used to generate steam for plant consumption. The result is the receipt of approximately 3.0 tons per hour, of blended waste (or 5 tons per hour of wood flour) generating 50,000 lb/hr of saturated steam at 150 psig, and the production of approximately 745 lbs per hour of ash.

II. SYSTEM DESCRIPTION

The WTE plant is composed of the following equipment:

A. Fuel Preparation – Carpet waste

The Carpet Waste Preparation System includes equipment, instruments and controls to perform the following functions:

1. Shred carpet.
2. Separate the shredded carpet and the carpet fines.
3. Convey and store the shredded Carpet and the Carpet fines.

The Carpet Waste Preparation System equipment list includes:

<u>EQUIP. TAG#</u>	<u>DESCRIPTION</u>
CS-810	Carpet Shredder
DC-850	Shredder Dust Collector
FB-860	Carpet Fines Blower
FB-870	Carpet Fines Bin/Silo
DC-870	Fines Bin dust Collector
CB-900	Shredded Carpet Blower
DC-910	Shredded Carpet Bin/Silo Dust Collector
CB-920	Shredded Carpet Bin/Silo

B. Fuel Preparation – Wood Flour Loading

The Wood Flour Loading System includes equipment, instruments and controls to perform the following function:

1. Transfer and store wood flour.

The Wood Flour Loading System equipment list includes:

<u>EQUIP. TAG#</u>	<u>DESCRIPTION</u>
EL-930	Wood Flour Unloading Elevator
WS-940	Wood flour Silo Infeed Screw
DC-950	Wood Flour Silo Dust Collector
WB-960	Wood Flour Silo
AL-910	Wood Flour Silo Dust Collector Air Lock

C. Fuel Preparation – Mixed Fuel Handling

The Mixed Fuel Handling System includes equipment, instruments and controls to perform the following functions:

1. Unload and meter shredded carpet from the CB-920 carpet silo.
2. Unload and meter wood flour from the WB-960 wood flour silo.
3. Mix and transfer the mixed fuel to the gasifier fuel bucket elevator.

The Mixed Fuel Handling System equipment list includes:

<u>EQUIP. TAG#</u>	<u>DESCRIPTION</u>
WB-960	Wood Flour Reclaim Auger
WB-960	Wood Flour Silo Discharge Auger
CB-920	Shredded Carpet Reclaim Auger
CB-920	Shredded Carpet Discharge Auger
MS-970	Mixed Fuel Transfer Screw Conveyor

D. Gasification System

The Primenergy L.L.C. Gasification System includes equipment, instruments and controls to perform the following functions:

1. Fuel (carpet waste/wood flour) transfer
2. Gasification of the fuel and Syngas delivery to the Energy Recovery system;

The Gasification System equipment list includes:

<u>EQUIP. TAG#</u>	<u>DESCRIPTION</u>
EL-120	Fuel Bucket Elevator
AL-130	Reactor Infeed Rotary Airlock
IS-200	Reactor Infeed Screw
R-200	KC-17 Gasifier
RV-201	Gasifier Relief Valve
AG-202	Gasifier Agitator
BG-200	Startup Gas Burner
B-210	Reactor Underfire Air Fan

E. Energy Recovery, Boiler, and Dust Recovery Systems

The Primenergy L.L.C. Energy Recovery System includes equipment, instruments and controls to perform the following functions:

1. Clean large particulate from syngas stream
2. Add additional air to lower combustibles level for emissions control
3. Add additional air to oxidize any remaining combustible syngas
4. Recover heat as Steam
5. Remove additional particulate from flue gas stream

The Energy Recovery System equipment list includes:

<u>EQUIP. TAG#</u>	<u>DESCRIPTION</u>
CY-200	Cyclone
AL-207	Cyclone Ash Rotary Air Lock
CT-415	Combustion Tube
B-410	Overfire Air Fan
RB-465	Reox Burner
B-450	Reox Air Fan
E-515	Steam Generator
V-550	Blowdown Flash Tank
E-555	Blowdown Cooler
E-525	Boiler Feedwater Economizer
DC-615	Multiclone
AL-615	Multiclone Air Lock
RB-615	Roll-off Bin
B-680	ID Fan
V-680	Vent Stack

F. Ash Transfer, Storage and Unloading

The Primenergy L.L.C. Ash Transfer, Storage and Unloading Systems includes equipment, instruments and controls to perform the following functions:

1. Remove ash from the Gasifier and Cyclone
2. Transfer and store the ash
3. Unload the ash storage silo.

The Ash Transfer, Storage and Unloading Systems equipment list includes:

<u>EQUIP. TAG#</u>	<u>DESCRIPTION</u>
AS-204	Ash Discharge Screw
AV-206	Ash Discharge Rotary Air Lock
AS-710	Ash Transfer Screw
EL-720	Ash Bucket Elevator
AB-750	Ash Storage Silo
DC-750	Bin Vent Filter
B-750	Bin Vent Exhaust Fan
AS-730	Ash Transfer Screw
AS-740	Ash Transfer Screw
DV-750	Ash Diverter Valve

G. Utilities

The utility systems consist of a packaged air compressor and dryer, and a packaged cooling water skid with an air-cooled heat exchanger and cooling water pumps.

The Utility Systems equipment list includes:

<u>EQUIP. TAG#</u>	<u>DESCRIPTION</u>
E-315	Air-Cooled Heat Exchanger
V-300	Cooling Water Expansion Tank
P-335A&B	Cooling Water Pumps
C-300	Instrument Air Compressor/Dryer

III. PROCESS AND OPERATIONAL DESCRIPTION

A. Fuel Preparation

1. Carpet Waste Preparation

The carpet waste is supplied in bales weighing from 900 to 1300 pounds. The bales are conveyed to the Carpet Shredder (CS-810) where they are reduced to two streams, shredded carpet and fines. The carpet shredder is equipped with a Dust Collector (DC-850) to control fugitive dust. The Carpet shredder is a self-contained system with its own control computer and instrumentation.

The vibratory separator at the exit of the carpet shredder removes the fines from the shredding process and the Carpet Fines Blower (FB-860) pneumatically conveys the fines to the Carpet fines Silo (FB-870). The shredded carpet is conveyed pneumatically by the shredded Carpet Blower (CB-900) to the Shredded Carpet Silo (CB-920).

Instruments for Carpet Waste Preparation and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
ST/SAL-850	Speed transmitter/alarm for Shredder dust Collector DC-850
PSH-860	High-pressure switch fines pneumatic system
LSHH-870	High-high level Carpet Fines Silo FB-870
LSH-870	High level Carpet Fines Silo FB-870
PDSH-870	High-pressure Carpet Fines Silo Dust Collector DC-870
PSH-900	High-pressure switch shredded carpet pneumatic system
LSHH-920	High-high level Shredded Carpet Silo CB-920
LSH-920	High level Shredded Carpet Silo CB-920
LSL-920	Low level Shredded Carpet Silo CB-920
PDSH-870	High-pressure Shredded Carpet Silo Dust Collector DC-910

2. Wood Flour Preparation

The Wood flour is delivered to the Wood Flour unloading area by a customer supplied self-unloading trailer. The self-unloading trailer transfers the wood flour to a Bucket Elevator (EL-930), which raises the wood flour to the Wood Flour Silo Infeed Conveyor (WS-940). The wood flour is then deposited into the Wood Flour Silo (WB-960).

Instruments for Wood Flour Preparation and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
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ST/SAL-910	Speed transmitter/alarm for Dust Collector DC-950
ST/SAL-930	Speed transmitter/alarm for Wood Flour Elevator EL-930
ST/SAL-940	Speed transmitter/alarm for Wood Flour Infeed WS-940
LSHH-960	High-high level Wood Flour Silo WB-960
LSH-960	High level Wood Flour Silo WB -960
LSL-960	Low level Wood Flour Silo WB -960
PDSH-950	High-pressure Wood Flour Silo Dust Collector DC-950

3. Mixed Fuel Handling

The shredded carpet and the wood flour are conveyed from their respective silos and mixed in the Mixed Fuel Transfer Conveyor (MS-970). The Mixed fuel is then deposited in the Mixed Fuel bucket Elevator (EL-120)

Instruments for Mixed Fuel Handling and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
TSH-920	High temperature hydraulic pump M-920B
LSL-920	Low Level Discharge Hopper CB-920
ST/SAL-920C	Speed transmitter/alarm for Discharge auger CB-920
ZAC-920C	Plugged discharge auger CB-920
ST/SAL-960B	Speed transmitter/alarm for Discharge auger CB-960
ZAC-960B	Plugged discharge auger CB-960
ST/SAL-970	Speed transmitter/alarm for Mixed Fuel MS-970
ZAC-970	Plugged discharge chute for Mixed Fuel MS-970

B. Gasification System

1. Fuel Transfer

The carpet waste/wood flour is utilized as fuel in the Gasification System to provide the thermal energy for the waste heat Boiler. A Feed System provided by Shaw controls the transfer rate of the fuel to the Fuel bucket Elevator (EL-120). The fuel is raised by the elevator to the required height for the Gasifier and dropped to a rotary air lock. Fuel falls through the Infeed Rotary Air Lock (AL-130) and is transferred into the Gasifier by the Reactor Infeed Screw (IS-200).

The bucket elevator, rotary airlock and infeed screw are equipped with speed transmitters, which confirm their proper operation. Once the operator is ready for

I.D.1

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I.D

operation of the fuel system, the Reactor Infeed Screw (IS-200), the Infeed Rotary Air Lock (AL-130), the Fuel bucket Elevator (EL-120), the Mixed Fuel Transfer Screw Conveyor (MS-970), the Shredded Carpet Discharge Auger (CS-920C) and the Wood Flour discharge Auger (WS-960), can be started in sequence.

Instruments for fuel transfer and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
ST/SAL-120	Speed transmitter/alarm for fuel bucket Elevator EL-120
ST/SAL-130	Speed transmitter/alarm for Infeed Rotary Air Lock AL-130
ST/SAL-200	Speed transmitter/alarm for Reactor Infeed screw IS-200

2. KC-17 Gasifier Assembly

The KC-17 gasifier (R-200) is a vertical, refractory lined reactor that converts the volatile components in a solid fuel to a combustible syngas. A natural gas burner is employed to heat the gasifier to operating temperature. Once the gasifier has reached a sufficient temperature, the natural gas burner is removed and fuel (wood flour/carpet waste) feed started. Fuel is delivered to the gasifier by the reactor infeed screw at a point above the gasifier refractory grate. When operating at normal operating temperature, the delivered fuel is rapidly heated and begins to release syngas as it falls to the grate. The gasification process is a starved air combustion process that is maintained by controlling the gasifier operating temperature. The operating temperature is adjusted by changing the quantity of air supplied by the reactor underfire air blower (B-210) to the under grate air plenum of the gasifier. Underfire air is controlled by the output signal of the upper gasifier temperature controller (TIC-210), which positions the inlet vane damper on the underfire air blower. At steady state gasification, an increase in airflow will increase the gasifier operating temperature; a decrease in airflow will decrease the operating temperature. The underfire air zone biasing valves (WV-216) are used to manually optimize the gasification process by distributing the underfire air to the different zones in the underfire air plenum.

The gasifier is equipped with a water-cooled agitator (AG-202), which rotates above the gasifier grate. The agitator stirs the fuel, maintains an even bed depth and pushes the remaining ash to the outer perimeter of the grate, where it is continuously removed from the gasifier by falling through one of two ash ports. The rotational speed of the agitator can affect the gasification efficiency, as well as the rate at which ash is removed from the grate. The rate of rotation is controlled by a variable frequency driven motor located below the center of the gasifier. A speed transmitter is provided to register the agitator's speed and to assure that the agitator is operating.

Operation of the agitator can be either in automatic mode, by establishing a RPM set point, or in manual mode at 10 to 100% output to the variable frequency driven motor. Zero speed of the agitator is interlocked with the fuel metering and delivery equipment to discontinue fuel feed.

The gasifier operates at a slight negative operating pressure in order to prevent gases from being forced out through the feed and ash system and shaft seals. Typical operating pressure should be about -5 mm H₂O (-0.2 " w.c.). Excessive negative pressure operation, less than -13 mm H₂O (-0.5 " w.c.), should be avoided to minimize excessive infiltration of uncontrolled air into the gasifier. The gasifier operating pressure is measured by the pressure transmitter (PT-200), which is connected to the upper section of the gasifier. The signal from the pressure transmitter goes to the gasifier pressure controller (PIC-200). The corresponding signal from the pressure controller controls the variable frequency driven motor on the induced draft fan (B-680). The Gasifier Relief Valve (RV-201) on top of R-200 automatically opens to safely exhaust syngas to the atmosphere in the event of an unplanned shutdown of the gasifier or downstream equipment.

Instruments for gasification of the fuel and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
ST/SAL-202	Speed transmitter/alarm for Agitator (AG-202)
SC-202	Variable frequency drive for AG-202
SIC-202	(Software) speed controller for SC-202
TE/TT-202	Lower gasifier thermocouple and transmitter
TI-202	(Software) Lower gasifier temperature
TAH-202	Lower gasifier high temperature alarm
TE/TT-203	Lower gasifier thermocouple and transmitter
TI-203	(Software) Lower gasifier temperature
TE/TT-210	Upper gasifier thermocouple and transmitter
TIC-210	(Software) gasifier temperature controller – controls TCV-210 to regulate underfire air and maintain the gasifier temperature at nominal 1450°F.
TIC-215	(Software) gasifier temperature controller, during heat up, controls TCV-201 and TCV-202 to regulate natural gas/air firing rate in BG-200.
TCV/TY-210	Underfire air control valve
PI-200	Gasifier pressure gauge
PT-200	Gasifier pressure transmitter
PAL/PAH-200	(Software) Low/High Gasifier pressure alarms
PIC-200	(Software) Gasifier pressure controller – controls ID Fan variable frequency drive (SC-480) to maintain gasifier pressure

	at nominal -0.25" w.c.
PI-212	Under fire air pressure gauge
PI-214	Under fire pressure gauge
PI-216	Under fire pressure gauge
RV-201	Gasifier Relief Valve
SG-201	Gasifier sight glass
SG-202	Gasifier sight glass

3. Packaged Burner assembly

The burner assembly is used only during heat up of the Gasifier. It consists of a burner, blower for combustion air, fuel gas control valve, flame safeguard controls and an associated piping skid. The piping skid has high and low fuel gas pressure switches, fuel gas pressure regulator, pilot gas pressure regulator, and double block and bleed valves on both main and pilot gas.

Instruments for the Packaged Burner assembly and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
PI-200	Supply fuel gas pressure
PCV-201	Main fuel gas pressure regulator
PCV-202	Pilot gas pressure regulator
PSL-201	Low fuel gas pressure
PSH-202	High fuel gas pressure
PI-202	Fuel gas pressure to burner
TCV-201	Fuel gas control valve
TCV-202	Combustion air control valve
PSL-203	Low combustion air pressure
BE/BS-201	Flame detector/relay
BA-201	Flame failure alarm
PI-203	Pilot gas pressure indication
SOV-201	Main fuel gas block valve
SOV-202	Main fuel gas block valve
SOV-203	Main fuel gas vent valve
SOV-204	Pilot fuel gas block valve
SOV-206	Pilot fuel gas block valve
SOV-205	Pilot fuel gas vent valve

B. Energy Recovery System

1. Cyclone and Energy Recovery Systems

Syngas exiting the Gasifier enters the Cyclone (CY-200). There the heavier particulate is removed and drops down to the Air lock (AL-207) in the base of the Cyclone for removal.

Syngas exiting the cyclone is partially oxidized in the Overfire Combustor (CT-415). Overfire Air Fan (B-410) provides air to CT-415. This staged combustion step occurs at high temperature, reducing conditions; destroying bound nitrogen compounds contained in the syngas which helps to minimize NO_x formation in the downstream oxidation process.

The Reox Air Fan (B-450) supplies air to Reox Burner (RB-465) for final excess air injection into the syngas.

Instruments for Energy Recovery and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
TE/TT-240	Flue gas thermocouple and temperature transmitter exiting the cyclone.
TI-240	(Software) Flue gas temperature exiting the cyclone.
TE/TT-403	Overfire Combustor thermocouple and temperature transmitter
TI-403	(Software) Overfire Combustor temperature.
TE/TT-410	Overfire Combustor thermocouple and temperature transmitter
TAH-410	High temperature alarm Overfire Combustor
TAL-410	Low temperature alarm Overfire Combustor
TIC-410	(Software) Overfire Combustor temperature controller – controls TCV/TY-410 to regulate overfire air and maintain the overfire combustor temperature at nominal 2400°F.
TCV/TY-410	Overfire air control valve
ACV/AY-450	Reox Air Fan inlet vane damper - Control valve regulates air to the reox burner with a signal from AIC-550

2. Boiler and Economizer

Completion of the oxidation of the syngas occurs in the Boiler (E-515). The flue gases are further cooled in a Boiler Feedwater Economizer (E-525).

Boiler water level is controlled by a combination single (LIC-1) and three (LIC-3) element control loop. When the steam flow is below the operational range of the steam flow transmitter (FT-510) or when the steam flow transmitter is off line, the level control loop automatically defaults to a single element control using the steam drum water level reading (LT-525) and directly controlling the boiler feed water control valve (LCV/LY-535).

Steam drum pressure is controlled by a pressure control loop (PIC-525) driving a vent valve (PCV/PY-535).

Continuous and intermittent water blow downs from the boiler are directed to a Flash Tank (FT-550) to temporarily store the liquids. Level control switches in the flash tank control the level, allowing excess to drain through a Blowdown Cooler (E-555) before being sent to the drain.

The flue gases are then directed to a Multiclone (DC-615) to remove any residual particulate.

The ID Fan (B-680) provides the motive force required to pull the syngas from R-200 and deliver it through the entire system to the Vent Stack (V-680).

Instruments for the Boiler and Economizer and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
LE-517A	Senses boiler water level at discrete points
LE-517B	Alternate low boiler water cut out
LSLL/LALL-517A	Low-Low boiler water level
LSL/LAL-517A	Low boiler water level
LSH/LAH-517A	High boiler water level
LSLL/LALL-517B	Low-Low boiler water level
LG-517	Boiler water level sight glass
LT-525	Boiler water level transmitter
TE/TT-522	Steam temperature transmitter
TI-522	(Software) Steam temperature
PT-525	Steam pressure transmitter
PI-525	Steam pressure indicator
PIC-525	(Software) Steam drum pressure controller - controls PCV/PY-535 to regulate steam drum pressure.
PAH-525	High pressure alarm - Steam drum
PCV/PY-535	Controls amount of steam to atmosphere

LIC-1-525	(Software) Single element drum level controller – controls boiler feed water valve (LCV/LY-535) to maintain steam drum level.
LIC-3-525	(Software) Three element drum level controller – controls steam drum level by measuring level, steam flow and feed water flow and adjusting the feed water flow control valve (LCV/LY-535) to maintain steam drum level.
FE/FT-510	Measures steam production
FQ-510	(Software) Totals steam flow
FE/FT-520	Measures feed water flow
FQ-520	(Software) Totals feed water flow
FIC-525	(Software) Feed water flow controller – In three element level control adjust the feed water flow based on the steam drum level and the outgoing steam flow.
LCV/LY-535	Boiler feed water control valve
PSV-530A	Steam drum pressure relief valve
PSV-530B	Steam drum pressure relief valve
TE/TT-515	Feed water temperature before economizer
TI-515	(Software) Feed water temperature before economizer
TE/TT-535	Feed water temperature after economizer
TI-535	(Software) Feed water temperature after economizer
AE/AT-550	Measures percent oxygen in flue gas stream
AIC-550	(Software) Oxygen controller - Controls percent oxygen in vent gas by adjusting the amount of air injected in the reox burner (RB-465).
AAL-550	Low oxygen in flue gas alarm
TE/TT-540	Measures flue gas temperature leaving the boiler
TI-540	(Software) Indicates temperature leaving the boiler
TE/TT-545	Measures flue gas temperature leaving the economizer
TI-545	(Software) Indicates temperature leaving the economizer
PCV-550	Regulates pressure in FT-550
LSHH/LAHH-550	Indicates high-high Flash Tank (FT-550) level
LSH/LSL-550	Controls flash tank level valve (LCV-501)
LCV-501	Flash tank level control valve
SP-515	Boiler sight glasses
FI-550	Indicates boiler blow down rate to drain.
PI-550	Indicates pressure in the Flash Tank (FT-550)
FI-1000	Indicates steam flow to existing header
PI-1000	Indicates steam pressure to existing header

3. Dust Recovery System

Cooled flue gases from the economizer are directed to Multiclone (DC-615), which

removes dust particulate from the gas stream. A rotary air lock then allows the dust to be removed to a bin (RB-615) for customer disposal.

An Induced Draft fan (B-680) provides the motivating force to pull the gases through the System and then pushes the flue gases out the vent Stack (V-680). It is controlled by the Gasifier (R-200) pressure and maintains the entire system under a slight negative pressure.

Instruments for dust recovery and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
ST/SAL-615	Speed transmitter/alarm for Multiclone ash airlock (AL-615)
PI-630	Pressure indicator before Multiclone
PI-631	Pressure indicator after Multiclone
PT-625	Pressure Transmitter after Multiclone
PI-625	(Software) Pressure indication after Multiclone
SC-680	ID Fan Variable Frequency Drive

C. Ash Recovery System

1. Ash Transfer & Storage

As AG-202 rotates, it levels the solid fuel and pushes the devolatilized material (gasifier bottom ash) to the outer circumference of R-200, where it gravity falls into an ash port and is removed by a water-cooled Ash Discharge Screw (AS-204). A thermocouple located at the discharge of AS-204 monitors the ash discharge temperature and controls upstream water injection onto the ash to sensibly cool the ash.

AS-204 conveys the gasifier bottom ash from underneath R-200 where it flows through an Ash Discharge Rotary Air Lock (AV-206) into the Ash Transfer Screw (AS-710).

The fly ash removed from the syngas by CY-200 falls through the Cyclone Ash Rotary Air Lock (AL-207) into the first Ash Transfer Screw (AS-710). AS-710 conveys the combined fly ash and gasifier bottom ash to the Ash Bucket Elevator (EL-720). EL-720 lifts and transfers the ash to an Ash Silo (AB-550) for storage. When the operator selects operation of the ash system, the listed equipment starts in automated sequence.

Instruments for ash transfer and storage and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
ST/SAL-204	Speed transmitter/alarm for the Ash Discharge Screw (AS-204)
ST/SAL-206	Speed transmitter/alarm for the Ash Discharge Rotary Air Lock (AV-206)
TE/TT-204	Ash discharge thermocouple and temperature transmitter
TAH-204	High ash discharge temperature
TIC-204	(Software) Ash discharge temperature controller – controls TCV-204 to regulate water injection onto the ash to maintain an ash discharge temperature of nominal 250°F
TCV/TY-204	Ash temperature control valve
ST/SAL-207	Speed transmitter/alarm for the Cyclone Ash Discharge Rotary Air Lock (AV-207)
ST/SAL-710	Speed transmitter/alarm for Ash Transfer Screw (AS-710)
ST/SAL-720	Speed transmitter/alarm for Ash Bucket Elevator (EL-720)

2. Ash Unloading

Ash is unloaded from the Ash Silo by a system composed of Ash Unloading Conveyors AS-730, AS-740 and Diverter valve DV-750. When Ash unloading conveyor AS-730 is activated the speed switch ST-730 confirms operation and allows Ash Conveyor AS740 to run. Speed Switch ST-740 confirms operation of Ash conveyor AS-740 and allows operation of the Diverter Valve DV-750 and introduction of water in the ash for dust suppression.

Instruments for unloading and their functions are:

<u>INST. TAG#</u>	<u>FUNCTION</u>
ST/SAL-730	Speed transmitter/alarm for Ash Unloading Screw (AS-730)
ST/SAL-740	Speed transmitter/alarm for Ash Unloading Screw (AS-740)
LSL/LAL-750	Ash Silo low level switch
LSH/LAH-750	Ash Silo high level switch
LSHH/LAHH-750	Ash Silo high-high level switch
TE-750	Ash Silo thermocouple
TT-750	Ash Silo temperature transmitter
TI-750	(Software) Ash Silo temperature indication
DV-750	Pneumatically operated Ash Silo dump valve (slide gate)
ZXO-750	Open position switch on DV-750
ZXC-750	Closed position switch on DV-750
PI-700	Spray water supply pressure
PI-701	Spray water pressure

D. Utility Systems

Cooling Water and Instrument Air Systems

The cooling water system provides cooling of gasifier components (agitator, infeed screw, relief valve, ash discharge screw) that are subjected to high temperatures

Water is circulated by pumps (P-335A-B) through the various pieces of equipment requiring cooling then routed back through an air-cooled heat exchanger (E-315), then dumped into an Expansion tank (V-300). The Expansion Tank also serves as a suction point for the pumps, completing the cooling loop. The water level in the expansion tank is maintained by either adding make up water or draining down the tank as required.

The instrument air is provided as a packaged system, which includes an integral desiccant dryer.

Instruments, controls, components and their relative functions for the Cooling Water and Instrument Air systems are as follows:

<u>INST. TAG#</u>	<u>FUNCTION</u>
TI-306	Cooling water return temperature gauge for gasifier relief valve (RV-201)
TI-314	Cooling water return temperature gauge for reactor infeed screw (IS-200)
TI-316	Cooling water return temperature gauge for reactor agitator (AG-202)
TI-318	Cooling water return temperature gauge for ash discharge screw jacket (AS-204)
TI-319	Cooling water return temperature gauge for blow down cooler (E-555)
TE/TT-304	Cooling water return thermocouple and temperature transmitter
TI-304	(Software) Cooling water return temperature
TAH-304	(Software) High temperature cooling water return
TI-320	(Software) Cooling water return temperature
TE/TT-320	Cooling water return thermocouple and temperature transmitter
PI-320	Cooling water return pressure gauge
TI-322	Cooling water return temperature gauge
TSH-315A-E	Start/Stop temperature switch for Heat Exchanger (E-315)

	cooling fans (M-315A-J)
PI-335	Cooling water supply pressure gauge
PSL/PAL-335	Cooling water supply low pressure switch/Alarm
TI-335	Cooling water supply temperature gauge
LSLL/LALL-300	Low-Low Expansion Tank (V-300) level
LSH-300	Expansion Tank (V-300) Stop fill
LSL-300	Expansion Tank (V-300) Start fill
SOV-301	Make up water to expansion tank
PI-300	Instrument air pressure
PT-301	Instrument air pressure transmitter
PI/PAL-301	(Software) Instrument air pressure indicator and low pressure alarm