

# WELLCOM

## *The application of jet pump technology to boost production from low pressure fields*

### Cost-Effective Production Boosting

Production and total recovery from many fields is restricted by low reservoir pressure. This can apply to many depleted fields or new fields where production pressure is insufficient for transport of fluids by pipeline or to meet downstream process requirements.

WELLCOM is a cost effective boosting system designed to meet production pressure requirements whilst allowing wellhead production pressure to be reduced, thus increasing production and recovery. At the heart of WELLCOM is a jet pump which utilises energy from a high pressure (HP) source to boost the production pressure of low pressure (LP) wells. The high pressure source can be a high pressure well or an existing boosting system such as a compressor or booster pump.

WELLCOM applies to both gas and oil production.

### Gas Production Applications

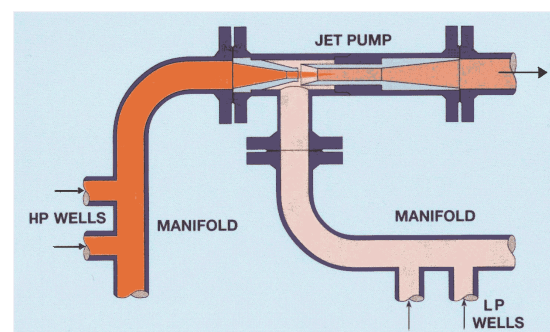
Examples:

- Boosting LP wells where the jet pump enables production at lower wellhead pressures, thus increasing production and recovery.
- Recovery of low pressure gas from process systems. To avoid flaring and wastage, the gas is boosted to a higher pressure so that it can be utilised, transported, or fed into compressors at a minimum required inlet pressure.

The HP flow may be supplied from HP wells or from other sources such as compressors.



*WELLCOM-Oil system at AGIP Trecate Italy*



*WELLCOM-Gas System*

Key factors which affect the performance of jet pumps in gas applications are HP/LP pressure and flow ratios. Figure 1 shows the performance of gas jet pumps under a range of conditions.

Presence of liquid, in either HP or LP gas, affects the performance of the system. Separation of the liquid phase may be necessary.

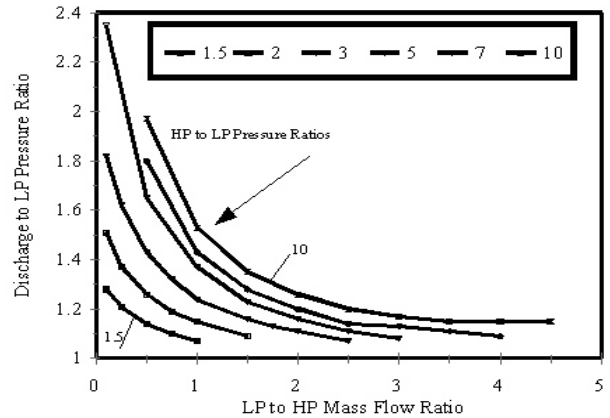


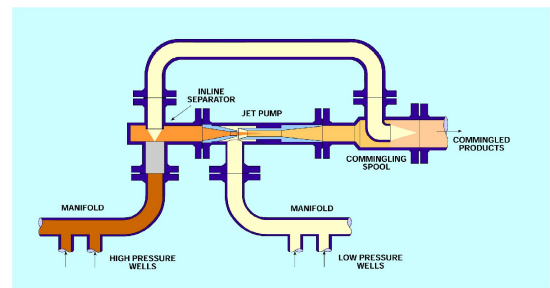
Figure 1: Performance of WELLCOM Gas Jet Pumps under various HP to LP pressure ratios

### Oil Production Applications

For oil production applications, WELLCOM comprises three main components:

- A compact separator
- A specially designed jet pump
- A commingling spool

CALTEC's compact separator, known as I-SEP, separates the gas from the liquid of the HP flow.



WELLCOM-Oil System

The separated liquid is fed into the nozzle of the jet pump as the motive flow. The total LP flow enters the suction line of the jet pump and combines with the HP flow, passing through the mixing tube and diffuser where transfer of energy takes place. The separated HP gas is combined with the fluid mixture from the outlet of the jet pump using a commingling spool.

**Performance:** Key factors effecting the performance of a WELLCOM Oil system are:

- HP/LP pressure ratio and liquid flow ratio
- The gas volume fraction (GVF) of the LP flow.
- Figure 2 shows examples of the system performance under different HP/LP pressures and GVF values.

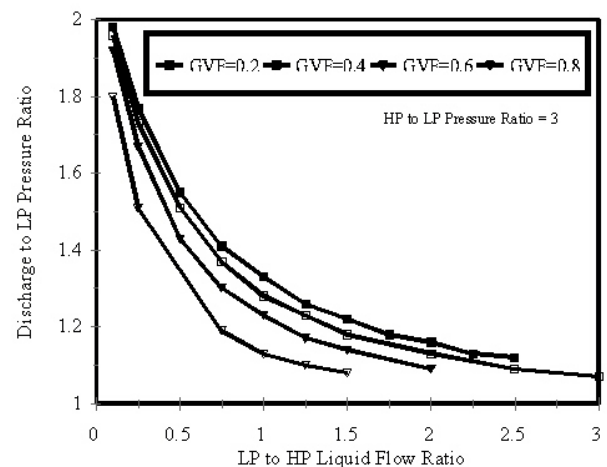
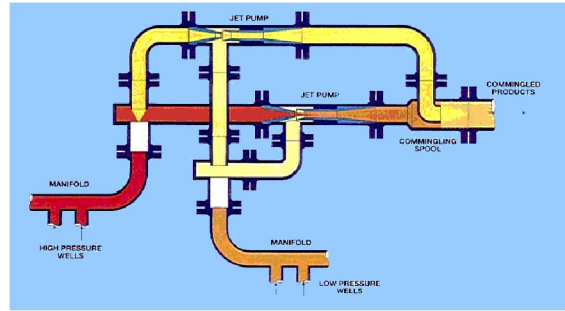


Figure 2: LP to HP Liquid Flow Ratio

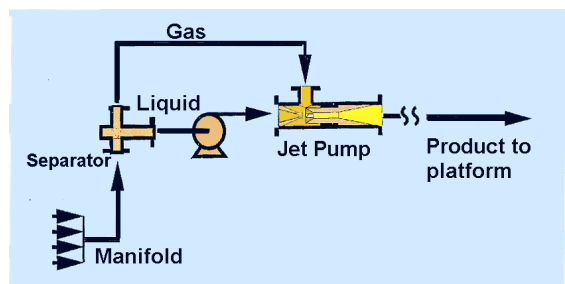
**Dual WELLCOM system:** In applications where the GVF of LP fluids is relatively high, a Dual WELLCOM system can provide a much improved performance. In this case, gas and liquid phases of both HP and LP flow are separated. Separate jet pumps are used for the gas and liquid phases. The fluids from the outlet of the two jet pumps are then combined using a commingler.



*Dual WELLCOM System*

**‘Boosted’ WELLCOM Applications**

In applications where HP wells are not available, high pressure liquid such as injection water can be used. Alternatively, by separating the gas and liquid phases using a compact separator, a single phase liquid pump can be used to boost the pressure of the liquid phase. This boosted liquid phase can then be fed into a jet pump as the motive flow using a jet pump. This is known as “Boosted WELLCOM” and its performance depends on the gas volume fraction (GVF) of the produced oil.



*Boosted WELLCOM System*

**Benefits**

WELLCOM offers a number of benefits depending on the application including:

- Increased production
- Increased total recovery from the field
- Low cost
- Short payback period
- Reliability – no moving parts
- Ease of operation
- Avoids, or defers, procurement of alternative, costly boosting systems such as compressors or multiphase pumps
- Can be used for well kick-off
- Increased pressure for pipeline transport of fluids
- Minimal or no maintenance required can prevent LP gas flaring

WELLCOM is equally applicable for boosting hydrocarbon production on land, offshore, subsea and in deep water.

## Economics

The system is very cost-effective. Typical payback period for the gas application is within a few weeks to a few months. For oil applications the payback period is a matter of a few weeks to several months. The cost and the payback period is dictated by a number of factors including the material and pressure rating of the system and the production characteristics of the LP wells.

## Range of Applications

There are a variety of applications for WELLCOM jet pump systems depending on the operating conditions and the source of high pressure fluids available. Some typical applications in both oil and gas production are illustrated in the appendix.

## Field Applications to Date

WELLCOM has been used successfully, worldwide, by a number of oil and gas companies. Clients include:

- AGIP SPA (Italy)
- Phillips Petroleum (UK)
- NAM (Holland)
- Shell Sarawak Berhad (Malaysia)
- ARCO (Indonesia)
- Marathon Oil UK Ltd (UK)
- Britannia Operator (UK)
- BP Amoco (UK)

## CALTEC Services

CALTEC is the leading specialist in this technology. The WELLCOM system and the compact separator (I-SEP) are protected by patents worldwide. A comprehensive software has been developed and validated for both oil and gas production. The software facilitates design of an optimal system and also prediction of its performance.

CALTEC provides.

- Feasibility studies
- System design and supply
- Commissioning
- Through-life service, including modifications to the unit during its service life if the operating conditions change and further optimisation becomes necessary.

**Free Service: CALTEC offers free initial assessment of your field applications.**

**Please complete WELLCOM questionnaire and return to [sales@caltec.com](mailto:sales@caltec.com)**

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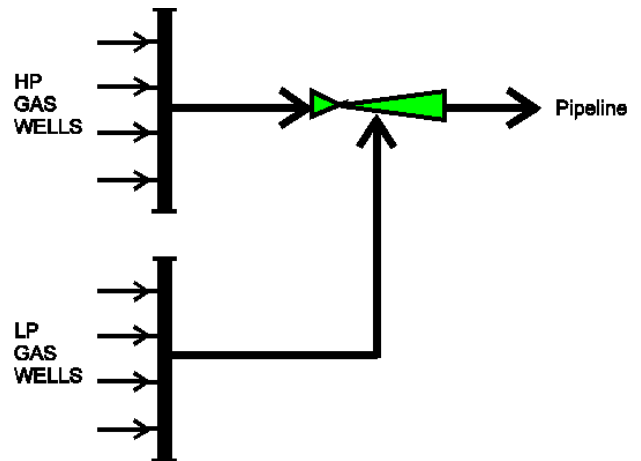
# APPENDIX

## Examples of the Applications of WELLCOM System in Oil and Gas production

### Gas Production

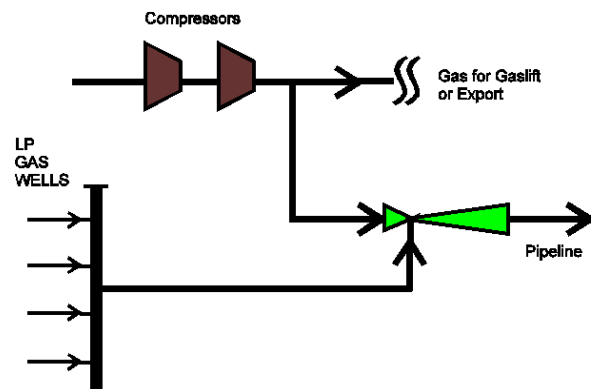
#### HP Well(s) Driving LP Well(s)

Gas from HP wells is used as the motive flow to boost the pressure of LP gas wells. Reduction in back pressure on LP wells results in increased production and total recovery. For both HP and LP wells more than one well may be involved, depending on HP/LP pressure ratio, flow ratio and the required discharge (pipeline) pressure.



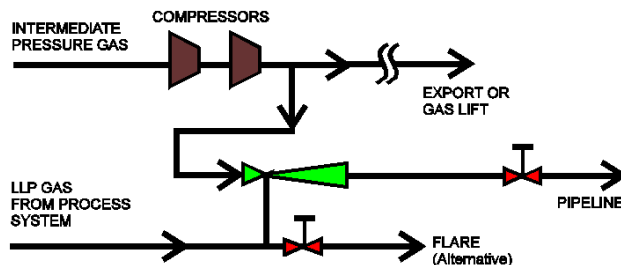
#### HP Gas from Compressors as Motive Flow

Where HP gas wells are not available, motive, HP, gas can be supplied from downstream of existing compressor(s). (The HP gas from compressor could be for export or gas lift purposes.) This solution reduces the back pressure on LP gas wells, thus increasing their production and total recovery. The pressure of gas downstream of the jet pump meets the pipeline pressure requirements for export or transportation to other platforms.



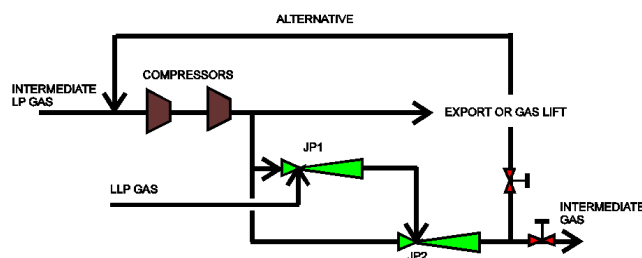
## LLP Gas Boosted using HP Gas from Compressors

Very low pressure gas, (LLP) traditionally flared, from the process system can be boosted, using HP gas from the outlet of existing compressors, to an intermediate level for pipeline transportation. Alternatively, it may be boosted to a level sufficient for the inlet of compressors or, in some applications, all or part of it can be used as fuel gas or fed into the 1<sup>st</sup> stage or 2<sup>nd</sup> stage compressors.



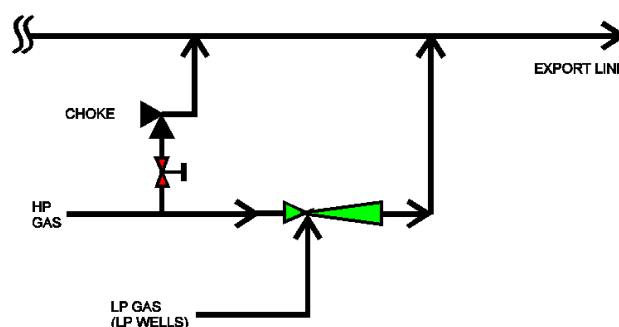
## LLP Gas Boosted using Two Jet Pumps in Series

In this application the pressure of LLP gas is too low to be boosted in a single stage. Two jet pumps in series enable the required discharge pressure to be met.



## Gas Boosted to Meet Export Line Pressure

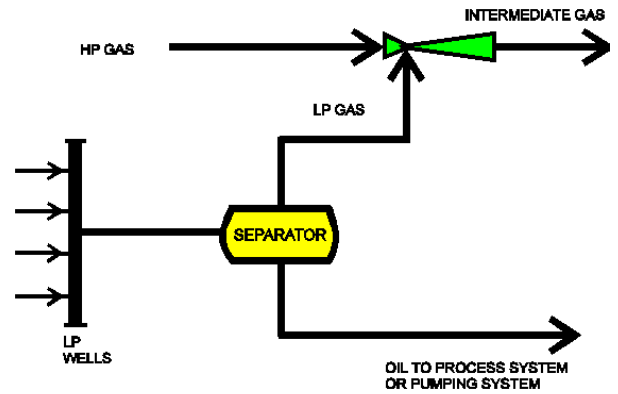
When the production from LP wells is restricted, because of the back pressure imposed by the export pipeline, HP gas, which in some cases is choked down to meet the export line pressure, may be used as the motive flow to bring the pressure of LP gas to that of the export line.



# Oil Production

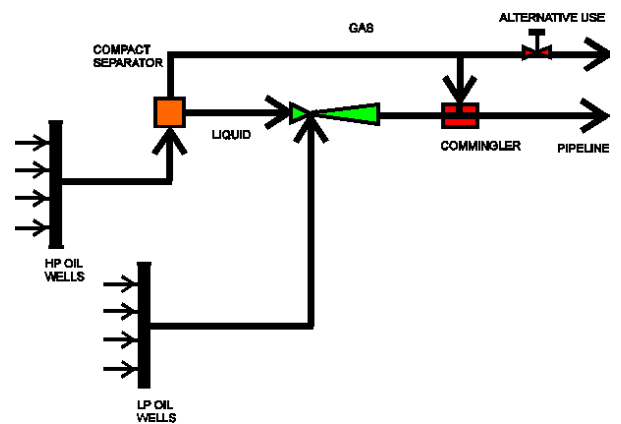
## Boosting the Pressure of LP Gas from a Separator

This case applies to an existing production system where the back pressure on LP wells is dictated by the pressure of the gas from the outlet of the separator. By boosting the pressure of this gas using a jet pump and HP gas, the operating pressure of the main separator can be dropped, thus reducing the back pressure on LP wells and increasing their production.



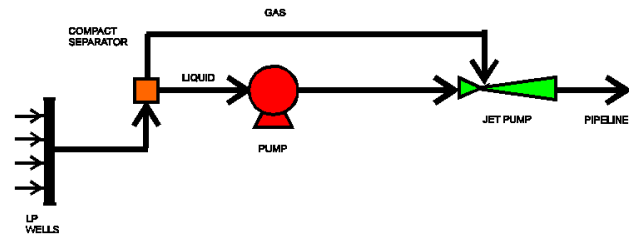
## WELLCOM Oil, HP Oil Wells Drive LP Oil Wells

Where HP oil wells are used as the motive (HP) source, a compact separator (I-SEP) separates the HP liquid phase, which is fed into the jet pump as the motive flow. HP gas bypasses the jet pump and is combined with the flow from the outlet of the jet pump, using a commingler. More than one HP or LP well may be utilised depending on HP/LP flow ratio, pressure ratio and the gas volume fraction of the LP flow.



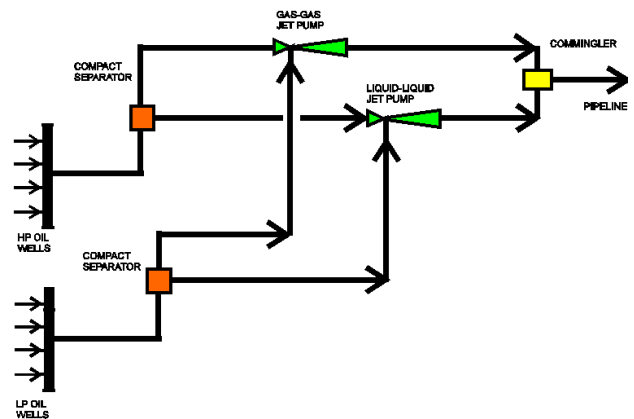
## Boosted WELLCOM – HP Motive Liquid Generated by a Liquid Booster Pump

HP wells are not available. Motive (HP) flow is generated by separating the gas the liquid phases of the LP flow. The liquid phase is boosted using a single phase pump. This boosted liquid phase is then used to boost the pressure of the separated gas using a specially designed jet pump.



## Dual WELLCOM System

Where the gas volume fraction of HP wells is high, single WELLCOM systems become less effective. The Dual WELLCOM system enables two jet pumps to be used. A gas-gas jet pump, using HP gas to boost LP gas, and a liquid-liquid jet pump using HP liquid phase to boost LP liquid phase. The two streams from the outlet of the jet pumps are combined using a comingler.



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