Process Description

Thermal Oxidiser "ECOPURE® VAR 2310" with Air Quench

	Name	Item	Signature	Date
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Revisions:

Version	Date	Name	Description
Rev. 0	25.04.13	Volker Herbert	First issue
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Contents

1. BASIC PROCESS INFORMATION

1.1 Introduction

Shell Global Solutions International BV builds at the Shell Technology Centre in Amsterdam a research pilot plant. Waste gaseous and liquid residual streams of this plant will be burned in a thermal oxidizer type ***Ecopure*® *VAR 2310***, planned and installed from Duerr Systems GmbH, Clean Technology Systems.

This outdoor installation will be installed in a location close to the existing Duerr Oxidiser and consists of the following main parts:

Off Gas System MA132

- Knock out drum V-950 for droplet separation
- WL transfer drum V-950A for waste liquid transport to the burner
- Knock out drum V-951 for droplet separation of bypass system
- Piping within the off gas system with safety equipment

The skid for MA132 is installed in a zone 2 area.

The other components of the incinerator are located in a non-ex area:

Oxygen Rich Off Gas System MA232

- Piping within the system with safety equipment

Waste Liquid Safety train MF150

- Piping for the organic liquids with safety equipment

Combustion chamber BK126-X950 with burners for:

- Natural gas and off gas (WG553-X100)
- Waste Liquid Injection (BK126-X200)
- Oxygen rich off gas
- Combustion and cooling air blower (VV141-V101)
- Combustion and cooling air blower (VQ112-V101)
- Stack with two in liners for clean gas and relief gas
- Electrical control equipment in a cabinet on site

The incinerator is designed for continuous operation 8.000 hours / year.

1.2 Design Basis:

The incinerator has to process hydrocarbon rich off gas, hydrocarbon lean off gas and residual liquid hydrocarbons. Their quantity and composition will change depending on the continuous operation mode of the plant and the activity of non-continuous units of the plant, as:

- Hydrogenation reactor
- Dryer nitrogen purges (discontinuous)
- Tank loading by truck (incidental)
- Start-up procedures
- Spent catalyst vessel purge
- ESD events etc.

In the requisition Data Sheet 5463-11-2218 dated 23-2-2013 for the incinerator are defined different scenarios for the combination of streams (Stream A .... Stream J: vapour; Stream K + Stream L: liquid).

Operational parameters:

Off gas to V950: (Streams A ... G, I)

Volume flow:	normal operation:	20 ... 261	Nm^3/h
	Design:	264	Nm^3/h
Mass flow:	normal operation:	27,4 ... 331	kg/h
	Design:	482,4	kg/h (ESD)
Temperature:	normal operation:	-17 ... 123	°C
	Design:	- 40 ... 200	°C
Pressure:	normal operation:	< 1,25	bara
	Design process:	1,5	bara (Set point relief valve)
	Design mechanical:	5,0	barg

Molecular Weight:	28,5 ... 45,35
Lower Heating Value (LHV)	0 ... 23,97 kWh/Nm^3)
Explosion Zone:	None
Explosion Group:	II B3 T3
Composition:	Conform requisition Data Sheet 5463-11-2218 dated 23-2-2013

Oxygen Rich Off Gas: (Stream H)

Volume flow:	normal operation:	< 70	Nm^3/h
	Design:	70	Nm^3/h
Mass flow:	normal operation:	< 87,2	kg/h
	Design:	87,2	kg/h
Temperature:	normal operation:	< 180	°C
	Design:	- 15 ... 200	°C
Pressure:	normal operation:	< 1,25	bara
	Design process:	1,25	bara

Waste Organic Liquids (Stream K, L)

Mass flow:	normal operation:	7,98	kg/h
	Design:	123,70	kg/h
Temperature:	normal operation (Stream K):	20	°C
	Design (Stream L):	- 1,1	°C
Pressure:	normal operation:	< 1,25	bara
	Design process:	1,5	bara (Set point relief valve V950)
	Design mechanical:	5,0	barg

Molecular Weight: 57,76 ... 85,20
Lower Heating Value (LHV) app. 10,0 kWh/Nm^3)
Composition: Conform requisition Data Sheet 5463-11-2218 dated 23-2-2013

Utilities at Battery Limits:

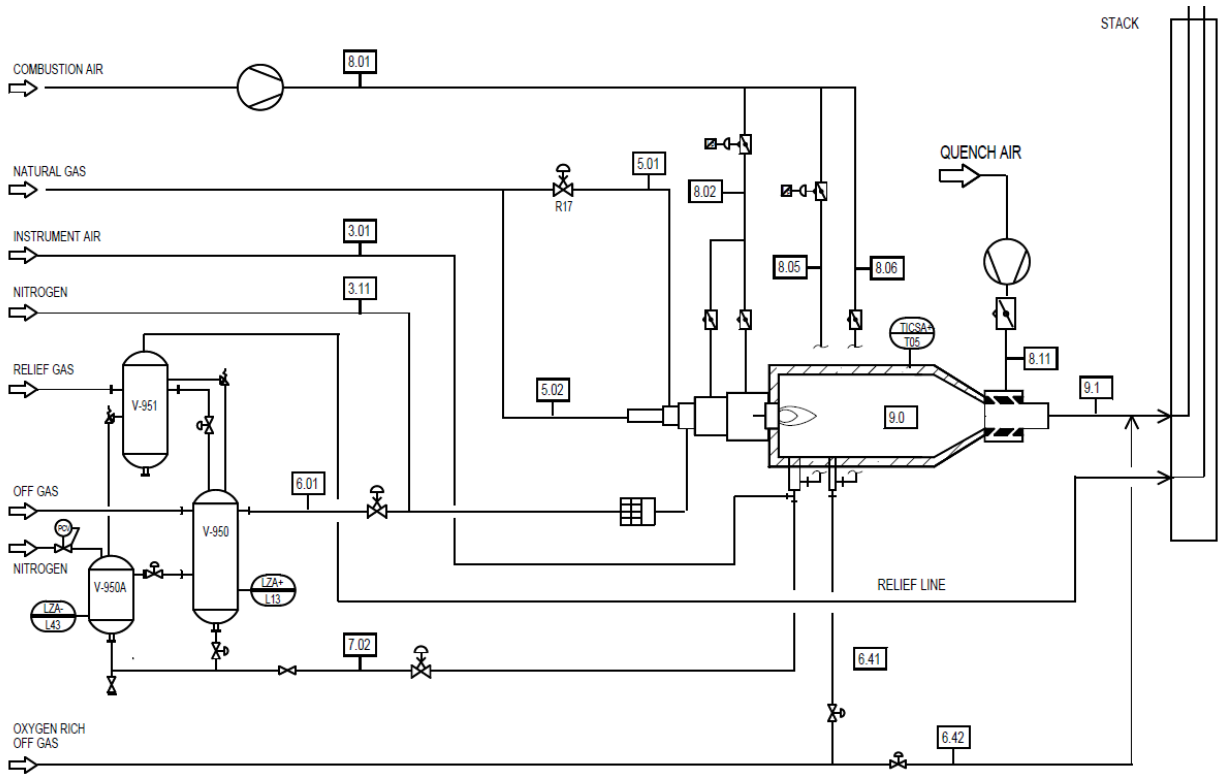
Nitrogen:	Normal operation:	20 °C	15 barg
	Design:	20 °C	22,5 barg
	Max. consumption:	50	Nm3/h
Instrument Air:	Normal operation:	20 °C	5,8 barg
	Design:	20 °C	10 barg
	Max. consumption:	50	Nm3/h
Natural Gas:	Normal operation:	20 °C	0,3 barg
	Design:	20 °C	4 barg
	LHV:	10,0	kWh/Nm^3
	Max. consumption:	120	Nm3/h
Electric power:		400/230V	50 Hz
	Max. consumption:	51	kW

1.3 Process Parameters in different Operation Modes:

The incinerator has to process hydrocarbon rich off gas, hydrocarbon lean off gas and residual liquid hydrocarbons. Their quantity and composition will change depending on the continuous operation mode of the plant and the activity of non-continuous units of the plant.
Supplementary to the composition data for waste liquid in the requisition (Streams K + L) may liquid water be fed into the KO drum V950. Due to its higher density, it will be stored at the bottom of the vessel below the organic phase. Evaporation of water is an energy demanding process, combustion of water has completely different demands for the combustion processing than liquid organic residues, which are fuels.
Following different operational cases have to be considered with view of the design of the burner / combustion system:

- Case 1: Start-up with heat up CC to normal operation temperature, fuel natural gas
- Case 2: Start-up off gas (nitrogen) with combustion of pure water, max. demand fuel gas
- Case 3: Normal off gas operation (Stream D + H) + max. organic Liquid
- Case 4: Design flow off gas (ESD, Stream I)

1.3.1 Flow Sheet for M&E Balances



1.3.2 Results Mass & Energy Balance Case 1

Stream No.	5.1	5.01	5.02	8.02	8.05	8.06	8.01
Name	Nat. Gas	Nat. Gas	Pilotgas	Comb-Air NG	CA-WL	CA-ORWG	Total CA
- - Overall - -							
Mass flow kg/h	43,00	37,30	5,70	1876,10	127,73	63,90	2067,72
Temp C	20,00	20,00	20,00	20,00	20,00	20,00	20,00
Pres bar	1,10	1,10	1,10	1,05	1,05	1,05	1,05
Vapor mole fraction	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average mol wt	16,04	16,04	16,04	28,82	28,63	28,63	28,63
Actual dens kg/m3	0,73	0,73	0,73	1,24	1,23	1,23	1,23
Std vap 0 C m3/h	60,08	52,08	8,00	1459,17	99,98	50,02	1609,17

Stream No.	6-01	7.02	9.0	8.11	9.1	6.4	6.41	6.42
Name	Off Gas	WasteLiq	FGexCC	Quen Air	Clean Gas	Stream H	Stream H	Stream H
- - Overall - -								
Mass flow kg/h	0,00	0,00	2110,73	13990,29	16101,02	87,20	0,00	87,20
Temp C	0,00	0,00	899,73	20,00	138,21	180,00	0,00	180,00
Pres bar	0,00	0,00	1,00	1,02	1,00	1,25	0,00	1,25
Vapor mole fraction	0,00	0,00	1,00	0,99	1,00	1,00	0,00	1,00
Average mol wt	0,00	0,00	28,33	28,53	28,50	28,41	0,00	28,41
Actual dens kg/m3	0,00	0,00	0,29	1,20	0,83	0,94	0,00	0,94
Std vap 0 C m3/h	0,00	0,00	1670,08	10992,43	12662,51	68,79	0,00	68,79

1.3.3 Results Mass & Energy Balance Case 2

Stream No.	5.1	5.01	5.02	8.02	8.05	8.06	8.01	6.01
Name	Tpt. NatGas	NatGas	Pilot Gas	Burner CA	CA-WL	CA-ORWG	Total CA	Off Gas J
- - Overall - -								
Mass flow kg/h	93,50	87,80	5,70	1762,72	1667,01	63,90	3493,63	266,00
Temp C	20,00	20,00	20,00	20,00	20,00	20,00	20,00	113,00
Pres bar	1,10	1,10	1,10	1,05	1,05	1,05	1,05	3,00
Vapor mole fraction	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average mol wt	16,04	16,04	16,04	28,63	28,63	28,63	28,63	28,01
Actual dens kg/m3	0,73	0,73	0,73	1,23	1,23	1,23	1,23	3,45
Std vap 0 C m3/h	130,63	122,63	8,00	1385,35	1304,83	50,02	2740,20	212,82

Stream No.	7.02	3.01	6.4	6.41	6.42	9.0	8.11	9.1
Name	WasteLiq	Atomiz.Air	Stream H	Stream H	Stream H	FGexCC	Quen Air	Clean Gas
- - Overall - -								
Mass flow kg/h	127,00	38,34	87,20	87,20	0,00	4112,69	13990,29	18102,98
Temp C	20,00	20,00	180,00	180,00	0,00	899,56	20,00	237,88
Pres bar	3,00	6,00	1,25	1,25	0,00	1,00	1,02	1,00
Vapor mole fraction	0,00	1,00	1,00	1,00	0,00	1,00	0,99	1,00
Average mol wt	23,75	28,53	28,41	28,41	0,00	27,58	28,53	28,30
Actual dens kg/m3	1000,00	7,03	0,94	0,94	0,00	0,28	1,20	0,67
Std vap 0 C m3/h	-	30,01	68,79	68,79	0,00	3342,82	10992,43	14335,25

1.3.4 Results Mass & Energy Balance Case 3

Stream No.	5.1	5.01	5.02	8.02	8.05	8.06	8.01	6.01
Name	NatGas	NatGas	NatGas	Comb-Air NG	CA-WL	CA-ORWG	Total CA	Off Gas D
- - Overall - -								
Mass flow kg/h	5,70	5,70	5,70	6316,19	1667,01	63,90	8047,10	334,84
Temp C	20,00	20,00	20,00	20,00	20,00	20,00	20,00	111,35
Pres bar	1,10	1,10	1,10	1,05	1,05	1,05	1,05	0,01
Vapor mole fraction	1,00	1,00	1,00	1,00	1,00	1,00	1,00	1,00
Average mol wt	16,04	16,04	16,04	28,82	28,63	28,63	28,63	28,51
Actual dens kg/m3	0,73	0,73	0,73	1,24	1,23	1,23	1,23	0,01
Actual vol m3/h	7,86	7,86	7,86	5085,91	1350,71	51,78	6488,40	37535,87
Std vap 0 C m3/h	7,96	7,96	7,96	4912,55	1304,83	50,02	6267,40	263,20

Stream No.	7.02	6.4	6.41	6.42	9.1	8.11	9.1
Name	WasteLiq	Stream H	Stream H	Stream H	FGexCC	Quen Air	Clean Gas
- - Overall - -							
Mass flow kg/h	123,74	87,20	247,64	0,00	8511,41	13990,29	22501,70
Temp C	-8,00	180,00	101,90	0,00	902,68	20,00	371,71
Pres bar	1,25	1,25	1,25	0,00	1,00	1,02	1,00
Vapor mole fraction	0,00	1,00	1,00	0,00	1,00	0,99	1,00
Average mol wt	58,11	28,41	28,55	0,00	28,59	28,53	28,55
Actual dens kg/m3	590,14	0,94	1,15	0,00	0,29	1,20	0,53
Actual vol m3/h	0,21	92,54	216,25	0,00	29103,42	11630,39	42265,31
Std vap 0 C m3/h	47,73	68,79	194,41	0,00	6671,54	10992,43	17663,97

1.3.5 Results Mass & Energy Balance Case 4 (ESD)

Stream No.	5.01	5.02	8.02	8.05	8.06	8.01	6.01	7.02	9.0	8.11	9.1
Name	Nat. Gas	Pilot Gas	Comb. AirNG	CA-WL	CA-ORWG	CA Total	Stream I	Waste Liqu.	FGexCC	Quench Air	Clean Gas
- - Overall - -											
Mass flow kg/h	0,00	5,70	11256,57	127,73	63,90	11448,20	482,38	0,00	11936,30	13990,29	25926,59
Temp C	0,00	20,00	20,00	20,00	20,00	20,00	56,60	0,00	1161,20	20,00	578,55
Pres bar	0,00	1,10	1,05	1,05	1,05	1,05	1,25	0,00	1,00	1,02	1,00
Vapor mole fraction	0,00	1,00	1,00	1,00	1,00	1,00	1,00	0,00	1,00	0,99	1,00
Average mol wt	0,00	16,04	28,82	28,63	28,63	28,63	40,91	0,00	28,56	28,53	28,54
Actual dens kg/m3	0,00	0,73	1,24	1,23	1,23	1,23	1,88	0,00	0,24	1,20	0,40
Actual vol m3/h	0,00	7,86	9064,00	103,49	51,78	9219,27	256,48	0,00	49849,61	11630,39	64340,65
Std vap 0 C m3/h	0,00	7,96	8755,03	99,98	50,02	8905,03	264,28	0,00	9368,18	10992,43	20360,61

1.4 Combustion Concept

The combustion concept must satisfy following demands:

- Combustion of off gas with following properties (depending of process modes)
  - Composition pure nitrogen (Stream J)
  - Low LHV of 3 kWh/Nm^3 (Stream F)
  - Very high LHV of 24 kWh/Nm^3 (Stream G)
  - Oxygen rich (Stream H, separate injection in the combustion chamber)

- Combustion waste liquid with following properties (depending of process modes)
  - Composition aliphatic C5 + C6 + aromatic HC (Stream K)
  - High volatile C4 –HC (Stream L)
  - Water with LHV of 0 kWh/Nm^3,' high energy demand for evaporation

The selected combustion concept is shown in the flow diagram Pt. 1.3.1
Reference is made also to the P&I-Diagram 5463-12-3066-D03, actual revision G.

The waste streams are burned in an internally ceramic lined combustion chamber at high temperatures of normally 900 °C. The hot clean gas is cooled down by means of air injection in the subsequent quench and fed into the stack.

The necessary combustion – and cooling air is delivered by the blowers VV141-V101 (Combustion air) and VQ112-V101 (Cooling air). On demand of Shell are both blowers operated without VSD at constant speed.
In order to handle the necessity of high turn down is the combustion air system equipped with a blow off system. Not demanded combustion air is blown into the atmosphere using the control loop VV141-PC02.
The quench air blower is operated at constant speed.

The incinerator unit consists of following major parts:

Off Gas System MA132

- Knock out drum V-950 for droplet separation
- WL transfer drum V-950A for waste liquid transport to the burner
- Knock out drum V-951 for droplet separation of bypass system
- Piping within the off gas system with safety equipment

The skid for MA132 is installed in a zone 2 area. The off gas is an inert gas stream and not classified in an internal explosion zone.

Oxygen Rich Off Gas System MA232

- Piping within the system with safety equipment

Waste Liquid Safety train MF150

- Piping for the organic liquids with safety equipment

Combustion chamber BK126-X950 with burners for:

- Natural gas and off gas (WG553-X100)
- Organic liquids (BK126-X200)
- Oxygen rich off gas injection device
- Combustion and cooling air blower (VV141-V101)
- Combustion and cooling air blower (VQ112-V101)

Stack

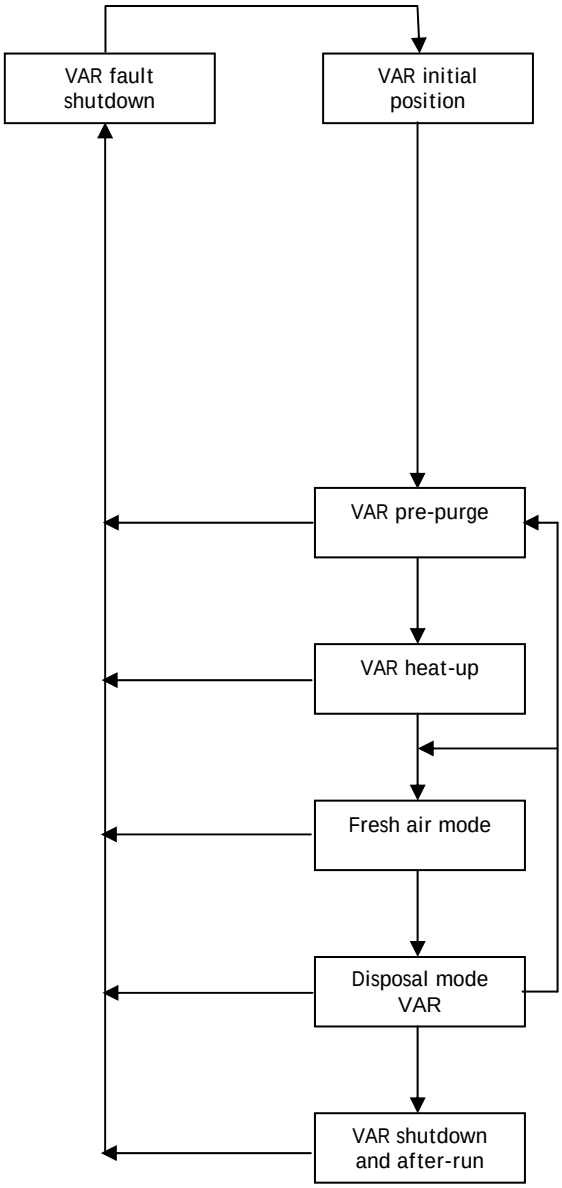
- with two in liners for clean gas (dia. 900 mm) and relief gas (DN 200)

Electrical control equipment in a cabinet on site

2. PROCESS DESCRIPTION

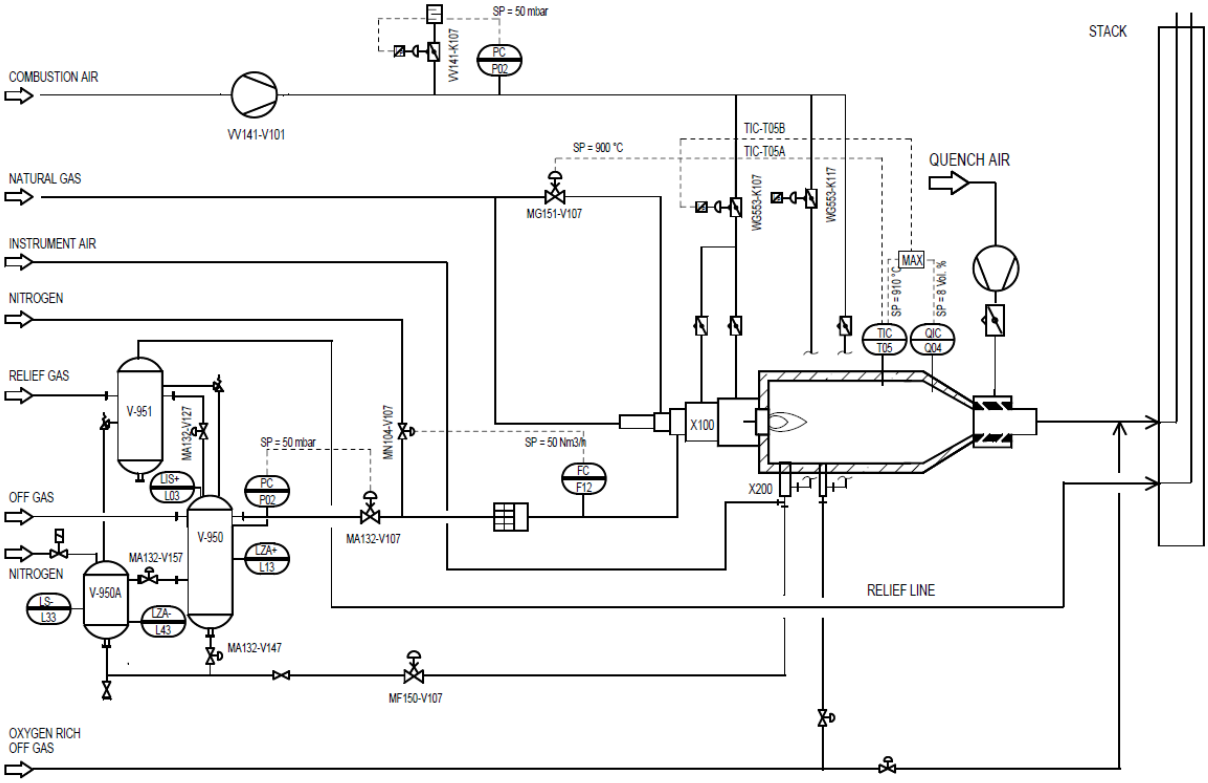
2.1 Operational Modes

Figure 2 shows the order in which the operating states of the ECOPURE® VAR can occur.



2.2 Control Sketch

To follow the process description please use also the P&ID 4563-12-3066-D02-Rev.G



2.3 Off Gas System MA132

Off gas and waste liquid from the Shell process plant is fed to the KO-drum V950, were the phases are separated: waste liquid is collected on the bottom, off gas leaves V950 in two directions:

- To the off gas burner, if the combustion chamber is ready to accept off gas
- To the KO-drum V951, if the combustion chamber is not ready or goes in a failure shut down

Off gas to the incinerator burner:

Prior to start off gas to burner, is it fed to the KO-drum V951, the SOV V127 and V137 are open. Once the off gas is released for combustion in the incinerator, is V127 released for control (SV27 pressurizes the actuator), the valve begins to ramp in close position (timer 1 – 5 min., will be optimized during commissioning).
If the SP = 20 mbar of the pressure switch PZ-P42 is exceeded, opens the SOV V117 in the line to the burner, the control valve V107 is released for pressure control PC-P02 with SP = 50 mbar. Up to 50 mbar is V107 in controlled intermediate open position.

When V127 reaches the close position, are the SV 27 and SV 37 de-energized, the valves V127 and V137 close by spring force.
In the line to the burner is a static flame arrester installed, which is equipped on the burner side with a fast reacting temperature switch TZ+T05. If a temperature of 200 °C is exceeded, fails the safety chain off gas, V107 and V117 close, V127 and V137 open, off gas is lead to the relief KO-drum V951 and from there to stack..

2.4 Waste Liquid to the WL-burner Group MF 150

Due to the partially high volatility of the components waste liquid, was the original concept to feed the WL with pumps to the burner, changed to another concept, which uses the principle of communicating vessels, as described subsequently.

Instead of pumps is a second vessel V-950A foreseen, which is linked with V-950 by a bottom line (liquid) and an upper line in the gas phase.
Each line is equipped with an automatic isolation valve; the operation is as follows:

- Normally is the valve V147 in the transition line liquid closed, V157 in the gas line closed, too
- The level in V-950 is < LS+L03
- The level in V-950A is at LS-L33
- If the level in V950 reaches LS+L03, is the valve in the liquid transition line opened,the line in the gas phase too. The levels in the two vessels will be equalised (communicating vessels). Pressure relieve via transition line in the gas phase.
- After a delay time sufficient for the level equalizing, are both valves in the transition lines closed (V147 and V157)
- Nitrogen is released to pressurizes V-950A to 4 barg
- The automatic valve for nitrogen remains open during discharge of WL.
- The combustion air valve WG553-K117 for the WL burner opens to a start position of 30%
- The WL feed to the WL burner is started after starting atomizing air to the atomization nozzle: WG553-V27 opens the flow switch FZ-F02 changes to “good” condition.
- MF150-V117 opens, V107 is released for opening ramp control
- Start of the opening ramp with timer 1 ... 5 min.
- When the level in V-950A reaches LSL-L33 is the feed to the burner stopped: V107 and V117 WL close
- MN104- V27 nitrogen purge opens for few minutes and closes again
- The nitrogen feed valve MN104- V37 to V950A closes after short delay
- The valve in the gas phase transition line opens: V950A is damped de-pressurized via orifice X180
- The system reaches the described start phase with level in V950 < LSH+L03 and in V950A = at LSL-L33.
- After expiring of the timer nitrogen purge is the combustion air valve WL burner WG553-K117 closed to min. (= cooling air) position.

2.5 Oxygen Rich Off Gas System MA232

After readiness of the combustion chamber for waste stream operation is oxygen rich off gas from the Shell process plant fed via SOV K107 to an injection device directly on the combustion chamber, which is cooled by a continuous small stream of cooling (pressure) air via WG553-H140.
The bypass valve K117 is simultaneously closed. If waste streams are not released or the incinerator fails, is the oxygen rich off gas stream routed via open K117 to the clean gas stack line, the SOV K107 to the combustion chamber is closed.

2.6 Combustion Chamber BK126

In the combustion chamber of thermal oxidizers, waste VOC components are oxidized in presence of oxygen (combustion air) at temperatures in a range of 800 – 1.200 °C. Combustion products are nontoxic components as CO_2 and H_2O in the case of pure hydrocarbons and toxic and corrosive components like HX, X_2, SO_2, SO_3, NO, NO_2 in case of presence of hetero atoms like Halogens (X), Sulphur (S), Nitrogen (N) etc. in the VOC molecule.
In case of presence of corrosive components special measures have to be implemented, which avoid corrosion of the equipment or parts of it. In the present case are corrosive components not taken into account.

The following reaction equations are shown without respect to the stoichiometry of the reactions:

Pure hydrocarbons:

$$C_nH_mO_p + \text{Air (Oxygen} + N_2) \rightarrow CO_2 + H_2O + N_2$$

2.6.1 Start of the NG Burners and Heat up

Prior to start with the feeding of waste streams to the combustion chamber, must these be heated up to normal combustion temperature of 900 °C. The heat up is performed by using natural gas as supplementary fuel and combustion air.
In the most operational cases A – J is off gas a rich fuel gas with high heating value, but during startup of process units can it be pure nitrogen. (Stream J).
In order to guarantee in all operational cases a stable flame of supplementary fuel gas, is foreseen to use a continuous burning pilot burner with constant heat duty of 60 – 100 kW and a main gas burner with a gas consumption of 0 ... 120 Nm^3/h natural gas (NG).

The start sequence of the NG burner begins with the start of the blowers VV141-V101 combustion air and VQ112-V101 quench air in star triangle control

After pre-purging and leakage test of the natural gas SOV MG 151-V107 and V17 is the combustion air flow reduced to the start and minimum flow of 1500 Nm^3/h. The pilot burner is started; a stable flame is safeguarded by a UV-flame detector.

The main NG burner is released after start of the pilot burner. During the burner start sequence is the combustion chamber pre-purged with a sufficient flow of air (5 x Volume of the flue gas path, from the combustion chamber inlet to the outlet of the stack).

Calculation of the pre-purge time:

Volume Combustion chamber: 5,3 m^3
Volume flue gas stack liner dia. 900 mm x 30 m: 19,1 m^3
Total volume: 25 m^3
Pre-purge flow combustion air: 9000 m^3/h = 2,5 m^3/s
Pre-purge time: t = 5x 25 m^3 / 2,5 m^3/s = 50 s

After successful start of the pilot burner is the main NG burner started with the NG control valve in start position. After start of the main burner is a temperature ramp of the controller PIC-T05 activated, which heats the combustion chamber up to normal operation temperature of 900 °C by action on the NG control valve at constant combustion air flow.

2.6.2 Disposal Mode: Operation with Waste Streams

After reaching of a CC temperature of 900 °C are the waste streams released for combustion.

Operation of Oxygen Rich Off Gas

Due to the low flow and LHV can the oxygen rich off gas be immediately be switched to the oxidizer:

- MA232-V107 is opened
- The bypass valve MA232-V117 is closed

The oxygen rich off gas not influences the operation of the combustion chamber significantly.

The other two waste streams with high heating value must be started in succession, in order to allow the CC temperature controls to work without grave fluctuations.

Off Gas (Rich fuel gas)

The off gas burner and the main natural gas burner are a functional unit with separate gas lances and common primary and secondary combustion air supply.
For the start of off gas must all criteria of its safety chain be fulfilled, (Temperature combustion chamber, temperature flame arrester, off gas pressure etc.) switches must be in a good condition, the chain must be closed.
If that is the case, will off gas be started with following sequence:

- Release of the flow control off gas MA132-FIC-F12, which acts on the nitrogen control valve MN104-V107, SP = 50 Nm^3/h
- Opening of MA132-V117 and MA132-V07 (3/2 way SV)
- MA132-PIC-P02 is released for pressure control with SP = 50 mbar, control valve MA132-V107
- The bypass valve MA132-V127 starts a closing ramp, within a time which allows the pressure control to act without fluctuations
- When valve MA132-V127 reaches the close position, is MA132-V137 closed V27 is de-energized. The way to V951 is fail safe closed.

If high calorific off gas is injected in the combustion chamber, shows the temperature increasing trend, via control loop BK126-TIC-T05A (SP = 900 °C) is the natural gas flow to the NG main burner controlled closed. If the temperature CC is still increasing, will the controller TIC-T05B (SP = 910 °C) begin to open the combustion air control valve.

If the ESD case occurs with high heat input, will the combustion air valve be opened complete. Up to this point increases the combustion temperature to max. 1.200 °C. The peak VOC load decreases fast within 15 min. to 50 %, the combustion chamber temperature decreases again to normal values of 900 – 1.000 °C.

If the input of energy via off gas is very fast, may be the temperature control will be overrun because of the measurement inertia. In this case decreases the concentration of oxygen in the combustion chamber.
During normal operation is the oxygen concentration in the combustion chamber 11 – 13 Vol. %. If it decreases, begins the oxygen controller QIC-Q04 to act with a SP = 9 Vol.%. The controller output signal 4 – 20 mA is linked together with the output signal of TIC-T05B in a MAXIMUM selection device, the higher signal acts on the CA control valve WG553-K107 and increases the CA supply. If the oxygen concentration increases again, takes the temperature control again over the CA control.

2.7 Control Narratives

2.7.1 Control Loop VV141-PIC-P02

Loop	**VV141-PIC-P02 Combustion Air Pressure**
Algorithm	PID
Trend	Yes
Alarm	H/L
Switch	
Operation Mode	MAN, AUTO
Control device	VV141-V107 Blow-up
Control action	Valve opens at increasing pressure
Output signal	4 – 20 mA
Min. output limitation	No
Max. output limitation	No
Set Point	30 mbar
Remarks	The controller PIC-P02 is in forced manual mode with output 0 %, if the blower VV141-V101 is not released for operation. The release for automatic control is given by the Siemens S7 PLC during the burner start sequence.

2.7.2 Control Loop MA132-FIC-F12

Loop	**MA132-FIC-F12 Flow Off Gas**
Algorithm	PID
Trend	Yes
Alarm	
Switch	S-, Z+
Operation Mode	MAN, AUTO
Control device	MN104-V107 Nitrogen
Control action	Valve opens at decreasing flow
Output signal	4 – 20 mA
Min. output limitation	Yes, 6 mA
Max. output limitation	Yes, set during commissioning
Set Point	50 Nm^3/h
Remarks	The controller FIC-F12 is in forced manual mode with output 0 %, if the off gas is not released for operation. The release for automatic control is given by the Siemens S7 PLC during the off gas start sequence.

2.7.3 Control Loop MA132-PIC-P02

Loop	**MA132-PIC-P02 Off Gas Pressure**
Algorithm	PID
Trend	Yes
Alarm	H/L
Switch	
Operation Mode	MAN, AUTO
Control device	MA132-V107 Off gas
Control action	Valve opens at increasing pressure
Output signal	4 – 20 mA
Min. output limitation	No

Max. output limitation	No
Set Point	50 mbar
Remarks	The controller PIC-P02 is in forced manual mode with output 0 %, if the off gas is not released for operation. The release for automatic control is given by the Siemens S7 PLC during the off gas start sequence.

2.7.4 Control Loop BK126-TIC-T05A

Loop	**BK126-TIC-T05A Combustion chamber temperature**
Algorithm	PID
Trend	Yes
Alarm	
Switch	S+ SP = 1200 °C
Operation Mode	MAN, AUTO
Control device	MG151-V107 Natural gas
Control action	Valve closes at increasing temperature
Output signal	4 – 20 mA
Min. output limitation	No
Max. output limitation	No
Set Point	900 °C
Remarks	The controller TIC-T05A is in forced manual mode with output 0 %, if the main NG burner is not released for operation. The release for automatic control is given by the Siemens S7 PLC during the burner gas start sequence.

2.7.5 Control Loop BK126-TIC-T05B

Loop	**BK126-TIC-T05B Combustion chamber temperature**
Algorithm	PID
Trend	Yes
Alarm	
Switch	
Operation Mode	MAN, AUTO
Control device	WG553-V107 Combustion air
Control action	Valve opens at increasing temperature
Output signal	4 – 20 mA
Min. output limitation	Yes, corresponding to a CA flow of 1.500 Nm3/h
Max. output limitation	If necessary, set during commissioning

Set Point	910 °C
Remarks	The controller TIC-T05B is in forced manual mode with min. output signal, if waste streams iare not released for operation. The release for automatic control is given by the Siemens S7 PLC prior to waste stream disposal release. The output signal is operated together with the output signal of The CC oxygen control in a MAX selection device.

2.7.6 Control Loop BK126-QIC-Q04

Loop	**BK126-QIC-Q04 Combustion chamber oxygen concentr.**
Algorithm	PID
Trend	Yes
Alarm	
Switch	Z- SP = 3 %
Operation Mode	MAN, AUTO
Control device	WG553-V107 Combustion air
Control action	Valve opens at decreasing oxygen concentration
Output signal	4 – 20 mA
Min. output limitation	Yes, corresponding to a CA flow of 1.500 Nm3/h
Max. output limitation	If necessary, set during commissioning
Set Point	910 °C
Remarks	The controller QIC-Q04 is in forced manual mode with min. output signal, if off gas V950 is not released for operation. The release for automatic control is given by the Siemens S7 PLC prior to waste stream disposal release. The output signal is operated together with the output signal of the CC temperature control in a MAX selection device.