FULL TRANSCRITICAL EFFICIENCY

Rev.	Date	By	Purpose
0	08/02/22	IVC	Initial Release

Kysor Warren FTE

Introduction

Full Transcritical Efficiency (FTE) system is a technology that helps to improve the standard CO2 systems efficiency.
This system operates in the intermediate pressure side of the CO2 refrigeration cycle, specifically at the suction side of the medium temperature evaporators.
The objective is to reduce the superheat on the medium temperature cases to have more refrigerant in them and be able to raise their suction temperature/pressure which in consequence will increase the suction pressure of medium temperature compressors, reducing the compression ratio and therefore lowering the energy consumption of the system.
The FTE system is integrated in the same compressor rack from Kysor Warren; this is a simple technology that allows CO2 systems to operate more efficiently.
Figure 1.0 is a graphic representation of the FTE system concept.

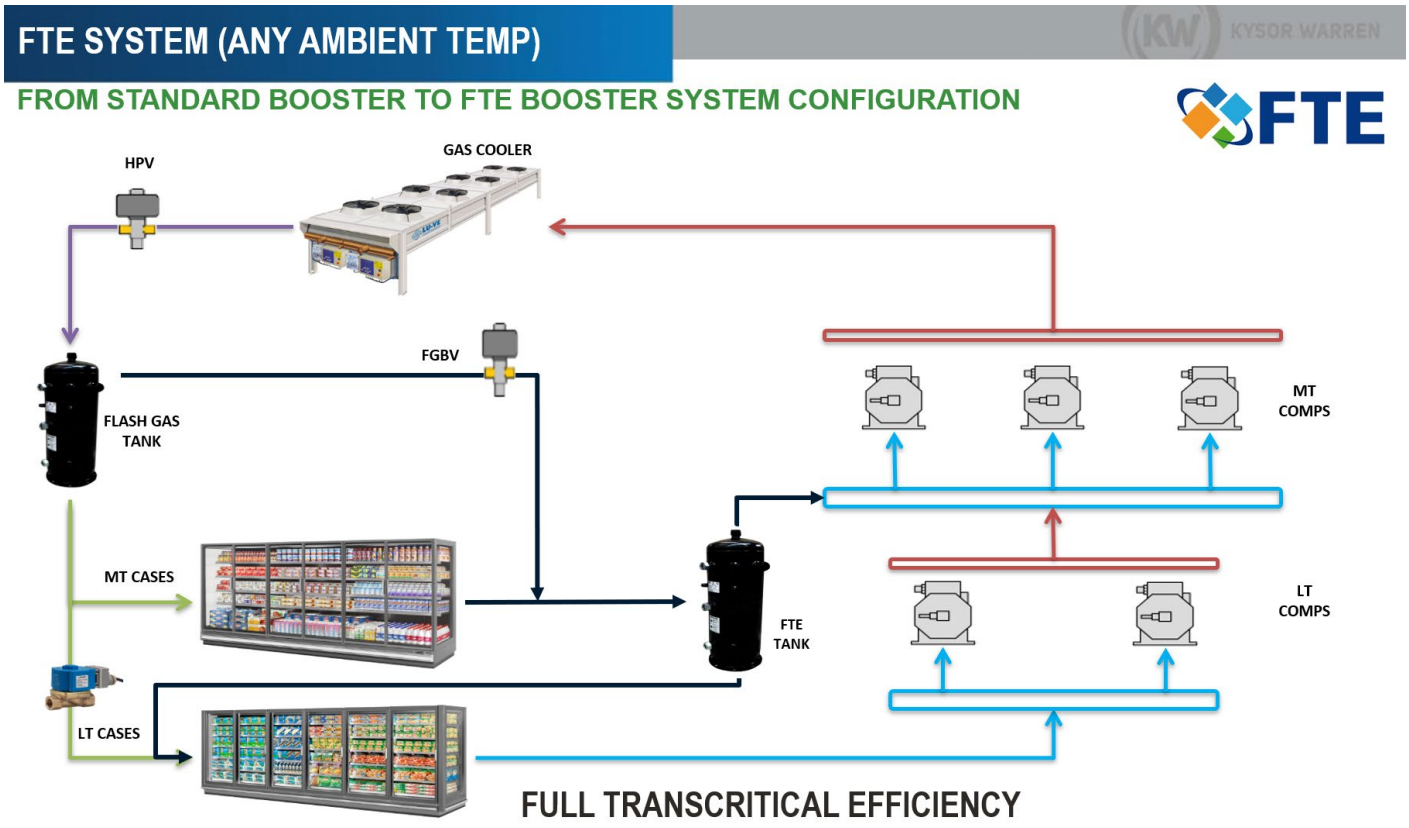


Figure 1.0

The system will be able to operate in Standard Transcritical CO2 booster configuration and in FTE System configuration. There will be a series of valves that will need to be closed or open, depending on what mode the system will operate.

FTE System main components

a) FTE Tank
b) Liquid level sensors (4)
c) Liquid line solenoids (2)
d) FTE PLC Controller

System operation

The FTE system operation principle is based on low superheat at the medium temperature evaporator level, by doing this the expansion valves will open more allowing more refrigerant to enter the coil therefore, increasing the capacity to absorb heat from those. This in the end will result in the ability to increase the suction temperature/pressure of the medium temperature coils and in consequence will happen the same at the medium temperature compressor level reducing the compressor work needed, reducing the energy consumption.

FTE System Piping and Instrumentation Diagram

Figure 2.0 represents the piping diagram for the FTE portion imbedded into transcritical booster system. The red rectangle captures all components that will be installed at the rack for FTE system to operate.

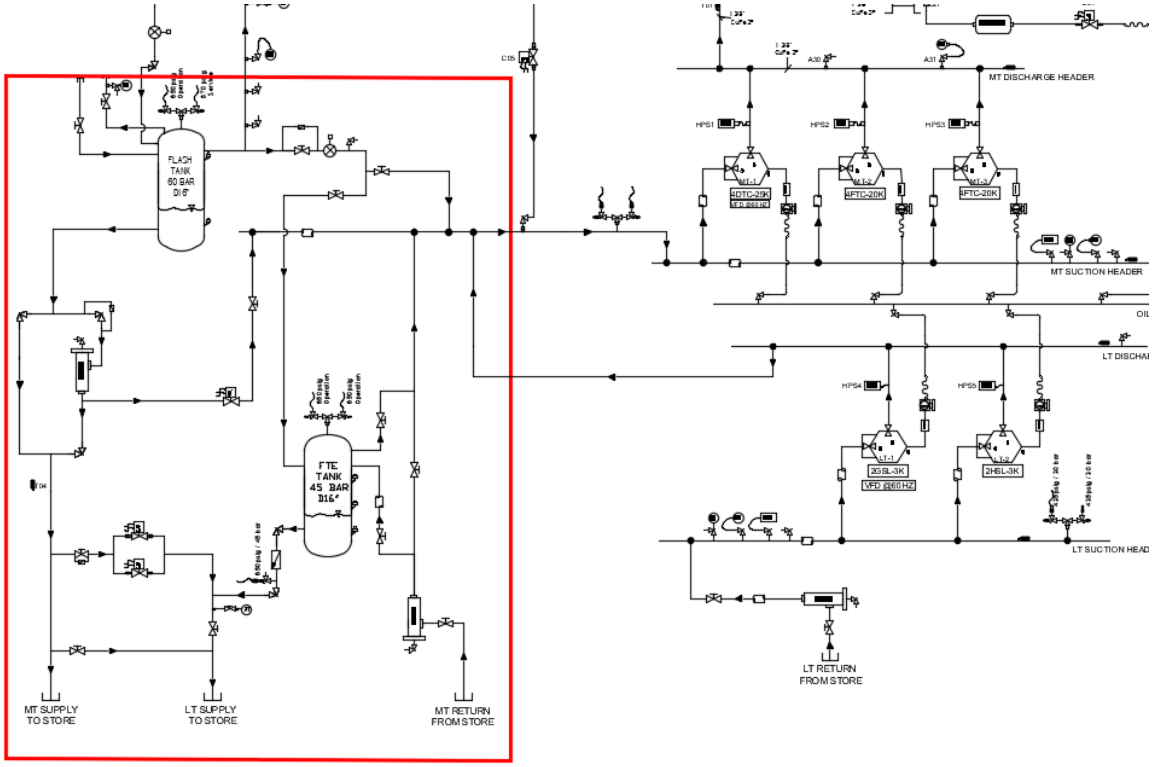


Figure 2.0

System minimum requirements:

a) Medium Temperature (MT) and Low Temperature (LT) loads – CO2 Booster system
b) Load ratio of 15% between LT to MT
c) Minimum 5 different LT loads
d) For installation it requires separate liquid lines for MT and LT

FTE startup and shut down procedures are described below. Please note that the valve numbers shown in the schematics are for illustration purposes only.

Non-FTE Startup Procedure

1- Perform pressure test in the system including FTE portion.
2- Perform leak test in the system including FTE portion.
3- Evacuate the system including FTE portion (triple evacuation).
4- Vapor charge the system to indicated pressure (normally 100-150 psi) including FTE portion.
5- Isolate FTE system as shown below in Figure 3.0.
    a. Open valves: B02, B04, B05 & B13
    b. Close valves: B08, B09, B10, B11 & B12
6- Startup as regular Transcritical Booster System.

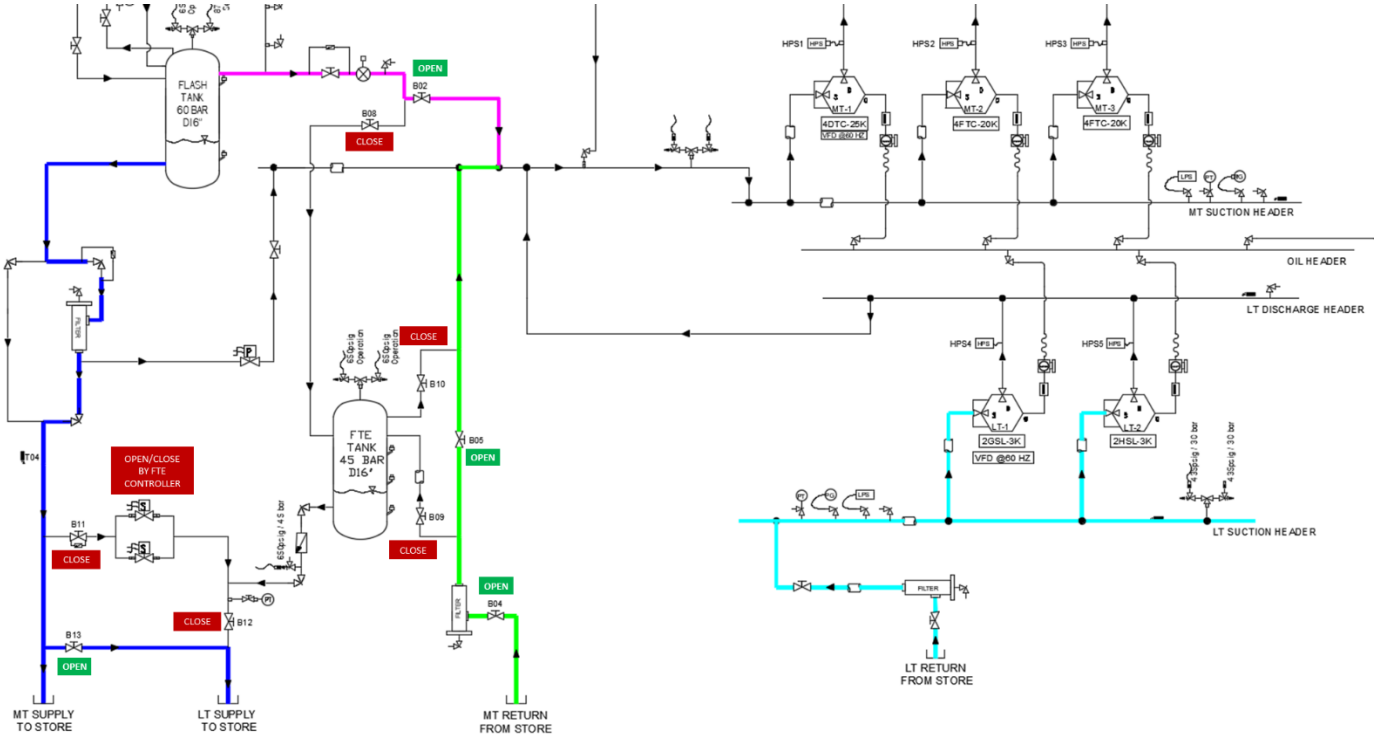
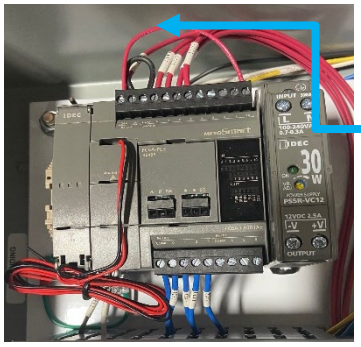


Figure 3.0

FTE Startup Procedure

1- System has been running for couple of weeks in regular booster system with full load.
2- System has been running stable with no issues.
3- MT cases for flooded mode have been identified and programmed.
4- Open valves B08, B09 and B10.
5- Close valve B02 & B05.
6- Open valve B11 & B12.
7- Remove jumper in FTE box (see figure 4.0).
8- Close valve B13.
9- Add liquid CO2 to flash tank as needed to maintain level above the first sight glass.
10- Verify valve opening/closing per figure 5.0 below.



PLC to control FTE
Jumper to disable/enable FTE
Points 24V – 10
Jumper in place = FTE DISABLE
Jumper removed = FTE ENABLE

Figure 4.0

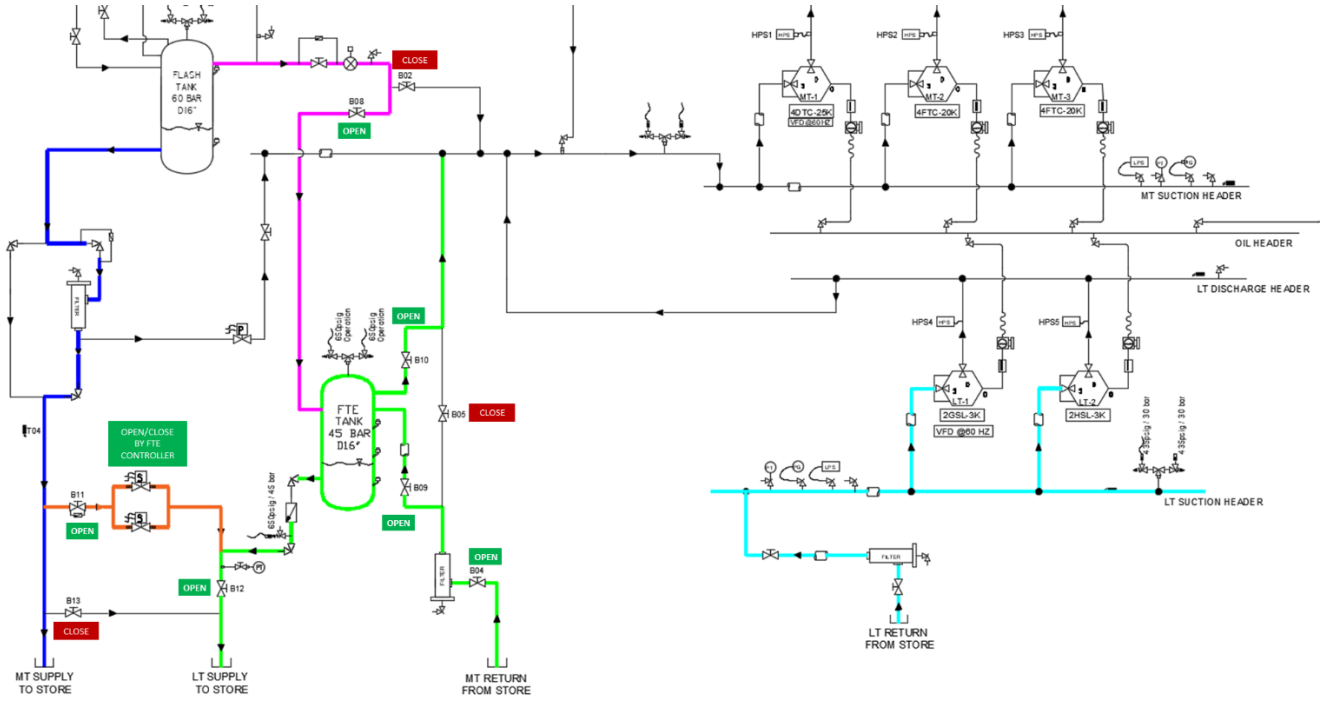


Figure 5.0

FTE Shutdown Procedure

1- Make jumper in FTE box (see figure # 4.0) to disable FTE.
2- Shut off valve 11, LT liquid feed from flash tank and wait about 30 min to empty FTE tank.
3- Open valve B05.
4- Close valve B09 and B10.
5- Open valve B02.
6- Close valve B08.
7- Verify all liquid sensors are off (no liquid, can be seen also in the FTE electrical panel).
8- If liquid is still present, allow more time for FTE tank to drain until all sensors are off or no sensing liquid.
9- Close valve B12.
10- Open valve B13.
11- Check flash tank liquid level. If liquid is above second sight glass (50%), remove CO2 from the system to have liquid level in flash tank between first and second sight glasses.
12- Valves open/close should look like same as figure 3.0 (here below for reference).
13- Lower MT suction pressure setpoint as per refrigeration schedule.

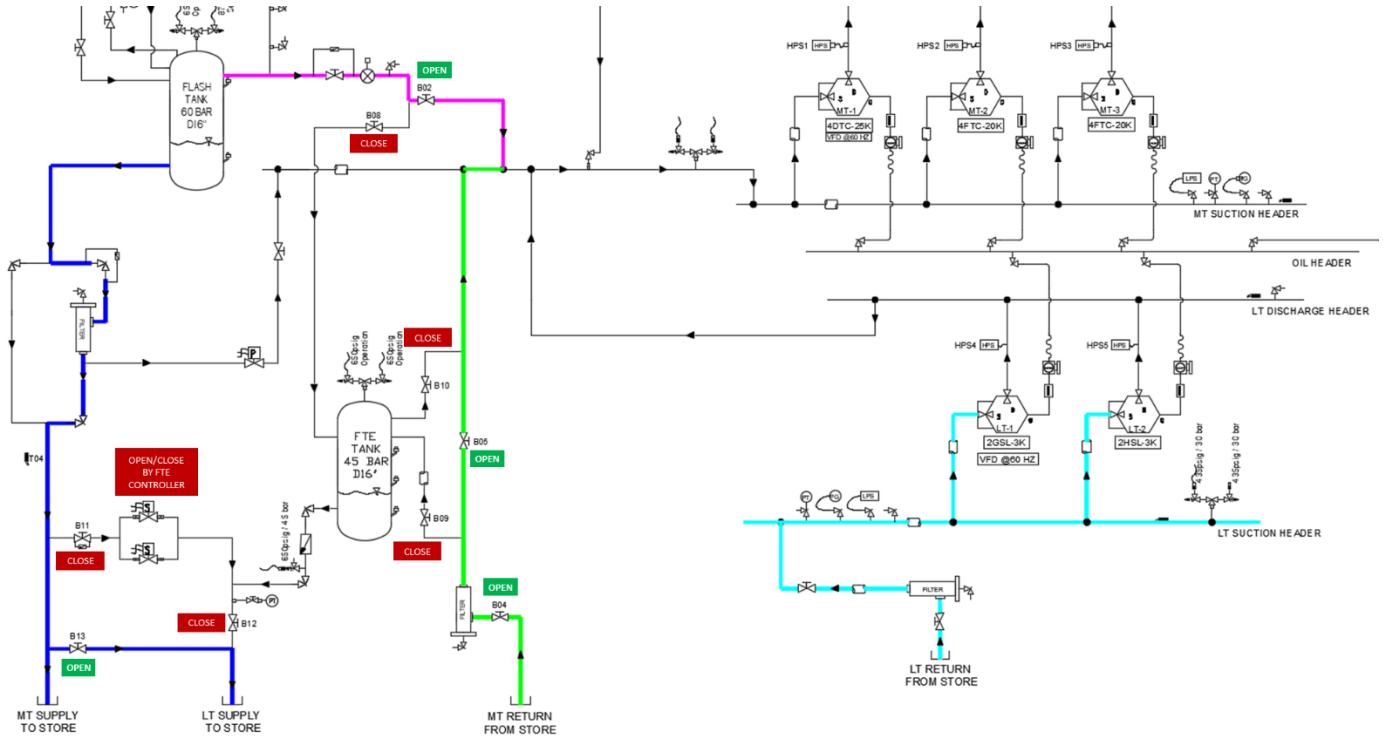


Figure 3.0

Figure 6.0 below represents the FTE control panel that is installed at the compressor rack. It will have lights for visual indication of the FTE operation.

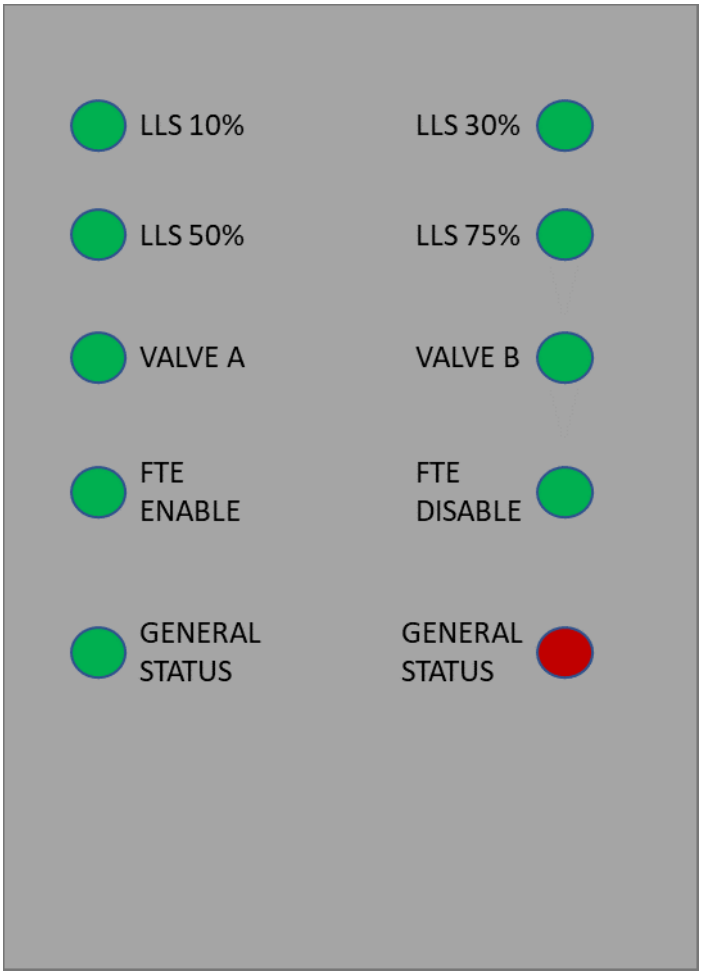


Figure 6.0