Advanced Cooling System

Fuel cooling system for marine gas oil

Application

Stricter fuel oil regulations imposed by the International Maritime Organization and national and regional authorities call for ships to change over from heavy fuel oils (HFO) to low-sulphur distillate fuel oils in designated Emission Control Areas.

Switching over from HFO to light fuel poses operational challenges, including fuel viscosity, lubricity and combustion quality. Ship owners and operators must therefore modify fuel oil systems onboard new and existing ships to ensure the protection of fuel oil injection components.

Cooling units are required to reduce the temperature of low-sulphur marine gas oil in order to supply a proper fuel to the engine.

Advanced Cooling System from Alfa Laval

The Advanced Cooling System (ACS) is a reliable, fully automatic fuel cooling system that facilitates fuel oil changeover while maintaining fuel viscosity within the limits set by engine manufacturers.

Inside the high-pressure stage of fuel conditioning, the ACS replaces the heating phase with a cooling phase, in order to keep the distillate fuel temperature low and ensure the proper viscosity.

The ACS can integrate the Alfa Laval Fuel Conditioning Module (FCM) as well as any other booster system, on new buildings or ships in operation.

Features and benefits

- *Compliance with new fuel regulations ACS allows the operators to:*
  - Achieve easy and full automated fuel changeover procedures
  - Handle up to 3 different fuels
  - Perform direct (HFO to MGO) and intermediate (HFO to MDO to MGO) fuel changeover procedure
- *Safety*
  ACS provides cutting edge control of variation in fuel temperature and viscosity. This makes possible to achieve safe fuel changeover procedures by avoiding any thermal shock and any drop in fuel viscosity.

The ACS Module

- *Integration*
  - Seamless communication between ACS and FCM for automatic and reliable fuel changeover procedures
  - Full compatibility of ACS with any fuel conditioning module, even from other suppliers
- *Automation*
  - ACS is fully automated and easy to operate
  - Possibillity of full process control from remote panel
  - Full changeover procedure customization by controlling all process parameters
- *Versatility*
  - Optional chiller unit available for the supply of proper cooling media to ACS
  - Possibility to develop ACS tailor made versions on request

Key components

The ACS scope of supply includes everything needed, with the exception of pipes and cables, to construct a complete fuel cooling system for newbuildings or to retrofit fuel supply systems on existing vessels.

- *ACS Cooler*
  The ACS is equipped with a heat exchanger that uses fresh water or seawater as cooling media. The plate heat exchanger cooler type has high corrosion resistance, high efficiency and compact design.

- *Mixing valve*
  This electrically operated three-way mixing valve regulates fuel temperature by partializing the amount of fuel flowing through the ACS cooler. The stepless flow adjustment allows a sharp temperature control of the light fuel, in order to provide a reliable temperature ramp and final injection temperature.

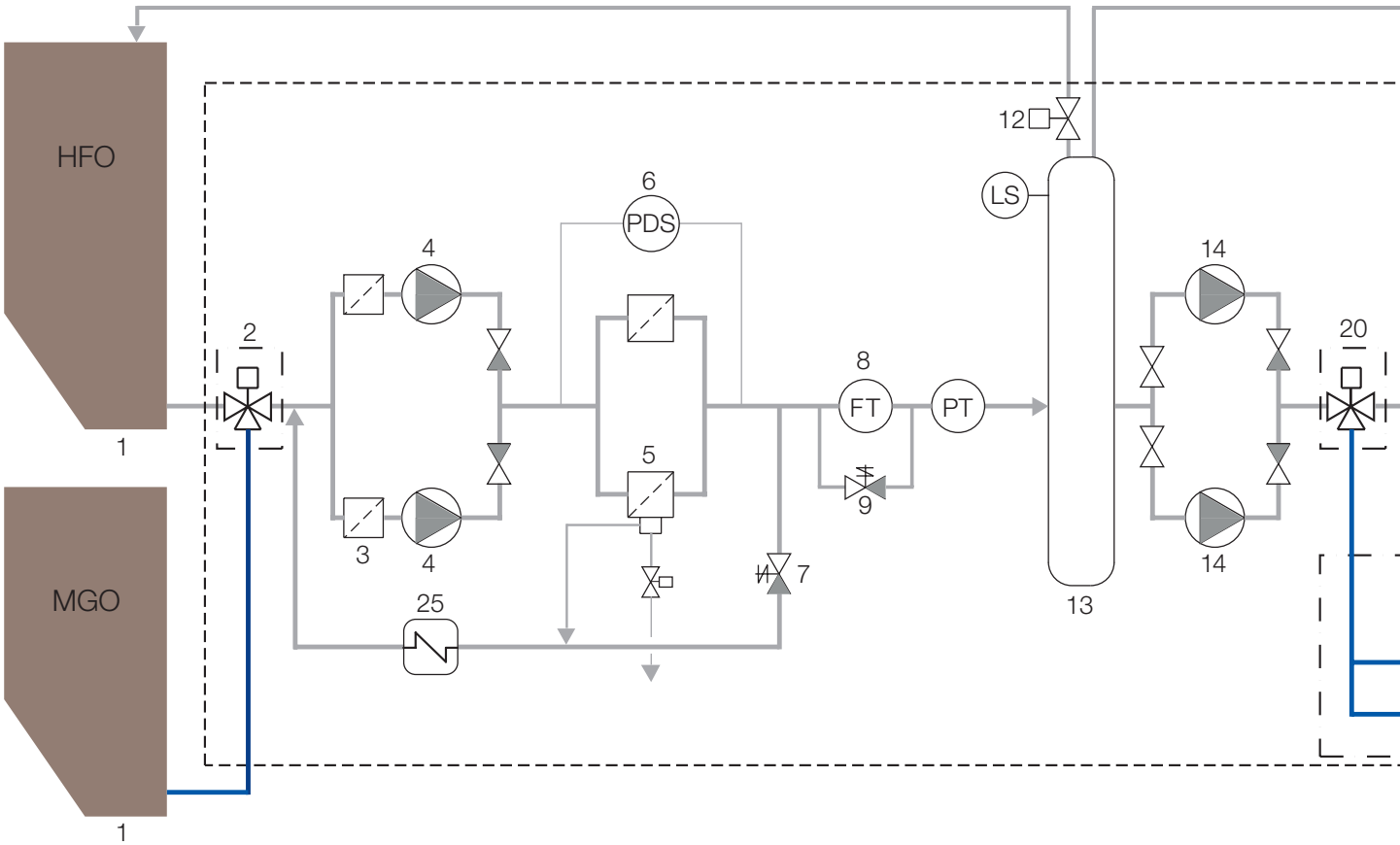
- *Temperature transmitter*
  Mounted on booster module or near the engine, the temperature transmitter supplies data about fuel temperature to the engine to the ACS control unit.

- *Changeover valves*
  The ACS incorporates two main three-way changeover valves positioned at the fuel supply feed inlet and prior to the inlet of the ACS cooler. These are supplied according to the dimensions of the connected pipework. One more three-way changeover valve is available as an option to handle a third fuel

- *Control system*
  ACS operation is steered and monitored by a control panel, and can be equipped for different levels of remote control:
  - Basic – free contacts (only alarms and readings)
  - Extended – free contacts (change over start up and alarms and temperature readings)
  - Modbus – full remote control through onboard automation system

- *Modularized assembly*
  ACS is a compact and skid mounted unit, ready for a space saving installation on any booster system.

- *Chiller unit*
  ACS is available with a chiller unit from our partner NOVENCO, with start/stop function integrated in the control panel.



Operating principle

The ACS operation is based on temperature adjustable setpoint and viscosity control operated by FCM viscosity sensor.

- *Changeover from HFO to MGO*

  To initiate the switch from HFO to MGO, the system gradually shifts the changeover valve (V1) from HFO position to MGO position and reduces the heating power in order to control fuel viscosity. The combination of the valve movement and continuous control of heating power ensures a safe and gradual changeover without the risk of thermal shock.

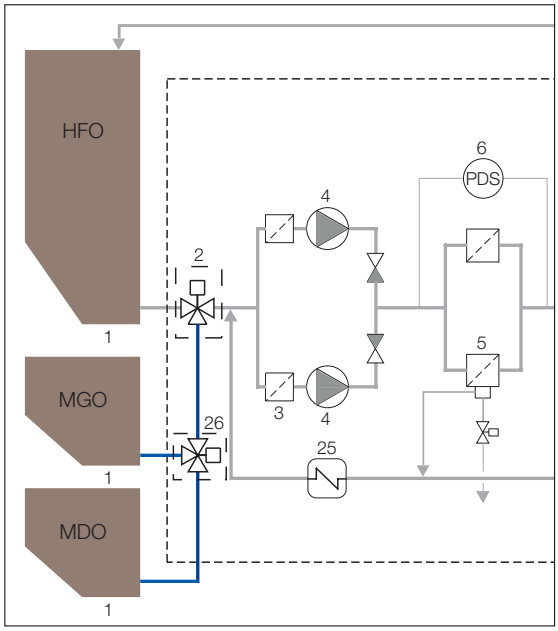
  Once the programmable set point temperature has been obtained, the ACS shifts the changeover valve (V2) from the heater position to the cooler position and begins to control the fuel temperature during the ramp phase by operating the three-way mixing valve (V3). Continuous control of this three-way mixing valve keep fuel temperature and viscosity stable.

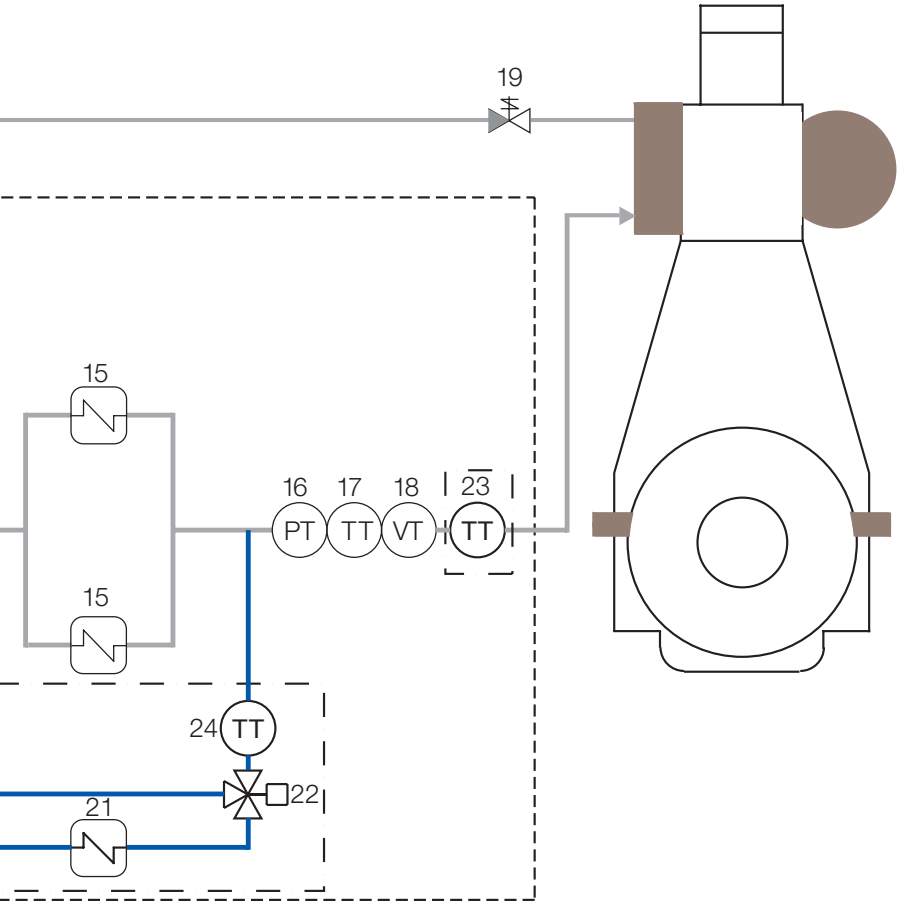
- *Changeover from MGO to HFO*

  To initiate the switch from MGO to HFO, the system gradually shifts the changeover valve (V1) from MGO position to HFO position and controls the fuel temperature ramp by operating the three-way mixing valve (V3). When the programmable set point temperature has been obtained, the ACS gradually shifts the changeover valve (V2) from the cooler position to the heater position; the booster controls the temperature ramp until the HFO working temperature has been obtained.

- *Three fuels handling*

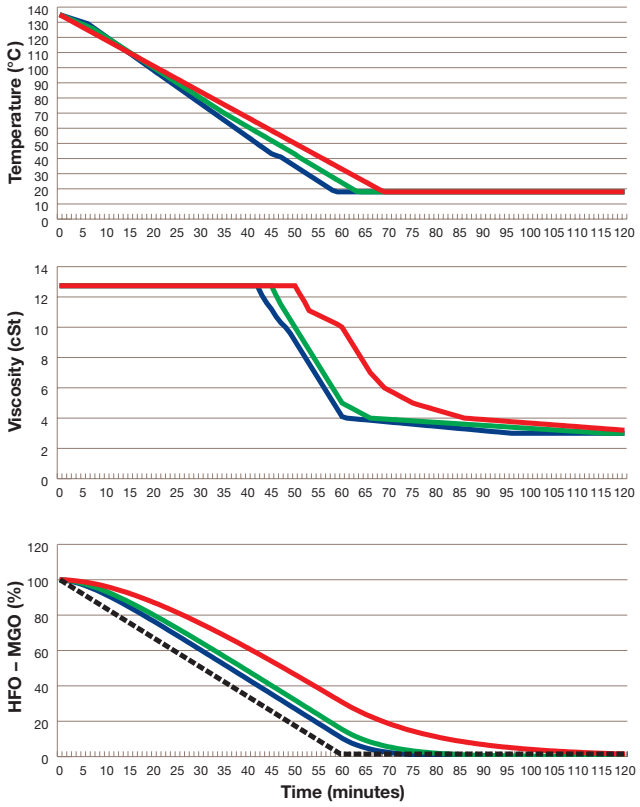
  As an option, the system can handle 3 different fuels and perform direct (HFO to MGO) and intermediate (HFO to MDO to MGO) fuel changeover procedure. This allows to save money by using the suitable fuel for the proper time.



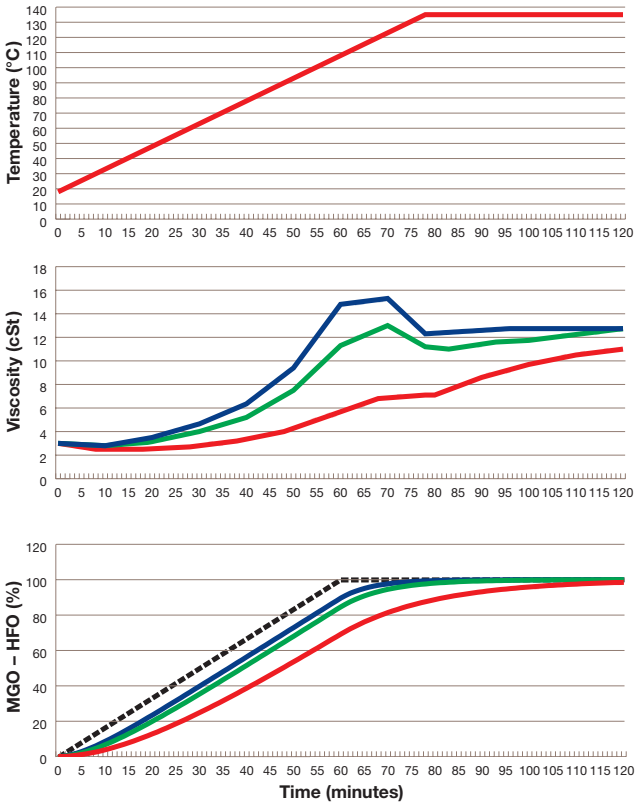


1. HFO and MGO day tank
2. Three way changeover valve (V1)
3. Pump strainers
4. Supply pump
5. Automatic backflushing filter
6. Filter pressure drop switch
7. Supply pressure control valve
8. Flow transmitter
9. Flow transmitter bypass
10. Pressure transmitter, supply pump
11. Level switch
12. Automatic de-aeration valve
13. Mixing tube
14. Circulation pump
15. Heaters
16. Pressure transmitter, circ. pump
17. Temperature sensor
18. Viscosity sensor
19. Engine pressure control valve
20. Three way changeover valve (V2)
21. ACS Cooler
22. Three way mixing valve (V3)
23. Temperature transmitter (TT2)
24. Temperature transmitter (TT3)
25. SPV Cooler
26. Three way changeover valve (V4)
27. Heating media valve (V6)
28. Cooling media valve (V7)

HFO to MGO changeover



MGO to HFO changeover



Position – Three-way valve
HFO on the circuit – Engine at 85% MCR
HFO on the circuit – Engine at 60% MCR
HFO on the circuit – Engine at 30% MCR

TECHNICAL DATA

ACS Module	Cooling media	Size	Weight
ACS 15 F	Fresh water	1200 x 600 x 1800 mm	320 kg
ACS 40 F	Fresh water	1200 x 600 x 1800 mm	350 kg
ACS 60 F	Fresh water	1500 x 600 x 1800 mm	400 kg
ACS 15 S	Seawater	1200 x 600 x 1800 mm	320 kg
ACS 40 S	Seawater	1200 x 600 x 1800 mm	350 kg
ACS 60 S	Seawater	1500 x 600x 1800 mm	400 kg
ACS 50 C	Chilled water	1200 x 600 x 1800 mm	320 kg
ACS 140 C	Chilled water	1200 x 600 x 1800 mm	350 kg
ACS 215 C	Chilled water	1500 x 600 x 1800 mm	400 kg
ACS 70 G	Glycol water	1200 x 600 x 1800 mm	320 kg
ACS 185 G	Glycol water	1200 x 600 x 1800 mm	350 kg
ACS 285 G	Glycol water	1500 x 600 x 1800 mm	400 kg

Main supply voltage	1-phase, 110/230 V
Main supply frequency	50 or 60 Hz
Max oil pressure	16 bar
Max oil temperature	160°C

Capacity range

The ACS accommodates a wide range of fuel supply requirements up to a cooling capability of 285 kW (when combined to a chiller unit). Larger capacities can be supplied upon request.

Alfa Laval Fuel Conditioning Module LPG

Fuel conditioning system for MAN B&W ME-LGIP dual-fuel engines

Introduction

Emissions regulations and the worldwide focus on fossil fuels are changing very swiftly. In this scenario the interest in Liquefied Petroleum Gas (LPG) as an alternative fuel for the ship propulsion is steadily increasing in the marine industry.

Alfa Laval has developed the FCM LPG, the first proven solution on the market to feed the LPG fuelled engines for the marine propulsion.

Application

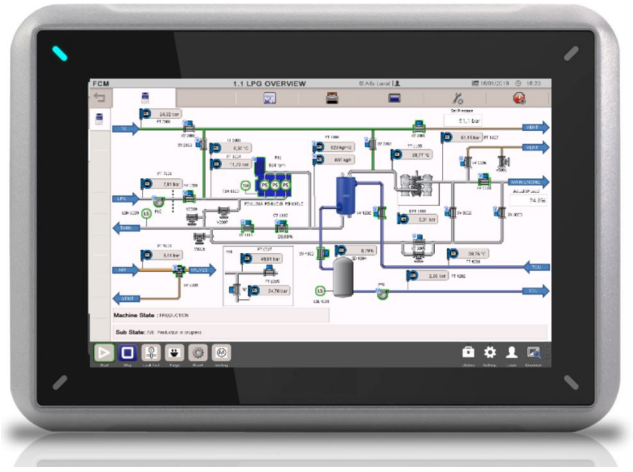
LPG is free from sulphur, virtually eliminating SOx emissions. It is a mixture of hydrocarbons, mainly of n-butane, i-butane, propane and a small percentage of ethane, not higher than 8%. These components can be mixed in different percentages, leading to a wide spread of compositions for use as fuel, and consequently a wide range of operative conditions.

Building on the experience with Fuel Conditioning Modules for standard fuels (HFO, MDO, MGO), for low flashpoint fuels (methanol) and for special applications (crude oil), Alfa Laval, in cooperation with MAN Energy Solutions, developed the Fuel Conditioning Module (FCM) LPG, a high pressure booster module designed to feeding the new MAN B&W ME-LGIP two strokes engine.

The module design and process was developed to be able to handle the new specific challenges of the LPG as a fuel: the FCM LPG is able to process the full range of LPG compositions available on the market, is able to react to the quick changes of the engine load and is protecting it against the solid pollutants contained in the product.

Benefits

- Module designed to serve the requirements of the LPG engine
- Proven technology in MAN R&D facilities for effective process control
- Automatic control of the LPG fuel conditioning and safety functions, and of the START/STOP procedures
- Modular plug-and-play solution that can be adapted to the different deck layouts and process conditions
- Turn-key skid mounted solution, for easy installation
- Independent from the cargo handling system
- System design ready to operate with ammonia as alternative of LPG fuel



HMI — real-time Process Flow Diagram Overview

Design & Standard configuration

The new FCM LPG is an independent system, with its own fully automated control cabinet, applicable both to LPG carriers and to non-LPG carriers fueled with LPG. It consists of a low-pressure (LP) and a high-pressure (HP) module, and of a control cabinet.

As standard option, a heating media loop for the control of the LPG temperature can be built on the HP skid itself. The complete pipework is made of AISI 316L stainless steel.

The module is suitable for the installation on the deck under a shelter or inside the compressor room in case of a ship carrying LPG as cargo.

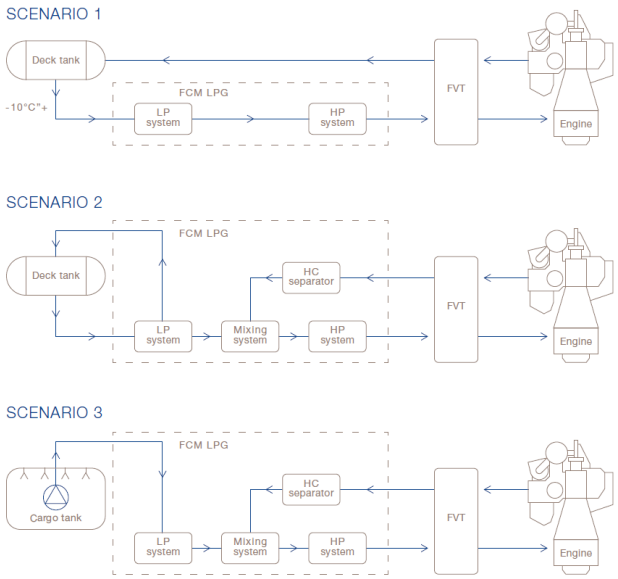
The FCM LPG is equipped with a completely dedicated automation system developed by Alfa Laval. The software was developed using a modular architecture; this allows it to adapt

to different layouts and configurations on board, without changing the control logic developed with MAN-ES.

A graphical 15” touchscreen panel (Human Machine Interface) ensures a simple safe operator experience, sharing the same intuitive interface used on the new generation of Alfa Laval systems.

Alfa Laval FCM LPG is working as a close loop with the engine, thus receiving the return of LPG from it and securing the cargo from receiving any pollutants coming from the engine.

Refer to the figures below for an overview of the possible alternative designs for marine application.



Alternative designs available for marine application

Technical Data

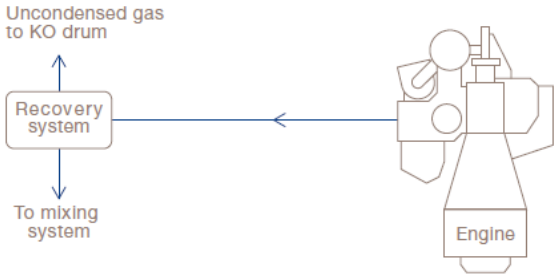
Process variable requirements at FCM LPG outlet battery limit

Process variable	Set point	Limits
Pressure outlet control	53 barg	+/-2 bar
Temperature outlet control	35 °C	+/-10 °C
Filtering degree for engine	-	10 µm
Flow	-	Approx. 2300 kg/h

Options

The relevant regulations and international guidelines clearly state that venting of hydrocarbons into the atmosphere should be avoided as far as practically possible. Moreover, the dispersion of the vented gas will is critical, which must be considered in the design.

It is then helpful, economical and ethical to recover as much LPG as possible after purging of the engine, the FVT (fuel valve train) or even the LFSS (Low-Flashpoint Supply System) in case of maintenance. For this reason, Alfa Laval developed the LPG recovery system as an option.



When an engine and FVT purging event occurs, the “return from engine” line is diverted to the recovery system and all the LPG and nitrogen flows into this system.

The system works as a liquid/gas separator, providing full liquid LPG recovery and partial LPG gas recovery. The recovered LPG, contaminated with seal oil, is then re-injected into the FCM LPG module.