SKID DESIGNS WITH MULTIPORT SYSTEMS

PRACTICE CASE

INTRODUCTION

There are well known advantages of the multiport design that could be summarized in the following terms:

1.- Reduction in number of pipes and accessories needed to make the assembly – Interconnecting multiple pressure vessels eliminates the need for more costly headers, manifolds, accessories, and additional piping.

2.- Reduction in number of weldings There are two advantage of this reduction: technical and economical, which, actually interflow each other. The quality welding is performed from special stainless steel and by highly qualified approved welders. Consequently, such welders and the work they perform can be a costly adder to any project. Interconnecting pressure vessels eliminates the need for additional pipe costs and welding costs.

As for the technical terms, welding is a critical point during installation, because it is a point in which the leaks and corrosion can appear in an easy way, mainly if the procedures are not followed in a proper way.

3.- Reduction of the physical space needed for installation assembly – "Reduced Footprint"·

The target of this exercise is use the extreme potential of the multiport vessels in order to reach the optimal design of a skid of a medium size.

On the other side, it is very important to highlight that this simple exercise could be extrapolated to any other system if we have the exact information about the system.

BEL Technical Department, with its experienced engineers deeply involved in desalination issues for many years, would like to offer this service to our customers in order to help them in their design or simply suggest free alternatives to their design.

Reducing the footprint of any system is a huge advantage in cost savings whether it be a building or mobile trailer. The use of multiport design significantly reduces the space needed in comparison to using an End Port or Side Port designed system of the same flow rate.

STARTING VALUES

The starting values are the main point to make a good design. It is very important to have the membrane reports. This document will provide all the information needed and related to the system we are going to study.

However any additional piece of information will be very helpful while designing a system with Multiple Pressure Vessels. We could get possible limitations in height with the skid and

this additional data could give us the best scenario to make the design according to the customers needs.

In an initial membrane report there are parameters that will give us the initial point to start the design.

- ✓ Pressure of the system. (Feed & Reject)
- ✓ Feed Flow
- ✓ Reject Flow
- ✓ Recovery of the system
- ✓ Membrane age.
- ✓ Disposition of stages and or passes.
- ✓ And any other normal parameter included in a membrane report of a RO system.

In this example we are going to consider a membrane report, in which we are going to select the most important information.

This exercise and the example provided below is intended to show the distinct advantage of employing a multi-port design in a given system and how BEL's technical team can assist in your design needs.

SKID DESIGN

The system is a single stage, with the following values, the values of a real working system are taken.

- ✓ Permeate flow: 97,70 m^3/h – (2.200,00 m^3/h)
- ✓ Feed flow: 229,17 m^3/h – (5.500,00 m^3/h)
- ✓ Recovery of the system: 40%
- ✓ Membrane age: 3 years
- ✓ Feed pressure: 67,50 bar
- ✓ Membrane Flux: 14,0 l/m^2.h
- ✓ Nº of elements: 160 units
- ✓ Nº of vessels: 20 units
- ✓ Nº of elements per vessel: 8 units.

With this scenario, we proceed to make an initial estimation about the grid of the skid.

The gird considered is 5 columns x 4 rows of 1.000 psi -8 membrane vessels.

To make the calculation of the ports of the vessels interconnected we will use a simple calculation as follows.

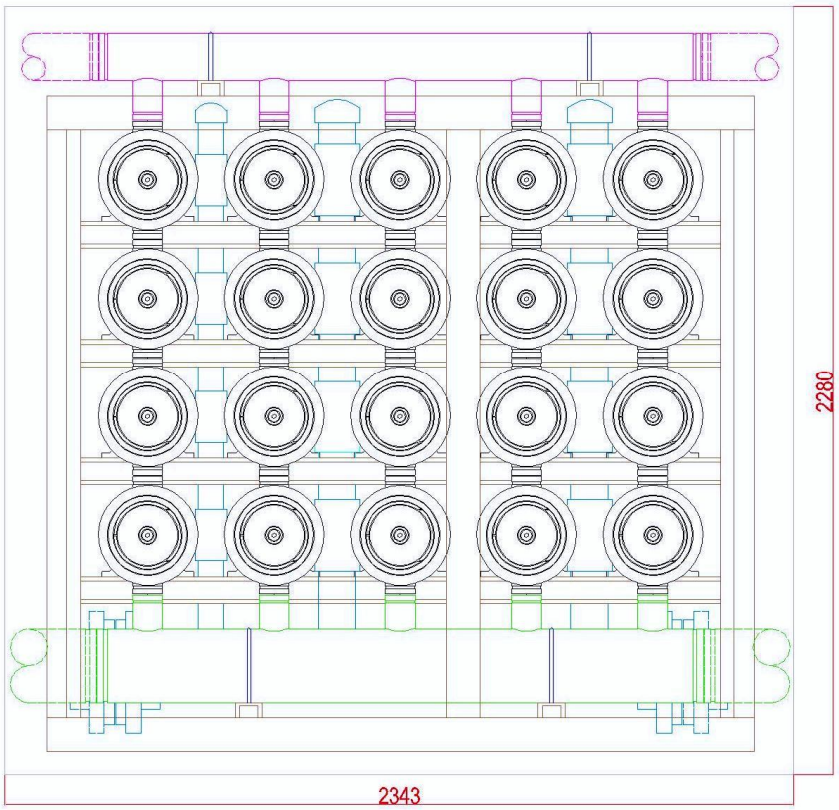
CUSTOMER:							
PROJECT:							
OPTION:							
SKID FEED SIDE							
FEED FLOW PER PARTIAL SKID				5.500,00	m3/d	229,17	m3/h
Nº PRESSURE VESSELS PER SEMI SKID				20,00	Units		
GRID				5,00	Columns	4,00	Rows
UNITARY FLOW PER PRESSURE VESSEL				275,00	m3/d	11,46	m3/h
Nº PRESSURE VESSELS INTERCONNECTED				**4,00**	Units		
FLOW PER PRESSURE VESSELS INTERCONNECTED				1.100,00	m3/d	45,83	m3/h
FLOW IN CRITICAL PORT				1.100,00	m3/d	45,83	m3/h
INITIAL VELOCITY FOR CALCULATION				2,80	m/s		
INTERNAL DIAMETER OF CRITICAL PORT				76,09	mm		
COMMERCIAL DIAMETER PORT				77,90	mm	**3"**	inch
REAL VELOCITY IN COMMERCIAL DIAMETER PORT				**2,67**	m/s		
FEED MANIFOLDS							
GENERAL FEED MANIFOLD							
FEED FLOW				5.500,00	m3/d	229,17	m3/h
INITIAL VELOCITY FOR CALCULATION				2,80	m/s		
INTERNAL DIAMETER OF PIPE - FEED MANIFOLD				170,14	mm		
COMMERCIAL DIAMETER PIPE		202,72	mm	**8"**	**Super Duplex Sch40**		
REAL VELOCITY IN COM. DIAM. PIPE		**1,97**	m/s				

CUSTOMER:							
PROJECT:							
OPTION:							
SKID REJECT SIDE							
FEED FLOW PER PARTIAL SKID				3.300,00	m3/d	137,50	m3/h
Nº PRESSURE VESSELS PER SEMI SKID				20,00	Units		
GRID				5,00	Columns	4,00	Rows
UNITARY FLOW PER PRESSURE VESSEL				165,00	m3/d	6,88	m3/h
Nº PRESSURE VESSELS INTERCONNECTED				**4,00**	Units		
FLOW PER PRESSURE VESSELS INTERCONNECTED				660,00	m3/d	27,50	m3/h
FLOW IN CRITICAL PORT				660,00	m3/d	27,50	m3/h
INITIAL VELOCITY FOR CALCULATION				2,80	m/s		
INTERNAL DIAMETER OF CRITICAL PORT				58,94	mm		
COMMERCIAL DIAMETER PORT				77,90	mm	**3"**	inch
REAL VELOCITY IN COMMERCIAL DIAMETER PORT				**1,60**	m/s		
REJECT MANIFOLD							
GENERAL REJECT MANIFOLD							
FEED FLOW				3.300,00	m3/d	137,50	m3/h
INITIAL VELOCITY FOR CALCULATION				2,80	m/s		
INTERNAL DIAMETER OF PIPE - FEED MANIFOLD				131,79	mm		
COMMERCIAL DIAMETER PIPE		154,06	mm	**6"**	**Super Duplex Sch40**		
REAL VELOCITY IN COM. DIAM. PIPE		**2,05**	m/s				

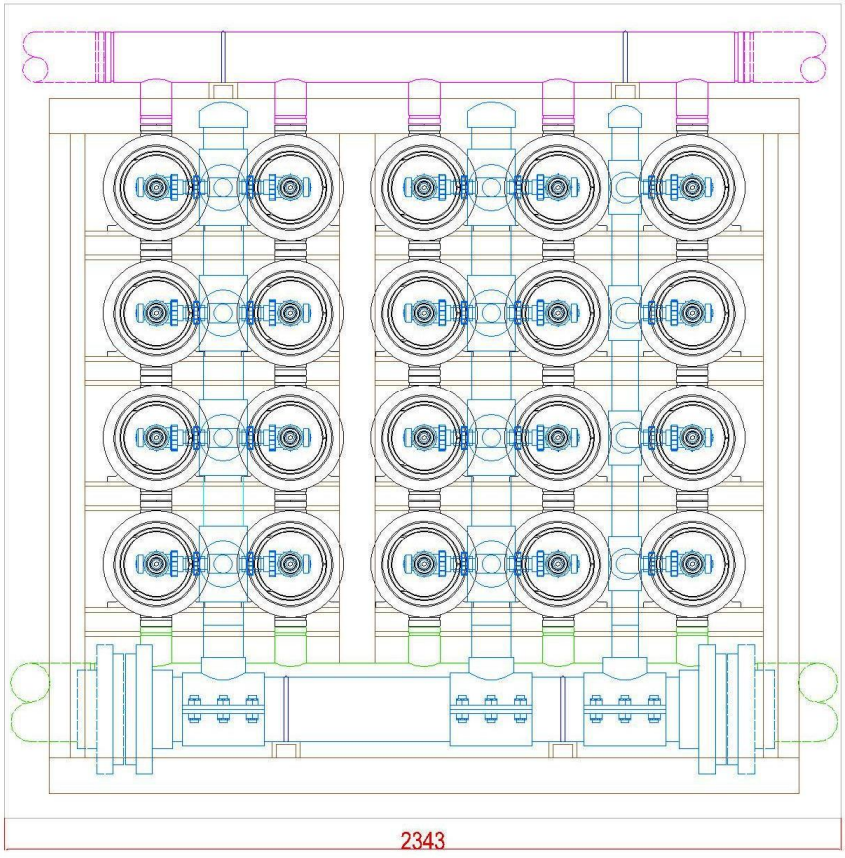
NOTE – The Calculations are done taking into account the maximum **velocity of 3,00 m/s**, considering the effect of high velocities on pipes and pressure drops linked to.

With this configuration we can make the design shown in the following images.

FRONT VIEW

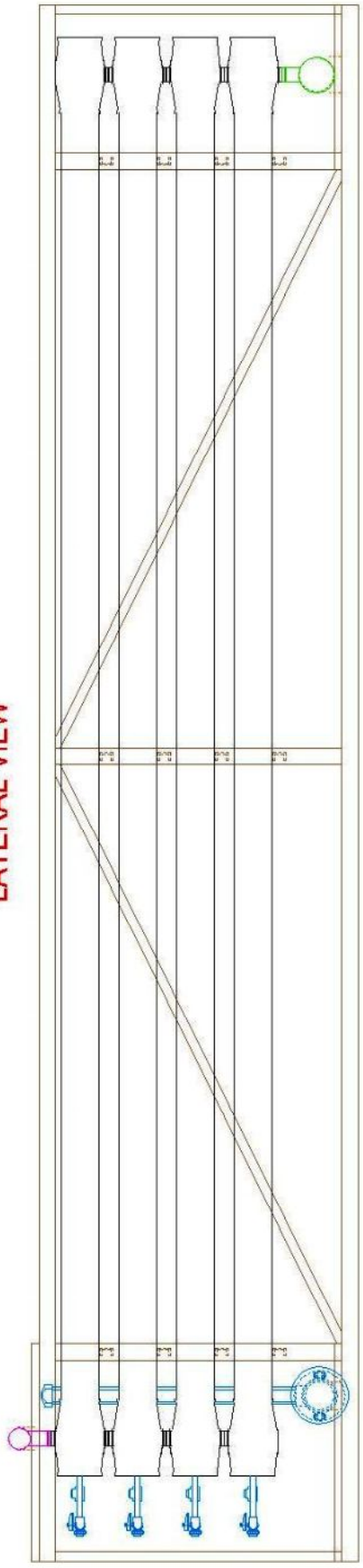


REAR VIEW



BEL

LATERAL VIEW



TOP VIEW