

## CO2 Liquefaction Plant #504



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## 1. Executive Summary

### 1.1 Plant Capacity

- 165 MTPD

### 1.2 Process Designer

- Toromont Industrial Service

### 1.3 Available Technical Documents

- Process description (operation & maintenance manual)
- PFDs
- P&IDs
- Production report
- Electrical Drawing

### 1.4 Specifications of CO<sub>2</sub> Feed Gas

- Pressure 161.3 KPAA
- Temperature – 20 °C (maximum)
- Gas composition (mol %, dry bases)

CO <sub>2</sub>	99.43%
Ethane	0.32%
Propane	0.13%
H <sub>2</sub> S	0.08%
COS	0.03%

### 1.5 Specifications of CO<sub>2</sub> Liquid Product

- Storage Pressure 1590 KPAA
- Temperature – 26.2 °C (CO<sub>2</sub> feed to storage)
- Non-food grade liquid CO<sub>2</sub> product
  - CO<sub>2</sub> 99%
  - Water 10 ppm v
  - Carbonyl Sulfide 1 ppm v
  - Hydrogen sulfide 1 ppm v
  - M-Mercapton 1 ppm v

### 1.6 Plant Type

Skid-mounted plant including 6 skids:

- A. 1st stage CO<sub>2</sub> compression
- B. COS / 2n stage CO<sub>2</sub> compression

- C. Drier / C3 compression
- D. C3 receiver
- E. Lo-Cat filter box
- F. Lo-Cat chemical addition

## 2. Process Description

This CO<sub>2</sub> liquefaction plant is designed to purify and condense raw CO<sub>2</sub> gas.

The 1<sup>st</sup> stage CO<sub>2</sub> compressor draws the CO<sub>2</sub> vapor from the plant inlet separator at approximately 51 kpag and compress it to 740 kpag. Steam is then injected into the CO<sub>2</sub> stream to optimize the conversion of the COS to H<sub>2</sub>S in the COS shift vessel. At the outlet of the COS shift process, the CO<sub>2</sub> is chilled for optimal H<sub>2</sub>S removal in the Lo-Cat system. The CO<sub>2</sub> leaves the Lo-Cat system saturated and enters the CO<sub>2</sub> interstage separator. Any water produced in this separator collects in the bottom of the vessel and is discharged into the water drain system. This is controlled by a level control loop, which includes an automated switching valve. When the valve opens the water is driven out by the high pressure in the separator as compared to the low pressure in the water drain system.

The CO<sub>2</sub> gas is taken into the 2<sup>nd</sup> stage CO<sub>2</sub> compressor, that is designed to compress the CO<sub>2</sub> vapor to 1786 kpag. The lube oil-gas mixture enters the 2<sup>nd</sup> stage CO<sub>2</sub> oil separator where the oil is removed from the CO<sub>2</sub> and returned to the compressor after passing through a filter and a cooler. The CO<sub>2</sub> vapor then enters a final oil separator, which polishes the vapor and removes any residual oil from the CO<sub>2</sub>.

The plant includes the following process systems.

- Lube Oil System
- Lubrication System
- COS to H<sub>2</sub>S Shift System
- H<sub>2</sub>S Removal System
- Residual Oil Removal System
- CO<sub>2</sub> Chilling and Separation System
- CO<sub>2</sub> Drier System
- CO<sub>2</sub> Condensing and Reflux Separation System
- Propane Refrigeration System
- Economized Refrigeration System

## 3. Consumptions (based on 165 MTPD production)

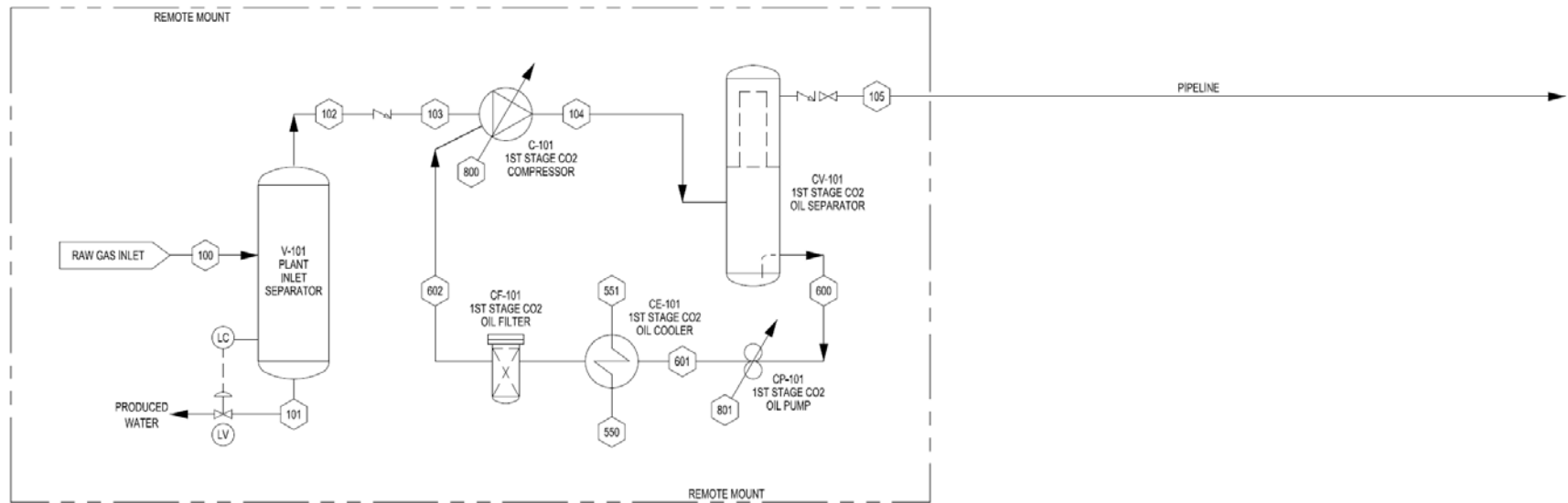
Power (estimated average)	184 KW hr / ton (no motor efficiencies)
Total power (average)	244 KW hr / ton
Total produced water	1.2 L/min (650 PPM (W) oil)
Instrument gas	10 Nm <sup>3</sup> /hr
CO <sub>2</sub> compressor oil	3.8 L/day (maximum)
C3 compressor oil	1.1 L/day (maximum)

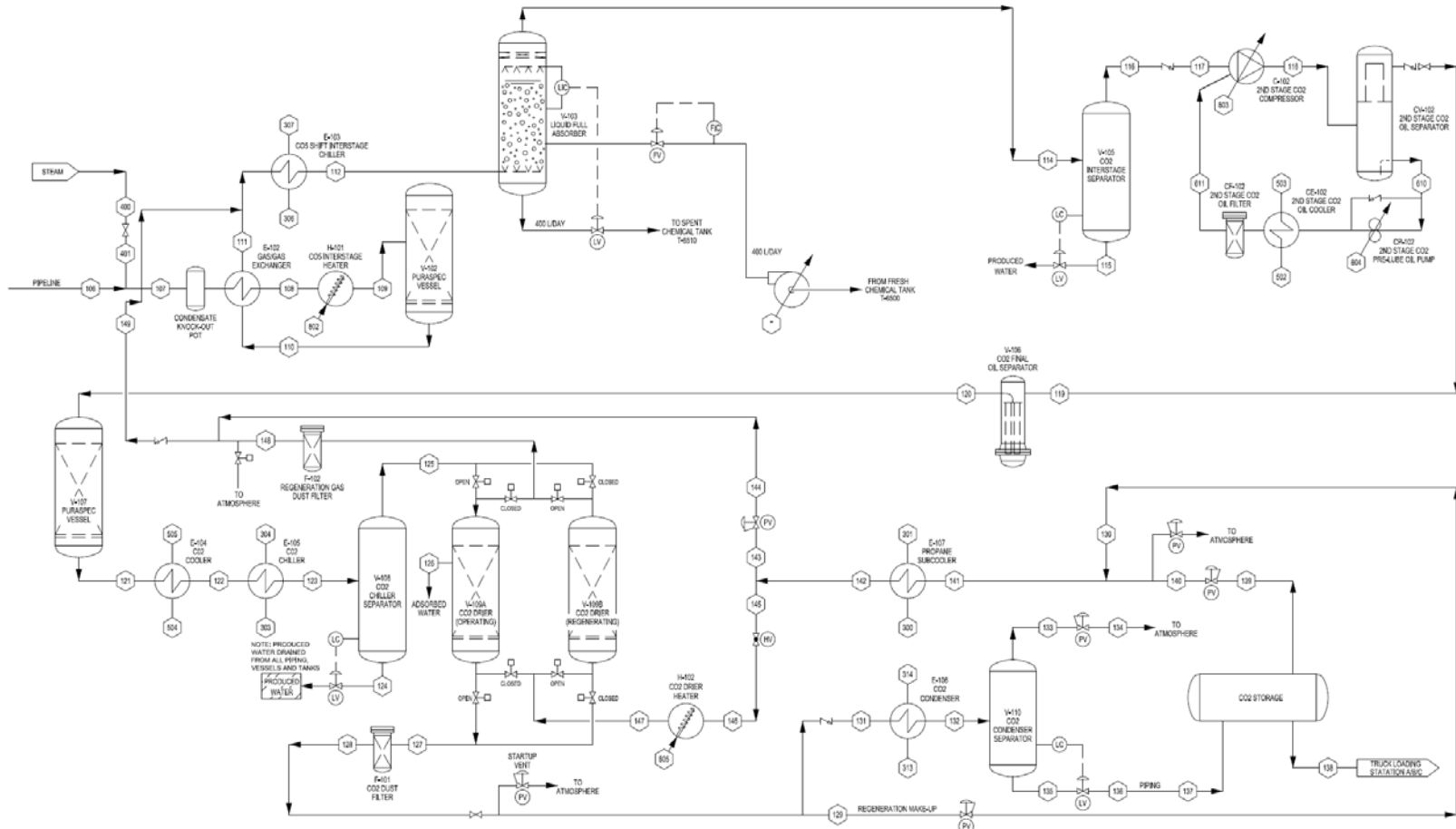
#### 4. Equipment List

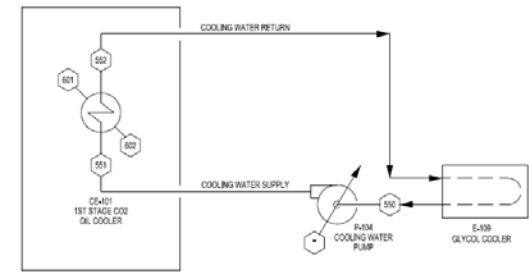
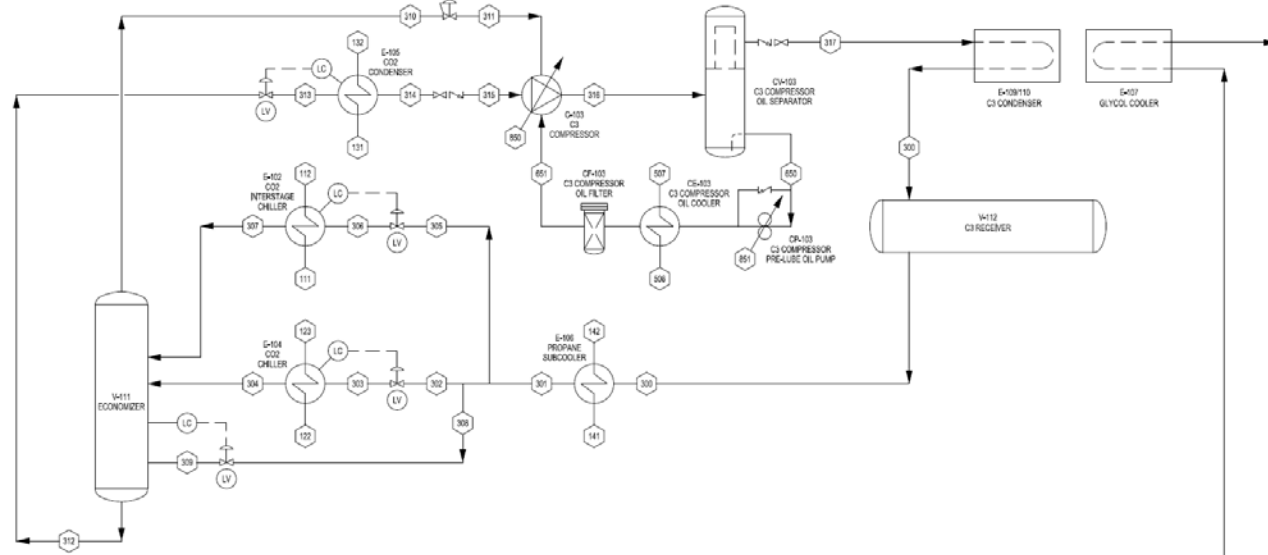
<u>TAG NO.</u>	<u>DESCRIPTION</u>
BF-104	BUILDING EXHAUST FAN
C-101	1ST STAGE CO2 COMPRESSOR
C-102	2ND STAGE CO2 COMPRESSOR
C-103	C3 COMPRESSOR
CE-101	1ST STAGE CO2 OIL COOLER
CE-102	2ND STAGE CO2 OIL COOLER
CE-103	C3 COMPRESSOR OIL COOLER
CF-101A/B	1ST STAGE CO2 OIL FILTERS
CF-102A/B	2ND STAGE CO2 OIL FILTERS
CF-103A/B	C3 COMPRESSOR OIL FILTERS
CM-101	1ST STAGE CO2 COMPRESSOR MOTOR
CM-102	2ND STAGE CO2 COMPRESSOR MOTOR
CM-103	C3 COMPRESSOR MOTOR
CP-101	1ST STAGE CO2 OIL PUMP
CP-102	2ND STAGE CO2 PRE-LUBE OIL PUMP
CP-103	C3 COMPRESSOR PRE-LUBE OIL PUMP
CPM-107	1ST STAGE CO2 OIL PUMP MOTOR
CPM-102	2ND STAGE CO2 PRE-LUBE OIL PUMP MOTOR
CPM-103	C3 COMPRESSOR PRE-LUBE OIL PUMP MOTOR
CV-101	1ST STAGE CO2 OIL SEPARATOR
CV-102	2ND STAGE CO2 OIL SEPARATOR
CV-103	C3 COMPRESSOR OIL SEPARATOR
E-101	GLYCOL COOLER
EM-101	GLYCOL COOLER FAN MOTOR
E-102	COS SHIFT GAS/GAS EXCHANGER
E-103	COS SHIFT CHILLER
E-104	CO2 COMPRESSOR AFTERCOOLER
E-105	CO2 CHILLER
E-106	CO2 CONDENSER
E-107	PROPANE SUBCOOLER
E-108	WATER COOLER
EM-108A/B	WATER COOLER FAN MOTORS
E-109	C3 CONDENSER
EM-109A/B	C3 CONDENSER FAN MOTORS
E-110	C3 CONDENSER
EM-110A/B	C3 CONDENSER FAN MOTORS
F-101	CO2 DUST FILTER
F-102	REGENERATION GAS DUST FILTER
F-103A/B	FILTER/DRIERS
H-101	COS SHIFT HEATER
H-102	CO2 DRIER HEATER
H-103A/B	BUILDING HEATER

<u>TAG NO.</u>	<u>DESCRIPTION</u>
P-101	ARI-340 ADDITION PUMP
PM-101	ARI-340 ADDITION PUMP MOTOR
P-102	ARI-400 ADDITION PUMP
PM-102	ARI-400 ADDITION PUMP MOTOR
P-103	ARI-600 ADDITION PUMP
PM-103	ARI-600 ADDITION PUMP MOTOR
P-104	ARI-350 ADDITION PUMP
PM-104	ARI-350 ADDITION PUMP MOTOR
P-105	45% KOH ADDITION PUMP
PM-105	45% KOH ADDITION PUMP MOTOR
P-106A/B	FILTRATE RETURN PUMPS
PM-106A/B	FILTRATE RETURN PUMP MOTORS
P-107	GLYCOL PUMP
PM-107	GLYCOL PUMP MOTOR
P-108	COOLING WATER PUMP
PM-108	COOLING WATER PUMP MOTOR
P-109	H2O PUMP
PM-109	H2O PUMP MOTOR
P-6550	TEXTRON LOADING PUMP
P-6555	TEXTRON LOADING PUMP
T-101	ARI-340 DRUM
T-102	ARI-400 DRUM
T-103	ARI-600 DRUM
T-104	ARI-350 DRUM
T-105	45% KOH DRUM
T-106	SULPHUR CAKE FILTER TANK
T-107	GLYCOL TANK
T-108	GLYCOL SURGE TANK
T-109	C3 OIL DRAIN TANK
T-6500	CARADAN C-3005T SCAVENGER
T-6505	PRODUCED H2O TANK
T-6510	SPENT CHEM. TANK
V-101	COS SHIFT SEPARATOR
V-102	COS SHIFT VESSEL
V-103	LIQUID ABSORBER
V-104	FLASH POT
V-105	CO2 INTERSTAGE SEPARATOR
V-106	CO2 FINAL OIL SEPARATOR
V-107	PURASPEC (COS SEPARATOR)
V-108	CO2 CHILLER SEPARATOR
V-109A/B	CO2 DRIERS
V-110	CO2 CONDENSER SEPARATOR
V-111	ECONOMIZER
V-112	C3 RECEIVER
V-113	PRESSURIZED H2O VESSEL
V-6530	CO2 STORAGE VESSEL
V-6540	CO2 STORAGE VESSEL

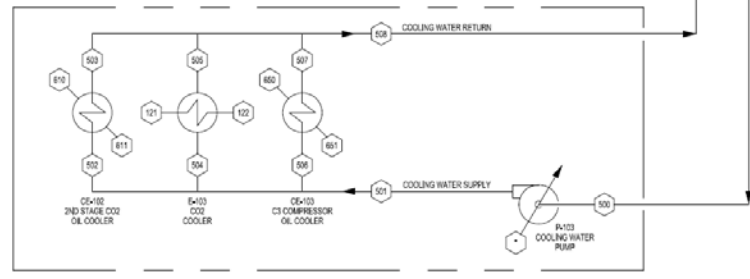
## 5. Process Flow Diagram







COOLING WATER SYSTEM - REMOTE MOUNT



COOLING WATER SYSTEM