Universitat Autònoma de Barcelona

TECHNICAL NOTE 87.2.17

C2 Detailed Engineering Datapackage

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TABLE OF CONTENT

1. OBJECT

1. OBJECT

The Universitat Autònoma de Barcelona, from now UAB, participate in the Project MELISSA (Micro-Ecological Life Support System Alternative), together with the European Space Agency (ESA), related to study how to establish the life conditions into the space during long time missions.

In the UAB facilities, there is installed a Pilot Plant consisting in several modules to study the different stages and processes of recycling and recovering of food, water and oxygen from wastes, i.e. CO_2 and organic wastes, using the light as a source of energy.

The UAB required to De Dietrich Equipos Químicos SL, from now DDEQ, to study the design and assembling of one of these modules, specifically the one defined as COMPARTMENT II.

DDEQ submitted to the UAB, one quotation, ref DDE-K 1764-SI, dated on Sept 23 2008, defined as: "Budget proposal for detail engineering works related with the design of a photo-bioreactor and ancillary equipment", in order to develop the design, engineering and economical investment cost for the design of that module.

The documentation of reference is basically:

- "Technical Note: 62.2 Preliminary design of the Compartment II Pilot Photobioreactor", and other documents from UAB.
- Information defined in different meetings held with MELiSSA people.
- Standards of design taken from the previous design of module Compartment IVa.

The UAB placed an order to DDEQ, reference: "contracte 2995/2008 d´enginyería del mòdul II per al projecte MELiSSA", dated on 12.01.09, for the execution of the works according conditions established in the scope of the quotation of DDEQ indicated.

With the present Project submitted to the UAB, DDEQ understands that it fulfil with the scope contemplated in the order of reference.

2. FUNCTIONAL SPECIFICATION

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1 INTRODUCTION: The MELiSSA project

MELiSSA is the acronym for Micro-Ecological Life Support System Alternative. This system consists of a loop of interconnected compartments envisaged to work as a complete unit. The driving element of MELISSA is the recovery of food, water and oxygen from organic waste, carbon dioxide and minerals. Based on the principle of an aquatic ecosystem, MELISSA is comprised of 5 compartments, colonized respectively by:

- thermophilic anoxygenic bacteria
- photo heterotrophic bacteria
- nitrifying bacteria
- photosynthetic bacteria and higher plants
- the last one being the crew

Such a system would be a key element to provide life support in any long term extraterrestrial manned activity as it would allow relieving the need for a constant food supply and waste disposal. A Moon or Mars planetary base or a permanent orbital station can be given as examples.
Each compartment has a given objective within the complete biotransformation loop.

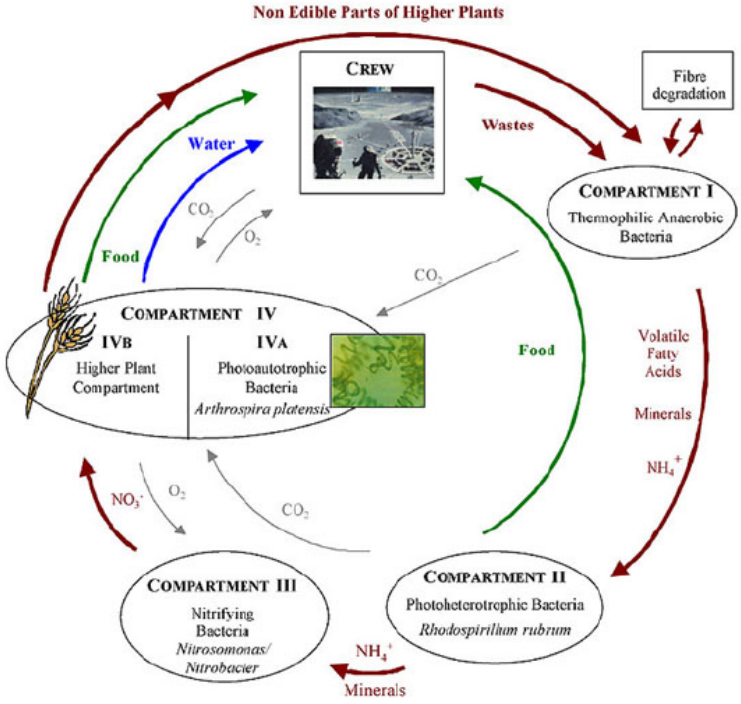


Figure 1: MELiSSA Advanced Loop Concept

1.1 Compartment II description:

The Compartment II of the MELiSSA Loop is the photo-heterotrophic compartment, which function is to consume the carbon sources that are not oxidized by the First Compartment. These carbon sources are mainly volatile fatty acids of low molecular weight.

The strain *Rhodospirillum rubrum* is grown in this compartment as it is capable to utilize all these carbon sources.

Due to the great degree of control that is needed in the operation of all the MELiSSA Compartments (particularly C-II), and for safety reasons, two main drivers have to be taken into account when designing and building this bio-reactor:

- the axenity of the bioreactor has to be ensured
- high standard of quality control has to be followed

1.2 Functional specification document:

This document claims to do a general description of all the plant control loops, control elements, output/input signals, alarms and lock out.

IMPORTANT NOTE: The alarms and lock outs described in this document are only a reference because there can be more alarms concerning the process which are not defined in this document.

The documents of reference for this section are:

- P&ID DD-8550-Z1-100-02 rev. F (P&ID: control loops)
- Instruments list rev. A
- Instruments specifications rev. A
- Digital/Analogical signals list rev. A

OBSERVATION:

The control loops list has been prepared by MPP and SHERPA. All the elements of the P&ID have been tagged according the UAB/MPP "Tag's and labeling" document and control loops list.

Compartment II loops list is the next:

DOCUMENT SECTION	LOOP NUMBER	DESCRIPTION
2	**2000**	Influent General
3	**2001**	Influent liquid Flow Control
4	**2002**	Feeding Tank Level Control
5	**2003**	Feeding Tank Temperature Control
6	**2004**	Feeding Tank Pressure Control
7	**2005**	Bioreactor General
8	**2006**	Bioreactor Lightning Control
9	**2007**	Bioreactor Temperature Control
10	**2008**	Bioreactor pH Control
11	**2009**	Bioreactor Pressure Control
12	**2010**	Bioreactor Level Control
13	**2011**	Bioreactor Biomass Production Control
14	**2012**	Gas Loop Control
15	**2013**	Bioreactor Outlet Gas Composition
16	**2014**	Effluent General
17	**2015**	Effluent Liquid Flow Control
18	**2016**	Harvest Level Control
19	**2017**	Harvesting Tank Temperature Control
20	**2018**	Harvesting Tank Pressure Control
21	**2019**	Helium Tank Control
22	**2020**	Antifoam Control
23	**2021**	Feeding Tank Sterilization
24	**2022**	Bioreactor Sterilization
25	**2023**	Harvesting Tank Sterilization

2 Loop 2000: Influent General

This loop includes the agitator, and all the instruments linked to another loop. At the moment, this loop only includes the agitation system of the feeding vessel VS 2000 01.

2.1 Control elements:

- GP 4001 03 speed regulator: Magnetic agitator. Feeding vessel agitation.

2.2 PLC output signals:

Equipment	Description	I/O	Signal Type
GP 2000 01	Start/Stop feeding tank agitator converter	DO	0/1
GP 2000 01	Feeding tank agitator speed set-point	AO	4-20 mA

2.3 PLC input signals:

Equipment	Description	I/O	Signal Type
GP 2000 01	Feeding tank agitator thermal protection	DI	0/1

2.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	GP 2000 01	Thermal protection	Err	To notify alarm to supervision	

3 Loop 2001: Influent Liquid Flow Control

This loop regulates the reactor inlet liquid flow. Liquid input media is provided from two pumps (GP 2001 01 and GP 2001 02), working alternatively depending on the pre-filters blockage or pump maintenance.
Flow rate set point is provided by the supervision.

3.1 Control elements:

- PS 2001 01/02: Pressure switch. Pump membrane breakage detection.
- PS 2001 03/04: Pressure switch. Lines over-pressure detection.
- DPT 2001 01: Differential pressure transmitter. Differential pressure measurement for inlet liquid pre-filters (LF 2001 01/02) blockage control.
- FT 2001 01: Liquid mass flow meter. Reactor inlet liquid flow measurement.
- DPT 2001 02: Differential pressure transmitter. . Differential pressure measurement for inlet liquid filters (LF 2001 03/04) blockage control.
- GP 2001 01/02 speed regulator: Feeding pumps. Bioreactor inlet liquid flow regulation.

3.2 PLC output signals:

Equipment	Description	I/O	Signal Type
GP 2001 01/02	Start/Stop inlet pumps converter	DO	0/1
GP 2001 01	Start/Stop inlet pump GP 2001 01	DO	0/1
GP 2001 02	Start/Stop inlet pump GP 2001 02	DO	0/1
GP 2001 01/02	Flow set-point (inlet pumps)	AO	4-20 mA

3.3 PLC input signals:

Equipment	Description	I/O	Signal Type
GP 2001 01/02	Inlet pumps thermal protection	DI	4-20 mA
PS 2001 01	Pressure switch (GP 2001 01)	DI	0/1
PS 2001 02	Pressure switch (GP 2001 02)	DI	0/1
PS 2001 03	Pressure switch	DI	0/1
PS 2001 04	Pressure switch	DI	0/1
FT 2001 01	Total liquid inlet flow to reactor	AI	4-20 mA
DPT 2001 01	Differential pressure measurement (pre-filters)	AI	4-20 mA
DPT 2001 02	Differential pressure measurement (filters)	AI	4-20 mA

3.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	PS 2001 01/02	Pressure	H	To notify alarm to supervision	
2	PS 2001 03/04	Pressure	H	To notify alarm to supervision	GP 2001 01/02
3	DPT 2001 01	Differential pressure	H	To notify alarm to supervision	
4	DPT 2001 01	Differential pressure	HH	To notify alarm to supervision	GP 2001 01/02
5	DPT 2001 02	Differential pressure	H	To notify alarm to supervision	
6	DPT 2001 02	Differential pressure	HH	To notify alarm to supervision	GP 2001 01/02

3.4.1 **Alarms and warnings description:**

1 → ALARM: The membrane of the feeding pump has broken.

⚠ **The pump works with a sandwich membrane which permits a quickly damage detection. If work membrane is broken, the process product is conducted through the control membrane to the pressure switch. When the sensors alarm is activated, the pump can continue with working by means of a fourth membrane during a maximum time of 24h.**

2 → ALARM: There is a line overpressure. (Probably because of a process pipe manual valve is closed). Stop feeding pumps.
3 / 5 → WARNING: The differential pressure (inlet/outlet of filter) has rise to ------bar. (Preventive maintenance)
4 / 6 → ALARM: The differential pressure (inlet/outlet of filter) has rise to 2.5-3 bar. Stop feeding pumps.

⚠ **It should be noted that the number of times the temperature is cycled from ambient to the sterilization temperature rather than the time at temperature determines the lifetime of the cartridge in steam.**

To maximize the life of the cartridge, the differential pressure across the cartridge should not exceed 0.30 bar (4.4 psi) at 142°C (288°F).

4 Loop 2002: Feeding Tank Level Control

This loop controls the liquid level of the feeding tank. The level is measured with a guided microwave level transmitter.
The level measure is sent to the supervision.

4.1 Control elements:

- LT 2002 01: Level transmitter. Feeding tank (VS 2000 01) level measurement.

4.2 PLC output signals:

There is not any signal sent by the PLC in this loop.

4.3 PLC input signals:

Equipment	Description	I/O	Signal Type
LT 2002 01	Feeding tank level measurement	AI	4-20 mA

4.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	LT 2002 01	Level	H	To notify alarm to supervision	
2	LT 2002 01	Level	L	To notify alarm to supervision	GP 2000 01
3	LT 2002 01	Level	LL	To notify alarm to supervision	GP 2001 01/02

4.4.1 Alarms and warnings description:

1 → WARNING: Feeding vessel level is at ------% or upper.
2 → ALARM: Feeding vessel level is at ------% or lower. Stop the tank agitator (GP 2000 01)
3 → ALARM: VS 2000 01 is empty. Stop feeding pump (GP 2001 01 or GP 2001 02)

5 Loop 2003: Feeding Tank Temperature Control

This loop regulates the temperature of the feeding tank medium. The temperature is measured with a temperature transmitter installed in the tank hoop.
The temperature is regulated by means of cool water flowing through the tank jacket. This flow is controlled with an on/off automatic valve installed in the jacket outlet.

5.1 Control elements:

- TT 2003 01: Temperature transmitter. Tank VS 2000 01 temperature measurement.
- SV 2003 01: Control valve. Feeding tank VS 2000 01 jacket cooling water outlet valve.

5.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2003 01	Open/Close cooling water outlet valve	DO	0/1

5.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2003 01	Cooling water inlet valve feedback	DI	0/1
TT 2003 01	Feeding tank temperature measurement	AI	4-20 mA

5.4 Alarms and warnings:

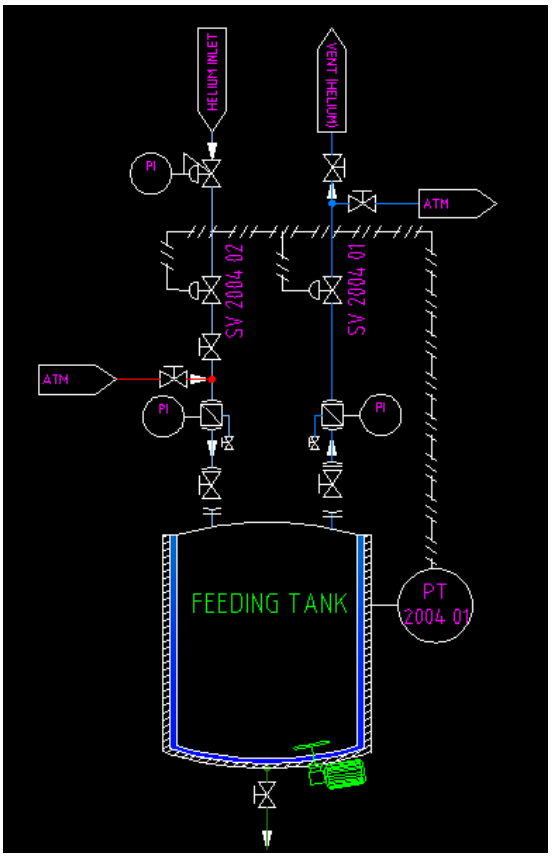
Nr.	Tag	Variable	Alarm	Action	Lock out
1	TT 2003 01	Temperature	H	To notify alarm to supervision	
2	SV 2003 01		Err	To notify alarm to supervision	

5.4.1 Alarms and warnings description:

1 → ALARM: Temperature is upper than ----ºC.

2 → ALARM: The automatic valve is not working.

6 Loop 2004: Feeding Tank Pressure Control



The feeding tank should be maintained, as all the plant, in anaerobic conditions.

The designed system has a way of allowing the inert gas (helium) into the tank, and a way to vent the gas when the pressure gets too high.

The helium is stored in a buffer tank of 40 l, which is used for the inertization of feeding and harvesting tank. This buffer tank operates at higher pressure than the feeding tank and for the vented gas storage is needed a gas compressor.

The system should operate at a slightly higher pressure than atmospheric.

A pressure transmitter measures the tank pressure and actuates over both automatic valves. When the pressure is lower than the set-point, the helium inlet is opened and when is higher, the helium is vented to the buffer tank.

6.1 Control elements:

- PT 2004 01: Pressure transmitter. Feeding tank VS 2000 01 pressure measurement.
- SV 2004 01: Control valve. Feeding tank VS 2000 01 vent pipe valve.
- SV 2004 02: Control valve. Feeding tank VS 2000 01 helium inlet pipe valve.
- SV 2004 03: Control valve. Compressor recycling valve.
- PS 2004 01: Pressure switch. Switch for compressor recycling control.

6.2 PLC output signals:

Equipment	Description	I/O	Signal Type
BLWR 2004 01	Start/Stop the compressor	DO	0/1
SV 2004 03	Open/Close compressor (BLWR 2004 01) bypass valve	DO	0/1
SV 2004 01	Open/Close feeding tank vent valve	DO	0/1
SV 2004 02	Open/Close helium inlet valve	DO	0/1

6.3 PLC input signals:

Equipment	Description	I/O	Signal Type
PS 2004 01	Pressure switch for compressor recycling	DI	0/1
SV 2004 01	Feeding tank vent valve feedback	DI	0/1
SV 2004 02	Helium inlet valve feedback	DI	0/1
SV 2004 03	Compressor (BLWR 2004 01) bypass valve feedback	DI	0/1
PT 2004 01	Feeding tank pressure measurement	AI	4-20 mA

6.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	PS 2004 01	Pressure	H	-----	
2	SV 2004 01		Err	To notify alarm to supervision	
3	SV 2004 02		Err	To notify alarm to supervision	
4	SV 2004 03		Err	To notify alarm to supervision	
5	PT 2004 01	Pressure	H	To notify alarm to supervision	
6	PT 2004 01	Pressure	L	To notify alarm to supervision	

7 Loop 2005: Bioreactor General

This loop regulates the bioreactor agitation. The speed of agitation is variable by means of a converter. Agitation speed set point is provided by the supervision.

7.1 Control elements:

- GP 2005 01 speed regulator: Bioreactor agitation. Bioreactor agitation rate regulation.

7.2 PLC output signals:

Equipment	Description	I/O	Signal Type
GP 2005 01	Start/Stop bioreactor agitator converter	DO	0/1
GP 2005 01	Bioreactor agitator speed set-point	AO	4-20 mA

7.3 PLC input signals:

Equipment	Description	I/O	Signal Type
GP 2005 01	Bioreactor agitator thermal protection	DI	0/1

7.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	GP 2005 01	Thermal protection	Err	To notify alarm to supervision	

IMPORTANT NOTE:

The red ox sensor is not included in any loop. The description of the function of this sensor is pending to be defined. The signals related to the sensor are the next:

Equipment	Description	I/O	Signal Type
AT 2005 01	Redox measurement	AI	4-20 mA
TT 2005 01	Temperature measurement (AT 2005 01)	AI	4-20 mA

8 Loop 2006: Bioreactor Lightning Control

This loop regulates the light intensity. The intensity is controlled by the PLC and is not possible to do it locally.
The light intensity can be regulated depending on the feedback of real intensity measures.

8.1 Control elements:

- IRC 2006 01: Light supply system. Light intensity regulation.

8.2 PLC output signals:

Equipment	Description	I/O	Signal Type
IRC 2006 01	Light intensity set-point	AO	4-20 mA

8.3 PLC input signals:

Equipment	Description	I/O	Signal Type
IRC 2006 01	Light Power Phase 1	AI	4-20 mA
IRC 2006 01	Light Power Phase 2	AI	4-20 mA
IRC 2006 01	Light Power Phase 3	AI	4-20 mA

8.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	**A)**	Temperature	H	To notify alarm to supervision	
2	**A)**	Temperature	HH	To notify alarm to supervision	Light intensity (safety value)

A) The temperature value used to set these alarms will be defined in the control software depending on the type of data processing because the PLC receive five temperatures values from the reactor instrumentation:

Equipment	Description	I/O	Signal Type
TT 2007 01	Reactor temperature measurement	AI	4/20 mA
TT 2008 01	Temperature measurement (AT 2008 01)	AI	4/20 mA
TT 2008 02	Temperature measurement (AT 2008 02)	AI	4/20 mA
TT 2005 01	Temperature measurement (AT 2005 01)	AI	4/20 mA
TT 2013 02	Temperature measurement (AT 2013 03)	AI	4/20 mA

8.4.1 Alarms and warnings description:

1 → WARNING: The PBR temperature has rise to ------ºC.

2 → ALARM: The PBR temperature has rise to ------ºC (maximum process admissible temperature). Set light intensity to safety value (--- %)

⚠ **From hardware point of view, the permissible operating temperature is 200ºC, provided that there is no sudden temperature shock.**

9 Loop 2007: Bioreactor Temperature Control

This loop measures and regulates the bioreactor temperature and provides this information to the control system. The temperature is regulated by two different systems: refrigerating with cool water through reactor jacket and refrigerating with air through lights system jacket.

9.1 Control elements:

- TT 2007 01: Temperature transmitter. Bioreactor temperature measurement.
- TT 2008 01: Temperature transmitter. Bioreactor temperature measurement (from pH sensor).
- TT 2008 02: Temperature transmitter. Bioreactor temperature measurement (from pH sensor).
- TT 2005 01: Temperature transmitter. Bioreactor temperature measurement (from redox sensor).
- TT 2013 02: Temperature transmitter. Bioreactor temperature measurement (from O_2/dO_2 sensor).
- BLWR 2007 01: Air Extractor. Air circulation in bioreactor refrigeration system by air.
- SV 2007 01: Control valve. Cooling water outlet valve.
- HX 2007 02: Electrical resistance. Electrical resistance for water heating.

9.2 PLC output signals:

Equipment	Description	I/O	Signal Type
HX 2007 02	Start/Stop electrical resistance	DO	0/1
BLWR 2007 01	Start/Stop air extractor	DO	0/1
SV 2007 01	Open/Close cooling water outlet valve	DO	0/1
PP 2007 01	Start/Stop the pump	DO	0/1
BLWR 2007 01	Air extractor set-point	AO	4-20 mA

9.3 PLC input signals:

Equipment	Description	I/O	Signal Type
BLWR 2007 01	Air extractor thermal protection	DI	0/1
SV 2007 01	Cooling water inlet valve feedback	DI	0/1
TT 2007 01	Reactor temperature measurement	AI	4-20 mA
TT 2008 01	Temperature measurement (AT 2008 01)	AI	4-20 mA
TT 2008 02	Temperature measurement (AT 2008 02)	AI	4-20 mA
TT 2005 01	Temperature measurement (AT 2005 01)	AI	4-20 mA
TT 2013 02	Temperature measurement (AT 2013 03)	AI	4-20 mA

9.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	A)	Temperature	H	To notify alarm to supervision	
2	A)	Temperature	HH	To notify alarm to supervision	Light intensity (safety value)
3	BLWR 2007 01	Thermal protection	Err	To notify alarm to supervision	
4	SV 2007 01		Err	To notify alarm to supervision	

A) The temperature value to set these alarms will be defined in the control software depending on the type of data processing. There are five measured values of the reactor temperature.

Equipment	Description	I/O	Signal Type
TT 2007 01	Reactor temperature measurement	AI	4/20 mA
TT 2008 01	Temperature measurement (AT 2008 01)	AI	4/20 mA
TT 2008 02	Temperature measurement (AT 2008 02)	AI	4/20 mA
TT 2005 01	Temperature measurement (AT 2005 01)	AI	4/20 mA
TT 2013 02	Temperature measurement (AT 2013 03)	AI	4/20 mA

9.4.1 **Alarms and warnings description:**

1 → WARNING: The PBR temperature has rise to ------ºC.

2 → ALARM: The PBR temperature has rise to ------ºC (maximum process admissible temperature). Set light intensity to safety value (--- %)

⚠ **From hardware point of view, the permissible operating temperature is 200ºC, provided that there is no sudden temperature shock.**

3 → ALARM: Alarm from the blower thermal protection.

4 → ALARM: The automatic valve is not working. Notify failure to the supervision.

10 Loop 2008: Bioreactor pH Control

This loop measures and regulates the bioreactor pH and provides this information to the control system. The pH is

10.1 Control elements:

- AT 2008 01: pH sensor/transmitter. Bioreactor pH measurement. (BPR lower part)
- AT 2008 02: pH sensor/transmitter. Bioreactor pH measurement. (Installed in BPR outlet liquid pipe)
- SV 2008 01: Control valve. Acid addition regulation.
- SV 2008 02: Control valve. Base addition regulation.
- WT 2008 01: Scale. Acid bottle weight measurement for level control.
- WT 2008 02: Scale. Base bottle weight measurement for level control.

10.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2008 01	Open/Close PBR acid inlet valve	DO	0/1
SV 2008 02	Open/Close PBR base inlet valve	DO	0/1
PP 2008 01	Start/Stop the acid pump	DO	0/1
PP 2008 02	Start/Stop the base pump	DO	0/1

10.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2008 01	PBR acid inlet valve feedback	DI	0/1
SV 2008 02	PBR base inlet valve feedback	DI	0/1
WT 2008 01	Weight (level) measurement	Eth	Ethernet
WT 2008 02	Weight (level) measurement	Eth	Ethernet
AT 2008 01	pH measurement	AI	4-20 mA
TT 2008 01	Temperature measurement (AT 2008 01)	AI	4-20 mA
AT 2008 02	pH measurement	AI	4-20 mA
TT 2008 02	Temperature measurement (AT 2008 02)	AI	4-20 mA

10.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	AT 2008 01/02	pH***)***	H	To notify alarm to supervision	
2	AT 2008 01/02	pH***)***	L	To notify alarm to supervision	Light intensity (safety value)
3	WT 2008 01	Weight (Level)	L	To notify alarm to supervision	
4	WT 2008 01	Weight (Level)	LL	To notify alarm to supervision	PP 2008 01
5	WT 2008 02	Weight (Level)	L	To notify alarm to supervision	
6	WT 2008 02	Weight (Level)	LL	To notify alarm to supervision	PP 2008 02
7	SV 2008 01		Err	To notify alarm to supervision	
8	SV 2008 02		Err	To notify alarm to supervision	

) The pH value to set these alarms will be defined in the control software depending on the type of data processing.

10.4.1 **Alarms and warnings description:**

1 → ALARM: The PBR pH has risen to ------.

2 → ALARM: The PBR pH has fallen to ------.

3 → WARNING: Acid vessel level is at ------% or lower.

4 → ALARM: VS 4006 01 is empty. Lock out stop PP 4006 01.

5 → WARNING: Base vessel level is at ------% or lower.

6 → ALARM: VS 4006 02 is empty. Lock out stop PP 4006 02.

7 → ALARM: The automatic valve is not working. Notify failure to supervision.

8 → ALARM: The automatic valve is not working. Notify failure to supervision.

11 Loop 2009: Bioreactor Pressure Control

This loop measures and controls the bioreactor pressure and provides this information to the control system.

11.1 Control elements:

- PT 2009 01: Pressure transmitter. PBR pressure measurement.
- PT 2009 02: Pressure transmitter. Bioreactor pressure measurement.
- SCV 2012 01: Control valve. Outlet gas flow control.
- FT 2012 01: Flow meter. Outlet gas flow measure.

11.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SCV 2012 01	PBR outlet gas flow set-point	AO	4-20 mA

11.3 PLC input signals:

Equipment	Description	I/O	Signal Type
PT 2009 01	Bioreactor pressure measurement	AI	4-20 mA
PT 2009 02	Bioreactor pressure measurement	AI	4-20 mA
FT 2012 01	PBR outlet gas flow measurement	AI	4-20 mA

11.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	PT 2009 01/02	Pressure	H	To notify alarm to supervision	
2	PT 2009 01/02	Pressure	HH	To notify alarm to supervision	FQRC 2012 04 (0 Nl/min)

11.4.1 Alarms and warnings description:

1 → WARNING: The PBR pressure has rise to -----bar.

4 → ALARM: The PBR pressure has rise to ----bar. Close FQRC 2012 04 (PBR gas inlet)

⚠ **From hardware point of view, the permissible operating pressure for the jacketed section pipe (DN200) is from -1 bar_g to 1 bar_g,**

12 Loop 2010: Bioreactor Level Control

This loop measures and controls the bioreactor pressure and provides this information to the control system.

12.1 Control elements:

- WT 2010 01: Weight cells. PBR weight measure for level controlling.
- PS 2015 01/02: Pressure switch. Pump membrane breakage detection.
- PS 2015 03/04: Pressure switch. Lines over-pressure detection.
- GP 2015 01/02 speed regulator: Feed pumps. Reactor outlet liquid pumping.

12.2 PLC output signals:

Equipment	Description	I/O	Signal Type
GP 2015 01/02	Start/Stop outlet pumps converter	DO	0/1
GP 2015 01	Start/Stop outlet pump GP 2015 01	DO	0/1
GP 2015 02	Start/Stop outlet pump GP 2015 02	DO	0/1
GP 2015 01/02	Flow set-point (outlet pumps)	AO	4-20 mA

12.3 PLC input signals:

Equipment	Description	I/O	Signal Type
GP 2015 01/02	Outlet pumps thermal protection	DI	4-20 mA
PS 2015 01	Pressure switch (GP 2015 01)	DI	0/1
PS 2015 02	Pressure switch (GP 2015 02)	DI	0/1
PS 2015 03	Pressure switch	DI	0/1
PS 2015 04	Pressure switch	DI	0/1
WT 2010 01	Bioreactor weight (level) measurement	AI	4-20 mA

12.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	WT 2010 01	Weight (Level)	HH	To notify alarm to supervision	GP 2001 01/02
2	WT 2010 01	Weight (Level)	H	To notify alarm to supervision	
3	WT 2010 01	Weight (Level)	L	To notify alarm to supervision	
4	WT 2010 01	Weight (Level)	LL	To notify alarm to supervision	GP 2015 01/02
5	PS 2015 01/02	Pressure	H	To notify alarm to supervision	GP 2015 01/02
6	PS 2015 03/01	Pressure	H	To notify alarm to supervision	GP 2015 01/02

12.4.1 **Alarms and warnings description:**

1 → ALARM: PBR level is upper than ----- L. Stop feeding pump.

2 → WARNING: PBR level is at ------L or upper.

3 → WARNING: PBR level is at ------L or lower.

4 → ALARM: PBR level is lower than ----- L. Stop harvesting pump.

5 → ALARM: The membrane of the harvesting pump has broken.

⚠ **The pump works with a sandwich membrane which permits a quickly damage detection. If work membrane is broken, the process product is conducted through the control membrane to the pressure switch. When the sensors alarm is activated, the pump can continue with working by means of a fourth membrane during a maximum time of 24h.**

6 → ALARM: There is a line overpressure. (Probably because of a process pipe manual valve is closed). Stop harvesting pumps.

13 Loop 2011: Bioreactor Biomass Production Control

The biomass production control is still pending to be defined. The control elements and the signals directly related to this loop are:

13.1 Control elements:

- AT 4011 01: biomass sensor/transmitter. Bioreactor biomass measurement.
- AT 4011 02: biomass sensor/transmitter. Bioreactor biomass measurement.

13.2 PLC output signals:

At the moment, there is not any defined signal sent by the PLC.

13.3 PLC input signals:

Equipment	Description	I/O	Signal Type
AT 2011 01	Biomass measurement	AI	4-20 mA
AT 2011 01	Biomass sensor failure	AI	22 mA
AT 2011 02	Biomass measurement	AI	4-20 mA
AT 2011 02	Biomass sensor failure	AI	22 mA

14 Loop 2012: Gas Loop Control

This loop includes inlet and outlet gas instrument excepting gas composition. The loop needs to be defined.

14.1 Control elements:

- FQRC 2012 01: Control valve/Flow meter. C. I gas flow measure and control.
- FQRC 2012 02: Control valve/Flow meter. CO_2 flow measure and control.
- FQRC 2012 03: Control valve/Flow meter. Helium flow measure and control
- FQRC 2012 04: Control valve/Flow meter. Total inlet gas flow measure and control
- FQRC 2012 05: Control valve/Flow meter. Circulated gas flow measure and control
- FQRC 2012 06: Control valve/Flow meter. C. II outlet gas flow measure and control.
- FQRC 2012 07: Control valve/Flow meter. Atmosphere outlet gas flow measure and control
- SV 2012 01 Control valve. Gas inlet to analyzer.
- SV 2012 02 Control valve. Compressor bypass valve.
- SV 2012 03 Control valve. Helium inlet valve to outlet gases buffer.
- SCV 2012 01 Control valve. Outlet gas flow control.
- FT 2012 01 Flow meter. Outlet gas flow measure.
- PT 2012 01: Pressure transmitter. Discharge vessel pressure measurement.
- PS 2012 01: Pressure switch. Pressure alarm for compressor bypass.

14.2 PLC output signals:

Equipment	Description	I/O	Signal Type
BLWR 2012 01	Start/Stop the compressor	DO	0/1
SV 2012 02	Open/Close compressor (BLWR 2012 01) bypass valve	DO	0/1
SV 2012 01	Open/Close analyzer inlet valve	DO	0/1
HX 4012 02	Start/Stop post-condenser	DO	0/1
SV 2012 03	Open/Close helium inlet valve	DO	0/1
FQRC 2012 01	Inlet process gas flow set-point	AO	4-20 mA
FQRC 2012 02	Inlet CO2 flow set-point	AO	4-20 mA
FQRC 2012 03	Inlet helium flow set-point	AO	4-20 mA
FQRC 2012 04	Total inlet gas flow set-point	AO	4-20 mA
FQRC 2012 05	Circulated gas flow set-point	AO	4-20 mA
FQRC 2012 06	C. II outlet gas flow set-point (to C.III)	AO	4-20 mA
FQRC 2012 07	Atm outlet gas flow set-point (to atm)	AO	4-20 mA
SCV 2012 01	PBR outlet gas flow set-point	AO	4-20 mA

14.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2012 02	Compressor (BLWR 2012 01) bypass valve feedback	DI	0/1
PS 2012 01	Pressure switch for compressor recycling	DI	0/1
SV 2012 01	Gas analyzer inlet valve feedback	DI	0/1
SV 2012 03	Helium inlet valve feedback	DI	0/1
FQRC 2012 01	Inlet process gas flow measurement	AI	4-20 mA
FQRC 2012 02	Inlet CO2 flow measurement	AI	4-20 mA
FQRC 2012 03	Inlet helium flow measurement	AI	4-20 mA
FQRC 2012 04	Total inlet gas flow measurement	AI	4-20 mA
FQRC 2012 05	Circulated gas flow measurement	AI	4-20 mA
FQRC 2012 06	C. II outlet gas flow measurement (to C.III)	AI	4-20 mA
FQRC 2012 07	C. II outlet gas flow measurement (to atm)	AI	4-20 mA
PT 2012 02	Discharge vessel pressure measurement	AI	4-20 mA
FT 2012 01	PBR outlet gas flow measurement	AI	4-20 mA
DPT 2012 01	Differential pressure measurement (filters)	AI	4-20 mA

15 Loop 2013: Bioreactor Outlet Gas Composition Control

The outlet gas composition control loop is not implemented. The gas is analyzed and the information is sent to the control system.

15.1 Control elements:

- FT 2012 01: Flow meter. Outlet gas flow measurement.
- TT 2013 01: Temperature sensor/transmitter. Outlet gas temperature measurement.
- PT 2013 01: Pressure sensor/transmitter. Outlet gas pressure measurement.
- AT 2013 01/02: Outlet gas composition measurement.
- AT 2013 03: Dissolved O_2 Analyzer. PBR O_2 composition measurement.
- SV 2013 01 Control valve. Analyzer gas inlet valve.

15.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2013 01	Open/Close gas analyzer inlet valve	DO	0/1

15.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2013 01	Gas analyzer inlet valve feedback	DI	0/1
FT 2012 01	PBR outlet gas flow measurement	AI	4-20 mA
AT 2013 01	Outlet gas analyzer	AI	4-20 mA
AT 2013 02	Outlet gas analyzer	AI	4-20 mA
AT 2013 03	Dissolved O2 analyzer	AI	4-20 mA
TT 2013 02	Temperature measurement (AT 2013 03)	AI	4-20 mA
PT 2013 01	Outlet gas pressure measurement	AI	4-20 mA
TT 2013 01	Outlet gas temperature measurement	AI	4-20 mA

15.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	PT 2013 01	Pressure	H	To notify alarm to supervision	
2	TT 2013 02	Temperature	H	To notify alarm to supervision	
3	SV 2013 01		Err	To notify alarm to supervision	

15.4.1 Alarms and warnings description:

1 / 2 → ALARM: pressure/temperature is out of analyzer operating range conditions. (see instrument manual)

3 → ALARM: The automatic valve is not working. Notify failure to supervision.

16 Loop 2014: Effluent General

This loop includes the agitator, and all the instruments linked to another loop. At the moment, this loop only includes the agitation system of the feeding vessel VS 2000 01.

16.1 Control elements:

- GP 2014 01: Agitator speed regulator. Harvesting tank agitation.

16.2 PLC output signals:

Equipment	Description	I/O	Signal Type
GP 2014 01	Start/Stop harvesting tank agitator converter	DO	0/1
GP 2014 01	Harvesting tank agitator speed set-point	AO	4-20 mA

16.3 PLC input signals:

Equipment	Description	I/O	Signal Type
GP 2014 01	Harvesting tank agitator thermal protection	DI	0/1

16.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	GP 2014 01		Err	To notify alarm to supervision	

17 Loop 2015: Effluent Liquid Flow Control

This loop regulates the reactor outlet liquid flow. Output flow rate is controlled by two pumps (GP 4002 01 and GP 4002 02), working alternatively depending on the pumps maintenance.
The flow rate is fixed with a set-point send from the supervision.

17.1 Control elements:

- PS 2015 01/02: Pressure switch. Pump membrane breakage detection.
- PS 2015 03/04: Pressure switch. Lines over-pressure detection.
- GP 4015 01/02 speed regulator: Feed pumps. Reactor outlet liquid pumping to harvest vessel.

17.2 PLC output signals:

Equipment	Description	I/O	Signal Type
GP 2015 01/02	Start/Stop outlet pumps converter	DO	0/1
GP 2015 01	Start/Stop outlet pump GP 2015 01	DO	0/1
GP 2015 02	Start/Stop outlet pump GP 2015 02	DO	0/1
GP 2015 01/02	Flow set-point (outlet pumps)	AO	4-20 mA

17.3 PLC input signals:

Equipment	Description	I/O	Signal Type
GP 2015 01/02	Outlet pumps thermal protection	DI	4-20 mA
PS 2015 01	Pressure switch (GP 2015 01)	DI	0/1
PS 2015 02	Pressure switch (GP 2015 02)	DI	0/1
PS 2015 03	Pressure switch	DI	0/1
PS 2015 04	Pressure switch	DI	0/1

17.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	GP 2015 01/02		Err	To notify alarm to supervision	
2	PS 2015 01/02	Pressure	H	To notify alarm to supervision	GP 2015 01/02
3	GP 2015 01/02	Pressure	H	To notify alarm to supervision	GP 2015 01/02

17.4.1 Alarms and warnings description:

1 → ALARM: Harvesting pump is not working. Notify failure to supervision.

2 → ALARM: The membrane of the harvesting pump has broken.

⚠ **The pump works with a sandwich membrane which permits a quickly damage detection. If work membrane is broken, the process product is conducted through the control membrane to the pressure switch. When the sensors alarm is activated, the pump can continue with working by means of a fourth membrane during a maximum time of 24h.**

3 → ALARM: There is a line overpressure. (Probably because of a process pipe manual valve is closed). Stop harvesting pumps.

18 Loop 2016: Harvest Level Control

18.1 Control elements:

- WT 2016 01: Weight measurement. Harvesting tank (VS 2014 01) weight measurement for tank level control.

18.2 PLC output signals:

There is not any output signal for this loop.

18.3 PLC input signals:

Equipment	Description	I/O	Signal Type
WT 2016 01	Harvesting tank weight (level) measurement	AI	4-20 mA

18.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	WT 2016 01	Weight (level)	HH	To notify alarm to supervision	GP 2015 01/02
2	WT 2016 01	Weight (level)	H	To notify alarm to supervision	
3	WT 2016 01	Weight (level)	L	To notify alarm to supervision	GP 2014 01

18.4.1 Alarms and warnings description:

1 → ALARM: VS 4002 01 is full. Stop harvesting pumps.

2 → WARNING: Harvesting vessel level is at ------% or upper.

3 → WARNING: Harvesting vessel level is at ------% or lower. Stop the vessel agitator.

19 Loop 2017: Harvesting Tank Temperature Control

This loop regulates the temperature of the harvesting tank. The temperature is measured with a temperature transmitter installed in the tank hoop.
The temperature is regulated by means of cool water flowing through the tank jacket. This flow is controlled with an on/off automatic valve installed in the jacket outlet.

19.1 Control elements:

- TT 2017 01: Temperature transmitter. Tank VS 2014 01 temperature measurement.
- SV 2017 01: Control valve. Feeding tank VS 2014 01 jacket cooling water outlet valve.

19.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2017 01	Open/Close cooling water inlet valve	DO	0/1

19.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2017 01	Cooling water inlet valve feedback	DI	0/1
TT 2017 01	Harvesting tank temperature measurement	AI	4-20 mA

19.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	TT 2017 01	Temperature	H	To notify alarm to supervision	
2	SV 2017 01		Err	To notify alarm to supervision	

20 Loop 2018: Harvesting Tank Pressure Control

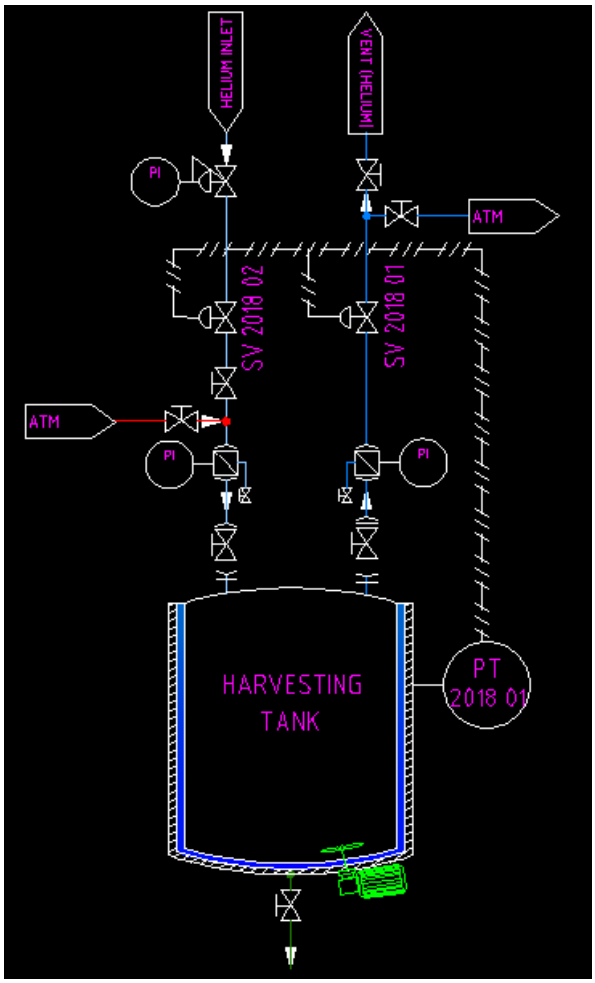
The harvesting tank should be maintained, as all the plant, in anaerobic conditions.

The designed system has a way of allowing the inert gas (helium) into the tank, and a way to vent the gas when the pressure gets to high.

The helium is stored in a buffer tank of 40 l, which is used for the inertization of feeding and harvesting tank. This buffer tank operates in higher pressure than the feeding tank and for the vented gas storage is needed a gas compressor.

The system should operate at a slightly higher than atmospheric.

A pressure transmitter measures the tank pressure and actuates over both automatic valves. When the pressure is lower than the set-point, the helium inlet is opened and when is higher, the helium is vented to the buffer tank.



20.1 Control elements:

- PT 2018 01: Pressure transmitter. Harvesting tank VS 2014 01 pressure measurement.
- SV 2018 01: Control valve. Harvesting tank VS 2014 01 vent pipe valve.
- SV 2018 02: Control valve. Harvesting tank VS 2014 01 helium inlet pipe valve.
- SV 2004 03: Control valve. Compressor recycling valve.
- PS 2004 01: Pressure switch. Switch for compressor recycling control.

20.2 PLC output signals:

Equipment	Description	I/O	Signal Type
BLWR 2004 01	Start/Stop the compressor	DO	0/1
SV 2004 03	Open/Close compressor (BLWR 2004 01) bypass valve	DO	0/1
SV 2018 01	Open/Close feeding tank vent valve	DO	0/1
SV 2018 02	Open/Close helium inlet valve	DO	0/1

20.3 PLC input signals:

Equipment	Description	I/O	Signal Type
PS 2004 01	Pressure switch for compressor recycling	DI	0/1
SV 2018 01	Feeding tank vent valve feedback	DI	0/1
SV 2018 02	Helium inlet valve feedback	DI	0/1
SV 2004 03	Compressor (BLWR 2004 01) bypass valve feedback	DI	0/1
PT 2018 01	Harvesting tank pressure measurement	AI	4-20 mA

20.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	PS 2004 01	Pressure	H	-----	
2	SV 2018 01		Err	To notify alarm to supervision	
3	SV 2018 02		Err	To notify alarm to supervision	
4	SV 2004 03		Err	To notify alarm to supervision	
6	PT 2018 01	Pressure	H	To notify alarm to supervision	
7	PT 2018 01	Pressure	L	To notify alarm to supervision	

21 Loop 2019: Helium Tank Control

The helium tank is a buffer tank of 40 l, which is used for the inertization of feeding and harvesting tanks. This buffer tank operates in higher pressure than the feeding tank and for the vented gas storage is needed a gas compressor.
A pressure transmitter measures the tank pressure and actuates over both automatic valves.
When the pressure is lower than the set-point, the helium inlet is opened and when is higher, the helium is vented to the atmosphere.

21.1 Control elements:

- SV 2019 01: Control valve. Helium tank VS 2019 01 helium inlet pipe valve.
- SV 2019 02: Control valve. Helium tank VS 2019 01 vent pipe valve.
- PT 2019 01: Pressure transmitter. Helium tank VS 2019 01 pressure measurement.

21.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2019 01	Open/Close helium inlet valve	DO	0/1
SV 2019 02	Open/Close atm. vent valve	DO	0/1

21.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2019 01	Helium inlet valve feedback	DI	0/1
SV 2019 02	Vent valve feedback	DI	0/1
PT 2019 01	Helium tank pressure measurement	AI	4-20 mA

21.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	SV 2019 01		Err	To notify alarm to supervision	
2	SV 2019 02		Err	To notify alarm to supervision	
3	PT 2019 01	Pressure	H	To notify alarm to supervision	
4	PT 2019 01	Pressure	L	To notify alarm to supervision	

22 Loop 2020: Antifoam Control

The reactor antifoam system description is still pending.

A foam detector is foreseen. The switch emits an alarm when foam is detected.

Equipment	Description	I/O	Signal Type
LS 2020 01	Bioreactor foam detection	DI	0/1

23 Loop 2021: Helium Tank Control

23.1 Control elements:

- TT 2003 01: Temperature sensor/transmitter. VS 2000 01 temperature measurement.
- SV 2021 01: Control valve. Steam inlet to VS 2000 01.
- PT 2004 01: Pressure transmitter. VS 2000 01 pressure measurement.

23.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2021 01	Open/Close steam inlet valve	DO	0/1

23.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2021 01	Steam inlet valve feedback	DI	0/1
TT 2003 01	Feeding tank temperature measurement	AI	4-20 mA
PT 2004 01	Feeding tank pressure measurement	AI	4-20 mA

23.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	TT 2003 01	Temperature	H	To notify alarm to supervision	
2	TT 2003 01	Temperature	L	To notify alarm to supervision	
3	PT 2004 01	Pressure	H	To notify alarm to supervision	
4	PT 2004 01	Pressure	L	To notify alarm to supervision	
5	SV 2021 01	Limit switch	Err	To notify alarm to supervision	

24 Loop 2022: Bioreactor sterilization

24.1 Control elements:

- TT 2005 01: Temperature sensor/transmitter. Bioreactor temperature measurement.
- TT 2007 01: Temperature sensor/transmitter. Bioreactor temperature measurement.
- TT 2008 01: Temperature sensor/transmitter. Bioreactor temperature measurement.
- TT 2013 02: Temperature sensor/transmitter. Bioreactor temperature measurement.
- SV 2022 01: Control valve. Steam inlet to Bioreactor.
- PT 2009 01: Pressure transmitter. Bioreactor pressure measurement.
- PT 2009 02: Pressure transmitter. Bioreactor pressure measurement.

24.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2022 01	Open/Close steam inlet valve	DO	0/1

24.3 PLC input signals:

Equipment	Description	I/O	Signal Type
TT 2005 01	Temperature measurement (AT 2008 03)	AI	4-20 mA
TT 2007 01	Reactor temperature measurement	AI	4-20 mA
TT 2008 01	Temperature measurement (AT 2008 02)	AI	4-20 mA
TT 2013 02	Temperature measurement (AT 2013 03)	AI	4-20 mA
SV 2022 01	Steam inlet valve feedback	DI	0/1
PT 2009 01	Bioreactor pressure measurement	AI	4-20 mA
PT 2009 02	Bioreactor pressure measurement	AI	4-20 mA

24.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	***)**	Temperature	H	To notify alarm to supervision	
2	***)**	Temperature	L	To notify alarm to supervision	
3	***²)**	Pressure	H	To notify alarm to supervision	
4	***²)**	Pressure	L	To notify alarm to supervision	
5	SV 2022 01	Limit switch	Err	To notify alarm to supervision	

*) The temperature value to set these alarms will be defined in the control software depending on the type of data processing. There are four values of the reactor temperature measured: TT 2005 01, TT 2007 01, TT 2008 01 and TT 2013 02.

***²)** The pressure value to set these alarms will be defined in the control software depending on the type of data processing. (PT 2009 01 and PT 2009 02)

25 Loop 2023: Harvesting Tank Sterilization

25.1 Control elements:

- TT 2017 01: Temperature sensor/transmitter. VS 2014 01 temperature measurement.
- SV 2023 01: Control valve. Steam inlet to VS 2014 01.
- PT 2018 01: Pressure transmitter. VS 2014 01 pressure measurement.

25.2 PLC output signals:

Equipment	Description	I/O	Signal Type
SV 2023 01	Open/Close steam inlet valve	DO	0/1

25.3 PLC input signals:

Equipment	Description	I/O	Signal Type
SV 2023 01	Steam inlet valve feedback	DI	0/1
TT 2017 01	Harvesting tank temperature measurement	AI	4-20 mA
PT 2018 01	Harvesting tank pressure measurement	AI	4-20 mA

25.4 Alarms and warnings:

Nr.	Tag	Variable	Alarm	Action	Lock out
1	TT 2017 01	Temperature	H	To notify alarm to supervision	
2	TT 2017 01	Temperature	L	To notify alarm to supervision	
3	PT 2018 01	Pressure	H	To notify alarm to supervision	
4	PT 2018 01	Pressure	L	To notify alarm to supervision	
5	SV 2023 01	Limit switch	Err	To notify alarm to supervision	

3. CALCULATIONS

3. CALCULATIONS

BIOREACTOR COOLING WATER SYSTEM

1. Bioreactor Cooling Water System

1.1. Design Parameters

- Energy from lights:

Lamps to be installed	N_{LAMPS}	=	200 lamps
Lights power	P	=	20 W/lamp
Lights heat	Q_1	=	$3{,}6\ KW$

Assuming lighting system at 100% capacity and that 90% of power is converted as heating, the heat coming from the lighting system is:

$$Q = 200\ lamps \cdot 20\ \frac{W}{lamp} \cdot 0{,}9 = 3600\ W = 3{,}6\ KW$$

- Cooling Water circuit:

Density		=	$1000\ Kg/m^3$
Specific heat	C_p	=	$1\ Kcal/Kg{\cdot}^oC$
	C_p	=	$4{,}18\ KJ/Kg{\cdot}^oC$
Assumed differential temperature	ΔT	=	$2\ ^oC$

1.2. Cooling Water Circuit

- Heat to be removed during steady operation:

Heat evolved by lighting	Q_1	=	3,6 KW
Heat evolved by agitator	Q_2	=	2,2 KW
Heat evolved by reaction	Q_3	=	*Not considered*
Total Heat	Q	=	5,8 KW

Observation: To make a worst case scenario calculation, the 100% of the agitator power is assumed as heating power.

$$Q = Q_1 + Q_2 + Q_3 = 3{,}6\ KW + 2{,}2\ KW = 5{,}8\ KW$$

- Required water flow:

$$Q = m \cdot C_P \cdot \Delta T$$

$$m = \frac{Q}{C_P \cdot \Delta T} = \frac{5{,}8\ KW \cdot 860\ {}^{Kcal/h}/_{KW}}{1\ {}^{Kcal}/_{Kg \cdot {}^{o}C} \cdot 2\ {}^{o}C} = 2494\ {}^{Kg}/_{h} \cong 2{,}5\ {}^{m^3}/_{h}$$

Design flow	Q_L	=	3,0 ${}^{m^3}/_{h}$

2. Heating Water for Bioreactor Start up

2.1. Design parameters

Bioreactor volume (total calculated volume)	V	=	$53\ L$
Assumed inlet temperature of media to reactor	T_1	=	$15\ ^{o}C$
Assumed working temperature of reactor	T_2	=	$30\ ^{o}C$
Heating time required	t	=	30 min

2.2. Heating evolved

Observation: In this calculation, the heat coming from the agitator power is not considered (safety parameter).

$$Q = \frac{V \cdot C_p \cdot \Delta T}{t}$$

$$Q = \frac{53\ l \cdot \frac{1\ Kg}{1\ l} \cdot 1\ Kcal/Kg \cdot ^{o}C \cdot (30\ ^{o}C - 15\ ^{o}C)}{30\ \text{min} \cdot \frac{1\ h}{60\ \text{min}}} = 1590\ Kcal/h$$

2.3. Required water flow

Required water flow (see section 1.2)	Q_L	=	$2{,}5\ m^3/h$
Heat evolved	Q	=	$1590\ Kcal/h$

$$\Delta T = \frac{Q}{m \cdot C_p} = \frac{-1590\ Kcal/h}{2{,}5\ m^3/h \cdot \frac{10^3\ Kg}{1\ m^3} \cdot 1\ Kcal/Kg \cdot ^oC} = -0{,}64\ ^oC$$

3. Heating Transfer through Reactor Jacket

3.1. Cooling (Steady operation)

3.1.1. Parameters

Transfer Area (D = 0,2 m / L = 1,4 m)	A	=	$0{,}88\ m^2$
Water Flow	Q_L	=	$2{,}5\ m^3/h$
Working temperature	T	=	$30\ ^oC$
Requested heat transfer	Q	=	$5{,}8\ KW$
		=	$5000\ Kcal/h$

3.1.2.Maximum heat transfer through the reactor jacket

Water temperature in	$T_{W,IN}$	=	$10\,^{o}C$
Water temperature out	$T_{W,OUT}$	=	$11\,^{o}C$
Reactor working temperature	T	=	$30\,^{o}C$
Logarithmic delta temperature	ΔTML	=	$18{,}8\,^{o}C$
Transferred heat (through reactor jacket)	Q	=	$2500\ Kcal/h$

3.1.3.Heat to be removed by the air system

Total heat to be removed	Q_T	=	$5000\,Kcal/h$
Transferred heat (bioreactor jacket)	Q	=	$2500\ Kcal/h$

Assuming the calculated available transfer of heat through the reactor jacket, the air system must be in operation during the reactor operation and must be able to remove a minimum heat of 2500 Kcal/h (at 100% of light intensity)

4. Bioreactor Cooling/Heating System: Equipment Design

4.1. Electrical Heater (item: HX 2007 02)

Required Power (see section 2.2)		=	$1590\,Kcal/h$
		=	$1{,}85\,KW$
Design Power	P	=	$2\,KW$

4.2. Plate Heat Exchanger (item: HX 2007 01)

Total heat to be removed (see section 1.2)		=	$5000\,Kcal/h$
		=	$5{,}8\,KW$
Heat to be removed through reactor jacket		=	$2500\,Kcal/h$
Design heat evolved (Safety factor of 20%)		=	$3000\,Kcal/h$

4.2.1. Design Parameters

Calculated Water Flow		=	$2{,}5\,m^3/h$
Temperature water in		=	$12\,^{o}C$
Temperature water out		=	$10\,^{o}C$

Calculated Glycol Flow		=	$1{,}49\,m^3/h$
Design Glycol Flow (Safety factor of 20%)		=	$1{,}8\,m^3/h$
Temperature glycol in		=	$4\,^oC$
Temperature glycol out		=	$6\,^oC$

4.2.2. Required Area

Logarithmic delta temperature	ΔTML	=	$6\,^oC$
Transfer Coefficient	U	=	$1500\ Kcal/^oC \cdot m^2 \cdot h$

$$A = \frac{Q}{\Delta TML \cdot U}$$

$$A = \frac{3000\ Kcal/h}{6\,^oC \cdot 1500\ Kcal/^oC \cdot m^2 \cdot h} = 0{,}33\ m^2$$

4.3. Circulating pump (item: PP 2007 01)

Operating Flow		=	$2{,}5\ m^3/h$
Design Flow		=	$4\ m^3/h$
Design Delta Height		=	$20\ mcw$

5. Hydraulic conditions for Cooling/Heating system

5.1. Reactor jacket

Free Area	A	=	$0{,}011\ m^2$
Water Flow	Q_L	=	$2{,}5\ m^3/h$
Water velocity	v	=	$0{,}06\ m/s$
Flow type			Laminar

5.2. Piping: water circuit

Inner diameter (DN1")	D	=	$22{,}10\ mm$
Section	S	=	$0{,}038\ dm^2$
Water velocity	v	=	$1{,}8\ m/s$
Flow type			Turbulent

6. General conclusions from the calculations

To achieve the maximum transference level through the reactor jacket, the water flow should be as highest as possible (turbulent flow).

- ✓ The circulating pump of the water circuit should be able to pump the sufficient water flow $\left(\cong 4\ m^3/h\right)$
- ✓ The diameter of pipes in the water circuit to the reactor should be increase to 1", in order to increase the turbulence in the reactor jacket.
- ✓ It is really important to check the real flow of cool water (glycol) available in the plant because of can be the limiting factor.

AIR REFRIGERATION FOR LIGHTING SYSTEM

1. Heat generation

- Energy from lights:

Lamps to be installed	N_{LAMPS}	=	200 lamps
Lights power	P	=	20 W/lamp
Lights heat	Q_1	=	$3{,}6\ KW$

Assuming lighting system at 100% capacity and that 90% of power is converted as heating, the heat coming from the lighting system is:

$$Q = 200\ lamps \cdot 20\ \frac{W}{lamp} \cdot 0{,}9 = 3600\ W = 3{,}6\ KW$$

2. Required air flow

OBSERVATION: Considered at worse conditions, that means to eliminate 100% of the heat generated.

Delta temperature	ΔT	=	$10\ ^{o}C$
Air density	ρ	=	$1{,}29\ Kg/m^2$
Specific heat	C_P	=	$0{,}2\ Kcal/Kg\cdot^{o}C$

$$Q = m \cdot C_P \cdot \Delta T$$

$$m = \frac{Q}{C_P \cdot \Delta T} = \frac{3{,}6\ KW \cdot 860\ Kcal/KW}{0{,}2\ Kcal/Kg\cdot^{o}C \cdot 10\ ^{o}C} = 1548\ Kg/h = 1200\ m^3/h$$

Design flow	Q_L	=	1500 m^3/h

3. Required section in reactor lighting system

3.1. Design Parameters

Out Diameter of reactor jacket	D_1	=	270 mm
In diameter of air conduct (PVC jacket)	D_2	=	390 mm
Free section assumed (lights and supports)		=	70 %

3.2. Circulation area

- Total area:

$$A = \frac{\pi}{4} \cdot \left({D_2}^2 - D_1^2 \right)$$

$$A = \frac{\pi}{4} \cdot \left(0{,}380^2 - 0{,}270^2 \right) = 0{,}062\ m^2$$

- Free area:

$$A_{FREE} = A \cdot \left(Free\ \mathrm{sec}tion \right)$$

$$A_{FREE} = 0{,}062\ m^2 \cdot 0{,}7 = 0{,}044\ m^2$$

- Air velocity:

$$\langle v \rangle = \frac{Q_L}{A_{FREE}} = 9{,}5\ m/s$$

$$\langle v \rangle = \frac{1500\ m^3/h \cdot \frac{1\ h}{3600\ s}}{0{,}044\ m^2} = 9{,}5\ m/s$$

4. Blower (item BLWR 2007 01)

Working flow		=	$1200\ m^3/h$
Design flow	Q_L	=	$1500\ m^3/h$
Delta pressure	ΔP	=	$150\ mbar$

5. Air ducts section

Ducts diameter (DN200)	D	=	$200\ mm$
Section	A	=	$0{,}125\ m^2$
Air velocity	$\langle v \rangle$	=	$3{,}3\ m/s$

$$\langle v \rangle = \frac{1500\ m^3/h \cdot \frac{1\ h}{3600\ s}}{0{,}125\ m^2} = 3{,}3\ m/s$$

6. General conclusions from the calculations

The air blower should be able to transport $1500\ m^3/h$ or more and to have sufficient delta pressure.

The blower should be installed as near as possible of the reactor in order to avoid big delta pressures in the aspiration.

BIOREACTOR OUTLET GAS CONDENSER (ITEM HX 2012 01)

1. Data design

Working parameters considered are the next:

- Outlet gas flow: $120\ l/h$
- At working temperature, it is assumed that no direct liquid evaporation will be produced.
- It will be considered a flow of evaporated liquid to condenser because of the stripping of the liquid in the reactor by the gas flow.
- Assumed: 10% of liquid evaporated in relation to gas flow $\Rightarrow V = 120 \cdot 0{,}10 = 12\ l/h$

2. Condenser calculation

Evaporation heat *)	λ	=	$100\ Kcal/Kg$
Density *)	ρ	=	$0{,}8\ kg/dm^3$
Evaporated liquid	V	=	$12\ l/h$
Logarithmic delta temperature	ΔTML	=	$70\ ^{o}C$

*)OBSERVATION: Assuming organics of boiling point at 80 ºC

$$Q = m \cdot \lambda = V \cdot \rho \cdot \lambda$$

$$Q = 12\ dm^3/h \cdot \frac{0{,}8\ Kg}{dm^3} \cdot 100\ Kcal/Kg = 960\ Kcal/h$$

$$A = \frac{Q}{U \cdot \Delta TML}$$

$$A = \frac{960\ Kcal/h}{50\ Kcal/m^2 \cdot h \cdot ^oC \cdot 70^oC} = 0{,}27\ m^2$$

The glass condenser is considered of $0{,}3\ m^2$

3. Inlet pipe section to condenser

- Calculation of the pipe diameter from the reactor to the condenser.

Gas flow	Q_L	=	$120\ l/h$
Assuming pipe diameter (3/4")	ID	=	$15{,}75\ mm$
Section	A	=	$0{,}019\ dm^2$
Gas velocity	$\langle v \rangle$	=	$0{,}17\ m/s$
Flow type		=	laminar

DROP PRESSURE: PROCESS GAS INSIDE BIOREACTOR

1. Design parameters

Height of liquid	h	=	$1{,}7\ m$
Density of media	ρ	=	$1000\ Kg/m^3$

2. Calculation

$$\text{Pressure at reactor bottom} = h \cdot \rho$$

$$\Delta P = 1{,}7\ m \cdot 1000\ Kg/m^3 = 1700\ Kg/m^2 = 0{,}17\ bar$$

4. UTILITIES: DESCRIPTION AND CONSUMPTIONS

4. UTILITIES: DESCRIPTIONS AND CONSUMPTIONS

The pilot plant where to install the MELIiSSA COMPARTMENT II must have the following available services:

- Water
- Cool water
- Low pressure steam
- Compressed air
- Technical gases lines: air, CO_2 and Helium/Argon
- Electrical supply

Document of reference: The estimated dates present in this document are derived from the section 2: "Calculations".

1. Water

The temperature control of the bioreactor is provided by a water flow through the reactor jacket. The circulated water is heated/cooled by an electrical resistance/plate heat exchanger.
The design value of water flow during the steady operation is:

- Max. metric flow = 2,5 - 3 m^3/h*)
- Max. velocity = 2 m/s

***) NOTE: The water circuit is a closed pressurized circuit so, during steady operation, it has no water consumption except the purge losses.**

2. Cool water (glycol)

Cooling water is used in three different plant equipments:

- In the plate heat exchanger (HX 2007 01) for the cooling of circulated water. The calculated flow of cool water is:

- Max. metric flow = 1,8 m^3/h

- In the condenser (HX 2012 01). This condenser will be installed in the head section of the PBR in order to condense the VFA of the outlet gas and part of the humidity. The condensate will return to the culture. The calculated flow of cool water in this case is:

- Max. metric flow = 0,5 m^3/h

- In the feeding/harvesting vessel jacket for temperature controlling. The cooling water flow is controlled by a control valve installed in the cooling water outlet pipe. The calculated flow of cool water for each tank is:

  - Max. metric flow = 0,5 m^3/h

NOTE: The available flow of cool water (glycol) in the pilot plant for Compartment II must be 3,3 m^3/h, being it the maximum consumption during the steady operation.

3. Low pressure steam

Steam is normally used to sterilize the plant or a part of it. It can be used too in the feed/harvest tanks jackets if it's necessary to heat the content of its. The maximum values of steam needed during the plant operation are:

  - Max. mass flow = 20 Kg/h

NOTE: The steam consumption may vary remarkably depending on the sterilization operations frequency.

4. Compressed air

Compressed air is used for control valves actuators and for feeding and harvesting tanks jacket emptying.

NOTE: The consumption of compressed air is occasional and in any case is not continuous.

5. Technical gases lines: air, CO_2 and Helium/Argon

5.1 Air

Air circulation is required to refrigerate the bioreactor which is heated by the lighting system. The design value of the required air flow is:

- Max. metric flow = 1500 m^3/h*)

**) This fan aspirates the air from the outside, and forces it to pass through the reactor air refrigeration system. The hot air is thrown out again to the outside of the pilot plant.*

NOTE: This system has no air consumption. The air used is not service air.

5.2 CO_2 and Helium/Argon

The compartment II will operate under anaerobic conditions so any air inlet will be completely avoided. Argon and/or CO_2 gas inlets will be provided.

NOTE: The consumption of its gases will be defined by the process.

6. Electrical supply

Compartment II electrical components are listed next:

- **Feed/Harvesting pumps (GP 2001 01/02, GP 2015 01/02):** These pumps allow the reactor media input and output.
- **Acid/base feeding pumps (PP 2008 01/02):** Reactor pH control is done actuating over these pumps.
- **Centrifuge air fan (BLWR 2007 01):** This fan aspirates the air from the outside, and forces it to pass through the reactor air refrigeration system. The hot air is thrown out again to the outside of the pilot plant.
- **Compressor (BLWR 2012 01):** This compressor is used to introduce the bioreactor outlet gases to the discharge vessel.
- **Compressor (BLWR 2004 01):** This compressor is used to introduce the helium to the helium buffer tank.
- **Reactor water circuit pump (PP 2007 01):** This pump allows the cooling water flow through the bioreactor glass jacket.
- **Feeding tank magnetic agitator (VS 2000 01):** This equipment provides the necessary agitation to the feed vessel.
- **Harvesting tank magnetic agitator (VS 2014 01):** This equipment provides the necessary agitation to the harvesting vessel.
- **Electrical heater (HX 2007 02):** This electrical resistance heats the reactor water circuit (jacket water) if necessary.
- **Sample gas cooler (HX 2012 02):** This equipment is used to post-condensate the residual humidity of the reactor outlet gas before entering the gas analyzer.
- **Reactor lighting system (IRC 2006 01):** The illumination system consists of 200 halogen lamps distributed homogenously around the glass part of the bioreactor. A voltage regulator allows having different light intensities.
- **Reactor agitation group (GP 2005 01):** The medium inside the reactor is agitated with a mechanical stirrer with the motor installed in the upper part of the reactor.

The characteristics and operating parameters of the electrical equipment are the next:

Item	Description	Power (KW)	Estimated operating load	Estimated consumption (KW·h/h)
GP 2001 01	Diaphragm pump	0,37	1,0	0,37
GP 2001 02	Diaphragm pump	0,37	0,0	0,00
GP 2015 01	Diaphragm pump	0,37	1,0	0,37
GP 2015 02	Diaphragm pump	0,37	0,0	0,00
PP 2008 01	Peristaltic pump	0,10	0,1	0,01
PP 2008 02	Peristaltic pump	0,10	0,1	0,01
BLWR 2007 01	Centrifuge air fan	0,14	1,0	0,14
BLWR 2012 01	Compressor	0,06	1	0,06
BLWR 2004 01	Compressor	0,06	1	0,06
PP 2007 01	Centrifuge pump	1,30	1,0	1,30
GP 2000 01	Magnetic agitator	0,20	1,0	0,20
GP 2014 01	Magnetic agitator	0,20	1,0	0,20
HX 2007 02	Electrical heater	2,00	0,05	0,10
HX 2012 02	Sample gas cooler	0,18	1,0	0,18
IRC 2006 01	Reactor lighting system	3,60	1,0	3,60
GP 2005 01	Reactor agitation group	2,20	1.0	2,20
Total		**11,62**	0,7	**8,17**

5. INVESTMENT

5. INVESTMENT

In the ANNEX III of the Project, there is included the quotation with the investment value of DDEQ, for the supply of the Melissa Pilot Plant Compartment II.

In that quotation there are detailed the investment costs for the construction and delivery of the indicated Compartment II, including:

- ✓ detail engineering pending works
- ✓ equipment supply
- ✓ piping, valves and accessories
- ✓ electric and control elements
- ✓ plant assembling
- ✓ commissioning

In the document, there is explained the scope of supply for each of the concepts considered.

The Annex of the document includes a complete part lists with the cost for each position.

A general planning for the development of the whole project is also included.

6. ANNEX I: LISTINGS

6.1. Equipment List
6.2. Piping List
6.3. Instrument List
6.4. Materials List
6.5. Electrical & Control signals List
6.6. Motors List

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EQUIPMENT LIST

EQUIPMENT

CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELISSA COMPARTMENT II	**DATE:**	19/01/2010	**PREPARED:**	J.GUBERN
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**CHECKED:**	J. MESTRE

TAG	DENOMINATION	DESCRIPTION	SUPPLIER	OBSERVATIONS
R 2005 01 GP 2005 01	Photobioreactor	Bioreactor with mechanical agitation. Material: AISI 316L / jacketed glass	DDEQ	
IRC 2006 01	Lighting system	PBR Lighting system	DDEQ	
HX 2012 01	Condenser	Condenser for reactor outlet gases. Material: glass borosilicate 3.3	DDPS	Transfer area: 0,3 m^2
BLWR 2007 01	Extractor	Fan for PBR air cooling system	SODECA	Required air flow: 1500 m^3/h
GF 2007 01	Air filter	Air filter for PBR air cooling system		
VS 2000 01 GP 2000 01	Feeding tank	Agitated tank in AISI 316L, provided with jacket for heating - cooling. Designed to operate at positive pressure. Magnetic driver		V=250 L
GP 2001 01 GP 2001 02	Feed pumps to reactor	Mettering pump in AISI 316 and PTFE membrane. Controlled by an electronic variator. Sterilizable.	LEWA	Required flow: 10 l/h P=20 bar
VS 2008 01	Acid vessel	Borosilicate glass vessel for acid addition	Fisher	V=5 L
VS 2008 02	Alkali vessel	Borosilicate glass vessel for alkali addition	Fisher	V=5 L
PP 2008 01	Acid pump	Peristaltic pump for acid dosing (pH control).	Watson Marlow	
PP 2008 02	Alkali pump	Peristaltic pump for alkali dosing (pH control).	Watson Marlow	
VS 2014 01 GP 2014 01	Harvesting tank	Agitated tank in AISI 316L, provided with jacket for heating - cooling. Designed to operate at positive pressure. Magnetic driver		V=250 L
GP 2015 01/02	Harvest pumps to reactor	Mettering pump in AISI 316 and PTFE membrane. Controlled by an electronic variator. Sterilizable.	LEWA	Required flow: 10 l/h P=20 bar

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DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**CHECKED:**	J. MESTRE

TAG	DENOMINATION	DESCRIPTION	SUPPLIER	OBSERVATIONS
VS 2012 01	Discharge vessel	Buffer tank in AISI 316L for process gas acumulation		V=200 L
BLWR 2012 01	Compressor	Membrane compressor in AISI 316 / PTFE for outlet gas flow		
VS 2019 01	Helium buffer	Buffer tank in AISI 316L for helium recycling		V=40 L
BLWR 2004 01	Compressor	Membrane compressor in AISI 316 / PTFE for helium flow		
HX 2007 01	Heat exchanger	Plate heat exchanger for water cooling with cool water (glycol)		Transfer area: 0,35 m^2
HX 2007 02	Water heater	Electrical resistance (heater)		Required Power: 2 KW
PP 2007 01	Circulation pump	Centrifugal pump for water loop (PBR temperature control)		Required flow: 3 m^3/h
VS 2007 01	Expansion vessel	Expansion vessel for water circuit. Material AISI 316.	Olaer	V=10 L
HX 2012 02	Post-cooler	Sample gas cooler for sampling conditioning	Sick-Maihack	
VS XXXX XX	Media preparation tank	Athmospheric agitated tank in AISI 316L.		V=300 L
GP XXXX XX	Media inlet pump	Sanitary centrifugal pump		

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DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

PROCESS LIQUID

PIPE NUMBER	FROM	TO	OBS	CLASS
PL-1/2"-SS2-001	COMPARTMENT LIQUID INLET	VS 2000 01	---	SS-2
PL-1/2"-SS2-002	VS 2000 01	PL-1/2"-SS2-003	---	SS-2
PL-1/2"-SS2-003	GP 2001 01	PL-1/2"-SS2-006	---	SS-2
PL-1/2"-SS2-004	GP 2001 02	PL-1/2"-SS2-003	---	SS-2
PL-1/2"-SS2-005	PL-1/2"-SS2-003	PL-1/2"-SS2-006	---	SS-2
PL-1/2"-SS2-006	PL-1/2"-SS2-003	PL-1/2"-SS2-007	---	SS-2
PL-1/2"-SS2-007	PL-1/2"-SS2-006	PL-1/2"-SS2-009	---	SS-2
PL-1/2"-SS2-008	PL-1/2"-SS2-007	PL-1/2"-SS2-009	---	SS-2
PL-1/2"-SS2-009	R 2005 01	PL-1/2"-SS2-007	---	SS-2
PL-1/2"-SS2-010	R 2005 01	PL-1/2"-SS2-011	---	SS-2
PL-1/2"-SS2-011	GP 2015 01	PL-1/2"-SS2-013	---	SS-2
PL-1/2"-SS2-012	GP 2015 02	PL-1/2"-SS2-013	---	SS-2
PL-1/2"-SS2-013	PL-1/2"-SS2-011	VS 2014 01	---	SS-2
PL-1/2"-SS2-014	VS 2014 01	COMPARTMENT LIQUID OUTLET	---	SS-2

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PROCESS GAS

PIPE NUMBER	FROM	TO	OBS	CLASS
PG-1/4"-SS2-001	C.I. GAS INLET	PG-1/2"-SS2-002	---	SS-2
PG-1/2"-SS2-002	PRC 2012 04	PG-1/2"-SS2-003	---	SS-2
PG-1/2"-SS2-003	PG-1/2"-SS2-002	R 2005 01	---	SS-2
PG-1/2"-SS2-004	R 2005 01	HX 2012 01	---	SS-2
PG-1/2"-SS2-005	HX 2012 01	HX 2012 02	---	SS-2
PG-1/2"-SS2-006	PG-1/2"-SS2-005	PG-1/2"-SS2-005	---	SS-2
PG-1/2"-SS2-007	HX 2012 02	BLWR 2012 01	---	SS-2
PG-1/2"-SS2-008	BLWR 2012 01	VS 2012 01	---	SS-2
PG-1/4"-SS2-009	VS 2012 01	PG-1/2"-SS2-002	---	SS-2
PG-1/2"-SS2-010	PG-1/2"-SS2-007	PG-1/2"-SS2-002	---	SS-2
PG-1/4"-SS2-011	VS 2012 01	COMPARTMENT GAS OUTLET	---	SS-2

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AIR and CO_2

PIPE NUMBER	FROM	TO	OBS	CLASS
AI-1/4"-SS1-001	HV 2003 06	GLY-3/4"-SS1-004	---	SS-1
AI-1/4"-SS1-002	HV 2003 06	GLY-3/4"-SS1-007	---	SS-1
AI-200-PVC-001	GF 2007 01	R 2005 01	---	PVC
AI-200-PVC-002	R 2005 01	BLWR 2007 01	---	PVC
AI-200-PVC-003	BLWR 2007 01	AIR OUTLET	---	PVC
CO2-1/4"-SS2-001	CO_2 INLET	PG-1/2"-SS2-002	---	SS-2

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ACID/ALKALI (for PBR pH control)

PIPE NUMBER	FROM	TO	OBS	CLASS
PAC-1/2"-PP-001	VS 2008 01	PAC-1/2"-SS2-002	---	PP
PAC-1/2"-SS2-002	PAC-1/2"-PP-001	R 2005 01	---	SS-2
PBA-1/2"-PP-001	VS 2008 02	PBA-1/2"-SS2-002	---	PP
PBA-1/2"-SS2-002	PBA-1/2"-PP-001	R 2005 01	---	SS-2

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CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	18/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

COOL WATER (GLYCOL)

PIPE NUMBER	FROM	TO	OBS	CLASS
GLY-1"-SS1-001	GLYCOL INLET	MISCELLANEOUS	---	SS-1
GLY-1"-SS1-002	MISCELLANEOUS	GLYCOL OUTLET	---	SS-1
GLY-3/4"-SS1-003	GLY-3/4"-SS1-001	VS 2000 01	---	SS-1
GLY-3/4"-SS1-004	VS 2000 01	GLY-3/4"-SS1-002	---	SS-1
GLY-3/4"-SS1-005	GLY-3/4·-SS1-003	GLY-3/4"-SS1-002	---	SS-1
GLY-3/4"-SS1-006	GLY-3/4"-SS1-001	VS 2014 01	---	SS-1
GLY-3/4"-SS1-007	VS 2014 01	GLY-3/4"-SS1-002	---	SS-1
GLY-3/4"-SS1-008	GLY-3/4"-SS1-006	GLY-3/4"-SS1-002	---	SS-1
GLY-3/4"-PP-009	GLY-3/4"-SS1-001	HX 2012 01	---	PP
GLY-3/4"-PP-010	HX 2012 01	GLY-3/4"-SS1-002	---	PP
GLY-1"-SS1-011	GLY-3/4"-SS1-001	HX 2007 01	---	SS-1
GLY-1"-SS1-012	HX 2007 01	GLY-3/4"-SS1-002	---	SS-1

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CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	18/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

INOCULUM / ANTIFOAM

PIPE NUMBER	FROM	TO	OBS	CLASS
IN-1/2"-SS2-001	INOCOULUM INLET	ST-1/2"-SS1-025	---	SS-2

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CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
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HELIUM (INERT GAS)

PIPE NUMBER	FROM	TO	OBS	CLASS
HE-1/4"-SS2-001	HELIUM INLET	PG-1/2"-SS2-002	---	SS-2
HE-1/4"-SS2-002	HELIUM INLET	VS 2019 01	---	SS-2
HE-1/4"-SS2-003	HELIUM INLET	VS 2012 01	---	SS-2

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DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

VENT PIPES

PIPE NUMBER	FROM	TO	OBS	CLASS
VT-1/2"-SS2-001	VS 2019 01	VS 2000 01	HELIUM	SS-2
VT-1/2"-SS2-002	VS 2000 01	VT-1/2"-SS2-003	HELIUM	SS-2
VT-1/2"-SS2-003	BLWR 2004 01	VT-1/2"-SS2-002	HELIUM	SS-2
VT-1/2"-SS2-004	VS 2019 01	BLWR 2004 01	HELIUM	SS-2
VT-1/2"-SS2-005	VS 2019 01	VS 2014 01	HELIUM	SS-2
VT-1/2"-SS2-006	VS 2014 01	VT-1/2"-SS2-003	HELIUM	SS-2
VT-1/2"-SS2-007	VS 2019 01	---	HELIUM	SS-2
VT-1/4"-SS2-008	PG-1/4"-SS2-011	---	HELIUM	SS-2
VT-1/4"-PP-009	VS 2008 02	VENTING	ALKALI BOTTLE	PP
VT-1/2"-PP-010	VS 2008 01	VENTING	ACID BOTTLE	PP

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WATER

PIPE NUMBER	FROM	TO	OBS	CLASS
WT-1"-SS1-001	WATER INLET	WT-1"-SS1-002	---	SS-1
WT-1"-SS1-002	WT-1"-SS1-001	R 2005 01	---	SS-1

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CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	18/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

STEAM

PIPE NUMBER	FROM	TO	OBS	CLASS
ST-3/4"-SS1-001	HV 2021 01		---	SS-1
ST-3/4"-SS1-001	HV 2021 01		---	SS-1
ST-3/8"-SS1-002	ST-3/4"-SS1-001	PL-1/2"-SS2-001	---	SS-1
ST-1/2"-SS1-003	ST-3/4"-SS1-001	GLY-3/4"-SS1-004	---	SS-1
ST-3/8"-SS1-004	ST-3/4"-SS1-001	HV 2001 01	---	SS-1
ST-1/2"-SS1-005	ST-3/4"-SS1-001	VT-1/2"-SS2-001	---	SS-1
ST-3/8"-SS1-006	ST-3/4"-SS1-001	HV 2004 03	---	SS-1
ST-1/2"-SS1-007	HV 2021 06 / HV 2021 07	CONDENSATE MANIFOLD	---	SS-1
ST-3/8"-SS1-008	ST-3/4"-SS1-001	VS 2000 01	---	SS-1
ST-3/8"-SS1-009	ST-3/4"-SS1-001	HV 2001 02	---	SS-1
ST-3/8"-SS1-010	ST-3/4"-SS1-001	HV 2001 04	---	SS-1
ST-3/8"-SS1-011	ST-3/4"-SS1-001	HV 2001 09	---	SS-1
ST-3/8"-SS1-012	ST-3/4"-SS1-001	HV 2001 14	---	SS-1
ST-3/8"-SS1-013	ST-3/4"-SS1-001	HV 2001 15	---	SS-1
ST-3/8"-SS1-014	ST-3/4"-SS1-001	PG-1/2"-SS2-003	---	SS-1
ST-3/8"-SS1-015	HV 2012 05	CONDENSATE MANIFOLD	---	SS-1
ST-3/8"-SS1-016	ST-3/8"-SS1-018	PAC-1/2"-SS2-002	---	SS-1
ST-3/8"-SS1-017	ST-3/8"-SS1-018	PBA-1/2"-SS2-002	---	SS-1
ST-3/8"-SS1-018	ST-3/4"-SS1-001	HV 2022 19	---	SS-1
ST-3/8"-SS1-019	HV 2022 22 / HV 2022 23	CONDENSATE MANIFOLD	---	SS-1
ST-3/8"-SS1-020	ST-1/2"-SS1-025	HV 2012 07	---	SS-1
ST-3/8"-SS1-021	ST-1/2"-SS1-025	HV 2012 07	---	SS-1

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CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	18/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

STEAM

PIPE NUMBER	FROM	TO	OBS	CLASS
ST-3/8"-SS1-022	ST-1/2"-SS1-025	HV 2012 08	---	SS-1
ST-3/8"-SS1-023	ST-1/2"-SS1-025	HV 2012 08	---	SS-1
ST-3/8"-SS1-024	HV 2022 28 / HV 2022 29	CONDENSATE MANIFOLD	---	SS-1
ST-3/4"-SS1-025	ST-3/4"-SS1-001	HV 2022 30	---	SS-1
ST-3/8"-SS1-026	HV 2012 06 / HV 2022 30	CONDENSATE MANIFOLD	---	SS-1
ST-1/2"-SS1-027	ST-3/4"-SS1-001	GLY-3/4"-SS1-002	---	SS-1
ST-3/8"-SS1-028	ST-3/4"-SS1-001	HV 2018 03	---	SS-1
ST-3/8"-SS1-029	ST-3/8"-SS1-034	VS 2014 01	---	SS-1
ST-3/8"-SS1-030	ST-3/8"-SS1-034	VS 2014 01	---	SS-1
ST-1/2"-SS1-031	ST-3/8"-SS1-034	VT-1/2"-SS2-005	---	SS-1
ST-3/8"-SS1-032	ST-3/8"-SS1-034	HV 2023 02	---	SS-1
ST-3/8"-SS1-033	ST-3/8"-SS1-034	HV 2023 03	---	SS-1
ST-3/8"-SS1-034	ST-3/4"-SS1-001	HV 2015 01	---	SS-1
ST-3/8"-SS1-035	HV 2015 08	ST-1/2"-SS1-037	---	SS-1
ST-3/8"-SS1-036	HV 2015 09	ST-1/2"-SS1-037	---	SS-1
ST-1/2"-SS1-037	ST-3/8"-SS1-035 / 036	ST-1/2"-SS1-037	---	SS-1
ST-3/8"-SS1-038	HV 2018 06 / HV 2023 12	CONDENSATE MANIFOLD	---	SS-1
ST-1/2"-SS1-039		CONDENSATE MANIFOLD	---	SS-1
ST-1/2"-SS1-040		CONDENSATE MANIFOLD	---	SS-1
ST-1/2"-SS1-041		CONDENSATE MANIFOLD	---	SS-1

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Instruments list

CONTROL VALVE

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	19/01/2010	**CHECKED:**	J. MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

TAG Nº	SITUATION	Inch	SERVICE	REFERENCE	MATERIAL	MANUFACTURER	T`P	AC	F/E	N	E
FQRC 2012 01	PG-1/4"-SS2-001	1/4"	PROCESS GAS C.I. INLET				--	--	--	--	--
FQRC 2012 02	CO2-1/4"-SS2-001	1/4"	CO2 INLET				--	--	--	--	--
FQRC2012 03	HE-1/4"-SS2-001	1/4"	HELIUM INLET				--	--	--	--	--
FQRC 2012 04	PG-1/2"-SS2-003	1/4"	PROCESS GAS				--	--	--	--	--
FQRC 2012 05	PG-1/4"-SS2-009	1/4"	PROCESS GAS				--	--	--	--	--
FQRC 2012 06	PG-1/2"-SS2-011	1/4"	PROCESS GAS				--	--	--	--	--
FQRC 2012 07	VT-1/4"-SS2-008	1/4"	HELIUM VENTING OUTLET				--	--	--	--	--
SCV 2012 01	PG-1/2"-SS2-007	1/2"	PROCESS GAS				--	--	--	--	--
SV 2003 01	GLY-3/4"-SS1-004	3/4"	GLYCOL OUTLET				1	A	X	1	X
SV 2004 01	VT-1/2"-SS2-002	1/2"	HELIUM VENTING OUTLET				1	A	X	1	X
SV 2004 02	VT-1/2"-SS2-001	1/2"	HELIUM VENTING RETURN				1	A	X	1	X
SV 2004 03	VT-1/2"-SS2-003	1/2"	HELIUM VENTING OUTLET				1	A	X	1	X
SV 2007 01	GLY-3/4"-SS1-012	3/4"	GLYCOL OUTLET				1	A	X	1	X
SV 2008 01	PAC-1/2"-SS2-002	1/2"	ACID INLET				1	A	X	1	X
SV 2008 02	PBA-1/2"-SS2-002	1/2"	BASE INLET				1	A	X	1	X

TP = TYPE **1**: ON/OFF	AC = **A**: PNEUMATIC (SIMPLE EFFECT) OPERATION	**F/E** = LIMIT SWITCH
TP = TYPE **2**: PROPORTIONAL	AC = **B**: PNEUMATIC (DOUBLE EFFECT) OPERATION	**N** = NUMBER OF LIMIT SWITCHES: **1**, **2**
TP = TYPE **3**: ELECTROVALVE	AC = **C**: PNEUMATIC (PROPORTIONAL) OPERATION	**E** = ELECTROVALVE

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Instruments list

CONTROL VALVE

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	19/01/2010	**CHECKED:**	J. MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

TAG Nº	SITUATION	Inch	SERVICE	REFERENCE	MATERIAL	MANUFACTURER	T`P	AC	F/E	N	E
SV 2012 01	PG-1/2"-SS2-010	1/2"	PROCESS GAS				1	A	X	1	X
SV 2012 02	PG-1/2"-SS2-008	1/2"	PROCESS GAS				1	A	X	1	X
SV 2012 03	HE-1/4"-SS2-003	1/4"	HELIUM INLET				1	A	X	1	X
SV 2013 01	PG-1/2"-SS2-007	1/2"	PROCESS GAS				1	A	X	1	X
SV 2017 01	GLY-3/4"-SS1-007	3/4"	GLYCOL OUTLET				1	A	X	1	X
SV 2018 01	VT-1/2"-SS2-006	1/2"	HELIUM VENTING OUTLET				1	A	X	1	X
SV 2018 02	VT-1/2"-SS2-005	1/2"	HELIUM VENTING RETURN				1	A	X	1	X
SV 2019 01	HE-1/4"-SS2-002	1/4"	HELIUM INLET				1	A	X	1	X
SV 2019 02	VT-1/2"-SS2-007	1/2"	HELIUM VENTING OUTLET				1	A	X	1	X
SV 2021 01	ST-1/2"-SS1-005	1/2"	STEAM				1	A	X	1	X
SV 2022 01	ST-1/2"-SS1-025	1/2"	STEAM				1	A	X	1	X
SV 2023 01	ST-1/2"-SS1-031	1/2"	STEAM				1	A	X	1	X

TP = TYPE **1**: ON/OFF	AC = **A**: PNEUMATIC (SIMPLE EFFECT) OPERATION	**F/E** = LIMIT SWITCH
TP = TYPE **2**: PROPORTIONAL	AC = **B**: PNEUMATIC (DOUBLE EFFECT) OPERATION	**N** = NUMBER OF LIMIT SWITCHES: **1**, **2**
TP = TYPE **3**: ELECTROVALVE	AC = **C**: PNEUMATIC (PROPORTIONAL) OPERATION	**E** = ELECTROVALVE

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Instruments list

ANALYZER

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
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DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

TAG Nº	SITUATION	Inch	DESCRIPTION	CONFIGURATED RANGE	MODEL	MAT.	MANUFACTURER
AT 2005 01	R 2005 01	1"	REDOX MEASUREMENT				
AT 2008 01	R 2005 01	1"	pH MEASUREMENT				
AT 2008 02	PL-1/2"-SS2-010	1"	pH MEASUREMENT				
AT 2011 01	R 2005 01	1"	BIOMASS MEASUREMENT				
AT 2011 02	PL-1/2"-SS2-010	1"	BIOMASS MEASUREMENT				
AT 2013 01	PG-1/2"-SS2-007	1"	GAS ANALYZER				
AT 2013 02	PG-1/2"-SS2-007	1"	GAS ANALYZER				
AT 2013 03	R 2005 01	1"	pO_2 MEASUREMENT				

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FLOW

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
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DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

TAG Nº	SITUATION	DN	DESCRIPTION	RANGE	SERVICE	MODEL	MATERIAL	MANUFACTURER
FT 2001 01	PL-1/2"-SS2-006	1/2"	INLET LIQUID FLOW MEASUREMENT		LIQUID			
FT 2012 01	PG-1/2"-SS2-007	1/2"	OUTLET GAS FLOW MEASUREMENT		GAS			

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Instruments list

LEVEL

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
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DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**CHECKED:**	J.MESTRE

TAG Nº	SITUATION		SERVICE	DESCRIPTION	MODEL	MAT.	MANUFACTURER
LT 2002 01	VS 2000 01	1"	LEVEL MEASUREMENT	LEVEL TRANSMITTER			
LS 2020 01	R 2005 01	1"	FOAM MEASUREMENT	LEVEL SWITCH			

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Instruments list

WEIGHT

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA					
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DRAWING:	DD-8550-Z1-100-01		REV.:	A	**CHECKED:**	J.MESTRE
TAG Nº	**SITUATION**	**SERVICE**	**DESCRIPTION**	**MODEL**	**CONF. RANGE**	**MANUFACTURER**
WT 2008 01	VS 2008 01	ACID BOTTLE WEIGHT (LEVEL) MEASURE	Weight Balance			
WT 2008 02	VS 2008 02	ALKALI BOTTLE WEIGHT (LEVEL) MEASURE	Weight Balance			
WT 2010 01	R 2005 01	REACTOR WEIGHT (LEVEL) MEASURE	Weight Cells			
WT 2016 01	VS 2014 01	HARVESTING TANK WEIGHT (LEVEL) MEASURE	Weight Balance			

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E-08012 BARCELONA

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Instruments list

PRESSURE

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
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TAG Nº	SITUATION	Inch	SERVICE	RANGE	MODEL	MATERIAL	MANUFACTURER
PI 2003 01	PRC 2003 01	1 1/2"	SERVICE AIR INLET				
PI 2004 01	VT-1/2"-SS2-002	1 1/2"	HELIUM VENTING OUTLET				
PI 2004 02	VT-1/2"-SS2-001	1 1/2"	HELIUM VENTING RETURN				
PI 2004 03	VT-1/2"-SS2-001	1 1/2"	HELIUM VENTING RETURN				
PI 2007 01	WT-3/4"-SS1-002	1 1/2"	WATER				
PI 2012 01	PRC 2012 01	1 1/2"	PROCESS GAS C.I. INLET				
PI 2012 02	PRC 2012 02	1 1/2"	CO_2 INLET				
PI 2012 03	PRC 2012 02	1 1/2"	HELIUM INLET				
PI 2012 04	PRC 2012 04	1 1/2"	PROCESS GAS				
PI 2012 05	PRC 2012 05	1 1/2"	PROCESS GAS				
PI 2012 06	PG-1/2"-SS2-003	1 1/2"	PROCESS GAS				
PI 2012 07	PG-1/2"-SS2-003	1 1/2"	PROCESS GAS				
PI 2012 08	PG-1/2"-SS2-005	1 1/2"	PROCESS GAS				
PI 2012 09	PG-1/2"-SS2-006	1 1/2"	PROCESS GAS				
PI 2012 10	PRC 2016 06	1 1/2"	PROCESS GAS				
PI 2012 11	HE-1/4"-SS2-003	1 1/2"	HELIUM INLET				
PI 2017 01	AI-1/4"-SS1-002	1 1/2"	SERVICE AIR INLET				
PI 2018 01	VT-1/2"-SS2-006	1 1/2"	HELIUM VENTING OUTLET				
PI 2018 02	VT-1/2"-SS2-005	1 1/2"	HELIUM VENTING RETURN				
PI 2018 03	VT-1/2"-SS2-005	1 1/2"	HELIUM VENTING RETURN				
PI 2019 01	HE-1/4"-SS2-002	1 1/2"	HELIUM INLET				
PS 2001 01	GP 2001 01	1 1/2"	MEMBRANE PROTECTION				
PS 2001 02	GP 2001 02	1 1/2"	MEMBRANE PROTECTION				

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E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

Instruments list

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TAG Nº	SITUATION	Inch	SERVICE	RANGE	MODEL	MATERIAL	MANUFACTURER
PS 2001 03	PL-1/2"-SS2-003	1 1/2"	LIQUID				
PS 2001 04	PL-1/2"-SS2-004	1 1/2"	LIQUID				
PS 2004 01	VT-1/2"-SS2-004	1 1/2"	HELIUM VENTING OUTLET				
PS 2012 01	PG-1/2"-SS2-008	1 1/2"	PROCESS GAS				
PS 2015 01	GP 2015 01	1 1/2"	MEMBRANE PROTECTION				
PS 2015 02	GP 2015 02	1 1/2"	MEMBRANE PROTECTION				
PS 2015 03	PL-1/2"-SS2-011	1 1/2"	LIQUID				
PS 2015 04	PL-1/2"-SS2-012	1 1/2"	LIQUID				
PS	MEDIA PREPARATION TANK	1 1/2"	LIQUID				
PT 2004 01	VS 2000 01	1 1/2"	FEEDING TANK				
PT 2009 01	R 2005 01	1 1/2"	BIOREACTOR				
PT 2009 02	R 2005 01	1 1/2"	BIOREACTOR				
PT 2012 01	VS 2012 01	1 1/2"	DISCHARGE BUFFER				
PT 2013 01	PG-1/2"-SS2-007	1 1/2"	PROCESS GAS				
PT 2018 01	VS 2014 01	1 1/2"	HARVESTING TANK				
PT 2019 01	VS 2019 01	1 1/2"	HELIUM BUFFER				
DPT 2001 01	PL-1/2"-SS2-003	1 1/2"	LIQUID				
DPT 2001 02	PL-1/2"-SS2-006	1 1/2"	LIQUID				
DPT 2012 01	PG-1/2"-SS2-005	1 1/2"	PROCESS GAS				

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E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

Instruments list

Temperature

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
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TAG Nº	SITUATION	Inch	DESCRIPTION	RANGE	MODEL	MATERIAL	MANUFACTURER
TT 2003 01	VS 2000 01		TEMP. MEASURE				
TT 2005 01	R 2005 01	1 "	REDOX ANALYZER				
TT 2007 01	R 2005 01		TEMP. MEASURE				
TT 2008 01	R 2005 01	1 "	pH ANALYZER				
TT 2008 02	R 2005 01	1 "	pH ANALYZER				
TT 2013 01	PG-1/2"-SS2-007		PROCESS GAS				
TT 2013 02	R 2005 01	1 "	pO_2 ANALYZER				
TT 2017 01	VS 2014 01		TEMP. MEASURE				

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Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

MATERIAL LIST

MANUAL VALVES

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TAG Nº	**SITUATION**	**DN**	**SERVICE**	**DESCRIPTION**	**MODEL**	**MATERIAL**	**MANUFACTURER**
HV 2000 01	ST-3/8"-SS1-008	3/8"	STEAM	Manual Valve			
HV 2000 01	PL-1/2"-SS2-001	1/2"	LIQUID	Manual Valve			
HV 2000 02	PL-1/2"-SS2-002	1/2"	LIQUID	Manual Valve			
HV 2000 03	PL-1/2"-SS2-001	1/2"	DRAIN	Manual Valve			
HV 2001 01	PL-1/2"-SS2-002	1/2"	LIQUID	Manual Valve			
HV 2001 02	PL-1/2"-SS2-003	1/2"	LIQUID	Manual Valve			
HV 2001 03	PL-1/2"-SS2-002	1/2"	DRAIN	Manual Valve			
HV 2001 04	PL-1/2"-SS2-004	1/2"	LIQUID	Manual Valve			
HV 2001 05	PL-1/2"-SS2-003	1/2"	DRAIN	Manual Valve			
HV 2001 06	PL-1/2"-SS2-004	1/2"	DRAIN	Manual Valve			
HV 2001 07	PL-1/2"-SS2-003	1/2"	LIQUID	Manual Valve			
HV 2001 08	PL-1/2"-SS2-004	1/2"	LIQUID	Manual Valve			
HV 2001 09	PL-1/2"-SS2-006	1/2"	LIQUID	Manual Valve			
HV 2001 10	PL-1/2"-SS2-005	1/2"	LIQUID	Manual Valve			
HV 2001 11	PL-1/2"-SS2-006	1/2"	LIQUID	Manual Valve			
HV 2001 12	PL-1/2"-SS2-005	1/2"	LIQUID	Manual Valve			
HV 2001 13	PL-1/2"-SS2-006	1/2"	DRAIN	Manual Valve			
HV 2001 14	PL-1/2"-SS2-008	1/2"	LIQUID	Manual Valve			
HV 2001 15	PL-1/2"-SS2-007	1/2"	LIQUID	Manual Valve			

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MANUAL VALVES

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TAG Nº	**SITUATION**	**DN**	**SERVICE**	**DESCRIPTION**	**MODEL**	**MATERIAL**	**MANUFACTURER**
HV 2001 16	PL-1/2"-SS2-008	1/2"	LIQUID	Manual Valve			
HV 2001 17	PL-1/2"-SS2-007	1/2"	LIQUID	Manual Valve			
HV 2001 18	PL-1/2"-SS2-009	1/2"	LIQUID	Manual Valve			
HV 2003 01	GLY-3/4"-SS1-001	3/4"	GLYCOL INLET	Manual Valve			
HV 2003 01	GLY-3/4"-SS1-001	3/4"	GLYCOL INLET	Manual Valve			
HV 2003 01	GLY-3/4"-SS1-001	3/4"	GLYCOL INLET	Manual Valve			
HV 2003 02	GLY-3/4"-SS1-001	3/4"	GLYCOL INLET	Manual Valve			
HV 2003 03	GLY-3/4"-SS1-003	3/4"	CONDENSATE	Manual Valve			
HV 2003 04	GLY-3/4"-SS1-004	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2003 05	GLY-3/4"-SS1-002	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2003 05	GLY-3/4"-SS1-002	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2003 05	GLY-3/4"-SS1-002	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2003 06	AI-1/4"-SS1-001	1/4"	SERVICE AIR INLET	Manual Valve			
HV 2003 06	AI-1/4"-SS1-002	1/4"	SERVICE AIR INLET	Manual Valve			
HV 2003 07	AI-1/4"-SS1-001	1/4"	SERVICE AIR INLET	Manual Valve			
HV 2003 08	GLY-3/4"-SS1-005	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2004 01	VT-1/2"-SS2-002	1/2"	HELIUM VENTING OUTLET	Manual Valve			
HV 2004 02	VT-1/2"-SS2-002	1/2"	HELIUM VENTING OUTLET	Manual Valve			
HV 2004 03	VT-1/2"-SS2-002	1/2"	HELIUM VENTING OUTLET	Manual Valve			

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MATERIAL LIST

MANUAL VALVES

CUSTOMER:	Universitat Autònoma de Barcelona / MPP						
PROJECT:	MELiSSA COMPARTMENT II			**DATE:**	19/01/2010	**PREPARED:**	J. GUBERN
DRAWING:	DD-8550-Z1-100-01			**REV:**	A	**CHECKED:**	J.MESTRE
TAG Nº	**SITUATION**	**DN**	**SERVICE**	**DESCRIPTION**	**MODEL**	**MATERIAL**	**MANUFACTURER**
HV 2004 04	VT-1/2"-SS2-004	1/2"	HELIUM VENTING OUTLET	Manual Valve			
HV 2004 05	VT-1/2"-SS2-001	1/2"	HELIUM VENTING RETURN	Manual Valve			
HV 2004 06	VT-1/2"-SS2-001	1/2"	HELIUM VENTING RETURN	Manual Valve			
HV 2004 07	VT-1/2"-SS2-001	1/2"	HELIUM VENTING RETURN	Manual Valve			
HV 2005 01	ST-3/8"-SS1-018	3/8"	STEAM	Manual Valve			
HV 2005 02	R 2005 01	1/2"	DRAIN	Manual Valve			
HV 2007 01	GLY-3/4"-SS1-011	3/4"	GLYCOL INLET	Manual Valve			
HV 2007 02	GLY-3/4"-SS1-011	3/4"	DRAIN	Manual Valve			
HV 2007 03	GLY-3/4"-SS1-012	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2007 04	WT-3/4"-SS1-001	3/4"	WATER	Manual Valve			
HV 2007 05	WT-3/4"-SS1-002	3/4"	DRAIN	Manual Valve			
HV 2007 06	WT-3/4"-SS1-002	3/4"	WATER	Manual Valve			
HV 2007 07	WT-3/4"-SS1-002	3/4"	HCL OUTLET	Manual Valve			
HV 2007 08	WT-3/4"-SS1-002	3/4"	HCL INLET	Manual Valve			
HV 2007 09	WT-3/4"-SS1-002	3/4"	WATER	Manual Valve			
HV 2007 10	WT-3/4"-SS1-002	3/4"	WATER	Manual Valve			
HV 2007 11	WT-3/4"-SS1-002	3/4"	WATER	Manual Valve			
HV 2008 01	PAC-1/2"-SS2-002	1/2"	ACID INLET	Manual Valve			
HV 2008 02	PBA-1/2"-SS2-002	1/2"	BASE INLET	Manual Valve			

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HV 2008 03	PAC-1/2"-SS2-002	1/2"	ACID INLET	Manual Valve			
HV 2008 04	PBA-1/2"-SS2-002	1/2"	BASE INLET	Manual Valve			
HV 2012 01	PG-1/4"-SS2-001	1/4"	PROCESS GAS C.I. INLET	Manual Valve			
HV 2012 02	CO2-1/4"-SS2-001	1/4"	CO2 INLET	Manual Valve			
HV 2012 03	HE-1/4"-SS2-001	1/4"	HELIUM INLET	Manual Valve			
HV 2012 04	PG-1/2"-SS2-003	1/2"	PROCESS GAS	Manual Valve			
HV 2012 05	PG-1/2"-SS2-003	1/2"	PROCESS GAS	Manual Valve			
HV 2012 06	PG-1/2"-SS2-004	1/2"	PROCESS GAS	Manual Valve			
HV 2012 07	PG-1/2"-SS2-006	1/2"	PROCESS GAS	Manual Valve			
HV 2012 08	PG-1/2"-SS2-005	1/2"	PROCESS GAS	Manual Valve			
HV 2012 09	PG-1/2"-SS2-006	1/2"	PROCESS GAS	Manual Valve			
HV 2012 10	PG-1/2"-SS2-005	1/2"	PROCESS GAS	Manual Valve			
HV 2012 11	PG-1/2"-SS2-008	1/2"	PROCESS GAS	Manual Valve			
HV 2012 12	PG-1/4"-SS2-009	1/4"	PROCESS GAS	Manual Valve			
HV 2012 13	PG-1/4"-SS2-011	1/4"	PROCESS GAS	Manual Valve			
HV 2012 14	HE-1/4"-SS2-003	1/4"	HELIUM INLET	Manual Valve			
HV 2012 15	GLY-3/4"-SS1-001	3/4"	GLYCOL INLET	Manual Valve			
HV 2012 15	VS 2012 01	1 1/2"	DRAIN	Manual Valve			
HV 2012 16	GLY-3/4"-SS1-002	3/4"	GLYCOL OUTLET	Manual Valve			

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TAG Nº	**SITUATION**	**DN**	**SERVICE**	**DESCRIPTION**	**MODEL**	**MATERIAL**	**MANUFACTURER**
HV 2012 17	GLY-3/4"-SS1-001	1/2"	DRAIN	Manual Valve			
HV 2013 01	PG-1/2"-SS2-007	1/2"	PROCESS GAS	Manual Valve			
HV 2014 01	ST-3/8"-SS1-030	3/8"	STEAM	Manual Valve			
HV 2014 02	PL-1/2"-SS2-014	1/2"	LIQUID	Manual Valve			
HV 2014 03	PL-1/2"-SS2-014	1/2"	LIQUID	Manual Valve			
HV 2015 01	PL-1/2"-SS2-010	1/2"	LIQUID	Manual Valve			
HV 2015 02	PL-1/2"-SS2-010	1/2"	DRAIN	Manual Valve			
HV 2015 03	PL-1/2"-SS2-011	1/2"	LIQUID	Manual Valve			
HV 2015 04	PL-1/2"-SS2-012	1/2"	LIQUID	Manual Valve			
HV 2015 05	PL-1/2"-SS2-011	1/2"	DRAIN	Manual Valve			
HV 2015 06	PL-1/2"-SS2-012	1/2"	DRAIN	Manual Valve			
HV 2015 07	PL-1/2"-SS2-012	1/2"	LIQUID	Manual Valve			
HV 2015 08	PL-1/2"-SS2-011	1/2"	LIQUID	Manual Valve			
HV 2015 09	PL-1/2"-SS2-013	1/2"	LIQUID	Manual Valve			
HV 2017 01	GLY-3/4"-SS1-001	3/4"	GLYCOL INLET	Manual Valve			
HV 2017 02	GLY-3/4"-SS1-006	3/4"	CONDENSATE	Manual Valve			
HV 2017 03	GLY-3/4"-SS1-007	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2017 04	AI-1/4"-SS1-002	1/4"	SERVICE AIR INLET	Manual Valve			
HV 2017 04	AI-1/4"-SS1-002	1/4"	SERVICE AIR INLET	Manual Valve			

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HV 2017 05	GLY-3/4"-SS1-008	3/4"	GLYCOL OUTLET	Manual Valve			
HV 2018 01	VT-1/2"-SS2-006	1/2"	HELIUM VENTING OUTLET	Manual Valve			
HV 2018 02	VT-1/2"-SS2-006	1/2"	HELIUM VENTING OUTLET	Manual Valve			
HV 2018 03	VT-1/2"-SS2-006	1/2"	HELIUM VENTING OUTLET	Manual Valve			
HV 2018 04	VT-1/2"-SS2-005	1/2"	HELIUM VENTING RETURN	Manual Valve			
HV 2018 05	VT-1/2"-SS2-005	1/2"	HELIUM VENTING RETURN	Manual Valve			
HV 2018 06	VT-1/2"-SS2-005	1/2"	HELIUM VENTING RETURN	Manual Valve			
HV 2019 01	HE-1/4"-SS2-002	1/4"	HELIUM INLET	Manual Valve			
HV 2019 02	VT-1/2"-SS2-007	1/2"	HELIUM VENTING OUTLET	Manual Valve			
HV 2019 03	VS 2019 01	1 1/2"	DRAIN	Manual Valve			
HV 2020 01	IN-1/2"-SS2-001	1/2"	INOCULUM / ANTIFOAM	Manual Valve			
HV 2021 01	ST-3/4"-SS1-001	3/4"	STEAM	Manual Valve			
HV 2021 01	ST-3/4"-SS1-001	3/4"	STEAM	Manual Valve			
HV 2021 02	ST-3/8"-SS1-002	3/8"	STEAM	Manual Valve			
HV 2021 03	ST-3/8"-SS1-003	1/2"	STEAM	Manual Valve			
HV 2021 04	ST-1/2"-SS1-005	1/2"	STEAM	Manual Valve			
HV 2021 05	ST-3/8"-SS1-006	3/8"	STEAM	Manual Valve			
HV 2021 06	ST-1/2"-SS1-007	1/2"	CONDENSATE	Manual Valve			
HV 2021 07	ST-1/2"-SS1-007	1/2"	CONDENSATE	Manual Valve			

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HV 2021 08	HV 2000 02	3/8"	CONDENSATE	Manual Valve			
HV 2021 09	ST-3/8"-SS1-008	3/8"	STEAM	Manual Valve			
HV 2022 01	ST-3/8"-SS1-004	3/8"	STEAM	Manual Valve			
HV 2022 02	ST-3/8"-SS1-009	3/8"	STEAM	Manual Valve			
HV 2022 03	PL-1/2"-SS2-003	1/2"	INERT GAS INLET	Manual Valve			
HV 2022 04	ST-3/8"-SS1-010	3/8"	STEAM	Manual Valve			
HV 2022 05	PL-1/2"-SS2-004	1/2"	INERT GAS INLET	Manual Valve			
HV 2022 06	HV 2001 07	3/8"	CONDENSATE	Manual Valve			
HV 2022 07	HV 2001 08	3/8"	CONDENSATE	Manual Valve			
HV 2022 08	ST-3/8"-SS1-011	3/8"	STEAM	Manual Valve			
HV 2022 09	HV 2001 11	3/8"	CONDENSATE	Manual Valve			
HV 2022 10	ST-3/8"-SS1-012	3/8"	STEAM	Manual Valve			
HV 2022 11	ST-3/8"-SS1-013	3/8"	STEAM	Manual Valve			
HV 2022 12	PL-1/2"-SS2-008	1/2"	INERT GAS INLET	Manual Valve			
HV 2022 13	PL-1/2"-SS2-007	1/2"	INERT GAS INLET	Manual Valve			
HV 2022 14	HV 2001 16	3/8"	CONDENSATE	Manual Valve			
HV 2022 15	HV 2001 17	3/8"	CONDENSATE	Manual Valve			
HV 2022 16	HV 2001 18	3/8"	CONDENSATE	Manual Valve			
HV 2022 17	ST-3/8"-SS1-014	3/8"	STEAM	Manual Valve			

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TAG Nº	**SITUATION**	**DN**	**SERVICE**	**DESCRIPTION**	**MODEL**	**MATERIAL**	**MANUFACTURER**
HV 2022 18	ST-3/8"-SS1-015	3/8"	CONDENSATE	Manual Valve			
HV 2022 19	ST-3/8"-SS1-018	3/8"	STEAM	Manual Valve			
HV 2022 20	ST-3/8"-SS1-016	3/8"	STEAM	Manual Valve			
HV 2022 21	ST-3/8"-SS1-017	3/8"	STEAM	Manual Valve			
HV 2022 22	ST-3/8"-SS1-019	3/8"	CONDENSATE	Manual Valve			
HV 2022 23	ST-3/8"-SS1-019	3/8"	CONDENSATE	Manual Valve			
HV 2022 24	ST-3/8"-SS1-020	3/8"	STEAM	Manual Valve			
HV 2022 25	ST-3/8"-SS1-021	3/8"	STEAM	Manual Valve			
HV 2022 26	ST-3/8"-SS1-022	3/8"	STEAM	Manual Valve			
HV 2022 27	ST-3/8"-SS1-023	3/8"	STEAM	Manual Valve			
HV 2022 28	ST-3/8"-SS1-024	3/8"	CONDENSATE	Manual Valve			
HV 2022 29	ST-3/8"-SS1-024	3/8"	CONDENSATE	Manual Valve			
HV 2022 30	ST-1/2"-SS1-025	1/2"	STEAM	Manual Valve			
HV 2022 31	ST-3/8"-SS1-026	3/8"	CONDENSATE	Manual Valve			
HV 2022 32	ST-3/8"-SS1-026	3/8"	CONDENSATE	Manual Valve			
HV 2022 33	ST-3/8"-SS1-026	3/8"	CONDENSATE	Manual Valve			
HV 2022 34	ST-3/8"-SS1-026	3/8"	CONDENSATE	Manual Valve			
HV 2022 35	ST-1/2"-SS1-039	1/2"	CONDENSATE	Manual Valve			
HV 2022 36	ST-1/2"-SS1-039	1/2"	CONDENSATE	Manual Valve			

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TAG Nº	**SITUATION**	**DN**	**SERVICE**	**DESCRIPTION**	**MODEL**	**MATERIAL**	**MANUFACTURER**
HV 2022 37	ST-1/2"-SS1-041	1/2"	CONDENSATE	Manual Valve			
HV 2022 38	ST-1/2"-SS1-041	1/2"	CONDENSATE	Manual Valve			
HV 2023 01	ST-3/8"-SS1-034	3/8"	STEAM	Manual Valve			
HV 2023 02	ST-3/8"-SS1-032	3/8"	STEAM	Manual Valve			
HV 2023 03	ST-3/8"-SS1-033	3/8"	STEAM	Manual Valve			
HV 2023 04	PL-1/2"-SS2-012	1/2"	INERT GAS INLET	Manual Valve			
HV 2023 05	PL-1/2"-SS2-011	1/2"	INERT GAS INLET	Manual Valve			
HV 2023 06	ST-3/8"-SS1-035	3/8"	CONDENSATE	Manual Valve			
HV 2023 07	ST-3/8"-SS1-035	3/8"	CONDENSATE	Manual Valve			
HV 2023 08	ST-3/8"-SS1-036	3/8"	CONDENSATE	Manual Valve			
HV 2023 09	ST-1/2"-SS1-031	1/2"	STEAM	Manual Valve			
HV 2023 10	ST-1/2"-SS1-028	3/8"	STEAM	Manual Valve			
HV 2023 11	ST-3/8"-SS1-038	3/8"	CONDENSATE	Manual Valve			
HV 2023 12	ST-3/8"-SS1-038	3/8"	CONDENSATE	Manual Valve			
HV 2023 13	ST-3/8"-SS1-030	3/8"	STEAM	Manual Valve			
HV 2023 14	HV 2014 03	3/8"	CONDENSATE	Manual Valve			
HV 2023 15	ST-1/2"-SS1-037	1/2"	CONDENSATE	Manual Valve			
HV 2023 16	ST-1/2"-SS1-037	1/2"	CONDENSATE	Manual Valve			
HV 2023 17	ST-1/2"-SS1-027	1/2"	STEAM	Manual Valve			

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TAG Nº	SITUATION	DN	SERVICE	DESCRIPTION	MODEL	MATERIAL	MANUFACTURER
HV 2023 18	ST-1/2"-SS1-039	1/2"	CONDENSATE	Manual Valve			
HV 2023 19	ST-1/2"-SS1-039	1/2"	CONDENSATE	Manual Valve			

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PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	19/01/2010	**PREPARED:**	J.GUBERN
DRAWING:	DD-8558-Z1-100-01	**REV:**	A	**CHECKED:**	J.MESTRE

TAG Nº	SITUATION	DN	SERVICE	DESCRIPTION	MODEL	MAT.	MANUFACTURER
NRV 2001 01	PL-1/2"-SS2-009	1/2"	LIQUID	Check Valve			
NRV 2008 01	PAC-1/2"-PP-001	1/2"	ACID INLET	Check Valve			
NRV 2008 02	PBA-1/2"-PP-001	1/2"	BASE INLET	Check Valve			
NRV 2012 01	PG-1/4"-SS2-001	1/4"	PROCESS GAS C.I. INLET	Check Valve			
NRV 2012 02	CO2-1/4"-SS2-001	1/4"	CO2 INLET	Check Valve			
NRV 2012 03	HE-1/4"-SS2-001	1/4"	HELIUM INLET	Check Valve			
NRV 2012 04	PG-1/2"-SS2-003	1/2"	PROCESS GAS	Check Valve			
NRV 2012 05	PG-1/2"-SS2-003	1/2"	PROCESS GAS	Check Valve			
NRV 2012 06	PG-1/2"-SS2-008	1/2"	PROCESS GAS	Check Valve			
NRV 2012 07	PG-1/4"-SS2-009	1/4"	PROCESS GAS	Check Valve			
NRV 2012 08	PG-1/4"-SS2-011	1/4"	PROCESS GAS	Check Valve			
NRV 2012 09	VT-1/4"-SS2-008	1/4"	HELIUM VENTING OUTLET	Check Valve			
NRV 2015 01	PL-1/2"-SS2-013	1/2"	LIQUID	Check Valve			
PRC 2003 01	AI-1/4"-SS1-001	1/4"	SERVICE AIR INLET	Pressure regulator			
PRC 2004 01	VT-1/2"-SS2-001	1/4"	HELIUM VENTING RETURN	Pressure regulator			
PRC 2012 01	PG-1/4"-SS2-001	1/4"	PROCESS GAS C.I. INLET	Pressure regulator			
PRC 2012 02	CO2-1/4"-SS2-001	1/4"	CO2 INLET	Pressure regulator			
PRC 2012 03	HE-1/4"-SS2-001	1/4"	HELIUM INLET	Pressure regulator			
PRC 2012 04	PG-1/2"-SS2-002	1/4"	PROCESS GAS	Pressure regulator			
PRC 2012 05	PG-1/2"-SS2-003	1/4"	PROCESS GAS	Pressure regulator			
PRC 2012 06	PG-1/4"-SS2-009	1/4"	PROCESS GAS	Pressure regulator			
PRC 2012 07	HE-1/4"-SS2-003	1/4"	HELIUM INLET	Pressure regulator			
PRC 2018 01	VT-1/2"-SS2-005	1/4"	HELIUM VENTING RETURN	Pressure regulator			
PRC 2019 01	HE-1/4"-SS2-002	1/4"	HELIUM INLET	Pressure regulator			
RV 2003 01	GLY-3/4"-SS1-004	3/4"	GLYCOL OUTLET	Relief Valve			

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TAG Nº	SITUATION	DN	SERVICE	DESCRIPTION	MODEL	MAT.	MANUFACTURER
RV 2004 02	VT-1/2"-SS2-003	1/2"	HELIUM VENTING OUTLET	Relief Valve			
RV 2004 01	VS 2000 01		BLOW UP	Relief Valve			
RV 2005 01	R 2005 01	1/2"	BLOW UP	Relief Valve			
RV 2007 01	GLY-1"-SS1-012	1"	GLYCOL OUTLET	Relief Valve			
RV 2007 02	WT-1"-SS1-002	1"	WATER	Relief Valve			
RV 2007 03	WT-1"-SS1-002	1"	WATER	Relief Valve			
RV 2012 01	PG-1/2"-SS2-005	1/2"	PROCESS GAS	Relief Valve			
RV 2012 02	GLY-1"-SS1-001	1"	GLYCOL INLET	Relief Valve			
RV 2012 03	PG-1/2"-SS2-008	1/2"	PROCESS GAS	Relief Valve			
RV 2012 04	VS 2012 01		BLOW UP	Relief Valve			
RV 2017 01	GLY-3/4"-SS1-007	3/4"	GLYCOL OUTLET	Relief Valve			
RV 2018 01	VS 2014 01		BLOW UP	Relief Valve			
RV 2019 01	VS 2019 01		BLOW UP	Relief Valve			
SF 2021 01	ST-1/2"-SS1-007	1/2"	CONDENSATE	Steam Trap			
SF 2022 01	ST-3/8"-SS1-015	3/8"	CONDENSATE	Steam Trap			
SF 2022 02	ST-3/8"-SS1-024	3/8"	CONDENSATE	Steam Trap			
SF 2022 03	ST-3/8"-SS1-026	3/8"	CONDENSATE	Steam Trap			
SF 2022 04	ST-1/2"-SS1-039	1/2"	CONDENSATE	Steam Trap			
SF 2022 05	ST-1/2"-SS1-041	1/2"	CONDENSATE	Steam Trap			
SF 2023 01	ST-3/8"-SS1-038	3/8"	CONDENSATE	Steam Trap			
SF 2023 02	ST-1/2"-SS1-037	1/2"	CONDENSATE	Steam Trap			
SF 2023 03	ST-1/2"-SS1-040	1/2"	CONDENSATE	Steam Trap			

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DRAWING:	DD-8558-Z1-100-01	**REV:**	A	**CHECKED:**	J. MESTRE

TAG Nº	SITUATION	DN	SERVICE	DESCRIPTION	MODEL	MATERIAL	MANUFACTURER
LF 2000 01	PL-1/2"-SS2-001	1/2"	PROCESS LIQUID	Liquid filter			
LF 2001 01	PL-1/2"-SS2-003	1/2"	PROCESS LIQUID	Liquid filter			
LF 2001 02	PL-1/2"-SS2-004	1/2"	PROCESS LIQUID	Liquid filter			
LF 2001 03	PL-1/2"-SS2-008	1/2"	PROCESS LIQUID	Liquid filter			
LF 2001 04	PL-1/2"-SS2-009	1/2"	PROCESS LIQUID	Liquid filter			
LF 2008 01	PAC-1/2"-SS2-002	1/2"	ACID INLET	Liquid filter			
LF 2008 02	PBA-1/2"-SS2-002	1/2"	BASE INLET	Liquid filter			
GF 2004 01	VT-1/2"-SS2-002	1/2"	HELIUM VENTING OUTLET	Gas filter			
GF 2004 02	VT-1/2"-SS2-001	1/2"	HELIUM VENTING RETURN	Gas filter			
GF 2008 01	VT-1/2"-PP-010	1/2"	ACID INLET	Gas filter			
GF 2008 02	VT-1/4"-PP-009	1/4"	BASE INLET	Gas filter			
GF 2012 01	PG-1/4"-SS2-001	1/4"	PROCESS GAS C.I. INLET	Gas filter			
GF 2012 02	CO2-1/4"-SS2-001	1/4"	CO_2 INLET	Gas filter			
GF 2012 03	HE-1/4"-SS2-001	1/4"	HELIUM INLET	Gas filter			
GF 2012 04	PG-1/2"-SS2-003	1/2"	PROCESS GAS	Gas filter			
GF 2012 05	PG-1/2"-SS2-003	1/2"	PROCESS GAS	Gas filter			
GF 2012 06	PG-1/2"-SS2-005	1/2"	PROCESS GAS	Gas filter			
GF 2012 07	PG-1/2"-SS2-006	1/2"	PROCESS GAS	Gas filter			
GF 2012 08	PG-1/2"-SS2-007	1/2"	PROCESS GAS	Gas filter			
GF 2012 09	PG-1/4"-SS2-009	1/4"	PROCESS GAS	Gas filter			
GF 2012 10	PG-1/4"-SS2-011	1/4"	PROCESS GAS	Gas filter			
GF 2012 11	VT-1/4"-SS2-008	1/4"	HELIUM VENTING OUTLET	Gas filter			
GF 2018 01	VT-1/2"-SS2-006	1/2"	HELIUM VENTING OUTLET	Gas filter			

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MATERIAL LIST

FILTERS

CUSTOMER:	Universitat Autònoma de Barcelona / MPP						
PROJECT:	MELiSSA COMPARTMENT II			**DATE:**	19/01/2010	**PREPARED:**	J. GUBERN
DRAWING:	DD-8558-Z1-100-01			**REV:**	A	**CHECKED:**	J. MESTRE
GF 2018 02	VT-1/2"-SS2-005	1/2"	HELIUM VENTING RETURN	Gas filter			

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ELECTRICAL AND CONTROL SIGNALS

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	20/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

CONTROL LOOP	EQUIPMENT	PLC ADRESS	DESCRIPTION	I/O	SIGNAL TYPE
2000	GP 2000 01		Start/Stop feeding tank agitator converter	DO	0/1
2000	GP 2000 01		Feeding tank agitator thermal protection	DI	0/1
2000	GP 2000 01		Feeding tank agitator speed set-point	AO	4-20 mA
2001	FT 2001 01		Total liquid inlet flow to reactor	AI	4-20 mA
2001	DPT 2001 01		Differential pressure measurement (pre-filters)	AI	4-20 mA
2001	DPT 2001 02		Differential pressure measurement (filters)	AI	4-20 mA
2001	GP 2001 01/02		Start/Stop inlet pumps converter	DO	0/1
2001	GP 2001 01		Start/Stop inlet pump GP 2001 01	DO	0/1
2001	GP 2001 02		Start/Stop inlet pump GP 2001 02	DO	0/1
2001	GP 2001 01/02		Inlet pumps thermal protection	DI	0/1
2001	GP 2001 01/02		Flow set-point (inlet pumps)	AO	4-20 mA
2001	PS 2001 01		Pressure switch (GP 2001 01)	DI	0/1
2001	PS 2001 02		Pressure switch (GP 2001 02)	DI	0/1
2001	PS 2001 03		Pressure switch	DI	0/1
2001	PS 2001 04		Pressure switch	DI	0/1
2002	LT 2002 01		Feeding tank level measurement	AI	4-20 mA
2003	TT 2003 01		Feeding tank temperature measurement	AI	4-20 mA
2003	SV 2003 01		Open/Close cooling water inlet valve	DO	0/1
2003	SV 2003 01		Cooling water inlet valve feedback	DI	0/1
2004	BLWR 2004 01		Start/Stop the compressor	DO	0/1

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CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	20/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

CONTROL LOOP	EQUIPMENT	PLC ADRESS	DESCRIPTION	I/O	SIGNAL TYPE
2004	SV 2004 03		Open/Close compressor (BLWR 2004 01) bypass valve	DO	0/1
2004	SV 2004 03		Compressor (BLWR 2004 01) bypass valve feedback	DI	0/1
2004	PS 2004 01		Pressure switch for compressor recycling	DI	0/1
2004	PT 2004 01		Feeding tank pressure measurement	AI	4-20 mA
2004	SV 2004 01		Open/Close feeding tank vent valve	DO	0/1
2004	SV 2004 01		Feeding tank vent valve feedback	DI	0/1
2004	SV 2004 02		Open/Close helium inlet valve	DO	0/1
2004	SV 2004 02		Helium inlet valve feedback	DI	0/1
2005	GP 2005 01		Start/Stop bioreactor agitator converter	DO	0/1
2005	GP 2005 01		Bioreactor agitator thermal protection	DI	0/1
2005	GP 2005 01		Bioreactor agitator speed set-point	AO	4-20 mA
2005	AT 2005 01		Redox measurement	AI	4-20 mA
2005	TT 2005 01		Temperature measurement (AT 2005 01)	AI	4-20 mA
2006	IRC 2006 01		Light Power Phase 1	AI	4-20 mA
2006	IRC 2006 01		Light Power Phase 2	AI	4-20 mA
2006	IRC 2006 01		Light Power Phase 3	AI	4-20 mA
2006	IRC 2006 01		Light intensity set-point	AO	4-20 mA
2007	TT 2007 01		Reactor temperature measurement	AI	4-20 mA
2007	HX 2007 02		Start/Stop electrical resistance	DO	0/1
2007	BLWR 2007 01		Start/Stop air extractor	DO	0/1

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CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	20/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

CONTROL LOOP	EQUIPMENT	PLC ADRESS	DESCRIPTION	I/O	SIGNAL TYPE
2007	BLWR 2007 01		Air extractor thermal protection	DI	0/1
2007	BLWR 2007 01		Air extractor set-point	AO	4-20 mA
2007	SV 2007 01		Open/Close cooling water inlet valve	DO	0/1
2007	SV 2007 01		Cooling water inlet valve feedback	DI	0/1
2007	PP 2007 01		Start/Stop the pump	DO	0/1
2008	AT 2008 01		pH measurement	AI	4-20 mA
2008	TT 2008 01		Temperature measurement (AT 2008 01)	AI	4-20 mA
2008	AT 2008 02		pH measurement	AI	4-20 mA
2008	TT 2008 02		Temperature measurement (AT 2008 02)	AI	4-20 mA
2008	SV 2008 01		Open/Close PBR acid inlet valve	DO	0/1
2008	SV 2008 01		PBR acid inlet valve feedback	DI	0/1
2008	SV 2008 02		Open/Close PBR base inlet valve	DO	0/1
2008	SV 2008 02		PBR base inlet valve feedback	DI	0/1
2008	PP 2008 01		Start/Stop the acid pump	DO	0/1
2008	PP 2008 02		Start/Stop the base pump	DO	0/1
2008	WT 2008 01		Weight (level) measurement		Ethernet
2008	WT 2008 02		Weight (level) measurement		Ethernet
2009	PT 2009 01		Bioreactor pressure measurement	AI	4-20 mA
2009	PT 2009 02		Bioreactor pressure measurement	AI	4-20 mA
2010	WT 2010 01		Bioreactor weight (level) measurement	AI	4-20 mA

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CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	20/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

CONTROL LOOP	EQUIPMENT	PLC ADRESS	DESCRIPTION	I/O	SIGNAL TYPE
2011	AT 2011 01		Biomass measurement	AI	4-20 mA
2011	AT 2011 01		Biomass sensor failure	AI	22 mA
2011	AT 2011 02		Biomass measurement	AI	4-20 mA
2011	AT 2011 02		Biomass sensor failure	AI	22 mA
2012	FQRC 2012 01		Inlet process gas flow measurement	AI	4-20 mA
2012	FQRC 2012 01		Inlet process gas flow set-point	AO	4-20 mA
2012	FQRC 2012 02		Inlet CO_2 flow measurement	AI	4-20 mA
2012	FQRC 2012 02		Inlet CO_2 flow set-point	AO	4-20 mA
2012	FQRC 2012 03		Inlet helium flow measurement	AI	4-20 mA
2012	FQRC 2012 03		Inlet helium flow set-point	AO	4-20 mA
2012	FQRC 2012 04		Total inlet gas flow measurement	AI	4-20 mA
2012	FQRC 2012 04		Total inlet gas flow set-point	AO	4-20 mA
2012	FQRC 2012 05		Circulated gas flow measurement	AI	4-20 mA
2012	FQRC 2012 05		Circulated gas flow set-point	AO	4-20 mA
2012	FQRC 2012 06		C. II outlet gas flow measurement (to C.III)	AI	4-20 mA
2012	FQRC 2012 06		C. II outlet gas flow set-point (to C.III)	AO	4-20 mA
2012	FQRC 2012 07		C. II outlet gas flow measurement (to atm)	AI	4-20 mA
2012	FQRC 2012 07		C. II outlet gas flow set-point (to atm)	AO	4-20 mA
2012	BLWR 2012 01		Start/Stop the compressor	DO	0/1
2012	SV 2012 02		Open/Close compressor (BLWR 2012 01) bypass valve	DO	0/1

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DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

CONTROL LOOP	EQUIPMENT	PLC ADRESS	DESCRIPTION	I/O	SIGNAL TYPE
2012	SV 2012 02		Compressor (BLWR 2012 01) bypass valve feedback	DI	0/1
2012	PS 2012 01		Pressure switch for compressor recycling	DI	0/1
2012	PT 2012 01		Discharge vessel pressure measurement	AI	4-20 mA
2012	FT 2012 01		PBR outlet gas flow measurement	AI	4-20 mA
2012	DPT 2012 01		Differential pressure measurement (filters)	AI	4-20 mA
2012	SCV 2012 01		PBR outlet gas flow set-point	AO	4-20 mA
2012	SV 2012 01		Open/Close analyzer inlet valve	DO	0/1
2012	SV 2012 01		Gas analyzer inlet valve feedback	DI	0/1
2012	HX 4012 02		Start/Stop post-condenser	DO	0/1
2012	SV 2012 03		Open/Close helium inlet valve	DO	0/1
2012	SV 2012 03		Helium inlet valve feedback	DI	0/1
2013	AT 2013 01		Outlet gas analyzer	AI	4-20 mA
2013	AT 2013 02		Outlet gas analyzer	AI	4-20 mA
2013	SV 2013 01		Open/Close gas analyzer inlet valve	DO	0/1
2013	SV 2013 01		Gas analyzer inlet valve feedback	DI	0/1
2013	AT 2013 03		Dissolved O_2 analyzer	AI	4-20 mA
2013	TT 2013 02		Temperature measurement (AT 2013 03)	AI	4-20 mA
2013	PT 2013 01		Outlet gas pressure measurement	AI	4-20 mA
2013	TT 2013 01		Outlet gas temperature measurement	AI	4-20 mA
2014	GP 2014 01		Start/Stop harvesting tank agitator converter	DO	0/1

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CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	20/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

CONTROL LOOP	EQUIPMENT	PLC ADRESS	DESCRIPTION	I/O	SIGNAL TYPE
2014	GP 2014 01		Harvesting tank agitator thermal protection	DI	0/1
2014	GP 2014 01		Harvesting tank agitator speed set-point	AO	4-20 mA
2015	GP 2015 01/02		Start/Stop outlet pumps converter	DO	0/1
2015	GP 2015 01		Start/Stop outlet pump GP 2015 01	DO	0/1
2015	GP 2015 02		Start/Stop outlet pump GP 2015 02	DO	0/1
2015	GP 2015 01/02		Outlet pumps thermal protection	DI	4-20 mA
2015	GP 2015 01/02		Flow set-point (outlet pumps)	AO	4-20 mA
2015	PS 2015 01		Pressure switch (GP 2015 01)	DI	0/1
2015	PS 2015 02		Pressure switch (GP 2015 02)	DI	0/1
2015	PS 2015 03		Pressure switch	DI	0/1
2015	PS 2015 04		Pressure switch	DI	0/1
2016	WT 2016 01		Harvesting tank weight (level) measurement	AI	4-20 mA
2017	TT 2017 01		Harvesting tank temperature measurement	AI	4-20 mA
2017	SV 2017 01		Open/Close cooling water inlet valve	DO	0/1
2017	SV 2017 01		Cooling water inlet valve feedback	DI	0/1
2018	PT 2018 01		Harvesting tank pressure measurement	AI	4-20 mA
2018	SV 2018 01		Open/Close feeding tank vent valve	DO	0/1
2018	SV 2018 01		Feeding tank vent valve feedback	DI	0/1
2018	SV 2018 02		Open/Close helium inlet valve	DO	0/1
2018	SV 2018 02		Helium inlet valve feedback	DI	0/1

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ELECTRICAL AND CONTROL SIGNALS

CUSTOMER:	Universitat Autònoma de Barcelona / MELiSSA				
PROJECT:	MELiSSA COMPARTMENT II	**DATE:**	20/01/2010	**CHECKED:**	J.MESTRE
DRAWING:	DD-8550-Z1-100-01	**REV:**	A	**PREPARED:**	J. GUBERN

CONTROL LOOP	EQUIPMENT	PLC ADRESS	DESCRIPTION	I/O	SIGNAL TYPE
2019	PT 2019 01		Helium tank pressure measurement	AI	4-20 mA
2019	SV 2019 01		Open/Close helium inlet valve	DO	0/1
2019	SV 2019 01		Helium inlet valve feedback	DI	0/1
2019	SV 2019 02		Open/Close atm. vent valve	DO	0/1
2019	SV 2019 02		Vent valve feedback	DI	0/1
2020	LS 2020 01		Bioreactor foam detection	DI	0/1
2021	SV 2021 01		Open/Close steam inlet valve	DO	0/1
2021	SV 2021 01		Steam inlet valve feedback	DI	0/1
2022	SV 2022 01		Open/Close steam inlet valve	DO	0/1
2022	SV 2022 01		Steam inlet valve feedback	DI	0/1
2023	SV 2023 01		Open/Close steam inlet valve	DO	0/1
2023	SV 2023 01		Steam inlet valve feedback	DI	0/1
----	E-stops		Emergency buttons (any button pressed)	DI	0/1
----	E-stops		Emergency released	DI	0/1
----	E-stops		Electrical enclosure RED led	DO	0/1
----	E-stops		Electrical enclosure GREEN led	DO	0/1

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POWER LIST

Motors

CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELISSA COMPARTMENT II	**DATE:**	20/01/2010	**PREPARED:**	J. GUBERN
DRAWING:	DD-8550-Z1-100-Z1	**REV:**	A	**CHECKED:**	J. MESTRE

ITEM	DESCRIPTION	POWER (Kw)	CHARACTERISTICS V / Hz / rpm	TYPE	PROTECTION	CLASIFICATION	OBSERVATIONS
GP 2001 01	SANITARY DIAPHRAGM PUMP	0,37	400/500 V - 50 Hz - 1400 rpm	Electric	IP55	--------	Feed pump
GP 2001 02	SANITARY DIAPHRAGM PUMP	0,37	400/500 V - 50 Hz - 1400 rpm	Electric	IP55	--------	Feed pump
GP 2015 01	SANITARY DIAPHRAGM PUMP	0,37	400/500 V - 50 Hz - 1400 rpm	Electric	IP55	--------	Harvest pump
GP 2015 02	SANITARY DIAPHRAGM PUMP	0,37	400/500 V - 50 Hz - 1400 rpm	Electric	IP55	--------	Harvest pump
PP 2008 01	PERISTALTIC PUMP	0,1	220-240 V - 50/60 Hz	Electric	IP31	--------	Acid addition pump
PP 2008 02	PERISTALTIC PUMP	0,1	220-240 V - 50/60 Hz	Electric	IP31	--------	Alkali addition pump
BLWR 2007 01	CENTRIFUGAL AIR FAN	1,3	230 V - 50/60 Hz	Electric	IP 54	--------	Air refrigeration
BLWR 2012 01	COMPRESSOR	0,06	230 V - 50 Hz	Electric	IP 20	--------	Gas outlet
BLWR 2004 01	COMPRESSOR	0,06	230 V - 50 Hz	Electric	IP 20	--------	Helium
PP 2007 01	CENTRIFUGAL PUMP	1,3	230 V - 50 Hz - 2780 rpm	Electric	IP 68	--------	Water cirulation
GP 2000 01	MAGNETIC AGITATOR	0,2	220 V - 50 Hz - 3000 rpm	Electric	IP 65	--------	VS 2000 01
GP 2014 01	MAGNETIC AGITATOR	0,2	220 V - 50 Hz - 3000 rpm	Electric	IP 65	--------	VS 2014 01
GP 2005 01	MECHANICAL AGITATOR	2,2	230/400 V - 50 Hz	Electric		--------	R 2005 01
HX 2007 02	ELECTRICAL HEATER	2	230 V - 50 Hz	Electric		--------	Water heating
HX 2012 02	SAMPLE GAS COOLER	0,18	230 V - 50/60 Hz	Electric	IP 20	--------	Sample conditioning
IRC 2006 01	REACTOR LIGHTING SYSTEM	3,6	220 V - 50 Hz	Electric		--------	

7. ANNEX II: SPECIFICATIONS

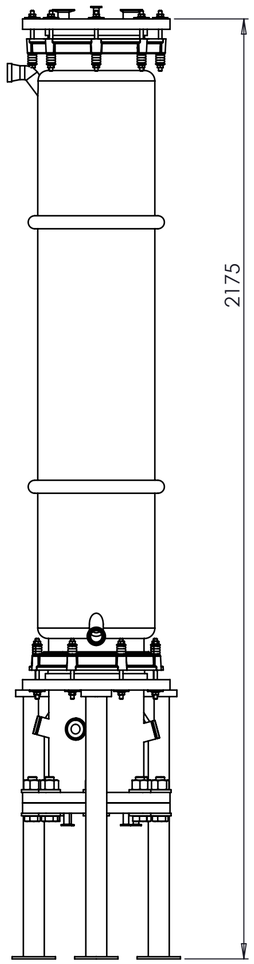
7.1. Equipment specifications

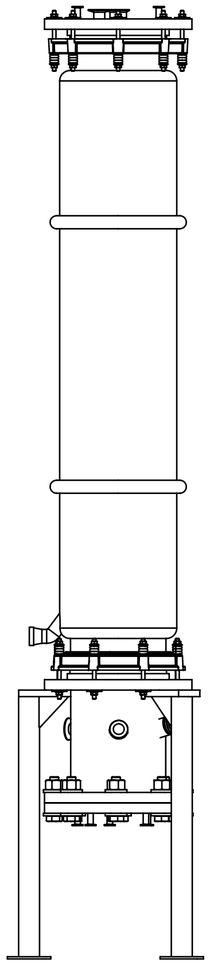
- **Reactor**
- **Auxiliary tanks**
- **Gas buffer**
- **Media preparation vessel**
- **Glass part**
- **Heat exchanger**
- **Condenser**

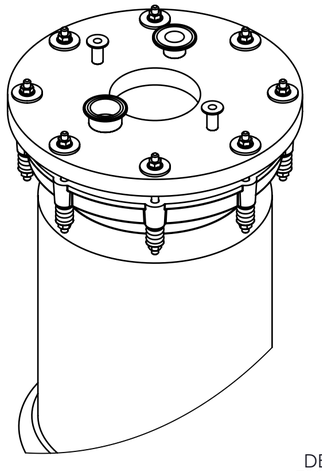
7.2. Instrument specifications

7.3. Electrical cabinet specifications

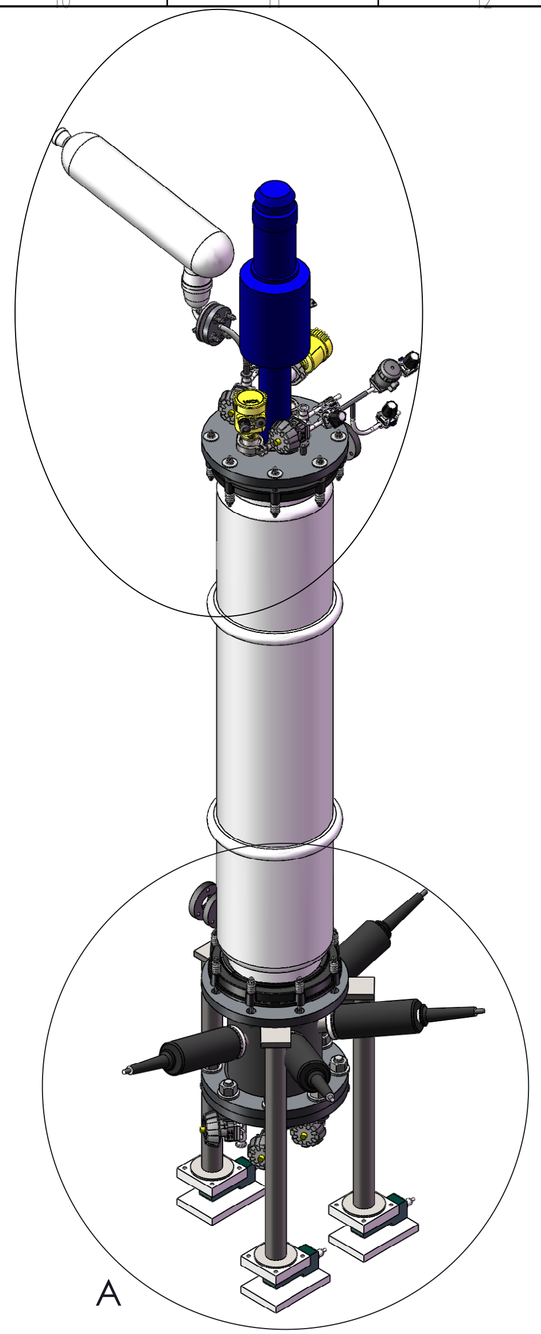
7.4. Accessories specifications

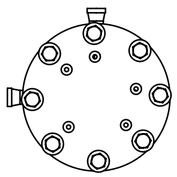


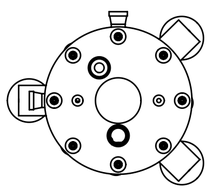


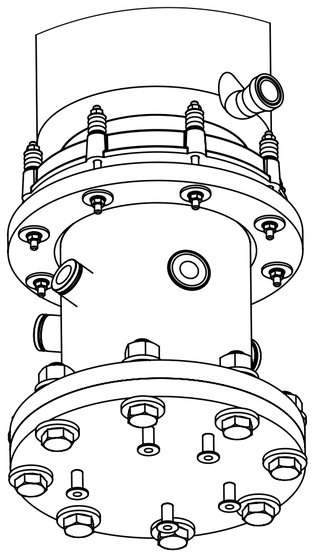


DETALLE B
ESCALA 1 : 5







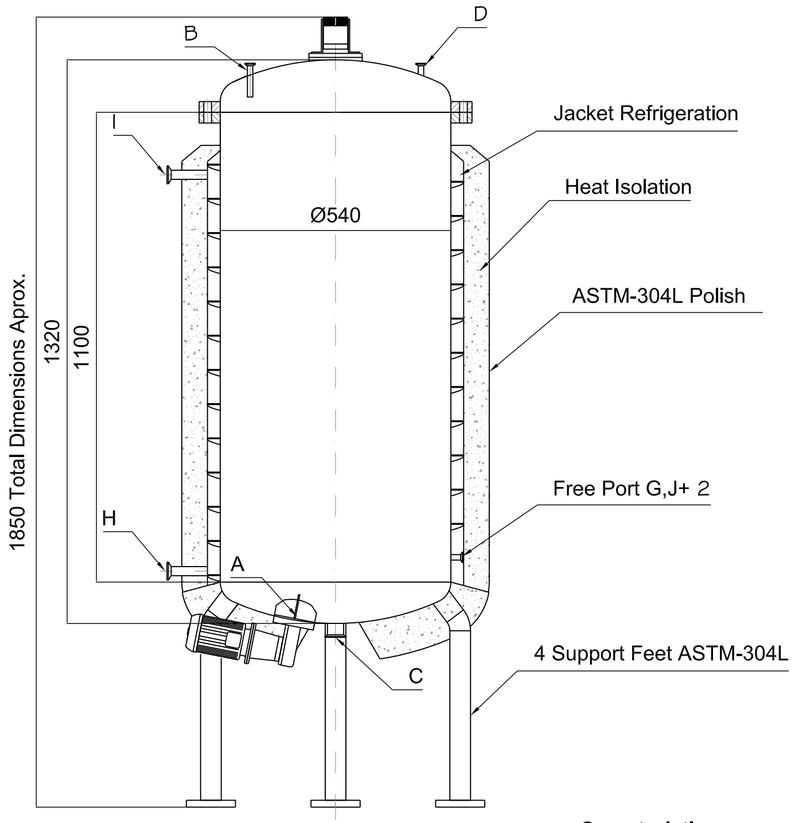


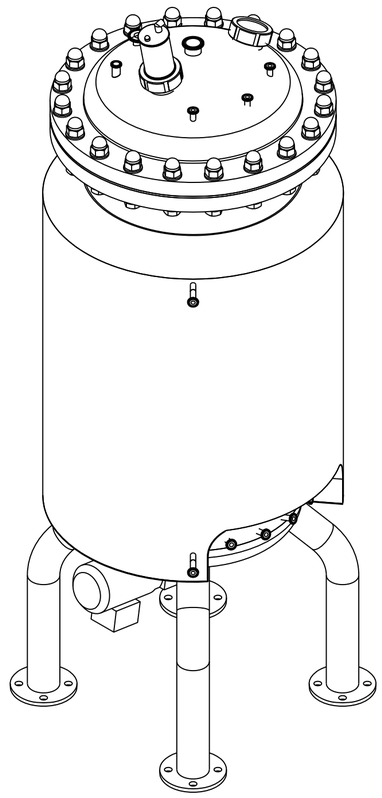
DETALLE A
ESCALA 1 : 5

De Dietrich Equipos Quimicos, S. L. Av. Princep d'Asturies 43-45, 1r-5a E-08012 BARCELONA	Dibujado: M.Pérez Comprobado: J. Mestre Fecha: 23/12/2009 Referencia: PRK-5449
PROYECTO: MELiSSA - COMPARTMENT II	CLIENTE: **UAB** BARCELONA
TITULO: REACTOR R 2005 01	
PLANO Nº: DD-8550-Z1-101-01 / Revision: A	Escala: 1:10

FORMATO: DIN A2

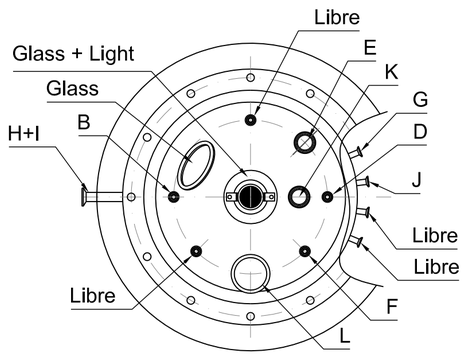
Rev.	Nota de revisión	Fecha	Dib.	Verif.





Vista tridimensional Aproximada

Imagen para idea general y tipo de acabados



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Volumen: 250l
-Tipo de agitador: Magnético Tipo Sterimixer (SMO)
incluido en oferta
-Luz y mirilla icluidas en el depósito.
-Acabado Interior: Pulido<0.5 micras
-Aislamiento Térmico: Lana de roca,
acabado exterior ASTM-304L Gr320
-Condiciones de diseño:
- Cuerpo: -1/+6 bar a 170ºC
- Envolvente: -1/+6 bar a 170ºC
-Conexiones: 3 de 11/2" Clamp IMPERIAL ASME BPE
1 de 3" Clamp IMPERIAL ASME BPE
11 de 1/2" Clamp IMPERIAL ASME BPE
-Cantidad: 2 Unidades

De Dietrich Equipos Químicos, S. L.
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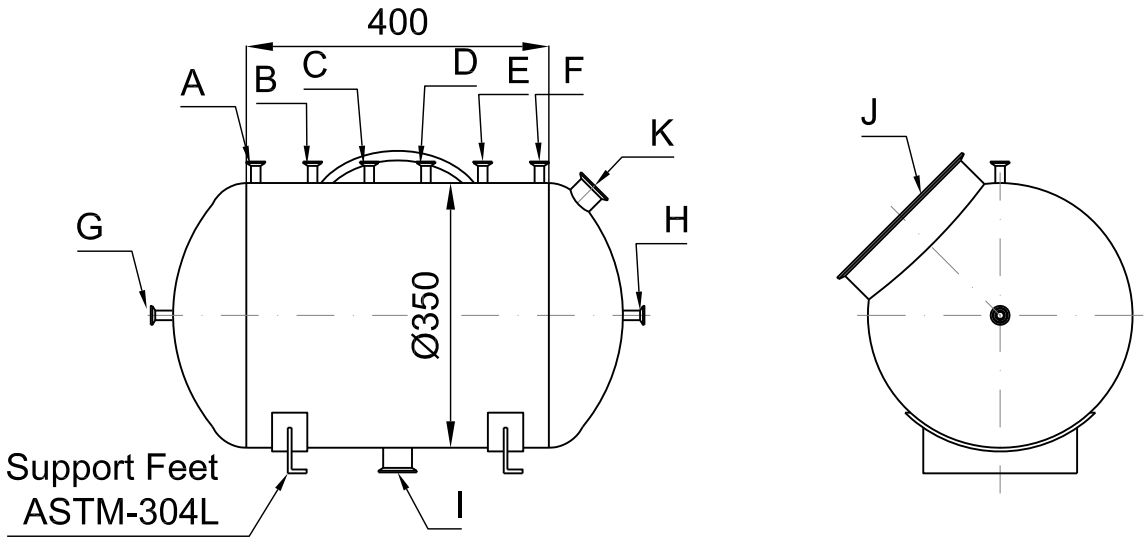
Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II
CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA
TITULO: TANKS VS 2000 01 & VS 2014 01
PLANO Nº: DD-8550-Z1-101-02
Revisión: A
Escala: 1/10

FORMATO: DIN A2

Rev.	Nota de revisión	Fecha	Dib.	Verif.



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: 3barg/ Vacio
-Volumen: 40l
-Acabado Interior: Pulido<0.5 micras
-Temperatura: 20º
-Conexiones: 8 de 1/2" Clamp IMPERIAL ASME BPE
1 de 1 1/2" Clamp IMPERIAL ASME BPE
1 de 3" Clamp IMPERIAL ASME BPE
1 de 8" Clamp
-Soportación: Mediante 2 cunas de ASTM-304L
-Cantidad: 1 Unidad

De Dietrich Equipos Químicos, S. L.
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA
Member of De Dietrich PROCESS SYSTEMS

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II

CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA

TITULO: TANK VS 2019 01

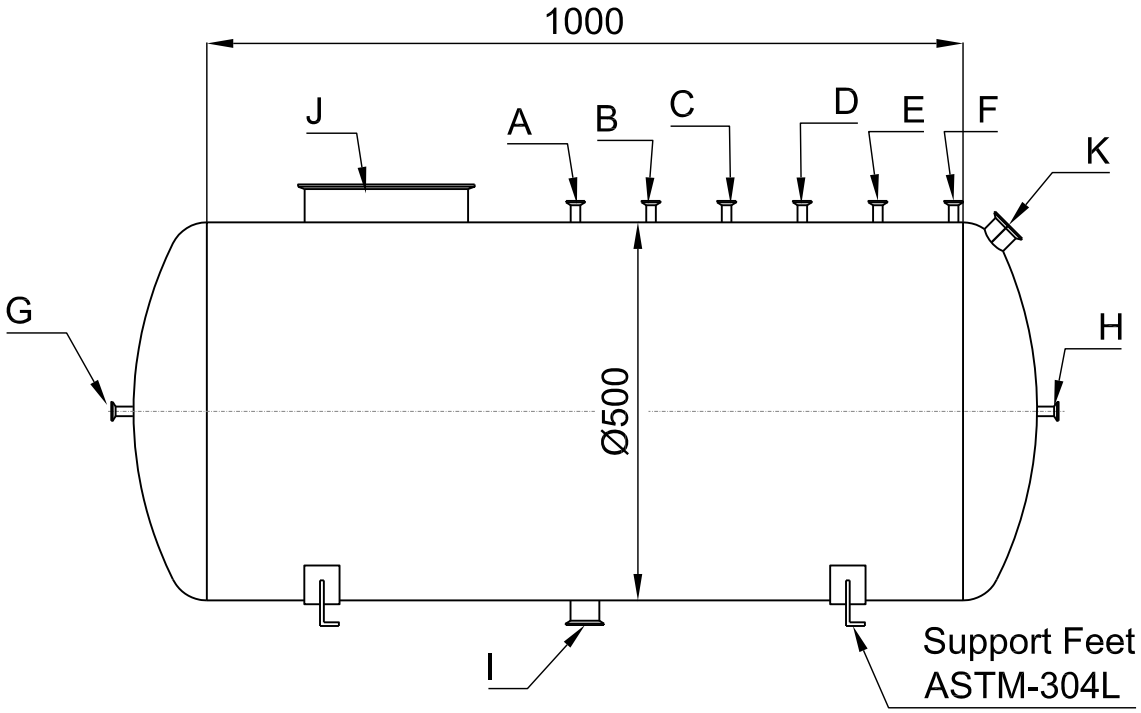
PLANO Nº: DD-8550-Z1-101-03

Revisión: A

Escala: 1/10

FORMATO: DIN A4

Rev.	Nota de revisión	Fecha	Dib.	Verif.



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: 4barg/ Vacio
-Volumen: 200l
-Acabado Interior: Pulido<0.5 micras
-Temperatura: 20º
-Conexiones: 8 de 1/2" Clamp IMPERIAL ASME BPE
1 de 1 1/2" Clamp IMPERIAL ASME BPE
1 de 3" Clamp IMPERIAL ASME BPE
1 de 8" Clamp
-Soportación: Mediante 2 cunas de ASTM-304L
-Cantidad: 1 Unidad

De Dietrich Equipos Químicos, S. L.
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Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II

CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA

TITULO: TANK VS 2012 01

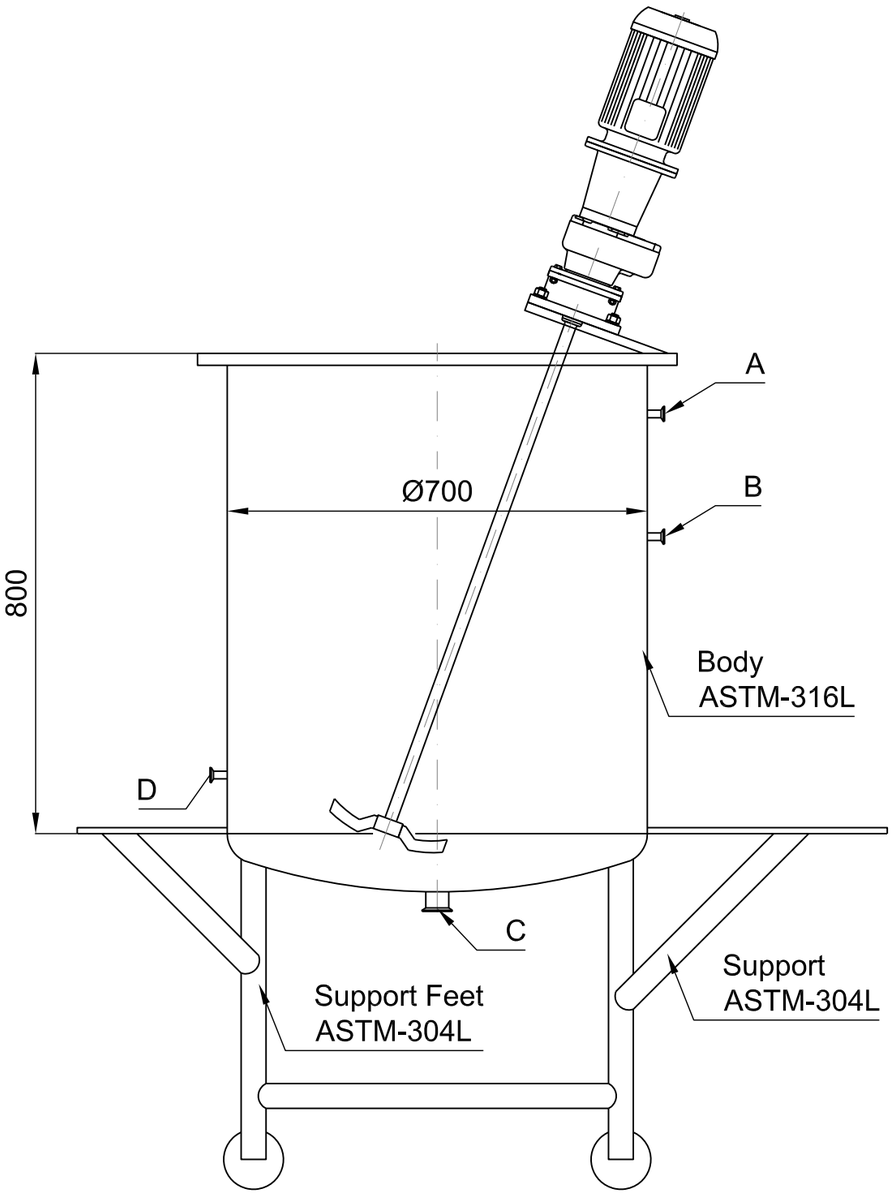
PLANO Nº: DD-8550-Z1-101-04

Revisión: A

Escala: 1/10

FORMATO: DIN A4

Rev.	Nota de revisión	Fecha	Dib.	Verif.



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: Atmosférico
-Volumen: 300l
-Agitador: Convencional Tipo Turbina
-Acabado Interior: Pulido<0.5 micras
-Temperatura: Ambiente
-Conexiones: 3 de 1/2" Clamp IMPERIAL ASME BPE
1 de 1 1/2" Clamp IMPERIAL ASME BPE
-Soportación: Mediante 4 patas con ruedas (2 con freno)
-Cantidad: 1 Unidad

De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
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E-08012 BARCELONA

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II

TITULO: MEDIA PREPARATION TANK

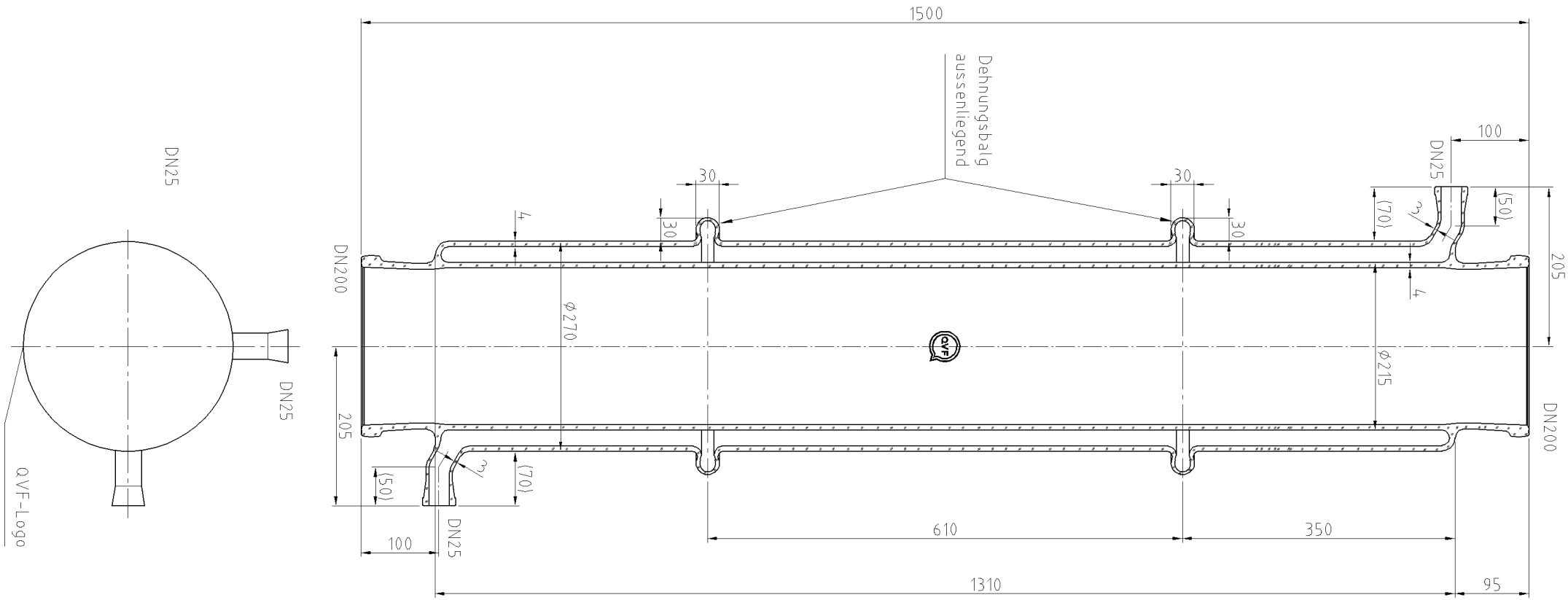
CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA

PLANO Nº: DD-8550-Z1-101-05

Revisión: A

Escala: 1/10

FORMATO: DIN A3



QVF

CE 0035

BORO 3.3
M702-.....
SK.....

	i.d.R.	u.d.R.	
PS =	-1/+1,5	0/+0,5	bar
TS =	180	180	°C
$\Delta\Theta \leq$	180	180	K

Allgemeintoleranzen
Tolerance
nach / acc. to WZ2847

Inhalt (i.d.R.): 48 L
Inhalt (u.d.R.): 18,5 L

Index/Rev.	Datum/Date	Änderung / Modification	gez/drawn	gepr./checked	geneh./approved

	Datum/Date	Name
gez./ drawn	13.02.2009	DIL/THR
gepr./ checked	13.02.2009	MKA
geneh./ approved	13.02.2009	MKA

Benennung / Title:
Mantelrohr DN200, L=1500

Jacketed Pipe DN200, L=1500

Maßstab / Scale: 1:5

QVF ENGINEERING
D-55122 Mainz

Zeichnungs-Nr. / Drawing No.:
SK39240

Blatt / Sheet: 1
von / of: 1
Format / Format A3

Index / Revision: -

Ers. f. / Sub. for:

Ers. d. / Sub. by:

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EQUIPMENT SPECIFICATIONS

HEAT EXCHANGER

CUSTOMER:	Universitat Autònoma de Barcelona				
PROJECT:	MELiSSA COMPARTMENT II	**ITEM:**	HX 2007 01	**FECHA:**	20/01/2010
DRAWING:	DD-8550-Z1	**REV:**	A	**PREPARADO:**	J. GUBERN
TIPO	Plate heat exchanger	**NORMA**			
MODELO	----------	**SERVICE**		Water cooling	
Nº UNITS	1	**SITUATION**		WT-1"-SS1-002	

REQUIREMENTS

CONCEPT	UNITS	PROCESS PART		SERVICE PART	
		INLET	OUTLET	INLET	OUTLET
LIQUID TYPE	-------	Water		Glycol	
CONCENTRATION	%	100			
FLOW	m^3/h	2,5		1,8	
LIQUID TEMPERATURE	ºC	12	10	4	6
DELTA PRESSURE	mca				
SPECIFIC WEIGHT	kg/m^3	1000		1000	
VISCOSITY	cp				
SPECIFIC HEAT	kcal/ kg ºC				
THERMAL CONDUCTIVITY	kcal/ h m ºC	1		1	
MAXIMUM OPERATION TEMPERATURE	ºC				
MAXIMUM OPERATION PRESSURE	bar				
EXCHANHE POWER	Kw	5,8			

PLATE HEAT EXCHANGER

DESIGN PRESSURE	bar	4	4
TESTS PRESSURE	bar		
DESIGN TEMPERATURE	ºC	50	-10
CALCULATED TRANSFER AREA	m^2	0,33	
REAL TRANSFER AREA	m^2		
DESIGN EXCHANHE POWER	kW	7	
CAPACITY	L		
OVERSIZING FACTOR	%	20	
CALCULATED DELTA PRESSURE	mca		
TOTAL NUMBER OF PLATES			

CONSTRUCTION DATA

Description	Quantity	Lenght	Wehdt	Thickness	Material	Observations
PLATES					AISI 316L	
BODY					AISI 316L	

CONNECTIONS

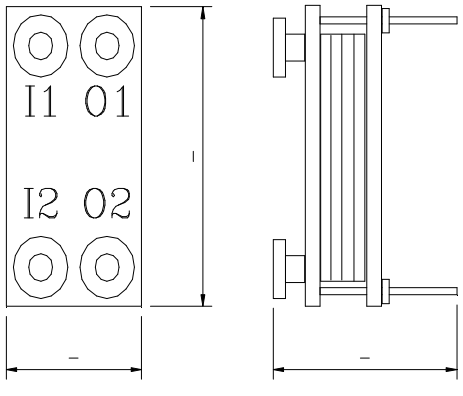
POSITION	I1	I2	O1	O2
DESCRIPTION	WATER INLET	WATER OUTLET	GLYCOL INLET	GLYCOL OUTLET
SIZING				
NORMA				

CORROSION OVERTHICKNESS: mm

PART	TYPE	MATERIAL
JOINTS		EPDM
SCREWS		INOX
FLANGE		INOX
SUPPORTS		INOX

CONNECTION	
MATERIAL	INOX
DIAMETER	
STANDARD CONEXIÓN	ASME-BPE

WEIGHT	
FULL OF LIQUID	kg
EMPTY	kg



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EQUIPMENT SPECIFICATIONS

HEAT EXCHANGER

CUSTOMER:	Universitat Autònoma de Barcelona				
PROJECT:	MELiSSA COMPARTMENT II	**ITEM:**	HX 2012 01	**FECHA:**	20/01/2010
DRAWING:	DD-8550-Z1	**REV:**	A	**PREPARADO:**	J. GUBERN

TIPO	Condenser	**NORMA**	
MODELO	----------	**SERVICE**	Gas condenser
Nº UNITS	1	**SITUATION**	PG-1/2"-SS2-004

REQUIREMENTS

CONCEPT	UNITS	PROCESS PART		SERVICE PART	
		INLET	OUTLET	INLET	OUTLET
FLUID TYPE	-------	Process gas		Glycol	
CONCENTRATION	%				
FLOW	L/h	120			
FLUID TEMPERATURE	℃	80	80		
DELTA PRESSURE	mca				
SPECIFIC WEIGHT	kg/m³				
VISCOSITY	cp				
SPECIFIC HEAT	kcal/ kg ℃				
THERMAL CONDUCTIVITY	kcal/ h m ℃				
MAXIMUM OPERATION TEMPERATURE	℃				
MAXIMUM OPERATION PRESSURE	bar				
EXCHANGHE POWER	Kw				

CONDENSER

DESIGN PRESSURE	bar	1,5	3
TESTS PRESSURE	bar		
DESIGN TEMPERATURE	℃	150	-10
CALCULATED TRANSFER AREA	m²	0,27	
REAL TRANSFER AREA	m²	0,3	
DESIGN EXCHANHE POWER	kW	1,5	
CAPACITY	L	2,5	0,3
OVERSIZING FACTOR	%	25	
CALCULATED DELTA PRESSURE	mca		
TOTAL NUMBER OF PLATES			

CONSTRUCTION DATA

Description	Quantity	Lenght	Diameter	Volume	Material
JACKET	1	555 mm	90 mm	2,5 L	Borosilicate glass 3.3
COIL	1			0,3 L	Borosilicate glass 3.3

CONNECTIONS

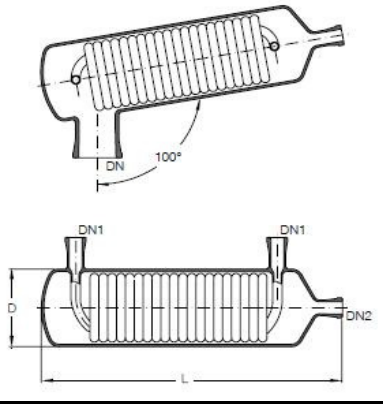
POSITION	DN	DN2	DN1	DN1
DESCRIPTION	GAS INLET	GAS OUTLET	GLYCOL INLET	GLYCOL OUTLET
SIZING	50	25	15	15
NORMA	DIN	DIN	DIN	DIN

CORROSION OVERTHICKNESS: mm

PART	TYPE	MATERIAL
JOINTS		
SCREWS		
FLANGE		
SUPPORTS		

CONNECTION	
MATERIAL	
DIAMETER	
STANDARD CONEXIÓN	

WEIGHT	
FULL OF LIQUID	kg
EMPTY	kg



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Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

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INSTRUMENTS SPECIFICATIONS

FLOW

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	1

ITEM		**FT 2001 01**	**FT 2012 01**	
PRODUCT		Water solution	Process gas	
PRESSURE (bar)	IN			
	OUT			
FLOW (L/h)	MINIMUM	0,25	0	
	MAXIMUM	10	120	
TEMPERATURE (ºC)		7	10	
SITUATION		PL-1/2"-SS2-006	PG-1/2-SS2-007	
PROCES CONNECTION		Tri-Clamp 1/2"	1/4" O.D.	
MATERIAL IN CONTACT WITH PRODUCT		AISI 316L	AISI 316L / Kalrez	
PROCESS CONNECTION MATERIAL		AISI 316L	AISI 316L	
PIPE SIZE		1/2"	1/2"	
MESURE RANGE		0…20 kg/h	3…150 NL/h	
SENSOR TYPE		Coriolis		
TRANSMITTER TYPE		COMPACT		
ACCURACY		0,1 % / 2 g/cm^2	± 0,5 mm	
OUTLET SIGNAL		4…20 mA	4…20 mA / RS232	
ELECTRICAL CLASIFICACTION ATEX		No	No	
PROTECTION		IP67		
ELECTRICAL CONNECTION		85-260 VAC	+15 24 Vcc	
OBSERVATIONS		Software: Default liquid	Mesure on tube	
		Mesure on tube	Not Sterilizable	
		Auto-drainable	Filter required	
		Sterilizable		
QUANTITY		1	1	
SUPPLIER		ENDRESS&HAUSER	IBERFLUID	
MANUFACTURER		ENDRESS&HAUSER	BRONKHÖRST	
MODEL		PROMASS		

CERTIFICATES

	Yes	No
MATERIALS CERTIFICATE	X	
CALIBRATION CERTIFICATE	X	
ATEX CERTIFICATE		X
PED 97/23/EC CERTIFICATE		X

De Dietrich Equipos Químicos, S.L.
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INSTRUMENTS SPECIFICATIONS

LEVEL

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	1

ITEM	LT 2002 01	LS 2020 01			
SITUATION	VS 2000 01	R 2005 01			
TYPE	Microwave	Level switch			
OUTLET SIGNAL	4...20 mA	0/1			
TYPE OF SENSOR	Guided microwave				
MATERIAL IN CONTACT WITH PRODUCT	AISI 316L	AISI 316L			
CALIBRATION RANGE	0…100 %	N/A			
PROCESS CONNECTION	Tri-clamp 1 1/2"	Tri-clamp 1/2"			
PROCESS CONNECTION MATERIAL	AISI 316L	AISI 316L			
SENSOR LENGHT	1000 mm				
SENSOR MATERIAL	AISI 316L				
SENSOR DIAMETER	6 mm				
POWER SUPPLY					
PROTECTION	IP66 / IP67	IP66			
ELECTRICAL CLASIFICACTION ATEX	No	No			
ACCURACY	± 0,5 mm	N/A			
DIGITAL INDICATION (LCD METER)	No	No			
ELECTRICAL CONNECTION					
FLUID TYPE	Water solution	Water solution			
FLUID STATE	Liquid	Liquid			
VISCOSITY	1 cP aprox.				
OPERATION PRESSURE (barg)					
MAXIMUM PRESSURE (barg)					
OPERATION TEMPERATURE (ºC)	5	35			
MAXIMUM TEMPERATURE (ºC)					
QUANTITY	1	1			
SUPPLIER	VEGA				
MANUFACTURER	VEGA				
MODEL	VEGAFLEX61				

OBSERVATIONS

	Yes	No
MATERIALS CERTIFICATE	X	
CALIBRATION CERTIFICATE	X	
ATEX CERTIFICATE		X
PED 97/23/EC CERTIFICATE		X

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

ACCESSORIES SPECIFICATIONS

WEIGHT

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	1

ITEM	WT 2008 01	WT 2008 02
PRODUCT	Acid solution	Base solution
PRODUCT DENSITY (kg/m^3)	1000	1000
OPERATION PRESSURE (bar)	atm	atm
TEMPERATURE (ºC)	atm	atm
SITUATION	VS 2008 01	VS 2008 01
TYPE	platform scale	platform scale
NUMBER OF CELLS	1	1
TRANSMITTER	Compact	Compact
MATERIAL	INOX	INOX
OUTLET SIGNAL	Ethernet	Ethernet
ELECTRICAL CLASIFICACTION ATEX	No	No
PROTECTION	IP43	IP43
MESURE WEIGHT RANGE	0…6 kg	0…6 kg
ACCURACY	1 g	1 g
OBSERVATIONS		

ITEM	WT 2010 01	WT 2016 01
PRODUCT	Water solution	Water solution
PRODUCT DENSITY (kg/m^3)	1000	1000
OPERATION PRESSURE (bar)	0,2 bar	0,2 bar
TEMPERATURE (ºC)	30 ºC	5 ºC
SITUATION	R 2005 01	VS 2014 01
TYPE	Weight cells	Platform scale
NUMBER OF CELLS	3	3
TRANSMITTER	M300	M300
MATERIAL	INOX	INOX
OUTLET SIGNAL	4…20 mA	4…20 mA
ELECTRICAL CLASIFICACTION ATEX	No	No
PROTECTION	IP65	IP65
MESURE WEIGHT RANGE		
ACCURACY		200 g
OBSERVATIONS		

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Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

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INSTRUMENTS SPECIFICATIONS

PRESSURE

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	1

ITEM	PT 2004 01	PT 2009 01	PT 2009 02	PT 2012 01	PT 2013 01
SITUATION	VS 2000 01	R 2005 01	R 2005 01	VS 2012 01	PG-1/2"-SS2-007
TYPE (absolut/gauge/differentiall)	abs	abs	abs	abs	abs
OUTLET SIGNAL	4...20 mA	4...20 mA	4...20 mA	4...20 mA	4...20 mA
TYPE OF SENSOR	VEGABAR	VEGABAR	VEGABAR	VEGABAR	VEGABAR
MATERIAL IN CONTACT WITH PRODUCT	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
CALIBRATION RANGE	-1…5 bar	-1...2 bar	-1...2 bar	0…5 bar	0...2 bar
PROCESS CONNECTION	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"
PROCESS CONNECTION MATERIAL	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
CAPILAR	N/A	N/A	N/A	N/A	N/A
CAPILAR MATERIAL	N/A	N/A	N/A	N/A	N/A
MEMBRANE	CERTEC	CERTEC	CERTEC	CERTEC	CERTEC
MEMBRANE MATERIAL	Ceramic	Ceramic	Ceramic	Ceramic	Ceramic
CAPILAR FILLING FLUID	KN.59	KN.59	KN.59	KN.59	KN.59
POWER SUPPLY					
PROTECTION	IP66 / IP67	IP66 / IP67	IP66 / IP67	IP66 / IP67	IP66 / IP67
ELECTRICAL CLASIFICACTION ATEX	No	No	No	No	No
ACCURACY	0,10%	0,10%	0,10%	0,10%	0,10%
DIGITAL INDICATION (LCD METER)	PLISCOM	PLISCOM	PLISCOM	PLISCOM	PLISCOM
ELECTRICAL CONNECTION					
FLUID TYPE	Water solution/helium	Water/process gas	Process gas	Process gas	Process gas
FLUID STATE					
VISCOSITY					
OPERATION PRESSURE (barg)					
MAXIMUM PRESSURE (barg)					
OPERATION TEMPERATURE (ºC)	5	35	35	20	10
MAXIMUM TEMPERATURE (ºC)					
QUANTITY	1	1	1	1	1
SUPPLIER	VEGA	VEGA	VEGA	VEGA	VEGA
MANUFACTURER	VEGA/WIKA	VEGA/WIKA	VEGA/WIKA	VEGA/WIKA	VEGA/WIKA
MODEL	VEGABAR52	VEGABAR52	VEGABAR52	VEGABAR52	VEGABAR52

OBSERVATIONS

.

	Yes	No
MATERIALS CERTIFICATE	X	
CALIBRATION CERTIFICATE	X	
ATEX CERTIFICATE		X
PED 97/23/EC CERTIFICATE		X

De Dietrich Equipos Químicos, S.L.
Av. Princep d'Asturies 43-45, 1r-5a
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INSTRUMENTS SPECIFICATIONS

PRESSURE

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	2

ITEM	**PT 2018 01**	**PT 2019 01**	**DPT 2001 01**	**DPT 2001 02**	**DPT 2012 01**
SITUATION	VS 2014 01	VS 2019 01	PL-1/2"-SS2-003	PL-1/2"-SS2-006	PG-1/2"-SS2-005
TYPE (absolut/gauge/differentiall)	abs	abs	diff	diff	diff
OUTLET SIGNAL	4...20 mA	4...20 mA	4...20 mA	4...20 mA	4...20 mA
TYPE OF SENSOR	VEGABAR	VEGABAR	VEGADIF	VEGADIF	VEGADIF
MATERIAL IN CONTACT WITH PRODUCT	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
CALIBRATION RANGE	-1…5 bar	0…5 bar	0/3 bar	0/3 bar	0/3 bar
PROCESS CONNECTION	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"	Tri-Clamp 1 1/2"
PROCESS CONNECTION MATERIAL	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
CAPILAR	N/A	N/A	Yes	Yes	Yes
CAPILAR LENGHT	N/A	N/A	1 m	1 m	1 m
MEMBRANE	CERTEC	CERTEC			
MEMBRANE MATERIAL	Ceramic	Ceramic	AISI 316L	AISI 316L	AISI 316L
CAPILAR FILLING FLUID	KN.59	KN.59	KN.59	KN.59	KN.59
POWER SUPPLY					
PROTECTION	IP66 / IP67	IP66 / IP67	IP66 / IP67	IP66 / IP67	IP66 / IP67
ELECTRICAL CLASIFICACTION ATEX	No	No	No	No	No
ACCURACY	0,10%	0,10%			
DIGITAL INDICATION (LCD METER)	PLISCOM	PLISCOM	LCD	LCD	LCD
ELECTRICAL CONNECTION					
FLUID TYPE	Water solution/helium	Helium	Water solution	Water solution	Process gas
FLUID STATE		Gas	Liquid	Liquid	Gas
VISCOSITY					
OPERATION PRESSURE (barg)					
MAXIMUM PRESSURE (barg)					
OPERATION TEMPERATURE (ºC)					
MAXIMUM TEMPERATURE (ºC)					
QUANTITY	1	1	1	1	1
SUPPLIER	VEGA	VEGA	VEGA	VEGA	VEGA
MANUFACTURER	VEGA/WIKA	VEGA/WIKA	VEGA/WIKA	VEGA/WIKA	VEGA/WIKA
MODEL	VEGABAR52	VEGABAR52	VEGADIF55	VEGADIF55	VEGADIF55

OBSERVATIONS

.

	Yes	No
MATERIALS CERTIFICATE	X	
CALIBRATION CERTIFICATE	X	
ATEX CERTIFICATE		X
PED 97/23/EC CERTIFICATE		X

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
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INSTRUMENTS SPECIFICATIONS

TEMPERATURE

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	1

ITEM	TT 2003 01	TT 2005 01	TT 2017 01	TT 2008 02
TYPE	Pt-100	Pt-100	Pt-100	Pt-100
SITUATION	VS 2000 01	R 2005 01	VS 2014 01	VS 2014 01
OUTLET SIGNAL	4...20 mA	4...20 mA	4...20 mA	4...20 mA
SENSIBLE ELEMENT				
POD MATERIAL	AISI 316L	AISI 316L	AISI 316L	AISI 316L
SENSOR DIAMETER				
TOTAL IMMERSION LENGHT (mm)	100	50	100	100
PROCESS CONNECTION MATERIAL	Tri-Clamp 1"	Tri-Clamp 1/2"	Tri-Clamp 1"	Tri-Clamp 1"
CONNECTION MATERIAL	AISI 316L	AISI 316L	AISI 316L	AISI 316L
CALIBRATION RANGE	0…200 ºC	0…200 ºC	0…200 ºC	0…100 ºC
TRANSMITTER	Analogical	Analogical	Analogical	Analogical
ELECTRICAL CLASIFICACTION ATEX	No	No	No	No
PROTECTION				
POWER SUPPLY				
ELECTRICAL CONNECTION	M20 x 1,5	M20 x 1,5	M20 x 1,5	M20 x 1,5
DIGITAL INDICATION (LCD METER)	No	No	No	No
ACCURACY	± 0,1 ºC	± 0,1 ºC	± 0,1 ºC	± 0,1 ºC
DIGITAL COMMUNICATION				
FLUID TYPE	Water solution	Water solution	Water solution	Process gas
FLUID STATE	Liquid	Liquid	Liquid	Gas
VISCOSITY				
OPERATION PRESSURE (barg)				
MAXIMUM PRESSURE (barg)				
OPERATION TEMPERATURE (ºC)	5	35		10
MAXIMUM TEMPERATURE (ºC)	200	200	200	200
QUANTITY	1	1	1	1
SUPPLIER				
MANUFACTURER				
MODEL				

OBSERVATIONS

	Yes	No
MATERIALS CERTIFICATE	X	
CALIBRATION CERTIFICATE	X	
ATEX CERTIFICATE		X
PED 97/23/EC CERTIFICATE		X

ELECTRICAL CABINET DESCRIPTION

This document tries to do a description of the power and control system that is foreseen for the for the compartment II of MELiSSA Pilot Plant.

Documents of reference:

- *P&ID (DD-8550-Z1-100-02 rev. F)*
- *Electrical and control signals list rev. A*
- *Room Lay-Out (DD-8550-Z1-102-02 rev. 0)*

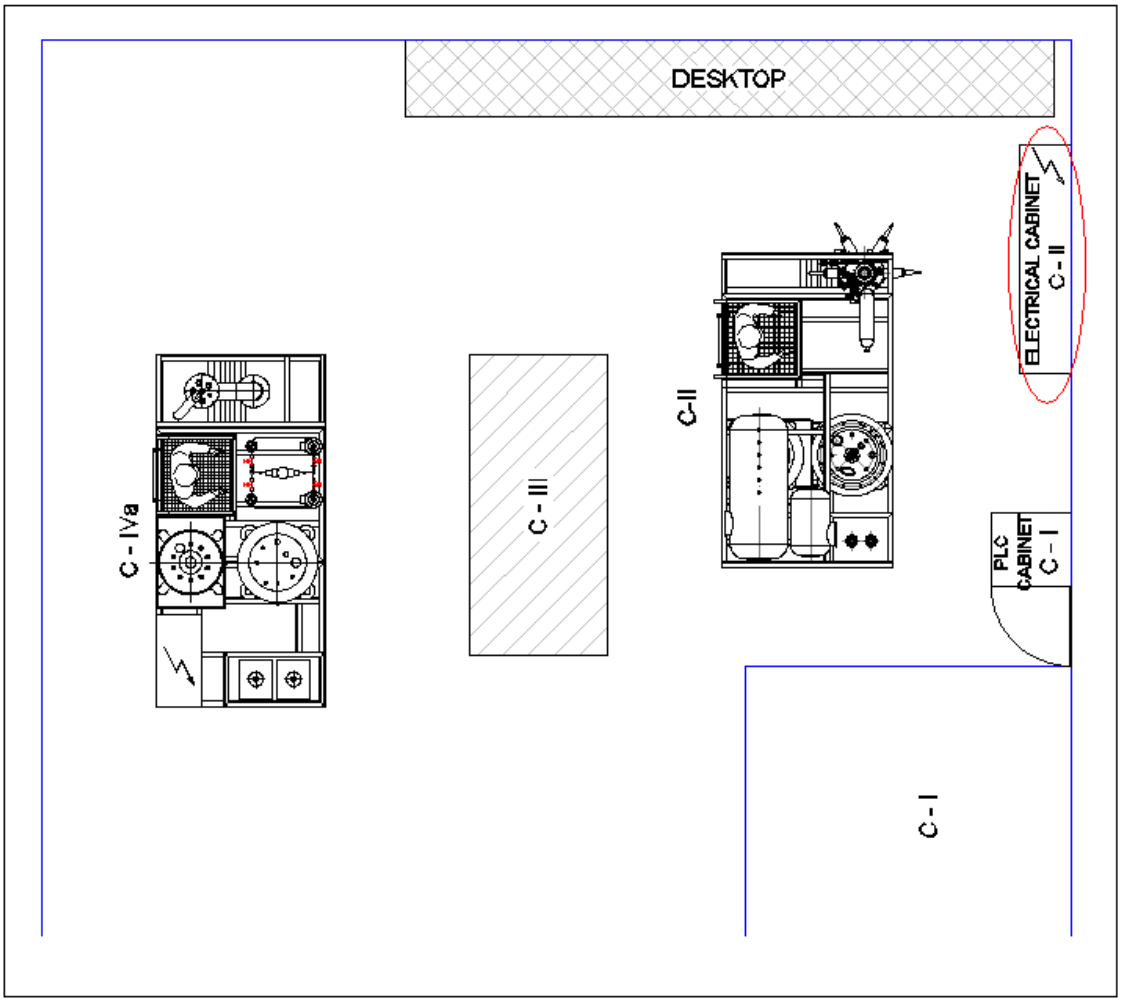
1 SITUATION OF THE ELECTRICAL CABINET

In previous meetings has been discussed with MELiSSA people the situation and dimensions of the compartment II and its electrical cabinet, which is foreseen out of the skid:

*"The electrical cupboards are foreseen by DDEQ out of the skid in order to save space in the same considering the room constraints" (*01.10.2009)
"MPP mentioned that the CI PLC cabinet could be moved to the corner near the GC in order to have more space for the C.II skid (to be confirmed by NTE)" (01.10.2009)

The designed electrical cabinet is 1800x2400x400 and it is conceptually divided in two different parts: power and control.
It can be physically divided too in order to be able to go through the pilot plant door.

The situation in the plant of the electrical cabinet is the next:



NOTE: For further details about dimensions refer to Room Lay-Out (DD-8550-Z1-102-02 rev. 0) included in the ANNEX II of this dossier.

2 SCOPE OF SUPPLY

2.1 Power and control panel

Supply of power and control panel, dimensions 1800 height, 2400 width and 400 depth, mechanized, mounted, connected and with the following elements and devices:

1→ Base panel and accessories
1→ Mounting board
1→ Cooper bar and accessories
1→ Overvoltage protection Class D IEC 1024-1
1→ Light switch "On service"
1→ General switch
1→ Main ground-fault protection and thermal-magnetic circuit breaker
1 → Emergency stop push button
1 → "Emergency stop activated" indicator (red led)
1 → White light indicator "Voltage in"
1 → Acknowledge push button
1 → Security check push button
1 → Safety relay PREVENTA
2 → Power supply 24Vdc/10 A
1→ Single ground-fault protection for all frequency converters
1 → General ground-fault protection for all the instrumentation
1 → DIMMER 3-phase to control lightning columns
1 → Transformer 3-phase 5KVA
1 → Single thermal-magnetic protection for 7 lightning columns
1 → Current metering and 4-20mA conversion
1 → DIMMER protection security circuit against low load in the output
1 → RS232/Ethernet converter

1→ Wiring of the following control signals:

- 38 Digital inputs
- 43 Analogical inputs
- 38 Digital outputs
- 15 Analogical outputs

1 → Set of galvanic isolators
1→ Set of thermal-magnetic circuit breakers
7 → Single-phase frequency converters 1,5KW
8 → Contactors
1→ Heater starter
1 → Set of circuit breaker auxiliary switch
1 → Set of connection strips
1 → Elements and devices mounted and connected according CE directive
1 → Design, technical managing and documentation

IMPORTANT NOTES:

- **It is not foreseen the connection to the plant power/pneumatic supply.**
- **The material included in these lists is the necessary for the electrical and control signals foreseen at the moment.** (See "electrical and control signals list" included in ANNEX II of this dossier)

2.2 Electrical mounting and setting-up in MELiSSA Pilot Plant

The materials which are required for this action are:

- 20 m galvanized cable tray 60x60 mm (without cover).
- 20 m galvanized cable tray 300x60 mm (without cover).
- Trays mounting accessories.
- 60 m shielded cable 4x0,5 mm²
- 20 m blue shielded cable 8x0,5 mm²
- 150 m cable 4x0,5 mm²
- 100 m shielded cable 4x1,5 mm²
- 200 m shielded cable 3x1,5 mm²
- 250 m flexible conduit.
- 10 m heat-shrinkable tubing.
- Other connection and mounting accessories.
- Cable signalling.
- 60 m pneumatic tubing.
- 3 emergency stop pushbuttons.
- Other pneumatic accessories.

NOTE: It is foreseen that the setting up of the plant will last approximately 2 weeks.

2.3 Photo-bioreactor Lighting system

The illumination system consists of 200 halogen lamps which surround the glass jacketed pipe section (DN200, L=1500m).

The type of lamps used will be the specified in the technical note 62.2 and are: OSRAM 12V, 20W BAB 38°.

2.3.1 Lighting system structure

The lights will be set-up on a portable structure made of stainless-steel with 10 columns of 20 halogen lamps of 20W 12V.

It will include 2 or 3 connection boxes sited on the half height of the structure.

These boxes will receive the cables from the lamps to link in 2 o 3 cables all the power to the main electric panel.

2.4 Phoenix material (NTE supplied formerly)

Set of Phoenix materials.

- Interface modules VARIOFACE FLKM50/MOFI-TSX/Q.
- Connectors PLC-V8/FLK14/OUT.
- Connectors PLC-V8/FLK14/IN.
- Relay PLC_RSP-24UC/21AU (24VDC).
- Plug-in bridges FBST 500-PLC BU
- Separating plates PLC-ATP BK.

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

ACCESSORIES SPECIFICATIONS

SAFETY

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	1

ITEM	RV 2003 01	RV 2004 01	RV 2004 02	RV 2005 01	RV 2007 01
PRODUCT	Glycol	Helium/water solution	Helium	Helium/water solution	Glycol
SITUATION	GLY-3/4"-SS1-004	VS 2000 01	VT-1/2"-SS2-003	R 2005 01	GLY-1"-SS1-012
INLET DIAMETER	3/8"	1"		1"	3/8"
OUTLET DIAMETER	3/8"	1"		1"	3/8"
TYPE		Sanitary		Sanitary	
FLOW					
TARE PRESSURE	4 bar	3 bar		1 bar	4 bar
SERVICE TEMPERATURE	7 ºC	5 ºC	20 ºC	5 ºC	7 ºC
BODY MATERIAL	INOX	INOX	INOX	INOX	INOX
INTERNAL PARTS MATERIAL	INOX	INOX	INOX	INOX	INOX
QUANTITY	1	1	1	1	1
MODEL	095 PN25	74700		74700	095 PN25
SUPPLIER	GRM	INOXPA		INOXPA	GRM
MANUFACTURER	VYC	INOXPA		INOXPA	VYC
OBSERVATIONS					
	Sterilizable with steam	Sterilizable with steam		Sterilizable with steam	
	EPDM joint	EPDM joint		EPDM joint	

ITEM	RV 2007 02	RV 2007 03	RV 2012 01	RV 2012 02	RV 2012 03
PRODUCT	Water	Water	Process gas	Glycol	Process gas
SITUATION	WT-1"-SS1-002	WT-1"-SS1-002	PG-1/2"-SS2-005	GLY-1"-SS1-012	PG-1/2"-SS2-008
INLET DIAMETER	1"	1"	1"	3/8"	3/8"
OUTLET DIAMETER	1"	1"	1"	3/8"	3/8"
TYPE					
FLOW					
TARE PRESSURE	0,5 bar	0,5 bar	1 bar	3 bar	
SERVICE TEMPERATURE	12 ºC	12 ºC	30 ºC	7 ºC	10 ºC
BODY MATERIAL	INOX	INOX	INOX	INOX	INOX
INTERNAL PARTS MATERIAL	INOX	INOX	INOX	INOX	INOX
QUANTITY	1	1	1	1	1
MODEL	095 PN25	095 PN25	74700	095 PN25	095 PN25
SUPPLIER	GRM	GRM	INOXPA	GRM	GRM
MANUFACTURER	VYC	VYC	INOXPA	VYC	VYC
OBSERVATIONS					
			Sterilizable with steam	Sterilizable with steam	
			EPDM joint	EPDM joint	

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Av. Príncep d'Asturies 43-45, 1r-5a
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ACCESSORIES SPECIFICATIONS

SAFETY

CUSTOMER:	Universitat Autònoma de Barcelona	**PREPARED BY:**	J. GUBERN
PROJECT:	MELiSSA Compartment II	**CHECKED BY:**	J. MESTRE
DRAWING:	DD-8550-Z1	**REV:**	A
DATE:	20/01/2010	**PAGE:**	2

ITEM	**RV 2012 04**	**RV 2017 01**	**RV 2018 01**	**RV 2019 01**	
PRODUCT	Process gas	Glycol	Helium/water solution	Helium	
SITUATION	VS 2012 01	GLY-3/4"-SS1-007	VS 2014 01	VT-1/2"-SS2-003	
INLET DIAMETER	3/8"	3/8"	1"		
OUTLET DIAMETER	3/8"	3/8"	1"		
TYPE			Sanitary		
FLOW					
TARE PRESSURE		4 bar	3 bar		
SERVICE TEMPERATURE	10 ºC	7 ºC	5 ºC	20 ºC	
BODY MATERIAL	INOX	INOX	INOX	INOX	
INTERNAL PARTS MATERIAL	INOX	INOX	INOX	INOX	
QUANTITY	1	1	1	1	
MODEL	095 PN25	095 PN25	74700		
SUPPLIER	GRM	GRM	INOXPA		
MANUFACTURER	VYC	VYC	INOXPA		
OBSERVATIONS					
		Sterilizable with steam	Sterilizable with steam		
		EPDM joint	EPDM joint		

ITEM					
PRODUCT					
SITUATION					
INLET DIAMETER					
OUTLET DIAMETER					
TYPE					
FLOW					
TARE PRESSURE					
SERVICE TEMPERATURE					
BODY MATERIAL					
INTERNAL PARTS MATERIAL					
QUANTITY					
MODEL					
SUPPLIER					
MANUFACTURER					
OBSERVATIONS					

8. ANNEX III: EQUIPMENT DATASHEETS

8.1. Feed and harvest pumps
8.2. Acid and base dosing pumps

LEWA
pumps + systems

BOMBAS DOSIFICADORAS

DESCRIPCIÓN TÉCNICA Y OFERTA

LEWA Ecodos Sanitary

Para	**DeDietrich – Sra. Júlia Gubert**
Ref. LEWA	104-B-02041-40
Ref. Cliente	
Fecha	23/09/08
Páginas	6
Anexos	

Lewa Hispania, S.L.
Vía Trajana, 50 - 56; Nave 49 – 08020 Barcelona
Oficinas comerciales en Barcelona y Madrid
www.lewa.es
info@lewa.es
Tel: 902364100
Fax: 902364200

INTRODUCCIÓN

Características generales

Las bombas Ecodos son bombas dosificadoras con cabezal dosificador de membrana, actuado mecánicamente. La membrana tiene un diseño patentado, y esta formada por cuatro capas individuales de PTFE macizo, lo que le confiere una gran fiabilidad y resistencia.

Principales características de las bombas LEWA ECODOS:

- ✓ El diseño de cuádruple membrana permite que la bomba pueda seguir operando en caso de que se produzca una rotura de la misma. La rotura de membrana es señalizada a través de un dispositivo instalado en el cabezal dosificador.
- ✓ Vida útil de la membrana superior a 16.000 horas de operación en régimen continuo.
- ✓ Garantía de dos años para la membrana
- ✓ Herméticamente estancas
- ✓ Ninguna junta deslizante o empaquetaduras
- ✓ A prueba de funcionamiento sin engrase
- ✓ Fácil desmontaje y montaje de la cámara de dosificación
- ✓ Posibilidad de combinaciones de bombas múltiples
- ✓ Diseño compacto para ahorrar espacio
- ✓ Admiten periodos de operación prolongados
- ✓ Alta precisión de dosificación, desviación de ± 1%
- ✓ Piezas en contacto con el fluido pulidas Ra ≤ 0.8 µm

Comentarios

Bomba para 10 l/h máx y 0.25 l/h min de un producto de características similares al agua en cuanto a densidad y viscosidad.
Presión de descarga igual o inferior a 20 bar. Temperatura ambiente.

Bomba para 900 l/h máx de un producto de características similares al agua en cuanto a densidad y viscosidad.
Presión de descarga igual o inferior a 5 bar. Temperatura ambiente.

Ambos equipos pueden ser esterilizados con vapor durante periodos de tiempo de 20 minutos.

ALCANCE DEL SUMINISTRO

Bombas dosificadoras

Pos. DESCRIPCIÓN

1. **BOMBA DOSIFICADORA LEWA TIPO ECODOS SANITARY 6S1**

Datos de proceso y ubicación

Fluido	No declarado
Temperatura de Proceso [°C]	<25
Densidad [Sg]	No declarada
Viscosidad [mPas]	3
Presión de vapor [bar abs]	
Concentración de sólidos/tamaño [%]/[mm]	-- / --
Caudal necesario (Min./Máx.) [l/h]	10 l/h
Presión en línea de impulsión [bar]	No declarada, suponemos < 5bar
Presión en línea de aspiración [bar]	0
Condiciones ambientales (temperatura, clima etc.)	Ubicación interior o exterior protegida de fenómenos atmosférico
Zona explosiva	
Alimentación eléctrica	400V, 50 Hz, 3F Protección motor IP55 Potencia 0.37 Kw, 4 polos Para trabajar con VdF. A 50Hz, 6l/h A 100Hz Q=12l/h

Datos de diseño

Caja de engranajes

Reducción [i]	17
Cadencia nominal [min^{-1}]	80
Ajuste de carrera	Manual, a máquina parada o en marcha. Por variador de frecuencia. (no incluido)

Cabezal	**1 x Cabezal**
Caudal a presión de impulsión [l/h]	6 l/h a 50Hz
Presión máxima de la bomba [bar]	20 bar
Precisión	Mejor del 1% en el rango de caudal 1:5
Señalización de rotura de membranas	Manómetro
Válvulas en aspiración [Tipo/Ø]	Bola/5
Válvulas en impulsión [Tipo/Ø]	Bola/5
Conexiones en aspiración	Tri-clamp ¼"
Conexiones en impulsión	Tri-clamp ¼"
Conexiones para la camisa de calefacción /Refrigeración	-

Materiales (en contacto con el fluido)

Cabezal	Acero inox 1.4571
Membrana	PTFE puro
Cuerpo de la válvula	Acero inox 1.4571
Elemento de cierre de la válvula	Oxido cerámico/Nylon

Motor de accionamiento	**Motor Asíncrono**
Potencia nominal [kW]	0.37Kw 4 polos
RPM [1/min]	1.400
Ex – Protección	-
Protección	IP55
Voltios/Frecuencia. [V]/[Hz]	400/500V, 50 Hz, 3F

Pos. DESCRIPCIÓN

2. BOMBA DOSIFICADORA LEWA TIPO ECODOS SANITARY 1100S1

Datos de proceso y ubicación

Fluido	No declarado
Temperatura de Proceso [°C]	<25
Densidad [Sg]	No declarada
Viscosidad [mPas]	3
Presión de vapor [bar abs]	
Concentración de sólidos/tamaño [%]/[mm]	-- / --
Caudal necesario (Min./Máx.) [l/h]	900 l/h
Presión en línea de impulsión [bar]	No declarada, suponemos < 5bar
Presión en línea de aspiración [bar]	0
Condiciones ambientales (temperatura, clima etc.)..	Ubicación interior o exterior protegida de fenómenos atmosférico
Zona explosiva	
Alimentación eléctrica	400V, 50 Hz, 3F Protección motor IP55 Potencia 1.5 Kw, 4 polos

Datos de diseño

Caja de engranajes

Reducción [i]	8.33
Cadencia nominal [min^{-1}]	170
Ajuste de carrera	Manual, a máquina parada o en marcha.

Cabezal	**1 x Cabezal**
Caudal a presión de impulsión [l/h]	1100 l/h a 50Hz a longitud máx de carrera

Presión máxima de la bomba ..... [bar]	5 bar
Precisión	Mejor del 1% en el rango de caudal 1:5
Señalización de rotura de membranas	Manómetro
Válvulas en aspiración ..... [Tipo/Ø].....	Bola/25
Válvulas en impulsión ..... [Tipo/Ø].....	Bola/25
Conexiones en aspiración.....	Tri-clamp 1"
Conexiones en impulsión.....	Tri-clamp 1"
Conexiones para la camisa de calefacción /Refrigeración	-

Materiales (en contacto con el fluido)

Cabezal.....	Acero inox 1.4571
Membrana.....	PTFE puro
Cuerpo de la válvula.....	Acero inox 1.4571
Elemento de cierre de la válvula	Oxido cerámico/Nylon

Motor de accionamiento	**Motor Asíncrono**
Potencia nominal .....[kW]	1.5 Kw 4 polos
RPM .....[1/min].....	1.400
Ex – Protección.....	-
Protección.....	IP55
Voltios/Frecuencia. .....[V]/[Hz].....	400/500V, 50 Hz, 3F

Opciones

Certificados y Pruebas

Documentación y pruebas estándar

- Manuales de funcionamiento y puesta en marcha
- Dibujos seccionales con lista de despiece para una identificación de todos los repuestos
- Dibujos dimensionales
- Identificación CE
- Certificación PTB (si procede)

Proceso de pintado según estándar de LEWA RAL 5015 azul

WATSON MARLOW Bredel PUMPS

100 200 300 500 600 700 800 SPX

SERIES

Improving your PERFORMANCE

323S/D and 323S/4D High-performance manual control variable speed pumps

Technical information and features

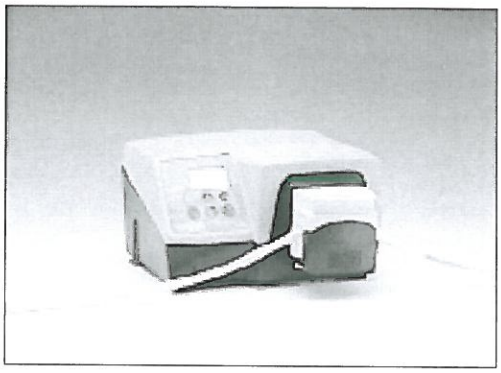
- High performance microprocessor controlled pumps
- Up to 2000 ml/min from three-roller 323S/D
- Up to 1600 ml/min from four-roller, lower pulsation 323S/4D
- Precision digital speed control 1rpm steps from 3 to 400rpm, 133:1 control ratio
- High visibility digital display and keypad lock
- Compact design, chemical resistant case, contemporary styling
- Zero maintenance, quiet brushless DC motor
- Rapid and simple tube loading flip-top pumphead
- Snap fit extension pumpheads up to 6 channels of flow
- MemoDose facility for accurate single shot dosing
- Auto-restart for mains failure recovery and timer control
- Alternative pumpheads

  314DW four roller pumphead for lower pulsation, 1.6mm wall thickness tube

  313DW2 three roller pumphead, 2.4mm wall tube for higher suction and delivery pressure

  314DW2 four roller pumphead, 2.4mm wall tube for higher suction and delivery pressure

  313X three roller and 314X four roller extension pumpheads for 1.6mm wall tube

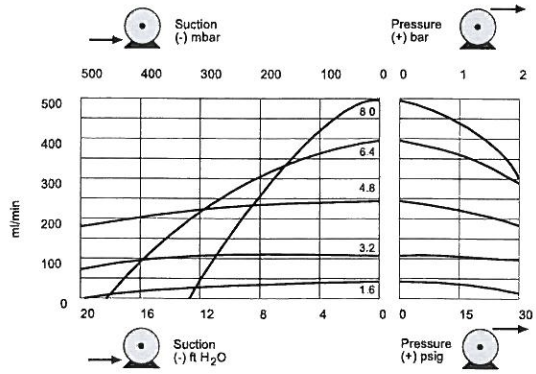


24 hour duty

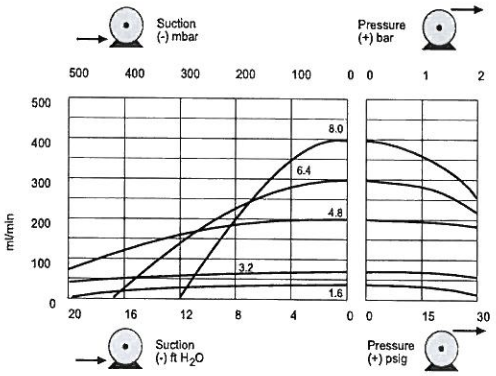
2 warranty

Flow rate ranges (ml/min)

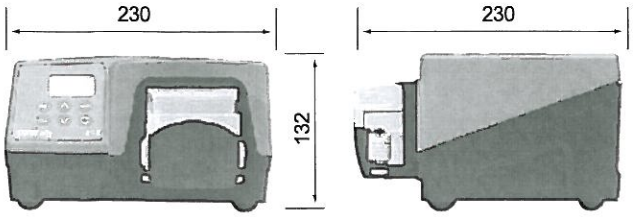
	Tube bore and flow rates (ml/min)							
	Speed rpm	0.5mm	0.8mm	1.6mm	3.2mm	4.8mm	6.4mm	8.0mm
323S/D (3 roller pumphead)	3.0 - 400	0.09-12	0.21-28	0.81-110	3.0-400	6.6-880	11-1400	15-2000
323S/4D (4 roller pumphead)	3.0 - 400	0.09-12	0.18-24	0.75-100	2.6-340	5.7-760	9.0-1200	12-1600



313 pumphead (3 roller) at 100rpm



314 pumphead (4 roller) at 100rpm



323S/D and 323S/4D High-performance manual control variable speed pumps

Product codes		
323S/D 3-400rpm	drive, bayonet mounting plate + 3 roller pumphead for 1.6mm wall tube	030.3134.4D0*
323S 3-400rpm	drive only	036.3134.000*
313DW	3 roller pumphead for 1.6mm wall tube	033.3451.000
313X	3 roller extension pumphead for 1.6mm wall tube (maximum five)	033.3431.000
313DW2	3 roller pumphead for 2.4mm wall tube (maximum one)	033.3551.000
314DW	4 roller pumphead for 1.6mm wall tube	033.4451.000
314X	4 roller extension pumphead for 1.6mm wall tube (maximum five)	033.4431.000
314DW2	4 roller pumphead for 2.4mm wall tube (maximum one)	033.4551.000

*Replace last **0** with **A**, **E** or **U** for **American**, **European** or **UK** mains supply (**American 110V 1ph 60Hz**)

If required for use with STA-PURE and Chem-Sure tubing, please contact Watson-Marlow Bredel technical support for drive and pumphead selection.

Tube ordering codes				
Bore/wall (mm)	Bioprene	Marprene	Platinum Silicone	PVC
0.5 / 1.6	903.0005.016	902.0005.016	913.A005.016	
0.8 / 1.6	903.0008.016	902.0008.016	913.A008.016	
1.6 / 1.6	903.0016.016	902.0016.016	913.A016.016	950.0016.016
3.2 / 1.6	903.0032.016	902.0032.016	913.A032.016	950.0032.016
4.8 / 1.6	903.0048.016	902.0048.016	913.A048.016	950.0048.016
6.4 / 1.6	903.0064.016	902.0064.016	913.A064.016	950.0064.016
8.0 / 1.6	903.0080.016	902.0080.016	913.A080.016	950.0080.016
1.6 / 2.4	903.0016.024	902.0016.024	913.A016.024	
3.2 / 2.4	903.0032.024	902.0032.024	913.A032.024	
4.8 / 2.4	903.0048.024	902.0048.024	913.A048.024	
6.4 / 2.4	903.0064.024	902.0064.024	913.A064.024	
Bore/wall (mm)	Neoprene	STA-PURE ®	Chem-Sure ®	Fluorel ®
0.8 / 1.6	920.0008.016			970.0008.016
1.6 / 1.6	920.0016.016	960.0016.016	965.0016.016	970.0016.016
3.2/ 1.6	920.0032.016	960.0032.016	965.0032.016	970.0032.016
4.8 / 1.6	920.0048.016	960.0048.016	965.0048.016	970.0048.016
6.4 / 1.6	920.0064.016	960.0064.016	965.0064.016	970.0064.016
8.0 / 1.6	920.0080.016	960.0080.016	965.0080.016	970.0080.016
1.6 / 2.4		960.0016.024	965.0016.024	
3.2 / 2.4		960.0032.024	965.0032.024	
4.8 / 2.4		960.0048.024	965.0048.024	
6.4 / 2.4		960.0064.024	965.0064.024	

® Fluorel is a registered trademark of Dyneon LLC, a 3-M Hoechst Enterprise

® STA-PURE and Chem-Sure are registered trademarks of W.L Gore & Associates Inc.

Please state the product code when ordering pumps and tubing.

Specification

Weight	4.7kg
Operational temperature range	4°C to 40°C
Noise	<70dBA at 1m
Control ratio	133:1
Standards	CE, IEC335-1, EN60529 (IP31)
Supply	1ph, 100-120V, 220-240V 50/60Hz, 100VA

Materials of construction

Drive	
Drive base	Powder coated aluminium casting
Drive top	Self-coloured ABS plastic
Pumphead	
Body rear	Glass filled polypropylene
Body front, body front extension	IXEF
Mounting plate, track and lever	IXEF
Rotor, tube clamp	Glass filled Nylon
Mounting plate locking tab	Glass filled Nylon
Rollers	MoS2 filled Nylon 6 (Nylatron)
Spindles	Electroless nickel plated, hardened steel
Fixings	Stainless steel
Bearings	Carbon steel - main shaft Sintered bronze - rollers

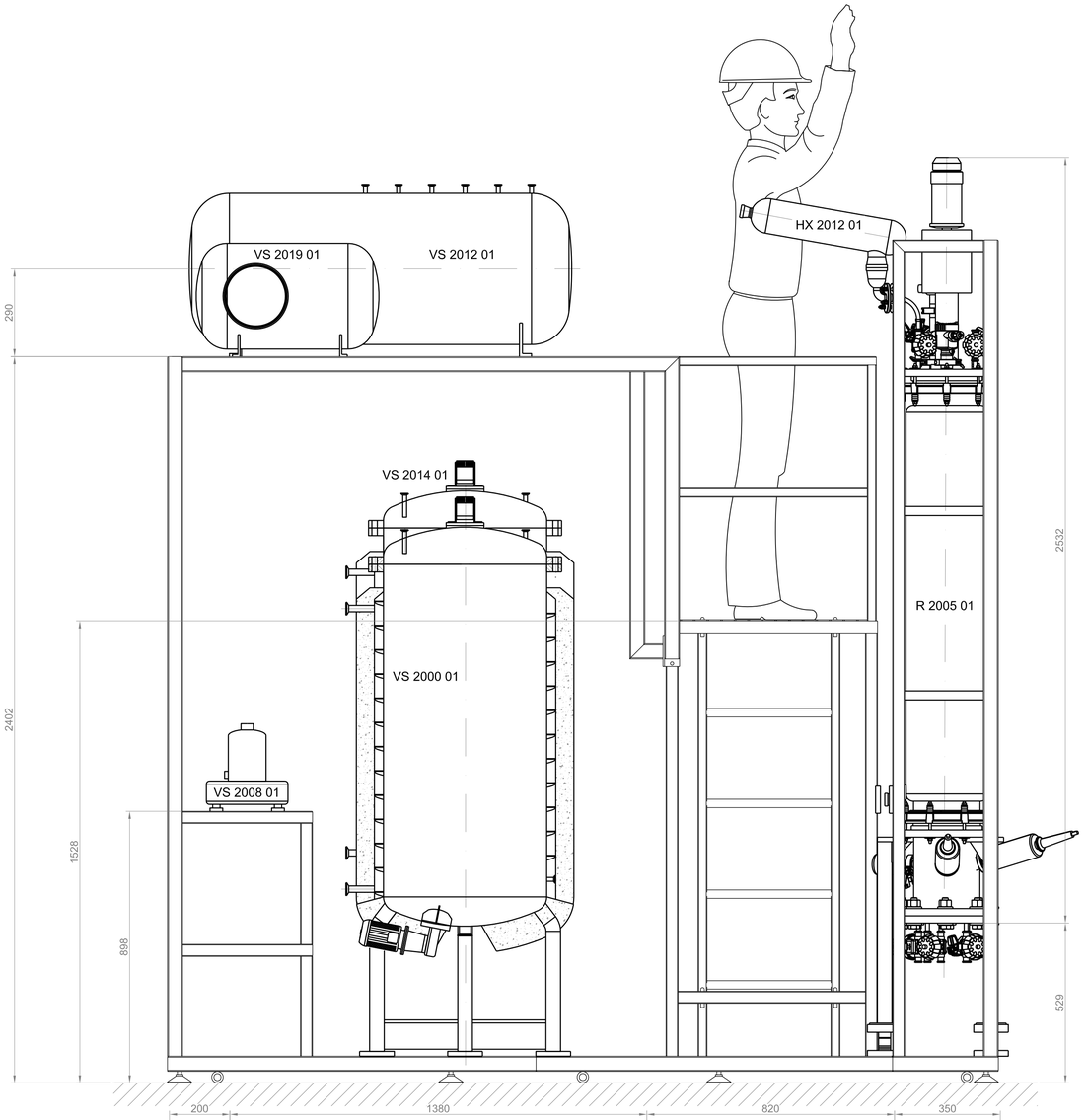
Watson-Marlow-Bredel Pumps
Falmouth
Cornwall
England
TR11 4RU
Tel: +44 (0) 1326 370370
Fax: +44 (0) 1326 376009
www.watson-marlow.com
Email support4gb@watson-marlow.co.uk

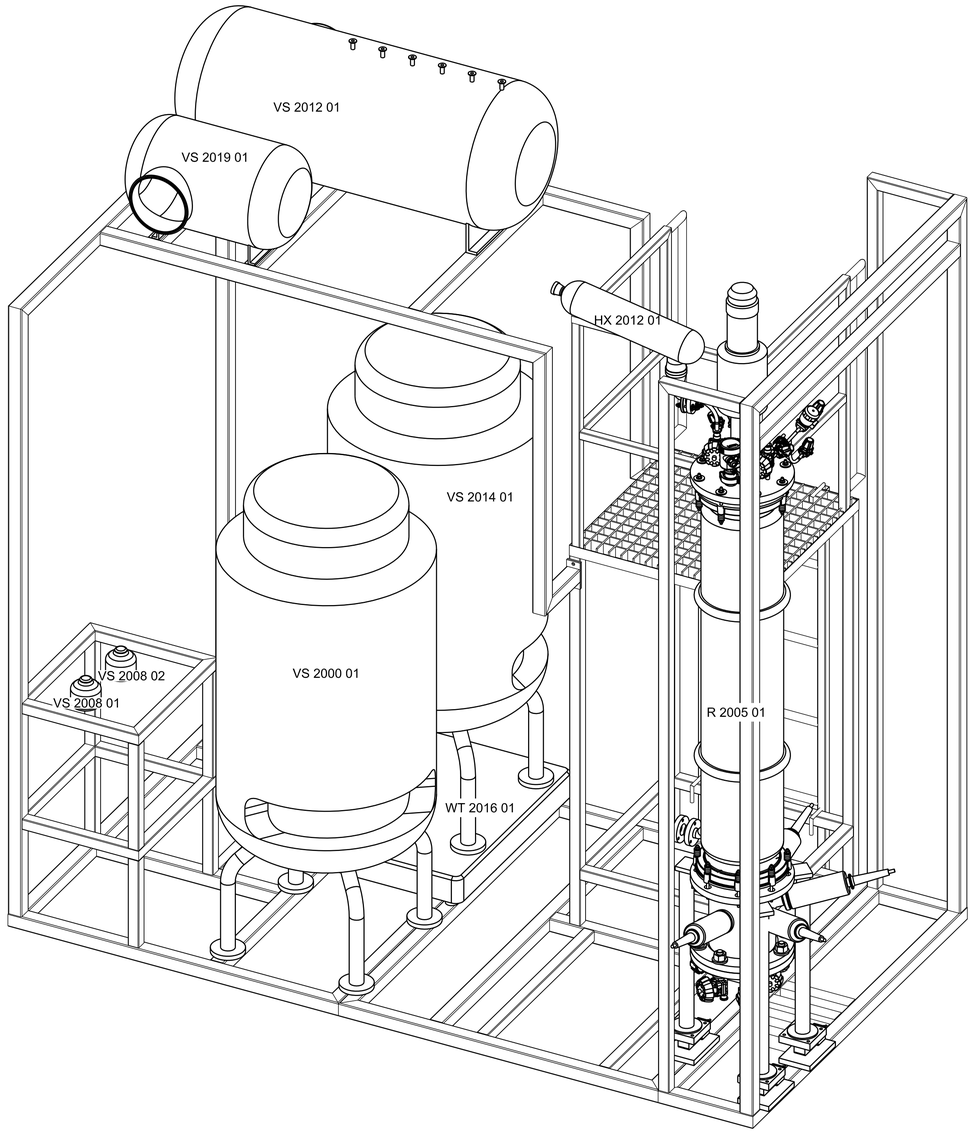
d-323sd-gb-01

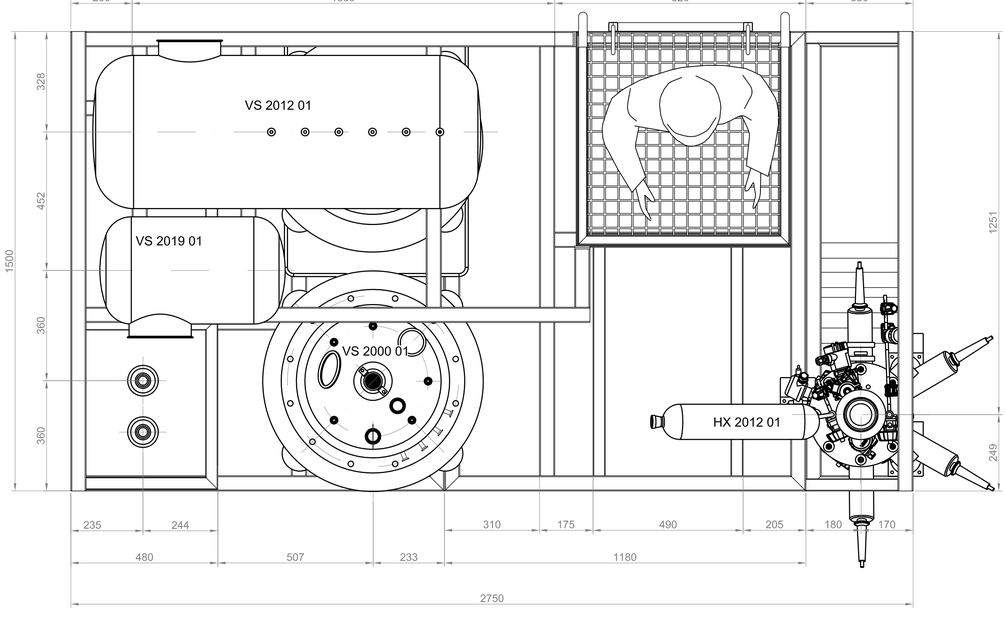
9. ANNEX IV: DRAWINGS

9.1. General layout (rev.
9.2. Layout (rev.
9.3. P&ID Diagram
9.4. P&ID Diagram (Control loops)

Rev.	Nota de revisión	Fecha	Dib.	Verif.



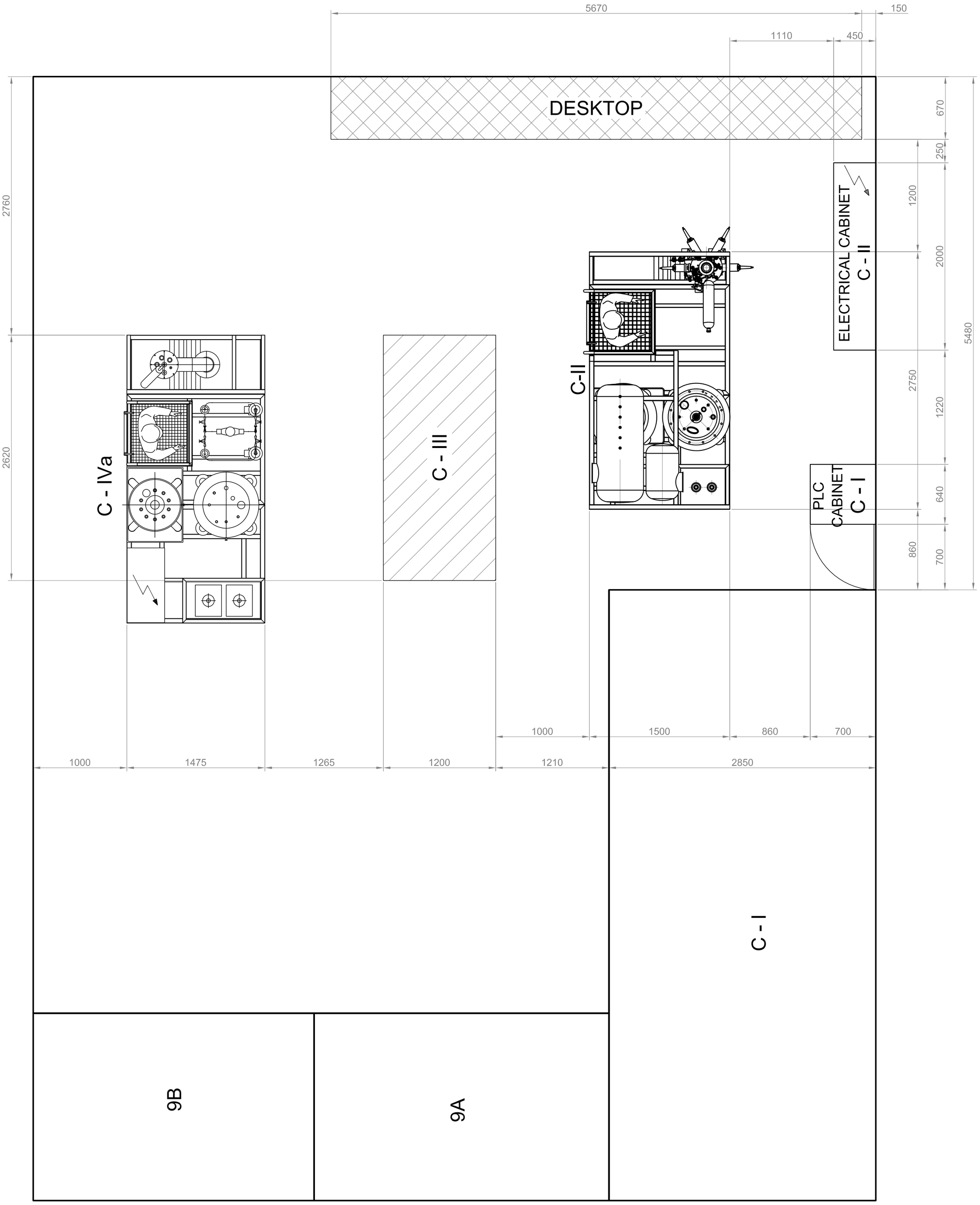




De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS Av. Princep d'Asturies 43-45, 1r-5a E-08012 BARCELONA		Dibujado	D. Tatay
		Comprobado	J. Mestre
		Fecha	21-09-2009
		Referencia	PRK-5449
PROYECTO: MELISSA - COMPARTMENT II		CLIENTE: Universitat Autònoma de Barcelona	
TITULO: PRELIMINAR LAY - OUT			
PLANO Nº: DD-8550-Z1-102-01	Revisión: B	Escala: 1/10	

Rev.	Nota de revisión	Fecha	Dib.	Verif.

CORRIDOR AREA



CONTROL ROOM AREA

De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS Av. Princep d'Asturies 43-45, 1r-5a E-08012 BARCELONA	Dibujado: D. Tatay Comprobado: J. Mestre Fecha: 21-09-2009 Referencia: PRK-5449
PROYECTO: MELISSA - COMPARTMENT II	CLIENTE: Universitat Autònoma de Barcelona
TITULO: ROOM LAY - OUT	
PLANO Nº: DD-8550-Z1-102-02 — Revisión: 0	Escala: 1/30

FORMATO: DIN A2

STEAM RACK
WATER RACK
HELIUM RACK
ID
ID
ID
VT-1/2"-SS2-006
VT-1/2"-SS2-005
ATM
VT-1/4"-SS2-008
C III
HELIUM INLET
HE-1/4"-SS2-003
PG-1/4"-SS2-011
VS 2012 01
PG-1/2"-SS2-008
BLWR 2012 01
PG-1/2"-SS2-007
PG-1/2"-SS2-005
HX 2012 01
DPT 2012 01
PG-1/2"-SS2-006
ST-3/8"-SS1-024
ST-3/8"-SS1-023
ST-3/8"-SS1-022
ST-3/8"-SS1-021
ST-3/8"-SS1-020
GLYCOL OUTLET
GLY-T"-SS1-002
GLYCOL INLET
GLY-T"-SS1-001
STEAM INLET
ST-3/4"-SS1-001
ST-3/4"-SS1-025
INOCULUM / ANTIFOAM
IN-1/2"-SS2-001
CONDENSATE MANIFOLD
GLY-3/4"-PP-010
PG-1/2"-SS2-004
R 2005 01
IRC 2006 01
HCI INLET
WT-T"-SS1-002
VS 2007 01
HX 2007 02
PP 2007 01
GLY-T"-SS1-012
GLY-T"-SS1-011
WT-T"-SS1-001
WATER INLET
HCI OUTLET
PL-1/2"-SS2-013
ST-3/8"-SS1-038
CONDENSATE MANIFOLD
AI-1/4"-SS1-002
SERVICE AIR INLET
ST-3/8"-SS1-035
ST-3/8"-SS1-036
ST-3/8"-SS1-037
PL-1/2"-SS2-011
PL-1/2"-SS2-012
VS 2014 01
Harvesting Tank
GLY-3/4"-SS1-007
GLY-T"-SS1-002
GLYCOL OUTLET
GLY-3/4"-SS1-008
GLY-3/4"-SS1-006
GLY-T"-SS1-001
GLYCOL INLET
ST-3/8"-SS1-029
ST-3/8"-SS1-028
ST-1/2"-SS1-027
PL-1/2"-SS2-014
LIQUID OUTLET
INERT GAS
ST-3/8"-SS1-033
ST-3/8"-SS1-032
ST-1/2"-SS1-031
ST-3/8"-SS1-030
ST-3/8"-SS1-034
ST-3/4"-SS1-001
STEAM INLET
PL-1/2"-SS2-010
PL-1/2"-SS2-009
PL-1/2"-SS2-008
PL-1/2"-SS2-007
PL-1/2"-SS2-005
PL-1/2"-SS2-006
PL-1/2"-SS2-003
PL-1/2"-SS2-004
PAC-1/2"-SS2-002
PAC-1/2"-PP-001
PP 2008 01
VT-1/2"-PP-010
ACID INLET
VS 2008 01
ACID VESSEL
ST-3/8"-SS1-018
ST-3/4"-SS1-001
STEAM INLET
AI-200-PVC-002
BLWR 2007 01
AI-200-PVC-003
Air Outlet
Grille
GF 2007 01
AI-200-PVC-001
Air Inlet
Filter & Grille
VT-1/4"-PP-009
PP 2008 02
BASE INLET
VS 2008 02
BASE VESSEL
ST-1/2"-SS1-039
ST-1/2"-SS1-040
ST-1/2"-SS1-041
CONDENSATE MANIFOLD
CONDENSATE MANIFOLD
CONDENSATE MANIFOLD
VT-1/2"-SS2-001
VS 2019 01
HE-1/4"-SS2-002
HELIUM INLET
VT-1/2"-SS2-007
ATM
VT-1/2"-SS2-004
BLWR 2004 01
VT-1/2"-SS2-003
VT-1/2"-SS2-002
PG-1/2"-SS2-002
CONDENSATE MANIFOLD
ST-3/8"-SS1-015
CONDENSATE MANIFOLD
PG-1/2"-SS2-003
ST-3/8"-SS1-016
ST-3/8"-SS1-017
ST-3/8"-SS1-019
PL-1/2"-SS2-009
PL-1/2"-SS2-008
PL-1/2"-SS2-007
PL-1/2"-SS2-005
PL-1/2"-SS2-006
PBA-1/2"-SS2-002
PBA-1/2"-PP-001
STEAM INLET
ST-3/4"-SS1-001
ST-3/8"-SS1-002
ST-3/8"-SS1-003
ST-3/8"-SS1-004
ST-3/8"-SS1-005
ST-3/8"-SS1-006
ATM
ST-3/8"-SS1-008
ST-3/8"-SS1-009
ST-3/8"-SS1-010
ST-3/8"-SS1-011
ST-3/8"-SS1-012
ST-3/8"-SS1-013
ST-1/2"-SS1-007
PL-1/2"-SS2-001
SERVICE AIR INLET
AI-1/4"-SS1-001
GLYCOL OUTLET
GLY-T"-SS1-002
GLY-3/4"-SS1-004
GLY-3/4"-SS1-005
GLYCOL INLET
GLY-T"-SS1-001
GLY-3/4"-SS1-003
VS 2000 01
Feeding Tank
ST-3/8"-SS1-008
ST-3/8"-SS1-004
PL-1/2"-SS2-002
CONDENSATE MANIFOLD
INERT GAS
INERT GAS
INERT GAS
INERT GAS

Rev.	Nota de revisión	Fecha	Dib.	Verif.

De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Príncep d'Asturles 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	D.Tatay
Comprobado	J.Mestre
Fecha	23/09/2009
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II
CLIENTE: UNIVERSITAT AUTONOMA DE BARCELONA
TITULO: P&ID DIAGRAM
PLANO Nº: DD-8550-Z1-100-01
Revisión: F
Escala: ---

FORMATO: DIN A1

STEAM RACK
WATER RACK
HELIUM RACK

VS 2012 01
BLWR 2012 01
VS 2014 01
Harvesting Tank
VS 2019 01
BLWR 2004 01
VS 2000 01
Feeding Tank
R 2005 01
IRC 2006 01
VS 2007 01
HX 2007 02
PP 2007 01
BLWR 2007 01
GF 2007 01
PP 2008 01
PP 2008 02
VS 2008 01
ACID VESSEL
VS 2008 02
BASE VESSEL

ATM
HELIUM INLET
C III
CI INLET
CO2 INLET
SERVICE AIR INLET
STEAM INLET
GLYCOL INLET
GLYCOL OUTLET
INOCULUM / ANTIFOAM
CONDENSATE MANIFOLD
INERT GAS
HCl INLET
HCl OUTLET
WATER INLET
LIQUID OUTLET
BASE INLET
ACID INLET
Air Outlet
Grille
Air Inlet
Filter & Grille
FROM PS 2004 01
TO BLWR 2004 01
FROM SV 2004 03
TO SV 2004 03

Rev.	Nota de revisión	Fecha	Dib.	Verif.

De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Prínicep d'Asturles 43-45, 1r-5a
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Dibujado	D.Tatay
Comprobado	J.Mestre
Fecha	23/09/2009
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II
CLIENTE: UNIVERSITAT AUTONOMA DE BARCELONA
TITULO: P&ID DIAGRAM: CONTROL LOOPS
PLANO Nº: DD-8550-Z1-100-02
Revisión: F
Escala: ---

FORMATO: DIN A1

10. QUOTATION

De Dietrich
PROCESS SYSTEMS

OFERTA EXS-M0127 Rev. 1

PROPOSAL FOR THE SUPPLY OF MELiSSA PILOT PLANT COMPARTMENT C-II, INCLUDING: DETAIL ENGINEERING WORKS, EQUIPMENT SUPPLY, PLANT ASSEMBLY AND COMMISIONING OF THE UNIT

UAB / MELiSSA Pilot Plant
Mr. Francesc Gòdia
Barcelona, May 19th 2010

De Dietrich Equipos Quimicos, S.L.
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QVF
ROSENMUND
De Dietrich

INDICE

1.- SUBJECT AND ANTECEDENTS

The Universitat Autònoma de Barcelona, hereafter UAB, takes part in the MELiSSA Project of the European Space Agency (ESA) and the European Space Research and Technology Centre (ESTEC). The Project objective is to study and define parameters to achieve life conditions in the space during long journeys.

Included in this research project there is a pilot plant installed in the Departament d`Enginyeria Química de l'Escola Tècnica Superior d`Enginyeria (ETSE) of the UAB. This pilot plant is based in several compartments linked together in a close loop to process and recycle the ambient air, water, food and feces.

De Dietrich Equipos Químicos, hereafter DDEQ, was commissioned by the UAB for the basic designing of compartment C-II of the pilot plant, according to DDEQ quotation DDE-K1764-SI.

The present proposal EXS-M0127 Rev. 1 for the construction and delivery of the skid corresponding to compartment C-II, is based in the documentation and designs generated during this basic engineering project development.

The proposal includes the following concepts:

- Carry out the required detailed and constructive engineering works to build up the plant
- Delivery of all the materials, equipments and goods.
- Carry out the assembly (mechanical and cabling) of the plant
- Commissioning and start-up of the plant
- Delivery of operation manual and technical dossier of the plant

2.- QUOTATION BASIS

To make this proposal the following documents (Data package) coming from the basic designing works of MELISSA – Compartment II Pilot Reactor, have been used:

P&ID Diagram DD-8550-Z1-100-01 Rev. F

Control Loops Diagram DD-8550-Z1-100-02 Rev. F

Main Equipments list Rev. A

Valves, filters and accessories list Rev. A

Piping list Rev. A

Instruments list Rev. A

Motor list Rev. A

Main Equipments Technical Specification Rev. A

Instruments Specification Rev. A

Electrical & Control Signals List Rev. A

At this stage it is mandatory that MPP and DDEQ establish a protocol to verify that the basic design elaborated fulfills the Technical Requirements (MPP/TN/2005/01 Version 1) and the Technical Note 62.2 edition 1. It has to be understood that a Prototype Pilot Plant might have some uncertainties that will not be clarified until the start up of the unit, and agreed changes might be required at that stage.

A document with the conclusion of this verification will be released and added to this quotation basis. In case that after the verification improvements or changes over the design should be implemented with relevant impact on the budget of the plant, a new revision of this quotation will be prepared.

3.- SCOPE OF SUPPLY

3.1.- Constructive Detail Engineering Contents

The Investment Budget has been calculated considering a Constructive Detail Engineering packet of 780h to execute the following works:

1. Definition and Execution of Final P&I'd.
2. Definition of utilities required and estimated consumptions.
3. Definition and Execution of Final Control Loops Diagram.
4. Final Lay-out drawing.
5. Final list of: Sensors, valves, lines and components.
6. Datasheets of sensors, valves and main equipments.
7. Constructive drawings of:
   - Liquid storage tanks and accessory vessels
   - Reactor
   - Frame, supports and skid
8. Sufficient drawings for the pipe assembly, including isometric drawing of process lines.
9. Final detailed control functional description.

Once this first Data package is ready it will be sent to MPP for revision and approval. Once the approval is received the rest of the Detail Engineering will be carried out and the purchases orders to suppliers will star to be released.

At this stage MPP will deliver the detailed control functional description plus the sensor and motor list with their datasheets to the control supplier (Sherpa) to star working on the PLC definition and program, as well as the scada control screens.

A *"kick off meeting"* with the MPP´s control contractor will be held at the UAB in order to clarify all the information provided by DDEQ to this contractor in the Data Package with points 1 to 9 (sensor list, motor list, automatic valves list, data sheets, control loops definitions, and final detailed control functional description).

10. HAZOP Analysis over final lay-out and P&ID
11. Prepare the "Test Protocols" for DDEQ Test and Commissioning as per stated in point 3.5
12. Electrical diagrams for the electrical cabinet. CE marking and legalization of the new cabinet.
13. CE marking and legalization of the liquid storage tanks.
14. Machines and Equipment Security Evaluation, made by ICICT, S.A. (TÜV Rheinland Group), for a Pilot Plant module installed at the UAB facilities in Cerdanyola del Vallès.

    Like for the C-IVa module the notified body will do a Study over Machines and Equipment security based on:
    - R.D. 1215/97 about Minimum Security and Health Measures for the use of equipments.
    - R.D. 1495/86 about Security in Machines
    - UNE-EN norms of application

The notified body will execute the following works:

- Hazards identification
- Risk analysis according the hazards detected
- Consensus about safety technical solutions based on UNE-EN norms

Final conclusions report and Machinery Conformity / Non Conformity Certificate emission.

To assure the traceability and control over the design, DDEQ will implement a ***"Design Changes Record"***. The objectives of this record are:

a. Assure traceability over design changes: date, problem detected, reason, decision, final change introduced, possible delays, cost.

b. Assure approval from both MPP and DDEQ.

c. Decision about who will take the cost of the change.

3.2.- Mechanical Turn-key supply of the compartment C-II

Mechanical turn-key supply of the mechanical and electrical equipment corresponding to the Compartment C-II of the Melissa Pilot Plant. The supply will be done in accordance to the "Quotation basis" shown in point 2 and the Detail Engineering to be carried out according to point 3.1.

Previously to any purchase DDEQ will inform UAB which is the selected supplier or contractor. Should the UAB has any inconvenience regarding a supplier or contractor DDEQ will change to another one, unless this might have an economic impact on the project or cause a delay in the schedule.

Mechanical Erection and installation of the unit at DDEQ warehouse and UAB laboratories at Cerdanyola del Vallés

2 Copies of the final dossier

3.3.- Electrical supply for the compartment C-II

Following we provide a description of the power and control system that is foreseen for the for the compartment II of MELiSSA Pilot Plant.

Documents of reference:

- *Control Loops P&ID (DD-8550-Z1-100-02 rev. F)*
- *Electrical and control signals list rev. A*
- *Room Lay-Out (DD-8550-Z1-102-02 rev. 0)*

3.3.1.- Situation of the electrical cabinet

In previous meetings has been discussed with MPP staff the situation and dimensions of the compartment II and its electrical cabinet, which is foreseen out of the skid:

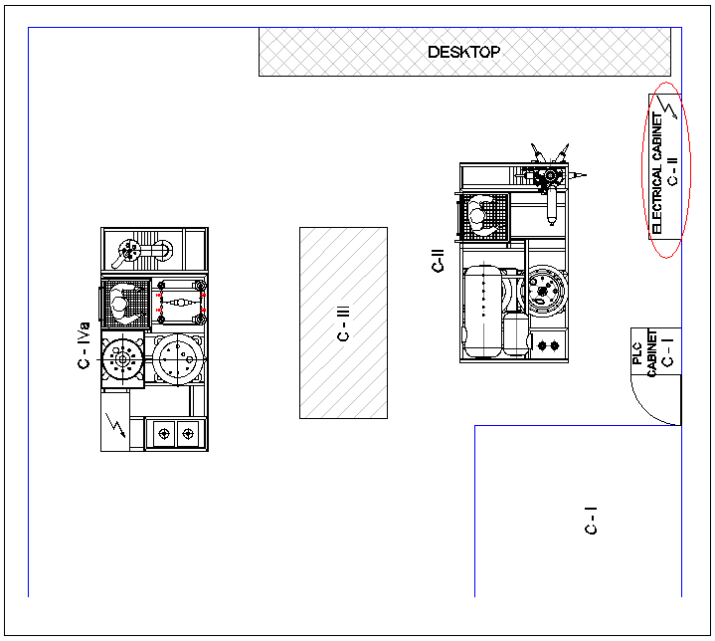
"The electrical cupboards are foreseen by DDEQ out of the skid in order to save space in it and considering the room constraints" (01.10.2009)

"MPP mentioned that the C-I PLC cabinet could be moved to the corner near the GC in order to have more space for the C.II skid (to be confirmed by NTE)" (01.10.2009)

The designed electrical cabinet is 1800x2400x400 and it is conceptually divided in two different parts: power and control. By control we mean concentrate all the control signals from site instruments to the cabinet, to communicate with the main PLC and supervisor (delivered and programmed by others).

It can be physically divided too in order to be able to go through the pilot plant door.

The situation in the plant of the electrical cabinet is the next:



NOTE: For further details about dimensions *refer to Room Lay-Out (DD-8550-Z1-102-02 rev. 0) included in the ANNEX II of the Engineering dossier.*

3.3.2.- Power and control panel

Supply of power and control panel, dimensions 1800 height, 2400 width and 400 depth, mechanized, mounted, connected and with the following elements and devices:

1 Base panel and accessories
1 Mounting board
1 Cooper bar and accessories
1 Overvoltage protection Class D IEC 1024-1
1 Light switch "On service"
1 General switch
1 Main ground-fault protection and thermal-magnetic circuit breaker
1 Emergency stop push button
1 "Emergency stop activated" indicator (red led)
1 White light indicator "Voltage in"
1 Acknowledge push button
1 Security check push button
1 Safety relay PREVENTA
2 Power supply 24Vdc/10 A
1 Single ground-fault protection for all frequency converters
1 General ground-fault protection for all the instrumentation
1 DIMMER 3-phase to control lightning columns
1 Transformer 3-phase 5KVA

1 Single thermal-magnetic protection for 7 lightning columns
1 Current metering and 4-20mA conversion
1 DIMMER protection security circuit against low load in the output
1 RS232/Ethernet converter
1→ Wiring of the following control signals:
- 38 Digital inputs
- 43 Analogical inputs
- 38 Digital outputs
- 15 Analogical outputs

1 → Set of galvanic isolators
1→ Set of thermal-magnetic circuit breakers
7 → Single-phase frequency converters 1,5KW
8 → Contactors
1→ Heater starter
1 → Set of circuit breaker auxiliary switch
1 → Set of connection strips
1 → Elements and devices mounted and connected according CE directive
1 → Design, technical managing and documentation

IMPORTANT NOTES:

- **It is not foreseen the connection to the plant power/pneumatic supply.**
- **The material included in these lists is the necessary for the electrical and control signals according to the Basic Engineering Design.**

3.3.3.- Electrical erection and commissioning of compartment C-II

The materials which are required for this action are:

- 20 m galvanized cable tray 60x60 mm (without cover).
- 20 m galvanized cable tray 300x60 mm (without cover).
- Trays mounting accessories.
- 60 m shielded cable 4x0,5 mm²
- 20 m blue shielded cable 8x0,5 mm²
- 150 m cable 4x0,5 mm²
- 100 m shielded cable 4x1,5 mm²
- 200 m shielded cable 3x1,5 mm²
- 250 m flexible conduit.
- 10 m heat-shrinkable tubing.
- Other connection and mounting accessories.

- Cable signalling.
- 60 m pneumatic tubing.
- 3 emergency stop pushbuttons.
- Other pneumatic accessories.

3.3.4.- Photo-bioreactor Lighting system

The illumination system consists of 200 halogen lamps which surround the glass jacketed pipe section (DN200, L=1500m).

The type of lamps used will be the specified in the technical note 62.2 and are: OSRAM 12V, 20W BAB 38°.

3.3.5.- Lighting system structure

The lights will be set-up on a portable structure made of stainless-steel with 10 columns of 20 halogen lamps of 20W 12V each.

It will include 2 or 3 connection boxes sited on the half height of the structure.

These boxes will receive the cables from the lamps to link in 2 o 3 cables all the power to the main electric panel.

3.3.6.- Phoenix material

Set of Phoenix materials. In module C-IV these elements were supplied by NTE but in C-II will be in our scope,

- Interface modules VARIOFACE FLKM50/MOFI-TSX/Q.
- Connectors PLC-V8/FLK14/OUT.
- Connectors PLC-V8/FLK14/IN.
- Relay PLC_RSP-24UC/21AU (24VDC).
- Plug-in bridges FBST 500-PLC BU
- Separating plates PLC-ATP BK.

3.4.- Manuals:

The manuals will be issued in English once points 1 to 9 of the Detail Engineering are approved by the MPP and while the module skid is pre-assembly in DDEQ´s warehouse. The manuals should be delivered to MPP at the same time the pilot skid is installed in the UAB´s laboratories.

3.4.1.- Operation Manual:

The Operation Manual will contain:

- System description.
- Components description.
- Detailed Operation Sequences:
  - Plant Start-up.
    - Liquid feeding

  - Reactor start-up
  - Reactor jacket fill up and temperature control
  - Liquid harvesting
  - pH control reactive addition
  - Gas feeding
  - Gas outlet regulation
  - Temperature regulation in the jacketed equipment.
  - Inert loading to the buffers

- Plant Stop. Description by homogeneous conjunctions:
  - Gas feeding stop
  - Gas outlet stop
  - Liquid feeding stop
  - Liquid harvesting stop
  - Reactor stop
  - Reactor jacket emptying
  - Jackets Heating/cooling systems stop
  - pH control reactive addition stop
  - Buffers emptying
- Microorganism inoculation sequence
- Pumps and filters installed in Stand-by change sequence.
- Sterilization:
  - Tanks sterilization
  - Reactor sterilization
  - Pumps sterilization
  - Filters sterilization

- Safety advices
- Service on hardware
- Calibrations advices
- Cleaning
- Control Loops Description and Initial Settings configuration of **process parameters supplied by MPP to the control supplier**. The optimization and fine adjustment of the settings will be responsibility of the MPP. If during the optimization and adjustment of the settings problems might arise due to the equipment supply, DDEQ will provide assistance to the MPP team.
- Alarms Description and Initial Set Points. The alarm management protocol will be responsibility of the MPP.

3.4.2.- Technical Dossier

- Check list of standard controls (routine maintenance and service on hardware) to be executed by the plant operator
- Compilation of operation, maintenance manuals and technical documents provided by the different suppliers of the equipment installed in the plant. Whenever it is possible this information will be supplied in electronic format as well.
- Spare part list for two years operation

3.5.- Test and commissioning of the Pilot Unit

3.5.1.- FAT by DDEQ

3.5.1.1.- Mechanical

Once the skid is pre-assembled at DDEQ´s warehouse and before the shipment to UAB´s laboratories MPP will assist to FAT verification consisting in:

- Verify that final approved P&I´d diagram has been observed in the assembly
- Verify that the sensors, valves and equipments used are the specified ones according the project datasheets.
- Verify supports robustness.

NOTE: A mechanical FAT record will be signed both by MPP and DDEQ and the shipment date to UAB´s laboratories will be agreed. The duration of this FAT test will be 2 or 3 working days.

No test with fluids will be included in the mechanical FAT as there are not such services at DDEQ´s warehouse.

3.5.1.2.- Electrical

The cabling of the C-II module will be executed at UAB premises. Therefore the Electrical FAT will focus only in the power and control cabinets delivered by DDEQ. This FAT will take place at DDEQ´s electrical contractor premises.

The Electrical FAT will consist in:

- Verify that all the sensors, automatic valves and equipments included in the P&I´d appears in the electrical diagrams.
- Verify that the electrical diagrams have been observed during the manufacturing of the cabinets.
- Test the power and control cabinets simulating the signals.
- Test the lighting system for the photo bio-reactor

NOTE: An electrical FAT record will be signed both by MPP and DDEQ and the shipment date to UAB´s laboratories will be agreed. The duration of this FAT test will be 2 working days.

3.5.2.- SAT by DDEQ

3.5.2.1.- Mechanical

The following tests have been considered for the plant commissioning based on a scheduled commissioning of fifteen (15) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Erection Manager (DDEQ)
- Mechanic official (DDEQ Contractor)
- MPP (permanent dedication of plant operator and technical staff)

The works to be done are:

- Pressure test with water for the liquid tanks and lines, as well as the reactor.
- Pressure test with compress air of the Gas lines and buffers.

- Pressure test with steam of the steam and condensate lines. After that a resume of sterilization sequences will be done. Resume means:
  - Not waiting all the sterilization time required until the temperature is reached
  - Not probing all the sterilization sequences but: tanks and complete sections between reactor and tanks. Sequences of individual equipment will not be checked.
- Pressure test with water of the heating / cooling circuits of the jacketed equipment.
- Test certificates and protocols filled up with the results

NOTE: For the mechanical SAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1. At the end of the mechanical SAT a record will be signed both by MPP and DDEQ.

3.5.2.2.- Electrical

The following tests have been considered for the plant commissioning based on a scheduled commissioning of ten (10) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Erection Manager (DDEQ)
- Electrical official (DDEQ Contractor)
- MPP (permanent dedication of plant operator and technical staff)

The works to be done are:

- Check of the spin direction of motors.
- Check the power supply to all the instruments.
- Check the output signals from the instruments to the cabinet.
- Check alarms contacts in the cabinet and signals to be sent to the PLC.
- Simulate PLC input signals from the cabinet to instruments and control valves.
- Test of the lighting system of the reactor and the air cooling equipment.
- Initial configuration (settings) of instruments and sensors.
- Test certificates and protocols filled up with the results.

NOTE: For the electrical SAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1. At the end of the mechanical SAT a record will be signed both by MPP and DDEQ.

3.5.2.3.- Control

The control commissioning will not be started until the mechanical and electrical commissioning (as per indicated in points 3.5.2.1 and 3.5.2.2) is finished.

To perform this part of the commissioning it is mandatory that both the PLC cabinet and PLC/supervision programs are finished, verified and implemented, and all the interconnecting cabling between DDEQ´s cabinet and the PLC cabinet (supplied by others) is done. The interconnecting cabling is also out from DDEQ´s scope.

The following tests have been considered for the plant commissioning based on a scheduled commissioning of ten (10) working days. The foreseen test team is:

- Project Engineer (DDEQ)

- Project Engineer (Sherpa)
- MPP (permanent dedication of plant operator and technical staff)
- Electrical official (DDEQ Contractor + Sherpa Contractor) If required because of problems

The works to be done are:

- Verify the arrival of the inputs signal from DDEQ´s cabinet to the PLC cabinet
- Verify the arrival of PLC commands to DDEQ´s cabinet
- Verify consistency in the measurements in the onsite instruments with the supervisor lectures.

We do not include any verification about the control loops program stability or performance, which is fully responsibility of the control supplier.

For further assistance or more extensive test and checks DDEQ will provide in point 5 "Price and Payment conditions" a daily net rate for engineers and technicians.

4.- EXCLUSIONS

The following services and works have not been taken into account in the present quotation and, therefore, are explicitly exclude of the scope of supply:

- Mechanical connections to UAB utilities nets (steam, air, CO_2, water,…)
- Gas analyzers are not defined yet by MPP. Therefore DDEQ has foreseen an estimation for its installation. Once MPP defines the gas analyzers desired for module C-II, DDEQ will evaluate the technical requirements. If necessary DDEQ will implement a Design change in the ***"Design Changes Record"*** as indicated in point 3.1.
- Electrical interconnecting cabling from DDEQ´s electrical cabinet for compartment C-II and the PLC cabinet, and from the PLC cabinet to the control room computer. Neither the main power supply from UAB´s general line to DDEQ´s cabinet is included.
- Carrying out the communication test between the electrical cabinet of new supply for the compartment C-II and the PLC cabinet, and from the PLC cabinet to the control room computer is responsibility of the control supplier. DDEQ will attend these test as stated in point 3.5.2.3
- Commissioning of the PLC program and the supervisor system implemented in the control room computer. Neither the operation manual of these elements is included.
- Plant star-up with process fluids.
- Plant validation and/or qualification.
- Further engineering works, out of what is clearly stated in the present proposal, as per example:

  Note: If any or the following works/tasks (or other not listed here) is required by the UAB, they will be invoiced separately accordingly to the "Daily rates" shown in point 5.2

  - Isometric drawings of the pipes but the process ones.
  - Engineering works to accommodate UAB facilities or utilities to the requirements of the unit (connections, modifications in services nets,...)
  - Drawings "as built" of the equipment showing the changes implemented over the approved detail constructive project.

    Note: A revised version of the P&I´d drawing will be released free of charge, including all the changes, modifications and extension works implemented during the erection or

commissioning of the equipment. In the same way, addendums over the manuals will be released to show **important changes** over the approved detail constructive project.

- Assistance and coordination with the Control Engineering involved in the project. The responsibility of control implementation is out of DDEQ´s scope. **A kick off meeting with the MPP´s control contractor will be held at the UAB in order to clarify all the information provided by DDEQ to this contractor in the Data Package with points 1 to 9 as shown in point 3.1 (sensor list, motor list, automatic valves list, data sheets, control loops definitions, and final detailed control functional description).**
- Engineering works to assure the right integration of the different modules of the Melissa loop.
- Environmental engineering concerning liquid or gaseous effluents
- Edition of Plant Operation Protocols for the field Operator
- Edition of Operational Emergencies and Alarms Management Protocol
- Edition of Sensor and Instrument Calibration Protocol
- Any legalization or CE marking of the pilot unit exceeding the Study over Machines and Equipment security edited by ICICT, S.A. (TÜV Rheinland Group)
- External sub-supplier management outside the scope of supply of the unit described in this proposal

- Official or legal projects, if necessary or required, as per example: Pressure Equipment Installation Project, Low Voltage Project, ….
- Further assistance services, out of what is clearly stated in the present proposal, as per example:
  - Check over the operational sequences, one by one.
  - Commissioning of the equipment with real process fluids.
  - Validation of the sterilization of the plant prior to its start-up in production
  - Once the commissioning phase is finished:
    - Optimization of the initial Control Settings and Alarm Set Points
    - Optimization of the Maintenance sequences and Cleaning instructions
  - Others

5.- PRICE AND PAYMENT CONDITIONS

5.1.- Price of the plant

The price of the Pilot Unit corresponding to Compartment C-II of the Melissa Pilot Plant according to the base equipment described in the Budget Rev. 0 included as Attachment 1 is:

NET PRICE (VAT excluded): -.669.301€.-

Note: The above price is a "**fix price**" according to *"2.- Quotation Basis"*, that will allow the UAB/MPP to place an order to DDEQ in order to fulfill the required delivery schedule. If during the constructive detail engineering the **relevant changes in the design appear** they will be reflected in the ***"Design Changes Record"*** and the economic impact must be agreed between both parties.

5.2.- Daily rates for special assistance or test

Any further assistance, out of what is clearly stated in points 3.1 and 3.5 of this quotation, required by the MPP both, during the detail engineering (coordination with control engineering, other

suppliers,…) or during the commissioning of the plant, will be invoiced according to the following daily rates:

Senior Engineer (mechanical or electrical/control):	740 €/day
Assembling coordinator:	560 €/day
Mechanic:	485 €/day
Electrician:	485 €/day
Travel expenses:	According to destination

5.3.- Orders and Payment conditions

DDEQ proposes the following payment conditions:

20% down payment at order placement, payment at 90 days after invoicing

30% at delivery of points 1 to 9 of the Detail Engineering as stated in point 3.1, payment at 90 days after invoicing

20% at conclusion of mechanical FAT test as stated in point 3.5.1.1, payment at 90 days after invoicing

10% at conclusion of electrical FAT test as stated in point 3.5.1.2, payment at 90 days after invoicing

5% at delivery of manuals as stated in point 3.4, payment at 90 days after invoicing.

5% at conclusion of the equipment installation at the UAB facilities at Cerdanyola del Vallès, payment at 90 days after invoicing

5% at the conclusion of the commissioning as stated in point 3.5, payment at 90 days after invoicing.

6.- PROPOSAL VALIDITY

This proposal is valid for a period of two natural months.

7.- PROJECT PLANNING

In practice the development of the Project will be mainly influenced by UAB/MPP final decisions about different design alternatives and the administrative delays in order to place the order and contract writting. Also delays in intermediate approvals will cause a longer delivery time for the skid.

Assuming an optimal schedule in the development of the project, the schedule would be as shown in the annex.

8.- GUARANTEE

DE DIETRICH EQUIPOS QUÍMICOS S.L., guarantees for one (1) operation year, against manufacturing defects or material failures, all the equipment supply and the erection and assembly works executed by its contractors. The guarantee applies only to the repair or the reposition of the defect element or equipment, once the defect is verified, checked and accepted as guarantee issue.

Elements subjected to wear and/or ageing are not covered by the present guarantee. For example (but not limited) mechanical seals, measurement probes, joints,...Neither is covered negligence in the operation of the equipment and normal maintenance or cleaning operations over the equipment, as well as, accidental failures of the unit.

As mentioned before, the guarantee covers only the repair / replacement of the damaged/defect equipment. No other service or compensation is covered. For third party components or equipments, if any, the guarantee will be provided by the manufacturer.

9.- GENERAL PROJECT CONDITIONS AND LIABILITY LIMITATION

- The works covered under this proposal will be considered finished as soon as the commissioning tests stated in point 3.5 are finished satisfactorily.
- Design will be implemented under the guidelines and process requirements provided by the UAB, and according to the good engineering practices known by DDEQ. Before the order is placed to DDEQ **it is mandatory that MPP and DDEQ establish a protocol to verify that the basic design elaborated fulfills the Technical Requirements (MPP/TN/2005/01 Version 1) and the Technical Note 62.2 edition 1. It has to be understood that a Prototype Pilot Plant might have some uncertainties that will not be clarified until the start up of the unit, and agreed changes might be required at that stage.**
- The engineering works executed by DDEQ, and consequently equipment supply, do not mean that DDEQ has any liability in case the throughout put of the unit is less or different from the foreseen one. Process responsibility is charge of the MPP.
- DDEQ will not accept any liability for direct or indirect damages causes without the intention to harm as per example: production looses, third part claims, prestige looses, overall project delays,… DDEQ will not be responsible either for defects or damages arising from wrong or incomplete information delivered by the UAB/MPP.
- The MPP will designate a main interlocutor to evacuate through all the correspondence, question, doubts,..The same person will concentrate all the information and questions from the MPP to DDEQ.

10.- CONFIDENTIALITY

All documents, data and information of the Project shared between MPP and DDEQ will be considered as confidential unless it is explicitly agree between both parts, is of public domain at the date of signing the contract or its use is necessary for the normal development of the project (inquiries or contracts to suppliers or contractors).

11.- ANNEX

Investment Budget Rev.0

Project planning

Barcelona, May 19th 2010
DE DIETRICH Equipos Químicos,S.L

Fdo. Roberto de Miguel
Managing Director

Fdo. Josep Mestre
Technical manager

11. PROPOSAL UPDATE (JUNE 2010)

PROPOSAL OF CHANGES IN PLANT DESIGN

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1. Object:

After the last meetings, some new requirements for the design have appeared. This document describes the proposed changes in the design of the plant regarding the Basic Engineering.

Documents of reference:

P&ID: DD-8550-Z1-100-01 rev. G

Influent/effluent tanks specifications: DD-8550-Z1-101-02 rev. B

Process gas buffer specifications: DD-8550-Z1-101-03 rev. B

Helium buffer specifications: DD-8550-Z1-101-04 rev. B

Reactor lighting system: DD-8550-Z1-101-06 rev. A

NOTE: All the modifications on the P&ID have been indicated with a mark on the drawing.

2. Compartment II Gas system

There are two independent gas loops in the plant: venting system for influent/effluent tanks and process gas circuit. Each loop has been studied independently.

2.1. Venting system for tanks: influent and effluent

2.1.1 Introduction

The influent/effluent tanks should be maintained, as all the plant, in anaerobic conditions.

The designed system has a way of allowing the inert gas (helium) into the tank, and a way to vent the gas when the pressure gets too high.

The helium is stored in a buffer tank, which is used for the inertization of influent and effluent tanks. This buffer must operate at a higher pressure than the process tanks so, for vented gas storage a gas compressor is needed.

A transmitter measures the influent/effluent tanks pressure and actuates over both automatic valves (helium inlet/helium vent).

2.1.1 Helium buffer design: volume and characteristics

The buffer volume is defined from the volume of gas to storage and the compressor compression factor.

In order to define the volume of this buffer, it is important to take into consideration the process requirements. In view of the compressor required, there are two different situations: filling/emptying of tanks and steady operation.

During steady operation, the flow of helium vent coming from the effluent tank will be 0.5 - 9 l/h of gas (according to *MPP/TN/2005/01).*

During the influent tank filling, the flow of helium will be higher. It will be defined from the time of the filling operation duration (flow of liquid).

2.1.1.1 Steady operation:

Vent flow: 0.5 - 9 l/h

The compressor defined (GC 2004 01) is a double diaphragm pump and its technical data are:

- Flow: 5 l/min
- Inlet pressure: 200 $mbar_g$
- Outlet pressure: 2 bar_g
- Maximum permissible pressure: 3.5 bar_g
- Motor: 230V/50Hz/IP44

The compressor operation flow, 5 l/min (300 l/h), is given from the compressor high outlet pressure required. To achieve this flow in the compressor inlet, a recirculation around the compressor has been planned, in order to maintain 200 $mbar_g$ on the compressor inlet.

A recirculation around the compressor requires: a new pressure transmitter and a new solenoid valve.

The gas compressor is always ON. The pressure transmitter (set-point: 200 $mbar_g$) modulate the solenoid valve permitting the gas recirculation to the compressor inlet in order to maintain 200 $mbar_g$. The recirculation rate would be high in order to maintain the compressor inlet flow in 5 l/min.

The high rate of circulated gas across the compressor can cause the gas warm-up as a consequence of the compression.

An exterior cooling coil is proposed for the helium buffer, operated manually depending on the temperature measured in the new thermometer installed on the tank.

2.1.1.2 Filling/emptying of tanks

After studding the compressors availability, a second compressor for the influent tank filling operation is required.

During the influent tank filling, helium vent flow will be higher than 5 l/min so, the compressor (GC 2004 01) will not be capable to compress this gas flow.

Before starting filling operation, vent flow should be manually diverted to the new compressor (GC 2004 02) which will be a double diaphragm pump and its technical data are:

- Flow: 15 l/min
- Inlet pressure: 200 $mbar_g$
- Outlet pressure: 2 bar_g
- Maximum permissible pressure: 3.5 bar_g
- Motor: 230V/50Hz/IP44

IMPORTANT NOTE: In order to avoid the vacuum formation in tank, influent tank pressure control loop should be activated.

For the study of the buffer volume, starting points for the calculations are:

- This buffer should be always capable of maintaining the influent/effluent vessels pressure controlled in order to ensure the axenity of the plant.
- The gas will be a mixture of gases. Because of its composition, pure helium can be assumed (Ideal gas case)
- The minimum pressure of the buffer (during the effluent tank emptying) is 750 $mbar_g$ approximately.
- During nominal operation the buffer will work at 2 bar_g (compressor outlet pressure).

The resultant volume for the helium buffer is 240 L.

2.1.2 Tanks venting system operational sequences.

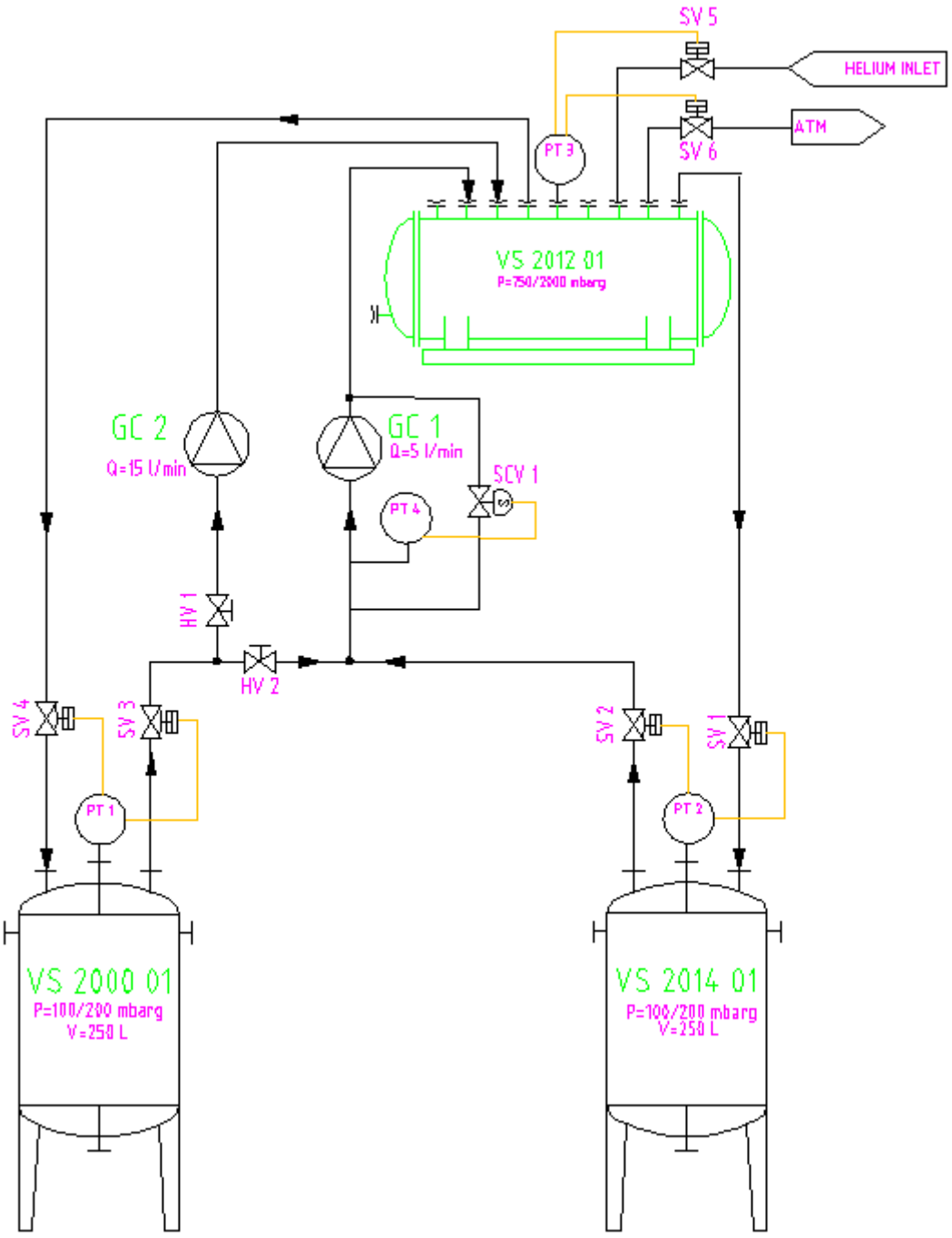
The outlet pressure given by the compressors is 2 bar_g, work pressure of the helium buffer.

During the start-up of the plant, the helium buffer pressure should be lower than 2 bar_g in order to accept the 250 L of helium moved during the tank filling. As seen while doing the calculations, the buffer starting pressure (for plant starting-up) should be 750 $mbar_g$ approximately.

During nominal operation, the buffer will be pressurized (2 bar_g) and consequently, the emptying/filling of tanks sequence should be clearly defined.

IMPORTANT NOTE: It will be necessary to empty the effluent tank before filling the influent tank. While emptying the effluent tank, the buffer pressure will fall around the 750 mbarg. With buffer working at 750 mbarg is possible to continue operating with the foreseen pressure control loops of influent/effluent tanks and, when necessary, to fill the influent tank.

A schematic view of the influent/effluent tanks venting system is:



2.1.2.1 Alarms and set-points value definition

It is important to define these values for a better understanding of the system operational.

IMPORTANT NOTE: All the values foreseen need to be better defined and adjusted during control SAT tests depending on the system stability.

a) Influent tank pressure transmitter (PT1):

- HH: 250 $mbar_g$ → open SV3
- H: 200 $mbar_g$ → close SV3
- L: 100 $mbar_g$ → close SV4
- LL: 50 $mbar_g$ → open SV4

b) Effluent tank pressure transmitter (PT2):

- HH: 250 $mbar_g$ → open SV2
- H: 200 $mbar_g$ → close SV2
- L: 100 $mbar_g$ → close SV1
- LL: 50 $mbar_g$ → open SV1

c) Buffer pressure transmitter (PT3):

- HH: 2200 $mbar_g$ → open SV6
- H: 2000 $mbar_g$ → close SV6
- L: 600 $mbar_g$ → close SV5
- LL: 400 $mbar_g$ → open SV5

2.1.2.1 Tanks emptying/filling sequences description

2.1.2.1.1 Nominal operation:

A. Effluent tank emptying:
   - Start emptying the tank
   - When: effluent tank pressure < 50 $mbar_g$ (LL alarm) → open the valve SV1. The helium is entering into the tank.
   - When the emptying is finished, the pressure of the tank will start increasing till tank pressure = [100-200] $mbar_g$ → close the valve SV1.

In this moment, 250 liters of helium have been moved to the effluent tank and the buffer pressure has fallen to 750 $mbar_g$.

IMPORTANT NOTE: In this situation (Buffer pressure = 750 $mbar_g$) is possible to continue with nominal operation or/and start the influent tank filling.

B. Influent tank filling:
   - Close the manual valve HV1
   - Open the manual valve HV2
   - Start the compressor GC2
   - Start filling the tank
   - When: influent tank pressure > 250 $mbar_g$ (HH alarm) → open the valve SV3. The helium of the tank is compressed by GC2 and sent to the buffer tank.
   - When the filling is finished, the pressure of the tank will start decreasing till tank pressure = [100-200] $mbar_g$ → close the valve SV3.

In this case, 250 liters of helium have been moved from the influent tank to the buffer and its pressure has rise to 2000 $mbar_g$.

2.1.2.1.1 Plant start-up:

When the plant is totally filled-up with helium:

- Influent/Effluent tank pressure = [100-200] $mbar_g$.
- Buffer pressure = 750 $mbar_g$.
- Influent tank filling:
  - Close the manual valve HV1
  - Open the manual valve HV2
  - Start the compressor GC2
  - Start filling the tank
  - When: influent tank pressure > 250 $mbar_g$ (HH alarm) → open the valve SV3. The helium of the tank is compressed by GC2 and sent to the buffer tank.
  - When the filling is finished, the pressure of the tank will start decreasing till tank pressure = [100-200] $mbar_g$ → close the valve SV3.

In this case, 250 liters of helium have been moved from the influent tank to the buffer and its pressure has rise to 2000 $mbar_g$.

The system is prepared for starting with nominal operation:

- Influent/Effluent tank pressure = [100-200] $mbar_g$.
- Buffer pressure = 2000 $mbar_g$.

2.2 Process circuit gas

2.2.1 Introduction

The reactor gas outlet is compressed and sent to a buffer which is designed in order to increase the compressor stability as in this compartment, gas loop is a critical point for maintaining the axenity of the entire plant.

2.2.2 Bioreactor outlet gas buffer design: volume and characteristics

The compressor foreseen for the bioreactor gas outlet (the same as GC 2004 01) is a double diaphragm pump and its technical data are:

- Flow: 5 l/min
- Inlet pressure: 200 $mbar_g$
- Outlet pressure: 2 bar_g
- Maximum permissible pressure: 3.5 bar_g
- Motor: 230V/50Hz/IP44

According to the document *MPP/TN/2005/01,* the bioreactor outlet flow will be 0 – 2 l/min so, a recirculation for the compressor is foreseen too.

A recirculation around the compressor requires: a new pressure transmitter and a new solenoid valve.

3. Bioreactor design: Illumination system

3.1. Introduction

After internal discussions, MPP has changed the illumination system requirements. The new number of lamps to install is from 190 (minimum number of lamps) to 270 (ideal) lamps.

Studying the feasibility of the mechanical installation of 270 lamps surrounding the glass cylinder, it has been seen that is possible. Another thing for taking into account is the thermal balance for refrigerating air system design.

3.2 Reactor thermal balance

- Number of lamps = 270
- Design flow of air = 1700 m^3/h
- Illumination column diameter = 430 mm

NOTE: The lamps are foreseen to install at 10 mm of the reactor glass jacket outlet wall.

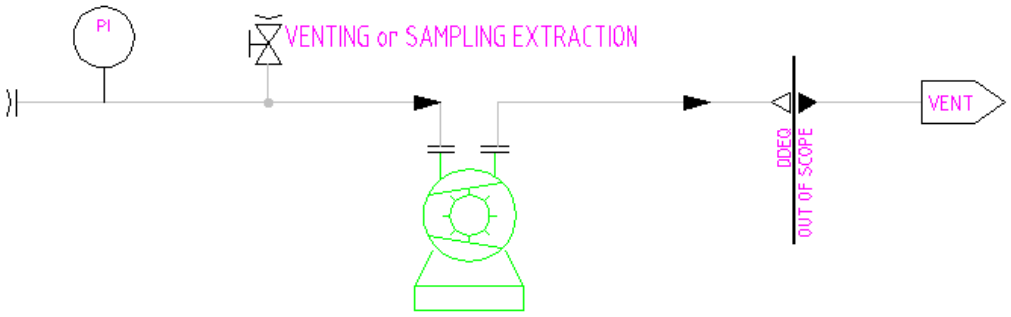
- Air ducts diameter = 260 mm

IMPORTANT NOTE: If the air refrigeration system should be capable to maintain the reactor temperature in case of refrigeration water system failure, the system should be designed as calculated in "EMERGENCY OPERATION"

NUMBER OF LAMPS		**270**	250	230	210	190
Lamp power	W			20		
Lamps power	W	5400,00	5000,00	4600,00	4200,00	3800,00
(Assumed) Power converted into heating	%			90		
Lamps heat	W	4860,00	4500,00	4140,00	3780,00	3420,00
(Assumed) Agitation heat	W	2200,00	2200,00	2200,00	2200,00	2200,00
(Assumed) Reaction heat	W	0	0	0	0	0
STEADY OPERATION						
Total heat to remove	W	7060,00	6700,00	6340,00	5980,00	5620,00
Heat removed by bioreactor jacket	W			2900,00		
Heat to be removed by the refrigeration air	W	4160,00	3800,00	3440,00	3080,00	2720,00
Required air flow	m^3/h	1386,67	1266,67	1146,67	1026,67	906,67
Design flow for blower selection	m^3/h	**1664,00**	1520,00	1376,00	1232,00	1088,00
PVC JACKET						
Desired air velocity	m/s			9		
(Assumed) Free section: lamps and supports	%			70		
Required pass section	m^2	0,07	0,07	0,06	0,05	0,05
Inside diameter (Wall of reactor glass jacket)	m			0,27		
Calculated outside diameter	m	0,41	0,40	0,39	0,38	0,37
Minimum required diameter (mechanical restrictions)	m			0,43		
Minimum section	m^2	0,09	0,09	0,09	0,09	0,09
Real air velocity	m	**5,25**	4,80	4,35	3,89	3,44
AIR DUCTS						
Desired air velocity	m/s	9,00	9,00	9,00	9,00	9,00
Calculated pass section	m^2	0,05	0,05	0,04	0,04	0,03
Ducts diameter	m	**0,26**	0,24	0,23	0,22	0,21
EMERGENCY OPERATION						
Total heat to remove	W	7060,00	6700,00	6340,00	5980,00	5620,00
Heat removed by bioreactor jacket	W			0		
Heat to be removed by the refrigeration air	W	7060,00	6700,00	6340,00	5980,00	5620,00
Required air flow	m^3/h	2353,33	2233,33	2113,33	1993,33	1873,33
Design flow for blower selection	m^3/h	**2824,00**	2680,00	2536,00	2392,00	2248,00

PVC JACKET						
Desired air velocity	m/s			9		
(Assumed) Free section: lamps and supports	%			70		
Required pass section	m^2	0,12	0,12	0,11	0,11	0,10
Inside diameter	m	0,27	0,27	0,27	0,27	0,27
Outside diameter	m	0,48	0,47	0,46	0,46	0,45
Air velocity during steady operation	m/s	**3,71**	3,57	3,42	3,24	3,05
AIR DUCTS						
Desired air velocity	m/s			9		
Calculated pass section	m^2	0,09	0,08	0,08	0,07	0,07
Ducts diameter	m	**0,33**	0,32	0,32	0,31	0,30

4. Plant inertization system for plant starting-up



For the inertization of the plant during start-up, a vacuum system is foreseen: vacuum pump, manual valve and manometer.

It will be necessary to connect the pump to the plant and do vacuum (10/20 mbar) followed of an inert gas inlet (900/100 mbar). This cycle should be repeated 2/3 times in order to guarantee the plant axenity.

Before disconnecting the horse of the system, it should be vented through the manual valve. If is necessary to take some gas sample, it is possible by means of the same valve.

5. Other design changes

5.1 Plate heat exchanger for bioreactor jacket heating

The electrical resistance that was previously foreseen has been replaced with a plate heat exchanger operating with hot water at 49 ºC (available in MPP).

5.2 Automatic valves for compartment produced gas outlet

Two automatic valves will be installed in the gas outlet instead of the gas flow meters/controllers that were previously foreseen. The reason for this change is that the way to interconnect the different MELiSSA compartments is still not decided by MPP people.

5.3 Manometers in liquid storage tanks, gas buffers and influent/effluent refrigeration jackets circuits

The installation of manometers was not scheduled because there is a pressure transmitter in each equipment, but thinking of the plant operation DDEQ things that is necessary to have a pressure local lecture.

Rev.	Nota de revisión	Fecha	Dib.	Verif.

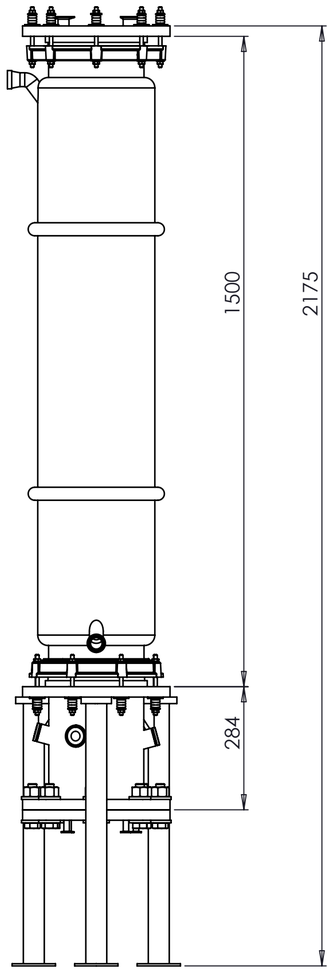
STEAM RACK
WATER RACK
HELIUM RACK

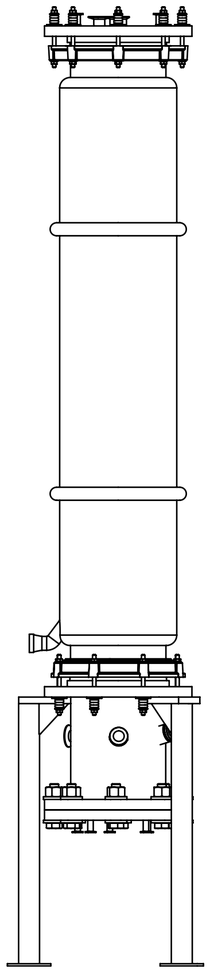
VS 2012 01
BLWR 2012 01
VS 2014 01
Harvesting Tank
VS 2000 01
Feeding Tank
R 2005 01
IRC 2006 01
VS 2007 01
PP 2007 01
VS 2019 01
BLWR 2004 01
BLWR 2007 01
GF 2007 01
PP 2008 01
VS 2008 01
ACID VESSEL
VS 2008 02
BASE VESSEL

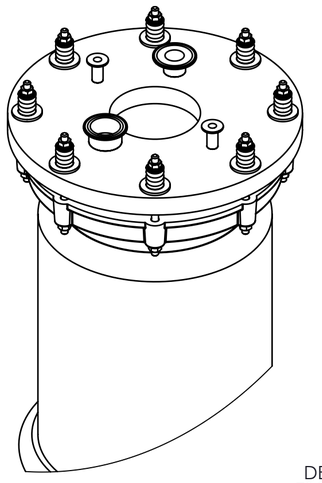
HELIUM INLET
C INLET
CO2 INLET
INERT GAS
GLYCOL OUTLET
GLYCOL INLET
STEAM INLET
INOCULUM / ANTIFOAM
CONDENSATE MANIFOLD
SERVICE AIR INLET
COOLING WATER OUTLET
COOLING WATER INLET
HCl INLET
HCl OUTLET
HOT WATER OUTLET
HOT WATER INLET
WATER INLET
CONDENSATE MANIFOLD
CONDENSATE MANIFOLD
CONDENSATE MANIFOLD
CONDENSATE MANIFOLD
CONDENSATE MANIFOLD
SERVICE AIR INLET
GLYCOL OUTLET
GLYCOL INLET
STEAM INLET
LIQUID OUTLET
Air Outlet
Grille
Air Inlet
Filter & Grille
BASE INLET
ACID INLET
VENT

De Dietrich Equipos Químicos, S. L. Member of De Dietrich Process Systems	Dibujado: D.Tatay
Av. Princep d'Asturies 43-45, 1r-Sa	Comprobado: J.Mestre
E-08012 BARCELONA	Fecha: 23/09/2009
	Referencia: PRK-5449
PROYECTO: MELiSSA - COMPARTMENT II	CLIENTE: UNIVERSITAT AUTONOMA DE BARCELONA
TÍTULO: P&ID DIAGRAM	
PLANO Nº: DD-8550-Z1-100-01	Revisión: G
	Escala: ---

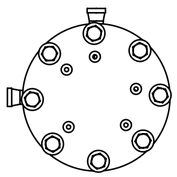
FORMATO: 1051x594

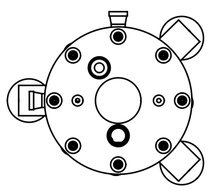


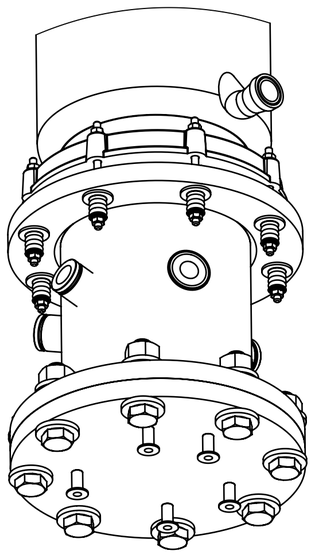




DETALLE B
ESCALA 1 : 5

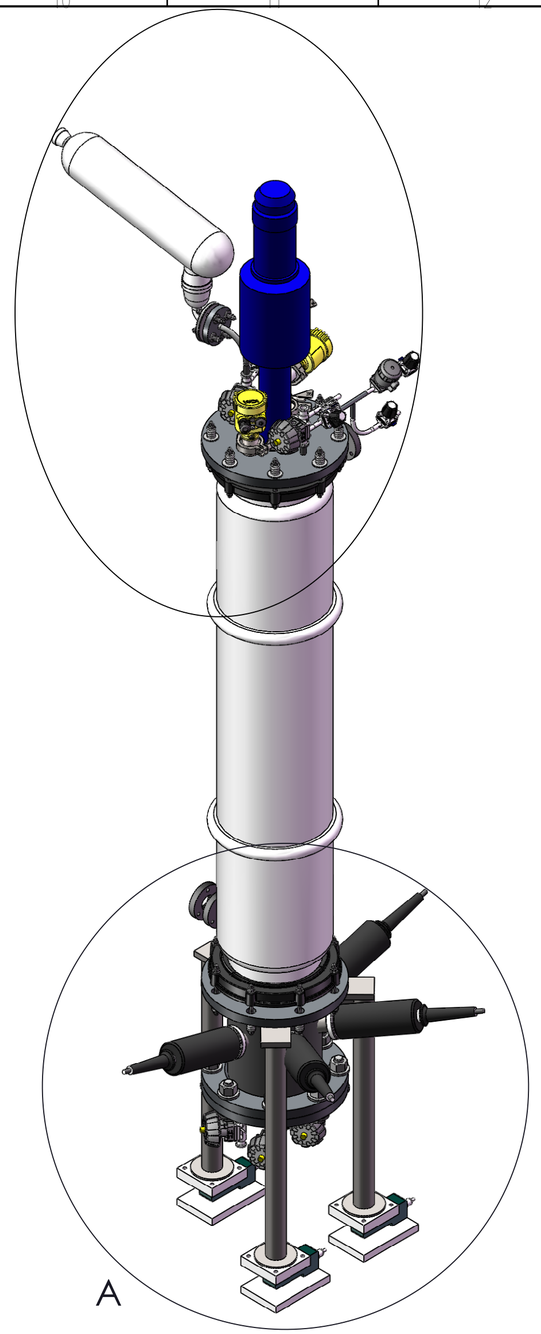






DETALLE A
ESCALA 1 : 5

B



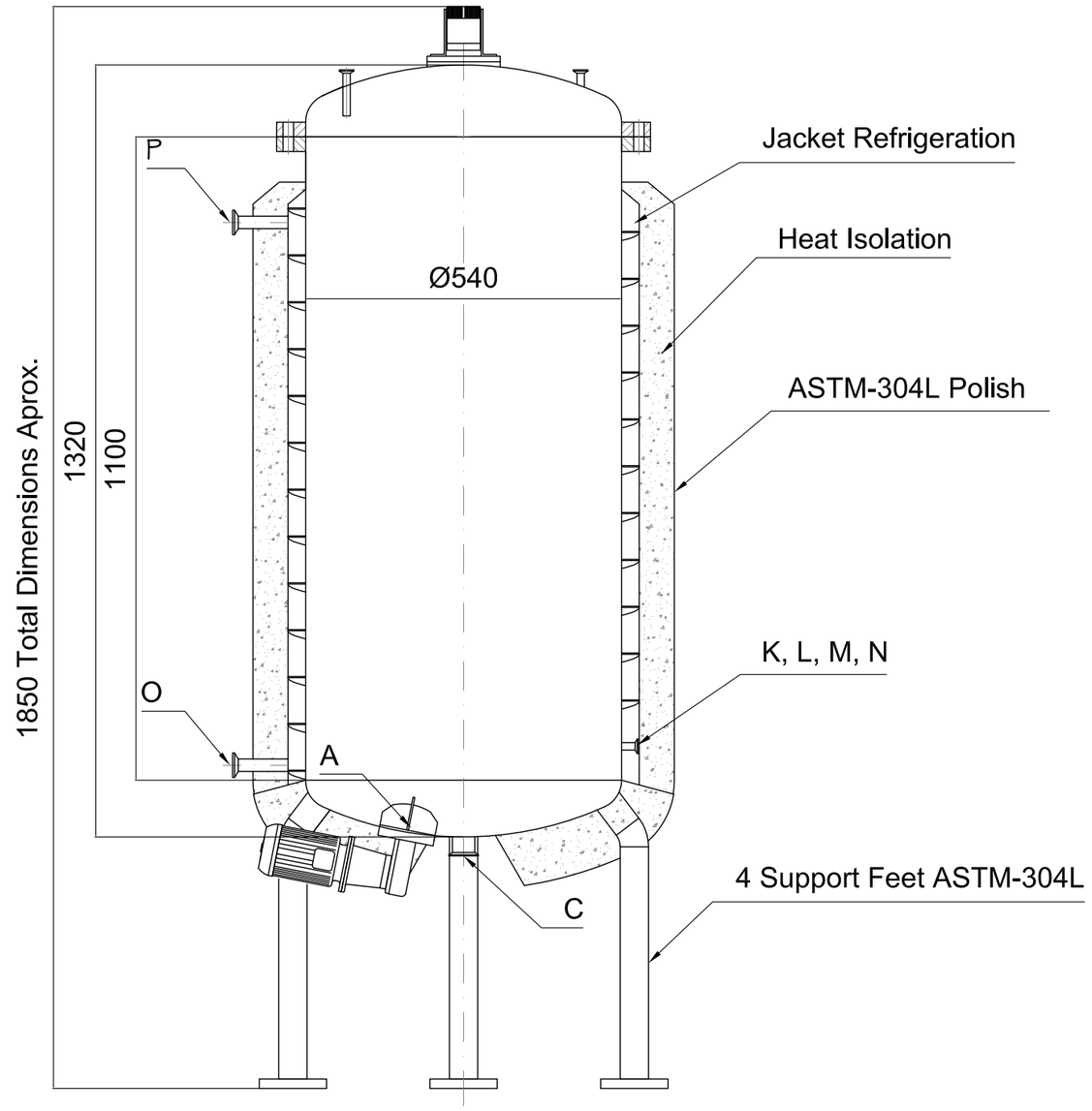
A

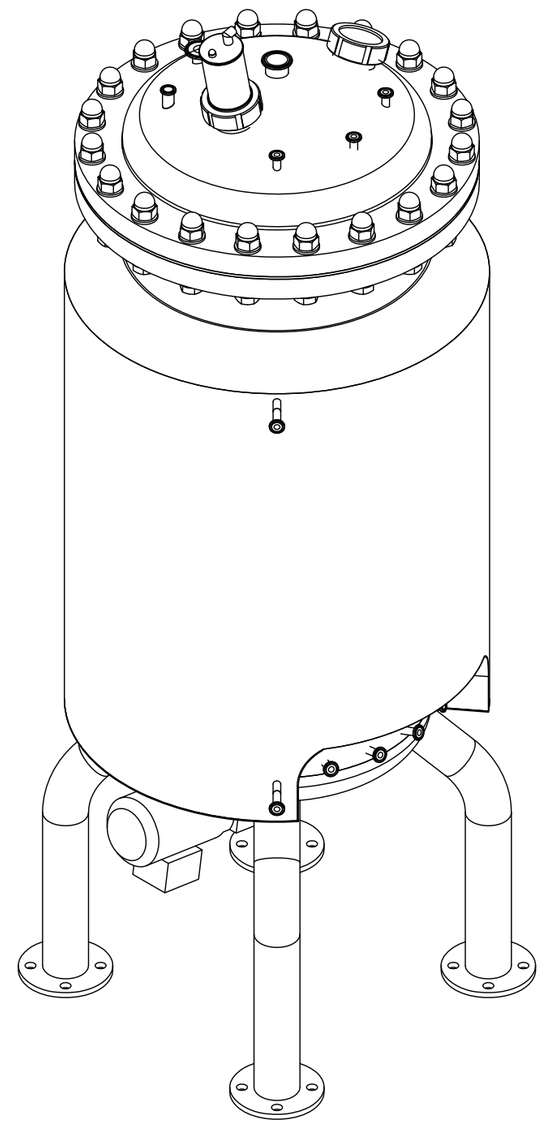
De Dietrich Equipos Quimicos, S. L. Av. Princep d'Asturies 43-45, 1r-5a E-08012 BARCELONA	Dibujado: M.Pérez Comprobado: J. Mestre Fecha: 23/12/2009 Referencia: PRK-5449
PROYECTO: MELiSSA - COMPARTMENT II	CLIENTE: **UAB** BARCELONA
TITULO: REACTOR R 2005 01	
PLANO Nº: DD-8550-Z1-101-01 / Revision: A	Escala: 1:10

FORMATO: DIN A2

Rev.	Nota de revisión	Fecha	Dib.	Verif.
B	Modificaciones según especificaciones	04/05/2010	H.Pérez	J.Mestre

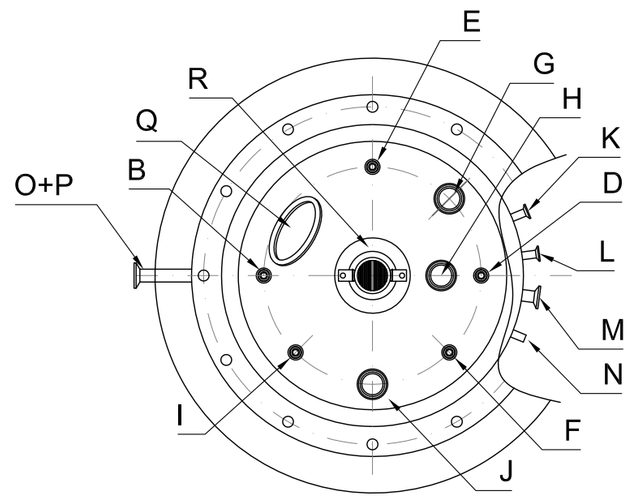
Imagen para idea general y tipo de acabados





Vista tridimensional Aproximada

TUBULADURAS			
Ref	Descripción	Tamaño	Ubicación
A	Agitador Magnético	Stermixer SMO	Fondo Inferior
B	Entrada Líquido	1" Clamp	Fondo Superior
C	Salida Líquido	1½" Clamp	Fondo Inferior
D	Salida Gas (venteo)	1" Clamp	Fondo Superior
E	Entrada Gas	1" Clamp	Fondo Superior
F	Válvula de Seguridad	1" Clamp	Fondo Superior
G	Transmisor de Presión	1½" Clamp	Fondo Superior
H	Transmisor de Nivel o Libre	1½" Clamp	Fondo Superior
I	Manómetro	1" Clamp	Fondo Superior
J	Libre	1½" Clamp	Fondo Superior
K	Transmisor de Temperatura	1" Clamp	Virola
L	Toma Muestras	1" Clamp	Virola
M	Libre	1½" Clamp	Virola
N	Libre	1" Ingold	Virola
O	Entrada Servicio	1" Clamp	Camisa
P	Salida Servicio	1" Clamp	Camisa
Q	Mirilla	NWGS	Fondo Superior
R	Mirilla + proyector	NWGS	Fondo Superior



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Volumen: 250l
-Tipo de agitador: Magnético Tipo Sterimixer (SMO) incluido en oferta
-Luz y mirilla icluidas en el depósito.
-Acabado Interior: Pulido<0.5 micras
-Acabado Exterior: Pulido Espejo
-Aislamiento Térmico: Lana de roca, acabado exterior ASTM-304L Gr320
-Condiciones de diseño:
- Cuerpo: -1/+6 bar a 170ºC
- Envolvente: -1/+6 bar a 170ºC
-Soporte para placa de características
-Cantidad: 2 Unidades

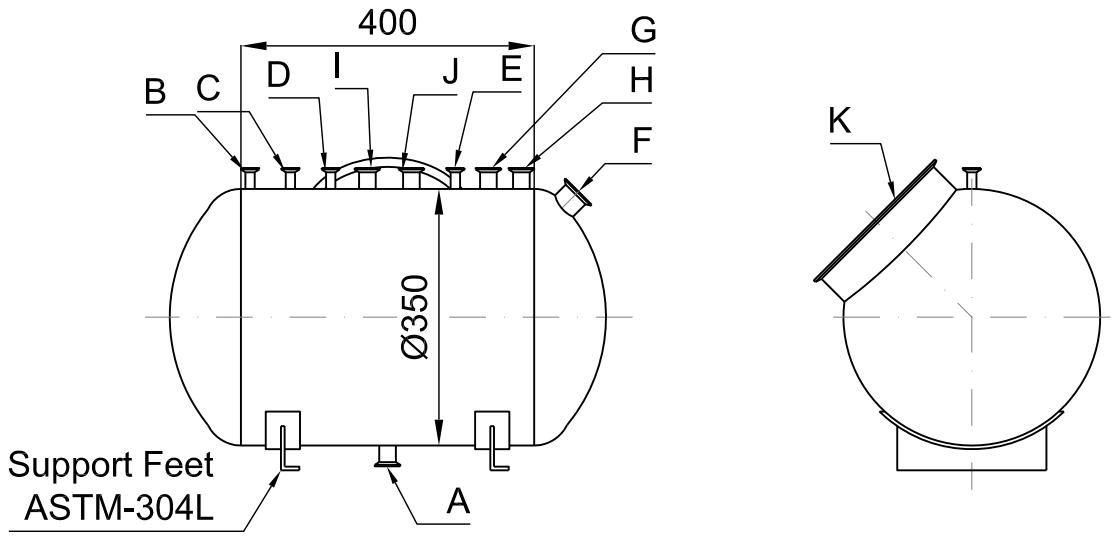
De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II
CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA
TITULO: TANKS VS 2000 01 & VS 2014 01
PLANO Nº: DD-8550-Z1-101-02
Revisión: B
Escala: 1/10

FORMATO: DIN A2

Rev.	Nota de revisión	Fecha	Dib.	Verif.
B	Modificaciones según especificaciones	04/05/2010	H.Pérez	J.Mestre



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: -1 / 4 barg
-Volumen: 50l
-Acabado Interior: Pulido<0.5 micras
-Acabado Exterior: Pulido Espejo
-Temperatura: 20º
-Soportación: Mediante 2 cunas de ASTM-304L
-Soporte Placa Características
-Cantidad: 1 Unidad

TUBULADURAS			
Ref	Descripción	Tamaño	Ubicación
A	Purga Líquido	1" Clamp	Fondo Inferior
B	Entrada Gas Proceso	½" Clamp	Fondo Superior
C	Salida Gas a Proceso	½" Clamp	Fondo Superior
D	Venteo	½" Clamp	Fondo Superior
E	Entrada Helio	½" Clamp	Fondo Superior
F	Transmisor de Presión	1½" Clamp	Fondo Superior
G	Manómetro	1" Clamp	Fondo Superior
H	Válvula de Seguridad	1" Clamp	Fondo Superior
I	Libre	1" Clamp	Fondo Superior
J	Libre	1" Clamp	Fondo Superior
K	Boca de Limpìeza		

De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II

CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA

TITULO: TANK VS 2012 01

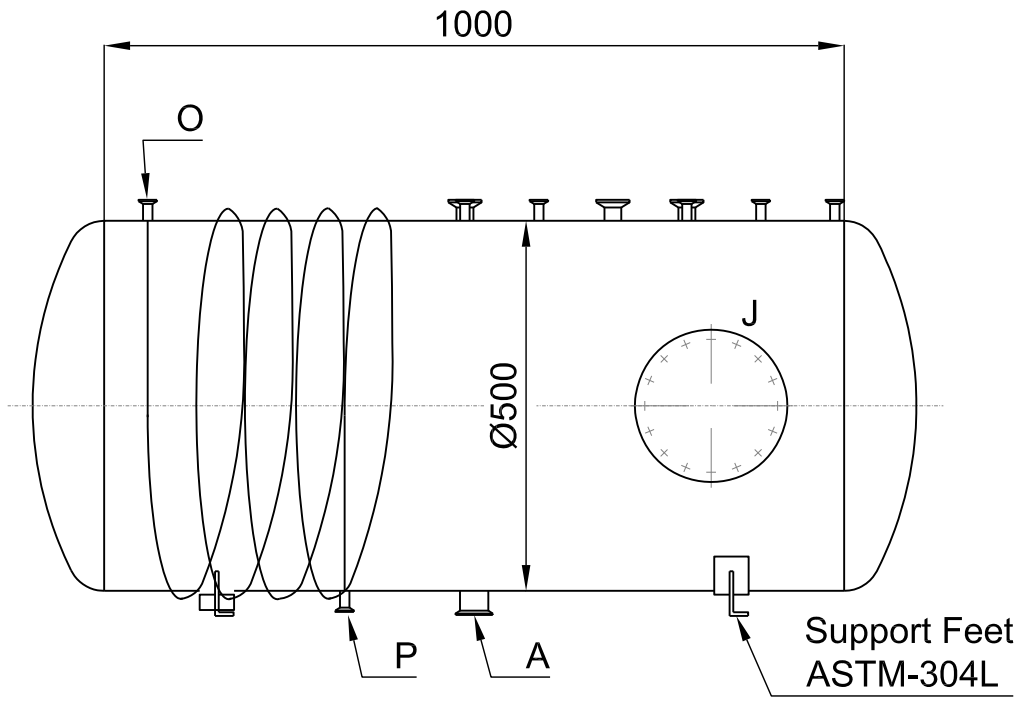
PLANO Nº: DD-8550-Z1-101-03

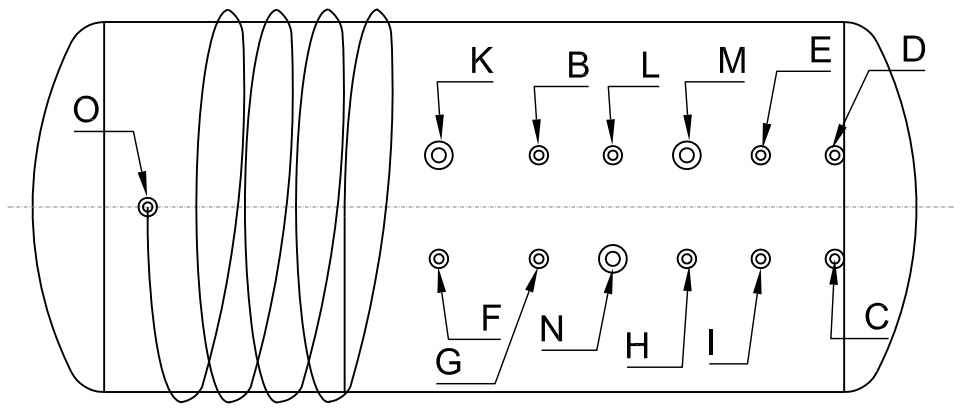
Revisión: B

Escala: 1/10

FORMATO: DIN A4

Rev.	Nota de revisión	Fecha	Dib.	Verif.
B	Modificaciones según especificaciones	04/05/2010	H.Pérez	J.Mestre





TUBULADURAS			
Ref	Descripción	Tamaño	Ubicación
A	Purga Líquido	1" Clamp	Fondo Inferior
B	Entrada Gas Proceso	½" Clamp	Fondo Superior
C	Salida Gas Proceso	½" Clamp	Fondo Superior
D	Venteo	½" Clamp	Fondo Superior
E	Entrada Hélio	½" Clamp	Fondo Superior
F	Transmisor de Presión	½" Clamp	Fondo Superior
G	Salida Gas Proceso	½" Clamp	Fondo Superior
H	Válvula de Seguridad	½" Clamp	Fondo Superior
I	Entrada Gas Proceso	½" Clamp	Fondo Superior
J	Boca de Limpieza	8" Clamp	Lateral
K	Manómetro	1" Clamp	Fondo Superior
L	Termómetro	½" Clamp	Fondo Superior
M	Libre	1" Clamp	Fondo Superior
N	Libre	1" Clamp	Fondo Superior
O	Entrada Servicio	¾" Clamp	Fondo Inferior
P	Salida Servicio	¾" Clamp	Fondo Superior

Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: -1 / 4barg
-Volumen: 240l
-Acabado Interior: Pulido<0.5 micras
-Acabado Exterior: Pulido Espejo
-Temperatura: 20º
-Media caña 4 espiras DN25 AISI 304L
-Soporte para placa de características
-Soportación: Mediante 2 cunas de ASTM-304L
-Cantidad: 1 Unidad

De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II
TITULO: TANK VS 2019 01
CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA
PLANO Nº: DD-8550-Z1-101-04
Revisión: B
Escala: 1/10

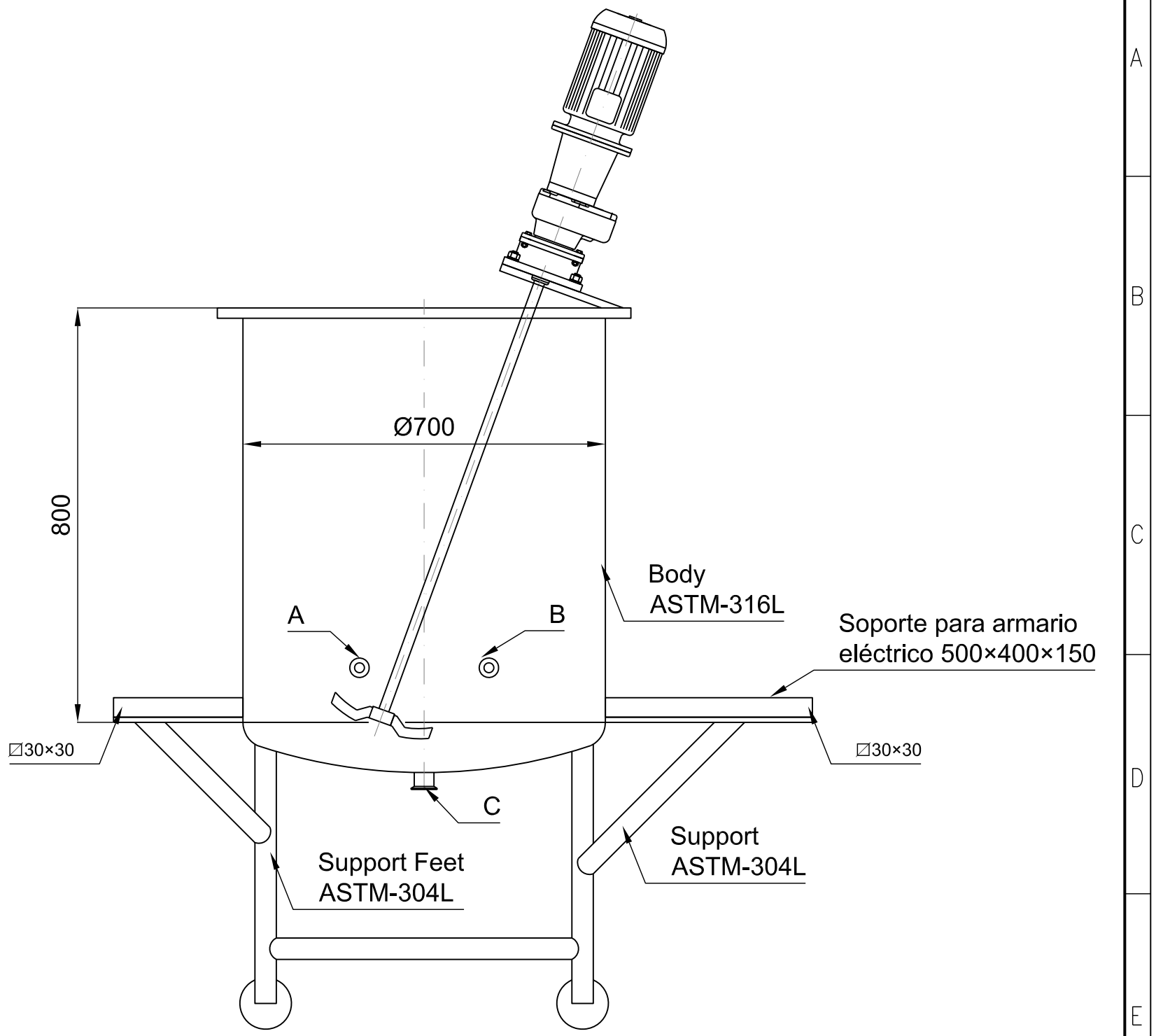
FORMATO: DIN A3

Rev.	Nota de revisión	Fecha	Dib.	Verif.
B	Modificaciones según especificaciones	04/05/2010	H.Pérez	J.Mestre

Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: Atmosférico
-Volumen: 300l
-Agitador: Convencional Tipo Turbina
-Acabado Interior: Pulido<0.5 micras
-Acabado Exterior: Espejo
-Temperatura: Ambiente
-Soporte para placa de características
-Soportación: Mediante 4 patas con ruedas (2 con freno)
-Cantidad: 1 Unidad

TUBULADURAS			
Ref	Descripción	Tamaño	Ubicación
A	Libre	1" Clamp	Lateral
B	Libre	1" Clamp	Lateral
C	Descarga Líquido	1½" Clamp	Fondo Inferior



De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK–5449

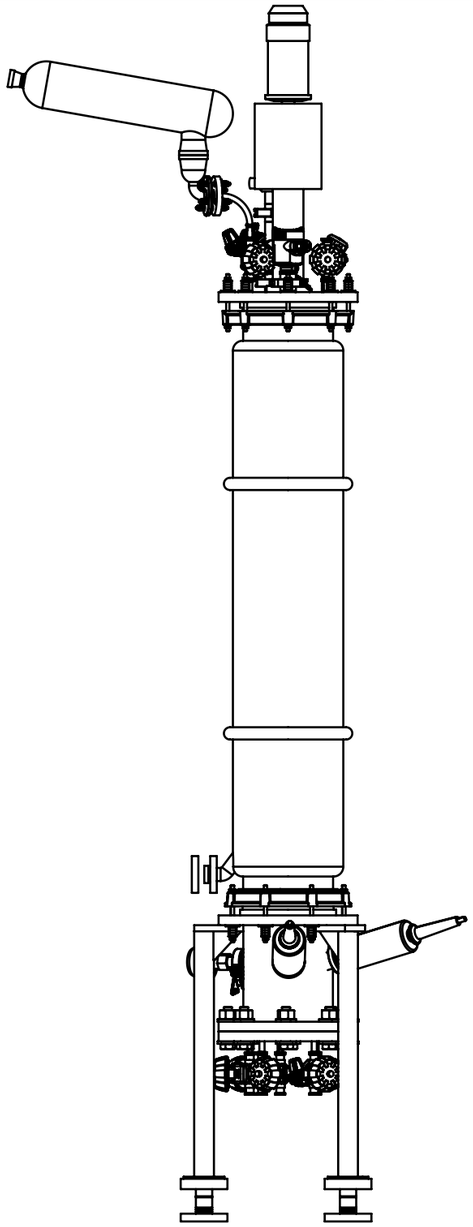
PROYECTO: MELiSSA - COMPARTMENT II

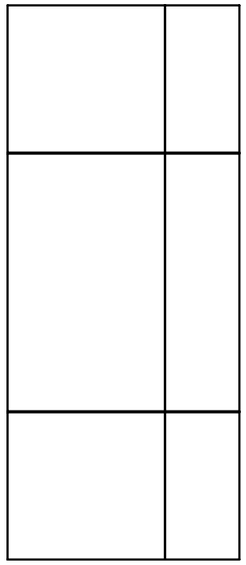
CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA

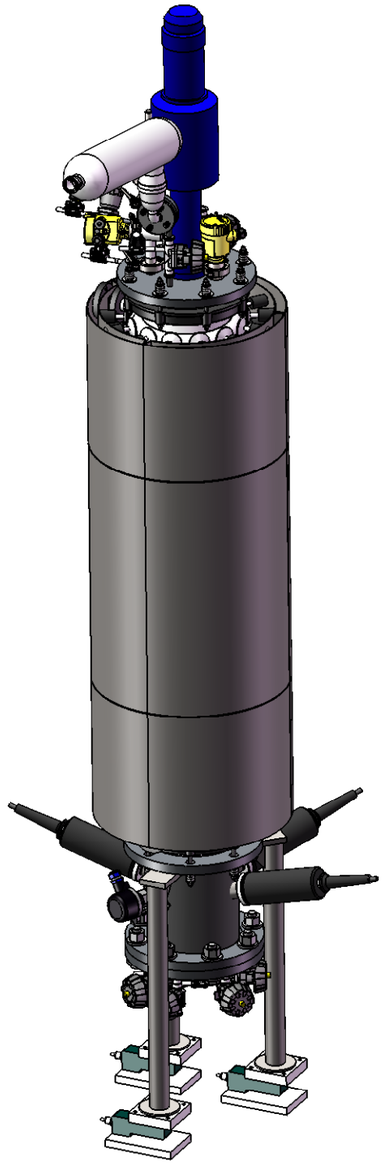
TITULO: MEDIA PREPARATION TANK

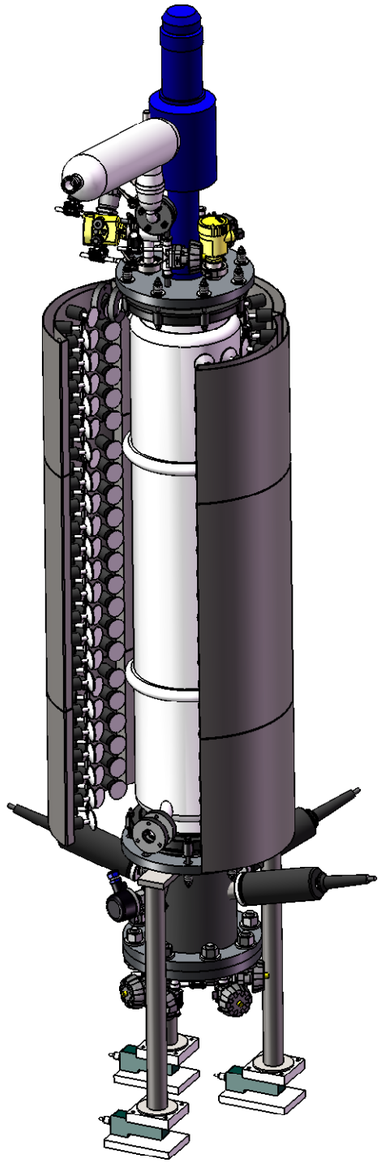
PLANO N° DD–8550–Z1–101–05 | Revisión B | Escala 1/10

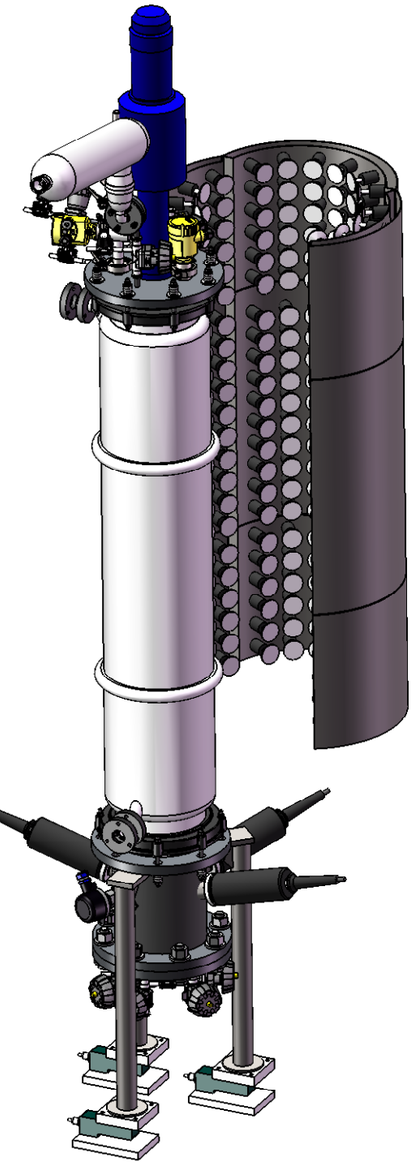
FORMATO: DIN A3

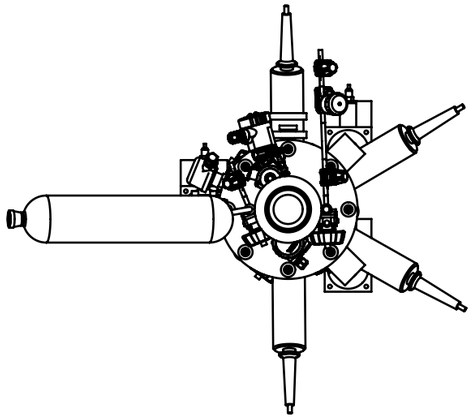


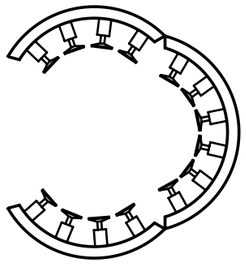












De Dietrich Equipos Quimicos, S. L.
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

De Dietrich PROCESS SYSTEMS

Dibujado	H.Pérez
Comprobado	J. Mestre
Fecha	04/06/2010
Referencia	PRK-5449

PROYECTO: MELISSA - COMPARTMENT II

TITULO: REACTOR LIGHTING SYSTEM

CLIENTE: **UAB** BARCELONA

PLANO Nº: DD-8550-Z1-101-06

Revision: A

Escala: 1:15

FORMATO: DIN A3

12. PROPOSAL UPDATE (AUGUST 2010)

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

EQUIPMENT LIST

EQUIPMENT

CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELISSA COMPARTMENT II	**DATE:**	04/08/2010	**PREPARED:**	J.GUBERN
DRAWING:	DD-8550-Z1-100-01 rev. I	**REV:**	B	**CHECKED:**	J. MESTRE

TAG	DENOMINATION	DESCRIPTION	SUPPLIER	OBSERVATIONS
R 2005 01 GP 2005 01	Photobioreactor	Bioreactor with mechanical agitation. Material: AISI 316L / jacketed glass	DDEQ	
IRC 2006 01	Lighting system	Bioreactor Lighting system. Portable structure of SS with 270 lamps.	DDEQ	
HX 2012 01	Condenser	Condenser for reactor outlet gases. Material: glass borosilicate 3.3	DDPS	Transfer area: 0,3 m^2
VS 2000 01 GP 2000 01	Feeding tank	Agitated tank in AISI 316L, provided with jacket for heating - cooling. Designed to operate at positive pressure. Magnetic driver		V=250 L
GP 2001 01 GP 2001 02	Feed pumps to reactor	Mettering pump in AISI 316 and PTFE membrane. Controlled by an electronic variator. Sterilizable.	LEWA	Required flow: 10 l/h P=20 bar
VS 2008 01	Acid vessel	Borosilicate glass vessel for acid addition	Fisher	V = 5 L
VS 2008 02	Alkali vessel	Borosilicate glass vessel for alkali addition	Fisher	V = 5 L
PP 2008 01	Acid pump	Peristaltic pump for acid dosing (pH control).	Watson Marlow	
PP 2008 02	Alkali pump	Peristaltic pump for alkali dosing (pH control).	Watson Marlow	
VS 2014 01 GP 2014 01	Harvesting tank	Agitated tank in AISI 316L, provided with jacket for heating - cooling. Designed to operate at positive pressure. Magnetic driver		V=250 L
GP 2015 01/02	Harvest pumps to reactor	Mettering pump in AISI 316 and PTFE membrane. Controlled by an electronic variator. Sterilizable.	LEWA	Required flow: 10 l/h P=20 bar
VS 2012 01	Discharge buffer	Buffer tank in AISI 316L for process gas		V=50 L
BLWR 2012 01	Compressor	Double membrane compressor in AISI 316 / PTFE for outlet gas flow compression	KNF	

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

EQUIPMENT LIST

EQUIPMENT

CUSTOMER:	Universitat Autònoma de Barcelona / MPP				
PROJECT:	MELISSA COMPARTMENT II	**DATE:**	04/08/2010	**PREPARED:**	J.GUBERN
DRAWING:	DD-8550-Z1-100-01 rev. I	**REV:**	B	**CHECKED:**	J. MESTRE

TAG	DENOMINATION	DESCRIPTION	SUPPLIER	OBSERVATIONS
HX 2007 01	Heat exchanger	Plate heat exchanger for water cooling with cool water (glycol)		Transfer area: 0,35 m^2
HX 2007 02	Heat exchanger	Plate heat exchanger for water cooling with hot water		Transfer area: 0,35 m^2
PP 2007 01	Circulation pump	Centrifugal pump for water loop (PBR temperature control)		Required flow: 3 m^3/h
VS 2007 01	Expansion vessel	Expansion vessel for water circuit. Material AISI 316.		V=10 L
HX 2012 02	Post-cooler	Sample gas cooler for sampling conditioning	Sick-Maihack	

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

CUSTOMER:	**UAB**		DATE	03/08/2010
PROJECT:	**MELiSSA - COMPARTMENT II**		REF.	
DRAWING:	**DD-8550-Z1**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		EQUIPMENT		
		New Foto-Bioreactor		**69.604,88 €**
		Agitation group: Electrical motor 0, 18 kW, nominal speed 250 (variable), shaft length: 1750 mm, double mechanical seal, 10 stages of axial turbines (impeller type) with 4 blades. ***Note: The agitator has been designed for being modificated if necessary. Modifications on the design are not included in this quotation.*	1	
		Jacketed pipe section DN200 L=1500 mm	1	
		Reactor bottom/top in AISI 316 with required nozzles	1	
		Lighting system and cabling (power cabinet included in supply and electrical assembling section)	1	
		Ingold connection and caps for required nozzles	1	
		Gas sparger	1	
		Others	1	
		Pre-assembly, package and transport	1	
		FAT's tests (tightness and agitation tests with water only)	1	3.466,67 €
		Spare part: Jacketed pipe section DN200 L=1500 mm	1	4.856,25 €
		Main gas condenser for the reactor 0,7 m^2 in borosilicate (M-HECH 80/7)	1	3.230,77 €
		Stainless steel tank 250 l with jacket, isolation and magnetic agitator	2	90.300,62 €
		Process gas buffer (50 l) in stainless steel	1	7.847,41 €
		Feeding and Harvesting pumps of liquid. Mod. Ecodos 0,55kW - Sanitary. Manufacturer: Lewa	3	10.237,50 €
		Acid and base pumps - Mod. 521Vi/R2C with freq. Variator. Manufacturer: Watson Marlow	2	3.525,00 €
		Gas compressor to discharge tank - Manufacturer: KNF (Double diaphragm)	1	4.656,25 €
		Vacuum pump for plant inertization (pump/filter/oil/others)	1	1.808,61 €
		Post cooler for gas analysis - Manufacturer: Sick Maihak	1	6.043,75 €
		Expansion vessel of reactor temperature control circuit	1	1.666,67 €
		Plate heat exchanger for heating/cooling reactor	2	6.622,52 €
		Circulation pump for reactor temperature control circuit	1	384,62 €
		Glass vessels 2 l capacity (acid and base)	2	270,00 €
		Exterior jacket for reactor refrigeration with air	1	2.533,33 €
		Transport and inspection of equipments	1	3.875,00 €
		TOTAL COST (EQUIPMENTS)		**220.930 €**
		SUPPLY AND MECHANICAL ASSEMBLING		
		Assembling of equipments. Construction and assembling of pipes and accessories/fittings	1	62.571,43 €
		Materials for pipes construction and accessories. Metalic support structure AISI 304.	1	41.600,00 €
		Platform . Structure in AISI304.	1	5.625,00 €
		Small modifications at assembling	1	4.375,00 €
		Orbital welding works	1	1.764,71 €
		Sterilizable gas filters - Manufacturer: Dominick Hunter	9	11.769,23 €
		Sterilizable liquid filters - Manufacturer: Dominick Hunter	7	7.107,69 €
		Filters for acid/base vents - Manufacturer: Dominick Hunter	2	350,77 €
		Filters (flow meters) - Manufacturer: HOKE	7	1.088,77 €
		Valves		
		Diaphragm valve 1/2"	47	10.480,37 €
		Diaphragm valves for argon inlet, steam inlet or condensate outlet	33	6.820,00 €
		Diaphragm valves 1/2" with steam inlet or condensate outlet valve	29	16.715,60 €
		Diaphragm valves 1/2" with double steam inlet valves	2	1.729,20 €
		Diaphragm valves 1" with condensate outlet valve	6	3.729,20 €
		Diaphragm valves 1 1/2" with steam inlet valve (feed/harvest tanks outlet)	2	1.413,33 €
		Ball valves 1/2"	22	6.776,00 €
		Ball valves 3/4"	6	1.973,36 €
		Ball valves 1"	12	4.720,00 €
		Ball valves 1/2" in PP	2	214,80 €
		Ball valves 1" in PP	2	270,13 €
		Diaphragm valves DN10 (gas filters purgue)	9	1.384,20 €

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

CUSTOMER:	**UAB**		DATE	03/08/2010
PROJECT:	**MELiSSA - COMPARTMENT II**		REF.	
DRAWING:	**DD-8550-Z1**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		Diaphragm valve 1/4" (liquid filters purgue)	7	728,00 €
		Sampling valve	3	5.413,60 €
		Check valves for liquids	2	1.006,00 €
		Check valves in PP (acid/base)	2	446,45 €
		Sanitary check valves for gases - FLUIVAL	2	392,80 €
		Check valves for gases (HOKE)	11	790,24 €
		Pressure reducing for gases with pressure indicator	8	384,00 €
		Safety Valves - Sanitary design	4	2.240,00 €
		Safety Valves	10	1.840,00 €
		Steam traps - Manufacturer: SARCO	9	1.944,00 €
		Other valves	1	1.933,33 €
		Certificates of materials 3.1B, FDA	1	1.062,50 €
		Partial dismantle and re-assembling in MPP	1	3.529,41 €
		Coordination of assembling works at field		
		Assembling coordinator	1	9.222,00 €
		Engineer supervision	1	3.125,00 €
		Diets and other expenses	1	777,78 €
		TOTAL COST (SUPPLY AND MECHANICAL ASSEMBLING)		**227.313,91 €**
		SUPPLY AND ELECTRICAL ASSEMBLIES		
		1-Electrical works		
		a) Power and control cabinet: See detail description in point 3.3 of quotation EXS-M0072 rev. 1	1	44.985,33 €
		b) Installation and electrical connection.	1	27.363,75 €
		c) Phoenix materials	1	8.550,00 €
		TOTAL COST (SUPPLY AND ELECTRICAL ASSEMBLING)		**80.899,08 €**
		INSTRUMENTS / FIELD CONTROL EQUIPMENTS		
		Level detector for feeding tank. Guided microwave type. Manufacturer: Vega	1	1.552,94 €
		Scales for acid/base vessels. RS232 Signal. Manufacturer: Mettler Toledo	2	1.588,24 €
		Differential pressure system for reactor level control (2 x presure transmitters and special connection)	1	2.401,53 €
		Scale for harvesting tank. Manufacturer: Mettler Toledo	1	3.880,00 €
		Foam detection system. Manufacturer: Charis	1	*excluded
		Biomass Analyzer, model InPro 8200 from Mettler Toledo	2	15.176,47 €
		Solved Oxygen analyzer. Manufacturer: Mettler Toledo	1	3.564,71 €
		pH Analyzer. Manufacturer: Mettler Toledo	2	10.176,47 €
		Redox Analyzer. Manufacturer: Mettler Toledo	1	3.518,82 €
		Outlet gas analyzer	1	*excluded
		Coriolis mass flowmeter for reactor liquid inlet. Manufacturer: E&H	1	5.764,71 €
		Gas flowmeter/regulation (3 x inlet gases, 2 x reactor total inlet gas, 1 x circulated gas)	6	10.588,24 €
		Gas flowmeter for the reactor outlet gases	1	1.342,35 €
		Pressure transmitter (1 x reactor, influent, effluent, buffer, gas analyzer, compresor)	6	5.261,79 €
		Differential Pressure transmitter for filters blockage detection	3	5.279,22 €
		Pressure switches with LCD indication	6	2.645,29 €
		Pressure switch for pump's membrane breakage detection	3	765,88 €
		Pressure gauge (lines, filters)	22	4.506,12 €
		Temperature transmitter for influent/effluent tanks, gas analyzer and condensate manifold	5	945,41 €
		Temperature sensor (PT-100) + transmitter for PBR	1	396,47 €
		Pod stainless steel for the temperature transmitters	1	235,29 €
		Proportional valve for PBR pressure control and compressor bypass	2	729,41 €
		Automatic diaphragm valves 1/2"	15	5.723,29 €
		Automatic ball valves	4	2.415,67 €
		Configuration and start-up for instruments that need it	1	2.117,65 €

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CUSTOMER:	**UAB**		DATE	03/08/2010
PROJECT:	**MELiSSA - COMPARTMENT II**		REF.	
DRAWING:	**DD-8550-Z1**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		Certificates of materials 3.1B, FDA	1	1.352,94 €
		Transport / inspection	1	1.171,76 €
		TOTAL (INSTRUMENTS /EQUPMENT OF CONTROL IN FIELD)		**93.101 €**
		OTHER CONCEPTS		
		GENERAL REVISION AFTER ASSEMBLING	1	2.266,67 €
		INSULATION (PIPES OF STEAM, CONDENSATE AND GLYCOL)	1	3.733,33 €
			COST	**6.000 €**
		DETAIL ENGINEERING + COMMISSIONING		
		DETAIL ENGINEERING (P&I´d definition, Lay-out, Detail drawings)		
		Technical designer	320	14.080,00 €
		Engineer	340	18.610,75 €
		Technical Manager	60	5.235,00 €
		Technical meetings with MPP for project advance control	40	2.250,00 €
		Paper work	1	1.750,00 €
		MANUAL AND FINAL DOSSIER		
		Technical designer	40	1.760,00 €
		Engineer	210	11.494,88 €
		Technical Manager	15	1.308,75 €
		Partial "As built"		
		Technical designer	60	2.640,00 €
		Engineer	40	2.189,50 €
		COMMISSIONING		
		(3.5.1.1) Mechanical FATs		
		Assembling coordinator	24	1.479,00 €
		Engineer	24	1.313,70 €
		(3.5.1.2) Electrical FATs		
		Engineer	24	1.313,70 €
		Electrical technician	40	1.750,00 €
		(3.5.2.1) Mechanical SATs		
		Assembling coordinator	120	7.395,00 €
		Engineer	120	6.568,50 €
		Mechanic official	120	4.500,00 €
		(3.5.2.2) Electrical SATs		
		Assembling coordinator	80	4.930,00 €
		Engineer	80	4.379,00 €
		Electrical technician	80	3.500,00 €
		(3.5.2.3) Communication comissioning		
		Engineer	40	2.189,50 €
		Electrical technician	40	1.750,00 €
		(4) Run test		
		Engineer	40	2.189,50 €
		Diets and other expenses	1	3.706,25 €
		CERTIFICATE FOR THE WHOLE INSTALLATION ACCORDING TÜV SPECIFICATIONS	1	6.250,00 €
		TOTAL COST (ENGINEERING)		**114.533 €**
		TOTAL COST OF THE PROJECT		**742.777 €**
		OPTIONAL:		
		MEDIA PREPARATION TANK:		
		Atmospheric stainless steel tank: 300 l with agitator	1	13.618,95 €
		Centrifugal pump to fill up feeding tank - Sanitary pump	1	1.666,67 €
		Electrical cabinet	1	3.312,82 €

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CUSTOMER:	**UAB**	DATE	03/08/2010
PROJECT:	**MELiSSA - COMPARTMENT II**	REF.	
DRAWING:	**DD-8550-Z1**	PREPARED	RdM

TAG	REF.	DESCRIPTION	QUANT.	COST
		Pressure switch with LCD indication	1	440,88 €
		Required manual valves	2	573,39 €
		Assembling works	1	971,43 €
		TOTAL COST (MEDIA PREPARATION SYSTEM)		**20.584 €**

De Dietrich
PROCESS SYSTEMS

OFERTA EXS-M0127 Rev. 2

PROPOSAL FOR THE SUPPLY OF MELiSSA PILOT PLANT COMPARTMENT C-II, INCLUDING: DETAIL ENGINEERING WORKS, EQUIPMENT SUPPLY, PLANT ASSEMBLY AND COMMISIONING OF THE UNIT

UAB / MELiSSA Pilot Plant
Mr. Francesc Gòdia
Barcelona, August 3th 2010

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INDICE

1.- SUBJECT AND ANTECEDENTS

The Universitat Autònoma de Barcelona, hereafter UAB, takes part in the MELiSSA Project of the European Space Agency (ESA) and the European Space Research and Technology Centre (ESTEC). The Project objective is to study and define parameters to achieve life conditions in the space during long journeys.

Included in this research project there is a pilot plant installed in the Departament d`Enginyeria Química de l'Escola Tècnica Superior d`Enginyeria (ETSE) of the UAB. This pilot plant is based in several compartments linked together in a close loop to process and recycle the ambient air, water, food and feces.

De Dietrich Equipos Químicos, hereafter DDEQ, was commissioned by the UAB for the basic designing of compartment C-II of the pilot plant, according to DDEQ quotation DDE-K1764-SI.

The present proposal EXS-M0127 Rev. 1 for the construction and delivery of the skid corresponding to compartment C-II, is based in the documentation and designs generated during this basic engineering project development, the Design Review conclusions during June 2.010 and MPP/ESA subsequent decisions.

The proposal includes the following concepts:

- Carry out the required detailed and constructive engineering works to build up the plant
- Delivery of all the materials, equipments and goods.
- Carry out the assembly (mechanical and cabling) of the plant
- Commissioning of the plant (DDEQ scope)
- Delivery of operation manual and technical dossier of the plant

2.- QUOTATION BASIS

To make this proposal the following documents (Data package) coming from the basic designing works of MELISSA – Compartment II Pilot Reactor, have been used:

P&ID Diagram DD-8550-Z1-100-01 Rev. I modified as per Basic Design Review conclusions based on meeting hold on June 7th, telecom hold on June 8th and mail from E. Peiro dated June 28th.

Control Loops Diagram DD-8550-Z1-100-02 Rev. F (not up-dated until constructive engineering)

Main Equipments list Rev. B

Valves, filters and accessories list Rev. A (not up-dated until constructive engineering)

Piping list Rev. A (not up-dated until constructive engineering)

Instruments list Rev. A (not up-dated until constructive engineering)

Motor list Rev. A (not up-dated until constructive engineering)

Main Equipments Technical Specification Rev. B

Instruments Specification Rev. A (not up-dated until constructive engineering)

Electrical & Control Signals List Rev. A (not up-dated until constructive engineering)

Nevertheless, it has to be understood that a Prototype Pilot Plant might have some uncertainties that will not be clarified until the start up of the unit, and agreed changes might be required at that stage.

3.- SCOPE OF SUPPLY

3.1.- Constructive Detail Engineering Contents

The Investment Budget has been calculated considering a Constructive Detail Engineering packet of 780h to execute the following works:

1. Definition and Execution of Final P&I'd.
2. Definition of utilities required and estimated consumptions.
3. Definition and Execution of Final Control Loops Diagram.
4. Final Lay-out drawing.
5. Final list of: Sensors, valves, lines and components.
6. Datasheets of sensors, valves and main equipments.
7. Constructive drawings of:
    - Liquid storage tanks and accessory vessels
    - Reactor
    - Lighting arrangement and supports
    - Frame, supports and skid
8. Sufficient drawings for the pipe assembly, including isometric drawing of process lines.
9. Final detailed control functional description.

As soon as this first Data package is ready it will be sent to MPP for revision and approval. Once the approval is received, the rest of the Detail Engineering will be carried out and the purchases orders to suppliers will star to be released.

At this stage MPP will deliver the detailed control functional description plus the sensor and motor list with their datasheets to the control supplier (Sherpa) to star working on the PLC definition and program, as well as the scada control screens.

A *"kick off meeting"* with the MPP´s control contractor will be held at the UAB in order to clarify all the information provided by DDEQ to this contractor in the Data Package with points 1 to 9 (sensor list, motor list, automatic valves list, data sheets, control loops definitions, and final detailed control functional description). The estimated duration of this meeting is about one day and will be held with project engineers involved in the project.

10. HAZOP Analysis over final lay-out and P&ID
11. Prepare the "Test Protocols" for DDEQ Test and Commissioning as per stated in point 3.5. The protocols will be agreed with MPP.
12. Electrical diagrams for the electrical cabinet. CE marking and legalization of the new cabinet.
13. CE marking and legalization of liquid storage tanks and buffer.
14. Machines and Equipment Security Evaluation, made by ICICT, S.A. (TÜV Rheinland Group), for a Pilot Plant module installed at the UAB facilities in Cerdanyola del Vallès.

    Like for the C-IVa module the notified body will do a Study over Machines and Equipment security based on:
    - R.D. 1215/97 about Minimum Security and Health Measures for the use of equipments.
    - R.D. 1495/86 about Safety in Machines

- UNE-EN norms of application

The notified body will execute the following works:

- Hazards identification
- Risk analysis according the hazards detected
- Consensus about safety technical solutions based on UNE-EN norms

Final conclusions report and Machinery Conformity / Non Conformity Certificate emission.

NOTE: The delivery of points 10-14 will be according the attached planning.

To assure the traceability and control over the design, DDEQ will implement a *"Design Changes Record"*. The objectives of this record are:

a. Assure traceability over design changes: date, problem detected, reason, decision, final change introduced, possible delays, cost.
b. Assure approval from both MPP and DDEQ.
c. Decision about who will take the cost of the change.

NOTE: This document will be prepared by DDEQ and shared with MPP for approval.

3.2.- Mechanical Turn-key supply of the compartment C-II

Mechanical turn-key supply of the mechanical and electrical equipment corresponding to the Compartment C-II of the Melissa Pilot Plant in accordance with the "Quotation basis" shown in point 2 and the Detail Engineering to be carried out according to point 3.1.

Previously to any purchase DDEQ will inform UAB which is the selected supplier or contractor. Should the UAB has any inconvenience regarding a supplier or contractor DDEQ will change to another one, unless this might have an economic impact on the project or cause a delay in the schedule.

Mechanical Erection and installation of the unit at DDEQ warehouse and UAB laboratories at Cerdanyola del Vallés

2 Copies of the final dossier

3.3.- Electrical supply for the compartment C-II

Following we provide a description of the power and control system that is foreseen for the for the compartment II of MELiSSA Pilot Plant.

Documents of reference:

- *Control Loops P&ID (DD-8550-Z1-100-02 rev. F)* (not up-dated until constructive engineering)
- *Electrical and control signals list rev. A* (not up-dated until constructive engineering)
- *Room Lay-Out (DD-8550-Z1-102-02 rev. 0)* (not up-dated until constructive engineering)

3.3.1.- Situation of the electrical cabinet

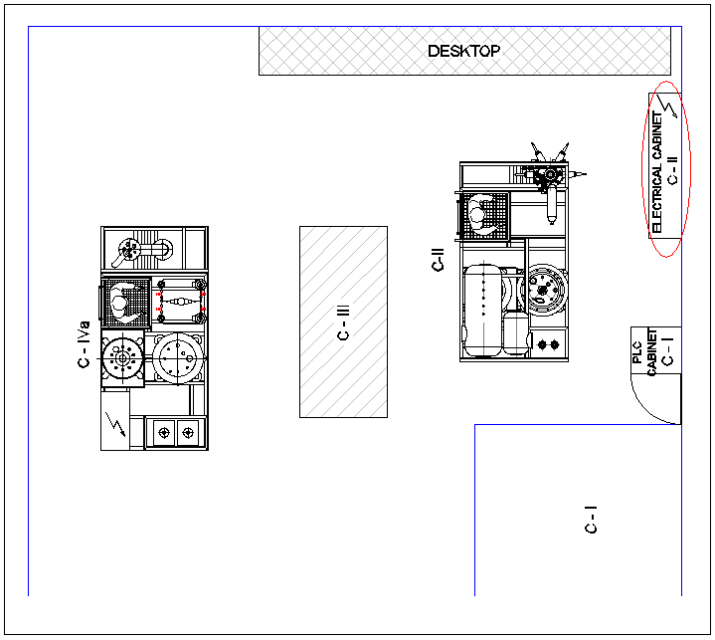
The electrical cupboards are foreseen by DDEQ out of the skid in order to save space in it and considering the room constraints.

MPP mentioned that the C-I PLC cabinet could be moved to the corner near the GC in order to have more space for the C.II skid (to be confirmed by NTE).

The designed electrical cabinet is 1800x2600x400 (height, width, depth) and it is conceptually divided in two different parts: power and control. By control we mean concentrate all the control signals from site instruments to the cabinet, to communicate with the main PLC and supervisor (delivered and programmed by others).

It can be physically divided too in order to be able to go through the pilot plant door.

The situation in the plant of the electrical cabinet is the next:



NOTE: For further details about dimensions *refer to Room Lay-Out (DD-8550-Z1-102-02 rev. 0) included in the ANNEX II of the Engineering dossier.*

3.3.2.- Power and control panel

Supply of power and control panel, dimensions 1800 height, 2600 width and 400 depth, mechanized, mounted, connected and with the following elements and devices:

1 Base panel and accessories
1 Mounting board
1 Cooper bar and accessories
1 Overvoltage protection Class D IEC 1024-1
1 Light switch “On service”
1 General switch
1 Main ground-fault protection and thermal-magnetic circuit breaker
1 Emergency stop push button
1 “Emergency stop activated” indicator (red led)
1 White light indicator “Voltage in”
1 Acknowledge push button
1 Security check push button
1 Safety relay PREVENTA
2 Power supply 24Vdc/10 A
1 Single ground-fault protection for all frequency converters

1 General ground-fault protection for all the instrumentation
1 DIMMER 3-phase to control lightning columns
1 Transformer 3-phase 5KVA
1 Single thermal-magnetic protection for 10 lightning columns
1 Current metering and 4-20mA conversion
1 DIMMER protection security circuit against low load in the output
1 RS232/Ethernet converter
1→ Wiring of the following control signals:

- 71 Digital inputs
- 52 Analogical inputs
- 49 Digital outputs
- 19 Analogical outputs

6 Galvanic isolators
1→ Set of thermal-magnetic circuit breakers
6 → Single-phase frequency converters 1,5KW
1 Set of Contactors
1→ Fan and filter
1 → Set of circuit breaker auxiliary switch
1 → Set of connection strips
1 → Elements and devices mounted and connected according CE directive
1 → Design, technical managing and documentation

IMPORTANT NOTES:

- **It is not foreseen the connection to the plant main power/pneumatic supply.**
- **All consumers will be equipped with ground-fault protection and thermal-magnetic circuit breaker.**
- **The material included in these lists is the necessary for the electrical and control signals according to the Basic Engineering Design and conclusions arose from the Design review done in June.**

3.3.3.- Electrical erection and commissioning of compartment C-II

The estimated materials which are required are:

- 20 m galvanized cable tray 60x60 mm (without cover).
- 20 m galvanized cable tray 300x60 mm (without cover).
- Trays mounting accessories.
- 160 m shielded cable 4x0,5 mm²
- 20 m blue shielded cable 8x0,5 mm²
- 250 m cable 4x0,5 mm²
- 200 m shielded cable 4x1,5 mm²
- 300 m shielded cable 3x1,5 mm²

- 250 m flexible conduit.
- 10 m heat-shrinkable tubing.
- Other connection and mounting accessories.
- Cable signalling.
- 100 m pneumatic tubing.
- 3 emergency stop pushbuttons.
- Other pneumatic accessories.

IMPORTANT NOTES:

- **If it is physically possible the power cables will be installed as separated as possible from the signal ones.**

3.3.4.- Photo-bioreactor Lighting system

The illumination system consists of 250-270 halogen lamps which surround the glass jacketed pipe section (DN200, L=1500m).

The type of lamps used will be the specified in the technical note 62.2 and are: OSRAM 12V, 20W BAB 38°.

3.3.5.- Lighting system structure

The lights will be set-up on a portable structure made of stainless-steel with 270 lamps of 20W 12V each, surrounded by a hybrid stainless steel – transparent plastic fairing, through which the cooling air can circulate.

It will include 2 or 3 connection boxes sited on the half height of the structure.

These boxes will receive the cables from the lamps to link in 2 o 3 cables all the power to the main electric panel.

3.3.6.- Phoenix material

Set of Phoenix materials:

- Analogical cable FLK 50/EX-DR/800
- Digital cable FLK 50/4X14/EZ-DR/800
- Interface modules VARIOFACE FLKM50/MOFI-TSX.
- Connectors PLC-V8/FLK14/OUT.
- Connectors PLC-V8/FLK14/IN.
- Relay PLC_RSP-24UC/21AU (24VDC).
- Plug-in bridges FBST 500-PLC BU
- Separating plates PLC-ATP-BK.

IMPORTANT NOTES:

- **We have included Phoenix Contact cables of 8 m. These cables will have in both sizes de connectors for flat cable BUT WILL NOT INCLUDE THE ADAPTERS TO CONNECT TO THE QUANTUM MODULES. These adapters must be supplied by the PLC cabinet manufacturer.**

3.4.- Manuals:

The manuals will be issued in English once points 1 to 9 of the Detail Engineering are approved by the MPP and while the module skid is pre-assembly in DDEQ´s warehouse. The Operation Manuals should be delivered to MPP the latest at the same time the pilot skid is installed in the UAB´s laboratories and the Technical Dossier no later than two months after the skid is installed.

3.4.1.- Operation Manual:

The Operation Manual will contain:

1. INTRODUCTION – SYSTEM DESCRIPTION
2. COMPONENT DESCRIPTION
3. PLANT CONTROL DESCRIPTION
4. PLANT SAFETY
5. GENERAL PROCEDURES
6. INSTALLATION START - UP
7. INSTALLATION SHUT - DOWN
8. NOMINAL OPERATION
9. SIP (STERILIZATION SEQUENCES)
10. SERVICE ON HARDWARE
11. PROCESS FOLLOW UP
12. CALIBRATIONS

3.4.2.- Technical Dossier

The Technical Dossier will contain

- Final P&I'd.
- Final Control Loops Diagram.
- Final Lay-out drawing.
- Constructive drawings of:
    - Liquid storage tanks and accessory vessels
    - Reactor
    - Lighting arrangement and supports
    - Frame, supports and skid
- Sufficient drawings for the pipe assembly, including isometric drawing of process lines.
- Final list of: Sensors, valves, lines and main equipments, and the corresponding Datasheets
- Final detailed control functional description.
- Electrical diagrams for the electrical cabinet. CE marking and legalization of the cabinet.

- CE marking and legalization of the liquid storage tanks.
- Welding controls and welding certificates for the storage tanks.
- Certificate issued by ICICT, S.A. (TÜV Rheinland Group) after the "Machines and Equipment Security Evaluation" for the Pilot Plant module installed at the UAB facilities in Cerdanyola del Vallès.
- Compilation of operation, maintenance manuals and technical documents provided by the different suppliers of the equipment installed in the plant. Whenever it is possible this information will be supplied in electronic format as well.
- Spare part list for two years operation

3.5.- Test and commissioning of the Pilot Unit

3.5.1.- FAT by DDEQ

3.5.1.1.- Mechanical

Once the skid is pre-assembled at DDEQ´s warehouse and before the shipment to UAB´s laboratories MPP will assist to FAT verification consisting in:

- Verify that final approved P&I´d diagram has been observed in the assembly
- Verify that the sensors, valves and equipments used are the specified ones according the project datasheets.
- Verify supports robustness.
- Test certificates and protocols filled up with the results.

NOTE: For the mechanical FAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1. At the end of mechanical FAT a record will be signed both by MPP and DDEQ and the shipment date to UAB´s laboratories will be agreed. The duration of this FAT test will be 2 or 3 working days.

No test with fluids will be included in the mechanical FAT as there are not such services at DDEQ´s warehouse.

3.5.1.2.- Electrical

The cabling of the C-II module will be executed at UAB premises. Therefore the Electrical FAT will focus only in the power and control cabinets delivered by DDEQ. This FAT will take place at DDEQ´s electrical contractor premises.

The Electrical FAT will consist in:

- Verify that all the sensors, automatic valves and equipments included in the P&I´d appears in the electrical diagrams.
- Verify that the electrical diagrams have been observed during the manufacturing of the cabinets.
- Test the power and control cabinets simulating the signals.
- Test the lighting system for the photo bio-reactor
- Test certificates and protocols filled up with the results.

NOTE: For the electrical FAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1, and tests will be done by DDEQ and electric

supplier. An electrical FAT record will be signed both by MPP and DDEQ and the shipment date to UAB´s laboratories will be agreed. The duration of this FAT test will be 3 working days.

3.5.2.- SAT by DDEQ

3.5.2.1.- Mechanical

The following tests have been considered for the plant commissioning based on a scheduled commissioning of fifteen (15) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Erection Manager (DDEQ)
- Mechanic official (DDEQ Contractor)
- MPP (permanent dedication of plant operator and technical staff)

The works to be done are:

- Pressure test with water for the liquid tanks and lines, as well as the reactor.
- Pressure test with compressed air of the Gas lines and buffers.
- Pressure test with steam of the steam and condensate lines. After that a resume of sterilization sequences will be done. Resume means:
  - Not waiting all the sterilization time required until the temperature is reached
  - Reactor, tanks and complete sections between reactor and tanks will be tested with steam during the accorded and defined time. Sequences for individual equipment will not be checked.
- Pressure test with water of the heating / cooling circuits of the jacketed equipment.
- Test certificates and protocols filled up with the results

NOTE: For the mechanical SAT commissioning of the pilot unit DDEQ will perform the tests using its own protocols, elaborated as per point 11 in paragraph 3.1. At the end of the mechanical SAT a record will be signed both by MPP and DDEQ.

3.5.2.2.- Electrical

The following tests have been considered for the plant commissioning based on a scheduled commissioning of ten (10) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Erection Manager (DDEQ)
- Electrical official (DDEQ Contractor)
- MPP (permanent dedication of plant operator and technical staff)

The works to be done are:

- Check of the spin direction of motors.
- Check the power supply to all the instruments.
- Check the output signals from the instruments to the cabinet.
- Check alarms contacts in the cabinet and signals to be sent to the PLC.
- Simulate PLC input signals from the cabinet to instruments and control valves.

- Test of the lighting system of the reactor and the air cooling equipment.
- Initial configuration (settings and range definition) of instruments and sensors with process parameters supplied by MPP to the control supplier. The optimization and fine adjustment of the settings will be responsibility of the MPP and therefore its implementation over the equipments on site.
- Test certificates and protocols filled up with the results.

NOTE: For the electrical SAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1 and tests will be done by DDEQ and electrical supplier. At the end of the mechanical SAT a record will be signed both by MPP and DDEQ.

3.5.2.3.- Communication commissioning

The communication commissioning will not be started until the mechanical and electrical commissioning (as per indicated in points 3.5.2.1 and 3.5.2.2) is finished and all the interconnecting cabling between DDEQ´s cabinet and the PLC cabinet (supplied by others) is done. The interconnecting cabling is also out from DDEQ´s scope.

The following tests have been considered for the plant commissioning based on a scheduled commissioning of five (5) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Project Engineer (Sherpa)
- MPP (permanent dedication of plant operator and technical staff)
- Electrical official (DDEQ Contractor + Sherpa Contractor)

The works to be done are:

- Verify the arrival of the inputs signal from DDEQ´s cabinet to the PLC cabinet
- Verify the arrival of PLC commands to DDEQ´s cabinet
- Verify consistency in the measurements in the onsite instruments with the PLC lectures.

We do not include any verification about the control loops program stability or performance, which is fully responsibility of the control supplier.

NOTE: For the electrical communication commissioning of the pilot unit DDEQ will use Sherpa´s protocols. At the end of the electrical communication commissioning a record will be signed by MPP, SHERPA and DDEQ

At the conclusion of all the Test and Commissioning process as stated in points 3.5.1 and 3.5.2 a “Pilot Unit Acceptance Document” will be signed between MPP and DDEQ. From that moment, the risk and responsibility of the unit will be transferred to MPP, being then authorized to operate the plant alone or with other suppliers. At the same time, the guarantee period of twelve (12) months will start.

For further assistance or more extensive test and checks DDEQ will provide in point 6 “Price and Payment conditions” a daily net rate for engineers and technicians.

4.- RUN TEST OF THE MODULE

As an additional service to MPP, DDEQ is ready to assist to a complete run test of the pilot module when the control supplier has finalized the delivery and test of its scope of supply.

We have considered the assistance during five (5) working days of our Project Engineer to help MPP staff during the integration under operation of the control with the hardware.

Leadership and execution of the Run Test is MPP responsibility and our task is to resolve doubts and give advices during the Trials. We will also take care of failures of the hardware but not accept any responsibility because of misuse, (in manual or automatic operation), of the hardware.

If additional presence over the five (5) foreseen days is required DDEQ will charge MPP according the rates indicated in point 6 "Price and Payment conditions".

5.- EXCLUSIONS

The following services and works have not been taken into account in the present quotation and, therefore, are explicitly exclude of the scope of supply:

- Mechanical connections to UAB utilities nets (steam, air, CO_2, water,…)
- Fan, filter and coolant battery for the lighting cooling system. Its installation (air tubes to the side of the C-II skid) and electrical connection (cabling to our cabinet) is not included. **The electrical maneuver will be in our cabinet and the control ins Sherpa´s scope.**
- Gas analyzer connection different of what was implemented in Module C-IVa. If additional requirements are demanded by MPP DDEQ will implement a Design change in the ***"Design Changes Record"*** as indicated in point 3.1.
- Electrical interconnecting cabling from DDEQ´s electrical cabinet for compartment C-II and the PLC cabinet, and from the PLC cabinet to the control room computer. Neither the main power supply from UAB´s general line to DDEQ´s cabinet is included.
- Carrying out the control commissioning neither commissioning of the PLC program and the supervisor system implemented in the control room computer. The operation manual of these elements is also out of our scope.
- Changes over design as per MPP Hazop analisys. If additional requirements are demanded by MPP DDEQ will implement a Design change in the ***"Design Changes Record"*** as indicated in point 3.1.
- Plant star-up with process fluids.
- Plant validation and/or qualification.
- Further engineering works, out of what is clearly stated in the present proposal, as per example:

  Note: If any or the following works/tasks (or other not listed here) is required by the UAB, they will be invoiced separately accordingly to the "Daily rates" shown in point 5.2

  - Isometric drawings of the pipes but the process ones.
  - Engineering works to accommodate UAB facilities or utilities to the requirements of the unit (connections, modifications in services nets,...)
  - Drawings "as built" of the equipment showing the changes implemented over the approved detail constructive project.

    Note: A revised version of the P&I´d drawing will be released free of charge, including all the changes, modifications and extension works implemented during the erection or commissioning of the equipment. In the same way, addendums over the manuals will be released to show **important changes** over the approved detail constructive project.
  - Control Commissioning of the plant.
  - Engineering works to assure the right integration of the different modules of the Melissa loop.
  - Environmental engineering concerning liquid or gaseous effluents

- Edition of Plant Operation Protocols for the field Operator
- Edition of Operational Emergencies and Alarms Management Protocol
- Edition of Sensor and Instrument Calibration Protocol
- Any legalization or CE marking of the pilot unit exceeding the Study over Machines and Equipment security edited by ICICT, S.A. (TÜV Rheinland Group)
- External sub-supplier management outside the scope of supply of the unit described in this proposal

- Official or legal projects, if necessary or required, as per example: Pressure Equipment Installation Project, Low Voltage Project, ….
- Further assistance services, out of what is clearly stated in the present proposal, as per example:
  - Commissioning of the equipment with real process fluids.
  - Validation of the unit
  - Once the commissioning phase is finished:
    - Optimization of the initial Control Settings and Alarm Set Points
    - Optimization of the Maintenance sequences and Cleaning instructions
  - Others

6.- PRICE AND PAYMENT CONDITIONS

6.1.- Price of the plant

The price of the Pilot Unit corresponding to Compartment C-II of the Melissa Pilot Plant according to the base equipment described in the Budget Rev. 2 included as Attachment 1 is:

NET PRICE (VAT excluded): -.742.777€.-

The tank for media preparation and its electrical cabinet, pump, required instrumentation and manual valves as well as the assembling of this set has been quoted separately. The price for this system, according to the base equipment described in the Budget Rev. 2 included as Attachment 1 is:

NET PRICE (VAT excluded): -.20.584€.-

Note: The above price is a "**fix price**" according to *"2.- Quotation Basis"*, that will allow the UAB/MPP to place an order to DDEQ in order to fulfill the required delivery schedule. If during the constructive detail engineering the **relevant changes in the design appear** they will be reflected in the ***"Design Changes Record"*** and the economic impact must be agreed between both parties.

6.2.- Daily rates for special assistance or test

Any further assistance, out of what is clearly stated in points 3.1 and 3.5 of this quotation, required by the MPP both, during the detail engineering (coordination with control engineering, other suppliers,…) or during the commissioning of the plant, will be invoiced according to the following daily rates:

Project Engineer (mechanical or electrical/control):	740 €/day
Assembling coordinator:	560 €/day
Mechanic:	485 €/day
Electrician:	485 €/day

Travel expenses:	According to destination

6.3.- Order and Payment conditions

DDEQ proposes the following payment conditions:

20% down payment with the order, payment at 90 days after invoicing

30% at delivery of points 1 to 9 of the Detail Engineering as stated in point 3.1, payment at 90 days after invoicing

25% at conclusion of mechanical FAT test as stated in point 3.5.1.1, payment at 90 days after invoicing

10% at conclusion of electrical FAT test as stated in point 3.5.1.2, payment at 90 days after invoicing

5% at delivery of manuals as stated in point 3.4.1, payment at 90 days after invoicing.

5% at conclusion of the equipment installation at the UAB facilities at Cerdanyola del Vallès, payment at 90 days after invoicing

5% at the conclusion of the SAT commissioning as stated in point 3.5.2, payment at 90 days after invoicing.

7.- PROPOSAL VALIDITY

This proposal is valid for a period of two natural months.

8.- PROJECT PLANNING

In practice the development of the Project will be mainly influenced by UAB/MPP final purchasing decision and the administrative delays in order to place the order and contract writing. Also delays in intermediate approvals will cause a longer delivery time for the skid.

Assuming an optimal schedule in the development of the project, the schedule would be as shown in the annex.

9.- GUARANTEE

DE DIETRICH EQUIPOS QUÍMICOS S.L., guarantees for one (1) operation year, against manufacturing defects or material failures, all the equipment supply and the erection and assembly works executed by its contractors. The guarantee applies only to the repair or the reposition of the defect element or equipment, once the defect is verified, checked and accepted as guarantee issue.

Elements subjected to wear and/or ageing are not covered by the present guarantee. For example (but not limited) mechanical seals, measurement probes, joints,...Neither is covered negligence in the operation of the equipment and normal maintenance or cleaning operations over the equipment, as well as, accidental failures of the unit.

As mentioned before, the guarantee covers only the repair / replacement of the damaged/defect equipment. No other service or compensation is covered. For third party components or equipments, if any, the guarantee will be provided by the manufacturer.

10.- GENERAL PROJECT CONDITIONS AND LIABILITY LIMITATION

- The works covered under this proposal will be considered finished as soon as the commissioning tests stated in point 3.5 are finished satisfactorily and the "Pilot Unit Acceptance Document" is signed between MPP and DDEQ.

- Design will be implemented under the guidelines and process requirements provided by the UAB, and according to the good engineering practices known by DDEQ.
- A design review was conducted in June 2.010 to verify that the basic design elaborated fulfills the Technical Requirements (MPP/TN/2005/01 Version 1) and the Technical Note 62.2 edition 1. Some changes emerged from that review agreed between MPP and DDEQ and a new P&I´d version has been released, being the main basis for the current proposal. **Again, it has to be understood that a Prototype Pilot Plant might have some uncertainties that will not be clarified until the real start up of the unit, and agreed changes might be required at that stage.**
- The engineering works executed by DDEQ, and consequently equipment supply, do not mean that DDEQ has any liability in case the throughout put of the unit is less or different from the foreseen one. Process responsibility is charge of the MPP.
- DDEQ will not accept any liability for direct or indirect damages causes without the intention to harm as per example: production looses, third part claims, prestige looses, overall project delays,… DDEQ will not be responsible either for defects or damages arising from wrong or incomplete information delivered by the UAB/MPP.
- The MPP will designate a main interlocutor to evacuate through all the correspondence, question, doubts,..The same person will concentrate all the information and questions from the MPP to DDEQ.

11.- CONFIDENTIALITY

All documents, data and information of the Project shared between MPP and DDEQ will be considered as confidential unless it is explicitly agree between both parts, is of public domain at the date of signing the contract or its use is necessary for the normal development of the project (inquiries or contracts to suppliers or contractors).

12.- ANNEX

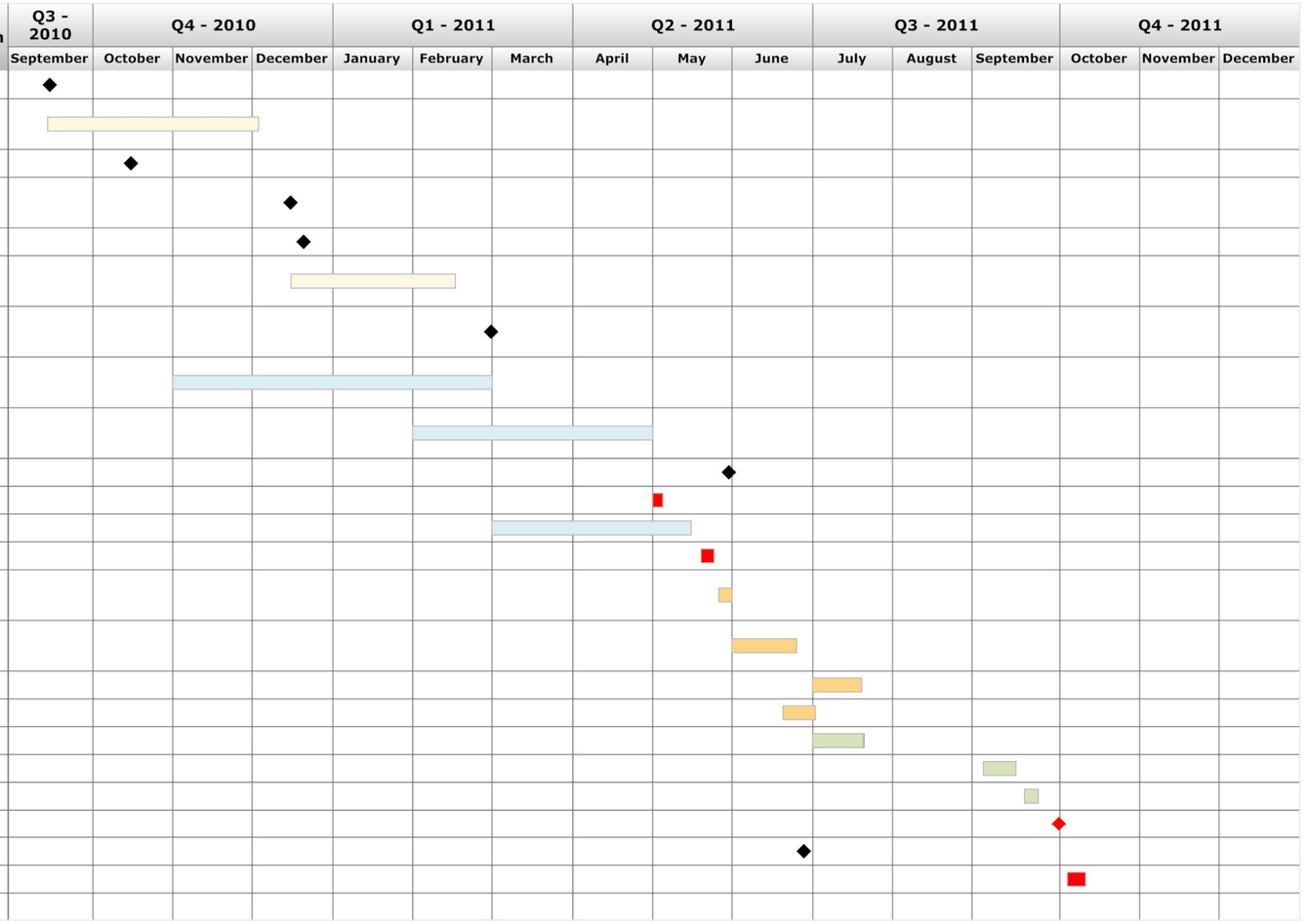
Investment Budget Rev.1

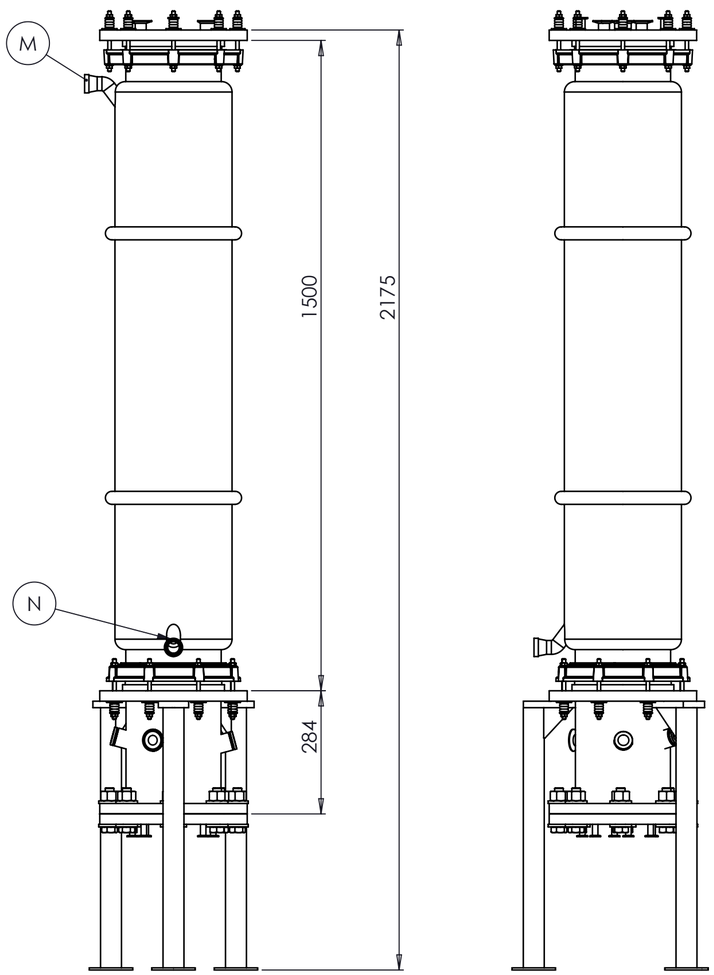
Project planning

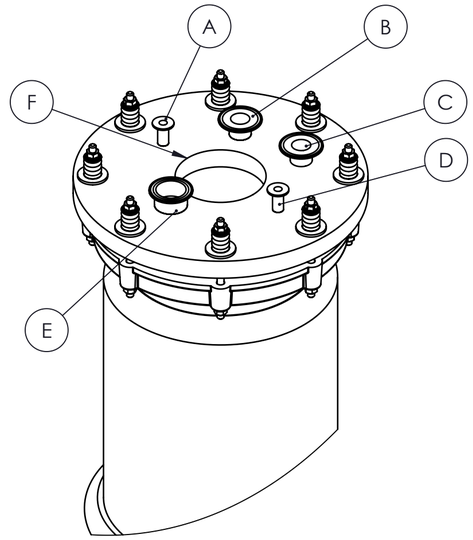
Barcelona, July 29th 2010
DE DIETRICH Equipos Químicos, S.L

Fdo. Roberto de Miguel Managing Director	Fdo. Josep Mestre Technical manager

Number	Task	Start	End	Duration
1	Order	15/9/2010	15/9/2010	1
2	Constructive Detail Design (CDD): Points 1 to 9	15/9/2010	3/12/2010	58
3	Approval Final P&Id	15/10/2010	15/10/2010	1
4	Approval Data package of CDD: Points 1 to 9	15/12/2010	15/12/2010	1
5	Kick off meeting with SHERPA	20/12/2010	20/12/2010	1
6	Constructive Detail Design (CDD): Points 10 to 13	16/12/2010	15/2/2011	44
7	Approval Data package of CDD: Points 10 to 13	28/2/2011	28/2/2011	1
8	Instruments & Equipments purchases and reception	1/11/2010	28/2/2011	86
9	Mechanical assembly at DDEQ warehouse	1/2/2011	30/4/2011	64
10	Manuals delivery	30/5/2011	30/5/2011	1
11	Mechanical FAT test	1/5/2011	4/5/2011	3
12	Electrical cabinets manufacturing	1/3/2011	15/5/2011	54
13	Electrical FAT test	20/5/2011	24/5/2011	3
14	Delivery of mechanical and electrical equipment to UAB laboratory	27/5/2011	31/5/2011	3
15	Complete assembly and cabling of the skid	1/6/2011	24/6/2011	18
16	Interconnecting cabling to PLC by UAB	1/7/2011	19/7/2011	13
17	Utilities connection by UAB	20/6/2011	1/7/2011	10
18	Mechanical SAT test	1/7/2011	20/7/2011	14
19	Electrical SAT test	5/9/2011	16/9/2011	10
20	Communication commissioning	19/9/2011	23/9/2011	5
21	Pilot Unit Acceptance Document	30/9/2011	30/9/2011	1
22	Call out to TÜV to execute CCD Point 14	27/6/2011	27/6/2011	1
23	RUN TEST OF THE MODULE	4/10/2011	10/10/2011	5

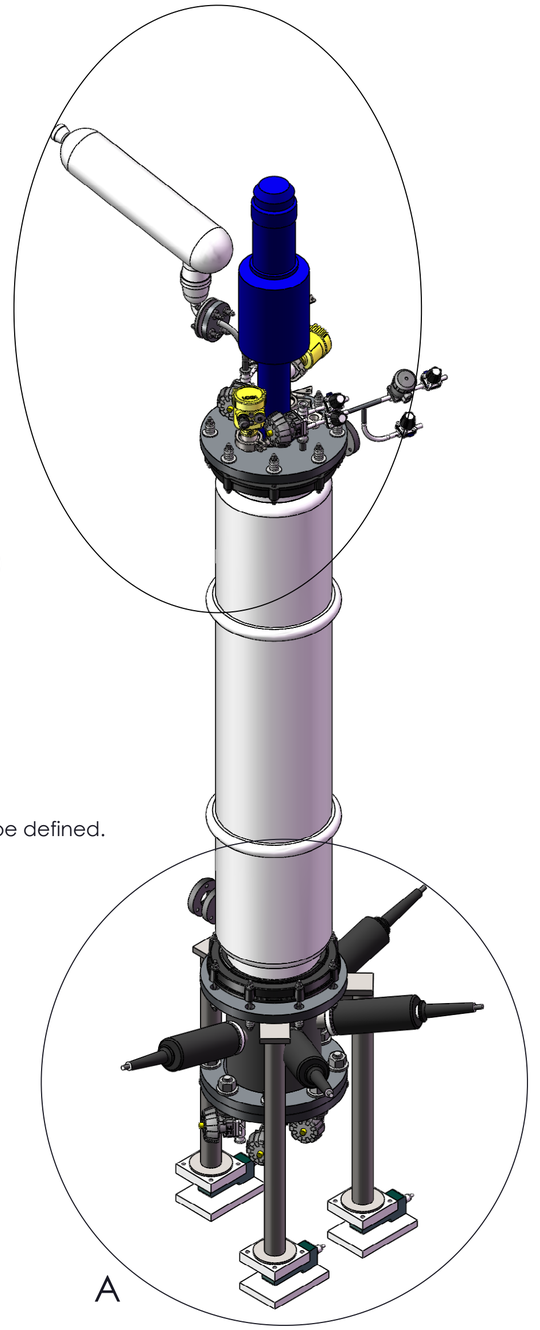






DETALLE B
ESCALA 1 : 5

B



A

REACTOR TOP / BOTTOM:

- **Top/Bottom:** DN200 Flange, PN10
- **Material:** ASTM - 316 L
- **Internal Roughness:** <0,5 mm
- **External Roughness:** Mirror Polish
- **Design Conditions:** -1/1,5 bar (180ºC)

VESSEL:

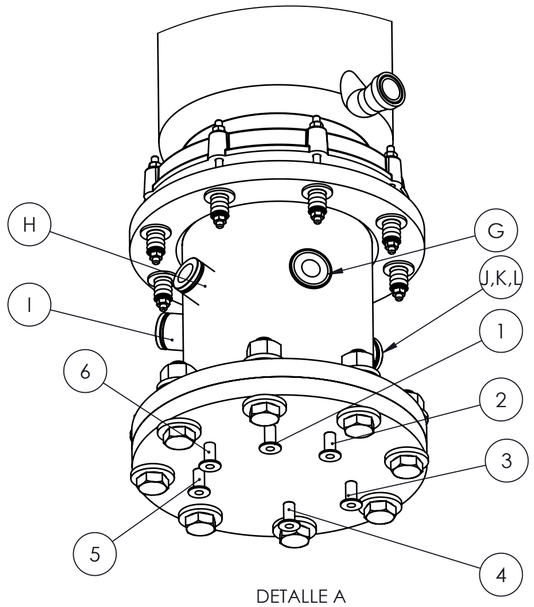
- DN200×1500 DN200 Jacketed Glass

REQUIRED NOZZLES:

TOP
A → ½" Imperial Clamp
B → 1½" Imperial Clamp
C → 1½" Imperial Clamp
D → ½" Imperial Clamp
E → 1" Imperial Clamp
F → Agitation device connection. To be defined.

BOTTOM
1 - 6 → ½" Imperial Clamp
G → 1" Ingold
H → 1" Ingold
I → 1" Ingold
J → 1" Ingold
K → ½" Imperial Clamp
L → 2" Imperial Clamp

JACKET
M → Outlet, DN25 QVF Glass
N → Inlet, DN25 QVF Glass



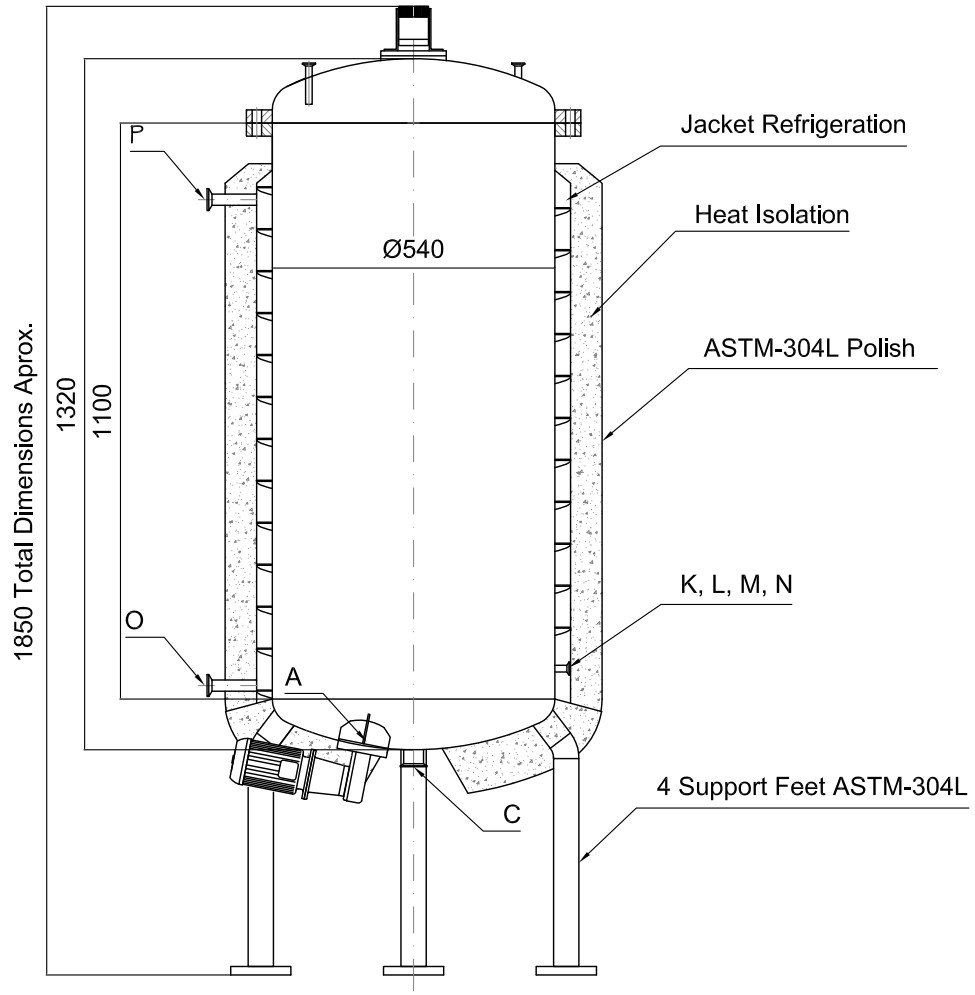
DETALLE A
ESCALA 1 : 5

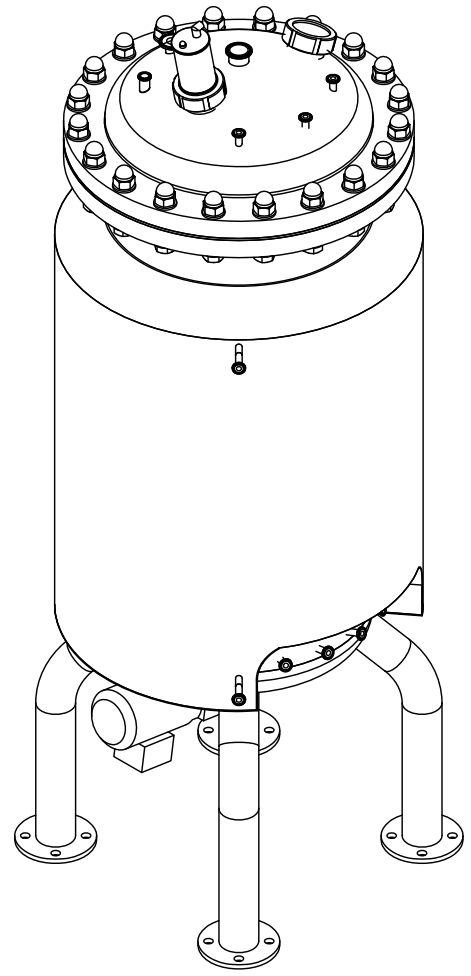
De Dietrich Equipos Quimicos, S. L. Av. Princep d'Asturies 43-45, 1r-5a E-08012 BARCELONA	Dibujado: H.Pérez Comprobado: J. Mestre Fecha: 23/12/2009 Referencia: PRK-5449
PROYECTO: MELiSSA - COMPARTMENT II	CLIENTE: **UAB** BARCELONA
TITULO: REACTOR R 2005 01	
PLANO Nº: DD-8550-Z1-101-01 — Revision: B	Escala: 1:10

FORMATO: DIN A2

Rev.	Nota de revisión	Fecha	Dib.	Verif.
B	Modificaciones según especificaciones	04/05/2010	H.Pérez	J.Mestre

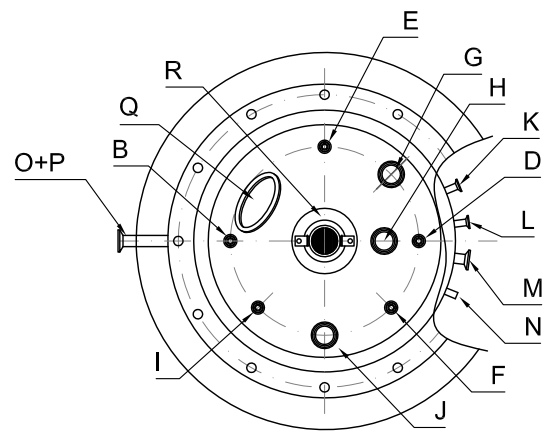
Imagen para idea general y tipo de acabados





Vista tridimensional Aproximada

TUBULADURAS			
Ref	Descripción	Tamaño	Ubicación
A	Agitador Magnético	Stermixer SMO	Fondo Inferior
B	Entrada Líquido	1" Clamp	Fondo Superior
C	Salida Líquido	1½" Clamp	Fondo Inferior
D	Salida Gas (venteo)	1" Clamp	Fondo Superior
E	Entrada Gas	1" Clamp	Fondo Superior
F	Válvula de Seguridad	1" Clamp	Fondo Superior
G	Transmisor de Presión	1½" Clamp	Fondo Superior
H	Transmisor de Nivel o Libre	1½" Clamp	Fondo Superior
I	Manómetro	1" Clamp	Fondo Superior
J	Libre	1½" Clamp	Fondo Superior
K	Transmisor de Temperatura	1" Clamp	Virola
L	Toma Muestras	1" Clamp	Virola
M	Libre	1½" Clamp	Virola
N	Libre	1" Ingold	Virola
O	Entrada Servicio	1" Clamp	Camisa
P	Salida Servicio	1" Clamp	Camisa
Q	Mirilla	NWGS	Fondo Superior
R	Mirilla + proyector	NWGS	Fondo Superior



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Volumen: 250l
-Tipo de agitador: Magnético Tipo Sterimixer (SMO) incluido en oferta
-Luz y mirilla icluidas en el depósito.
-Acabado Interior: Pulido<0.5 micras
-Acabado Exterior: Pulido Espejo
-Aislamiento Térmico: Lana de roca, acabado exterior ASTM-304L Gr320
-Condiciones de diseño:
- Cuerpo: -1/+6 bar a 170ºC
- Envolvente: -1/+6 bar a 170ºC
-Soporte para placa de características
-Cantidad: 2 Unidades

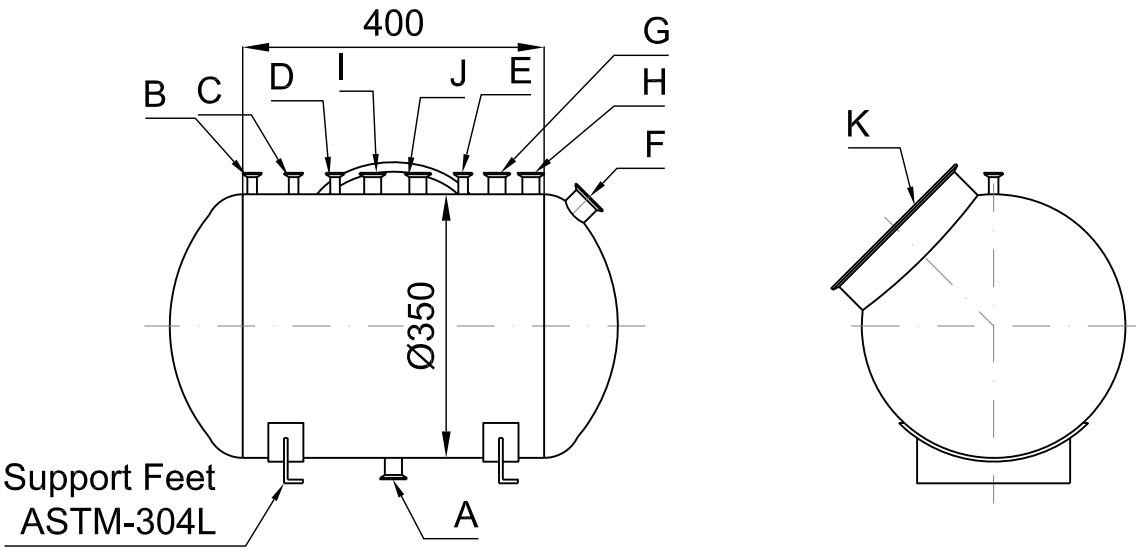
De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Princep d'Asturles 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK–5449

PROYECTO: MELiSSA - COMPARTMENT II
CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA
TITULO: TANKS VS 2000 01 & VS 2014 01
PLANO Nº: DD–8550–Z1–101–02
Revisión: B
Escala: 1/10

FORMATO: DIN A2

Rev.	Nota de revisión	Fecha	Dib.	Verif.
B	Modificaciones según especificaciones	04/05/2010	H.Pérez	J.Mestre



Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: -1 / 4 barg
-Volumen: 50l
-Acabado Interior: Pulido<0.5 micras
-Acabado Exterior: Pulido Espejo
-Temperatura: 20º
-Soportación: Mediante 2 cunas de ASTM-304L
-Soporte Placa Características
-Cantidad: 1 Unidad

TUBULADURAS

Ref	Descripción	Tamaño	Ubicación
A	Purga Líquido	1" Clamp	Fondo Inferior
B	Entrada Gas Proceso	½" Clamp	Fondo Superior
C	Salida Gas a Proceso	½" Clamp	Fondo Superior
D	Venteo	½" Clamp	Fondo Superior
E	Entrada Helio	½" Clamp	Fondo Superior
F	Transmisor de Presión	1½" Clamp	Fondo Superior
G	Manómetro	1" Clamp	Fondo Superior
H	Válvula de Seguridad	1" Clamp	Fondo Superior
I	Libre	1" Clamp	Fondo Superior
J	Libre	1" Clamp	Fondo Superior
K	Boca de Limpìeza		

De Dietrich Equipos Químicos, S. L.
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Member of De Dietrich PROCESS SYSTEMS

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II

CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA

TITULO: TANK VS 2012 01

PLANO Nº: DD-8550-Z1-101-03

Revisión: B

Escala: 1/10

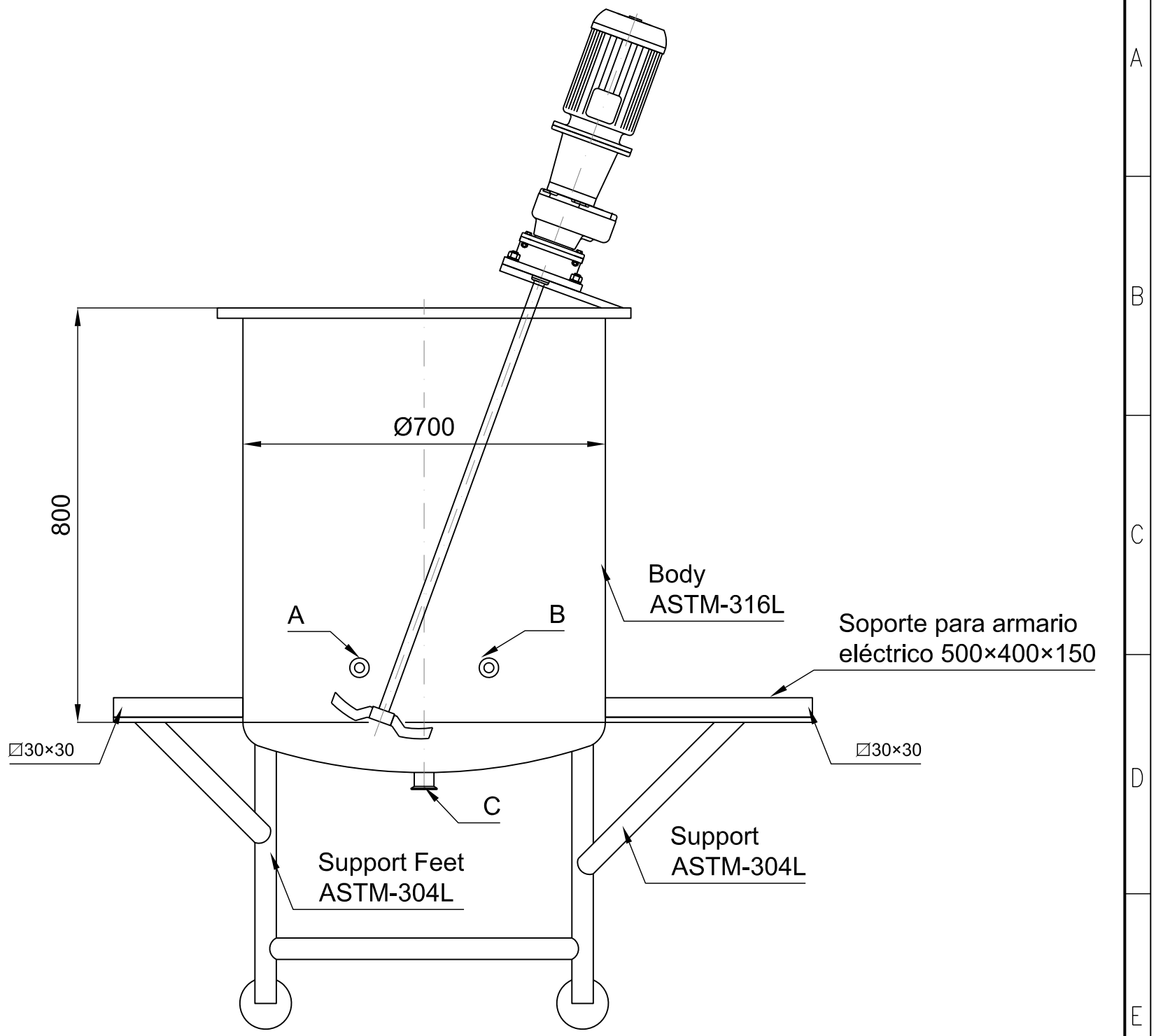
FORMATO: DIN A4

Rev.	Nota de revisión	Fecha	Dib.	Verif.
B	Modificaciones según especificaciones	04/05/2010	H.Pérez	J.Mestre

Características:

-Material: ASTM-316L (Cuerpo y contacto producto)
-Presión de trabajo: Atmosférico
-Volumen: 300l
-Agitador: Convencional Tipo Turbina
-Acabado Interior: Pulido<0.5 micras
-Acabado Exterior: Espejo
-Temperatura: Ambiente
-Soporte para placa de características
-Soportación: Mediante 4 patas con ruedas (2 con freno)
-Cantidad: 1 Unidad

TUBULADURAS			
Ref	Descripción	Tamaño	Ubicación
A	Libre	1" Clamp	Lateral
B	Libre	1" Clamp	Lateral
C	Descarga Líquido	1½" Clamp	Fondo Inferior



De Dietrich Equipos Químicos, S. L. Member of De Dietrich PROCESS SYSTEMS
Av. Princep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	H.Pérez
Comprobado	J.Mestre
Fecha	18/01/2010
Referencia	PRK-5449

PROYECTO: MELiSSA - COMPARTMENT II

CLIENTE: UNIVERSITAT AUTÓNOMA DE BARCELONA

TITULO: MEDIA PREPARATION TANK

PLANO N° DD-8550-Z1-101-05 | Revisión B | Escala 1/10

FORMATO: DIN A3

Rev.	Nota de revisión	Fecha	Dib.	Verif.

WATER RACK
HELIUM RACK
STEAM RACK
HV XXXXX
SV XXXXX

VACUUM BREAKING SYSTEM
ARGON INLET
TO ARGON INLET VALVES
STEAM INLET

OPTIONAL: MEDIA PREPARATION TANK

VS 2012 01
BLWR 2012 01
FUTURE ANALYZER
STEAM INLET
INOCULUM / ANTIFOAM
ATM
HELIUM INLET
C III
CO2 INLET
ARGON INLET

VS 2000 01
Feeding Tank
SERVICE AIR INLET
GLYCOL OUTLET
GLYCOL INLET

R 2005 01
IRC 2006 01
VS 2014 01
Harvesting Tank
SERVICE AIR INLET
GLYCOL OUTLET
GLYCOL INLET
LIQUID OUTLET

VS 2007 01
PP 2007 01
HOT WATER OUTLET
HOT WATER INLET
GLYCOL OUTLET
GLYCOL INLET
WATER INLET
HCl INLET
HCl OUTLET

PP 2008 01
PP 2008 02
VS 2008 01
ACID VESSEL
VS 2008 02
BASE VESSEL
BASE INLET
ACID INLET
Filter & Grille

CONDENSATE MANIFOLD

REACTOR AIR REFRIGERATION SYSTEM

PLANT INERTIZATION SYSTEM
VACUUM PUMP
VENT

De Dietrich Equipos Químicos, S. L. Member of De Dietrich Process Systems
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

Dibujado	D.Tolsy
Comprobado	J.Mestre
Fecha	23/09/2009
Referencia	PRK--5449

PROYECTO: MELiSSA - COMPARTMENT II
CLIENTE: UNIVERSITAT AUTONOMA DE BARCELONA
TITULO: P&ID DIAGRAM
PLANO Nº: DD-8550-Z1-100-01
Revisión: I
Escala: ---

FORMATO: 10514594

13. PROPOSAL UPDATE (OCTOBER 2010)

De Dietrich Equipos Químicos, S.L.
Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

CUSTOMER:	**UAB**		DATE	30/09/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		EQUIPMENT		
		New Foto-Bioreactor		**69.604,88 €**
		Agitation group: Electrical motor 0, 18 kW, nominal speed 250 (variable), shaft length: 1750 mm, double mechanical seal, 10 stages of axial turbines (impeller type) with 4 blades. ***Note: The agitator has been designed for being modificated if necessary. Modifications on the design are not included in this quotation.*	1	
		Jacketed pipe section DN200 L=1500 mm	1	
		Reactor bottom/top in AISI 316 with required nozzles	1	
		Lighting system and cabling (power cabinet included in supply and electrical assembling section)	1	
		Ingold connection and caps for required nozzles	1	
		Gas sparger	1	
		Others	1	
		Pre-assembly, package and transport	1	
		FAT's tests (tightness and agitation tests with water only)	1	3.466,67 €
		Spare part: Jacketed pipe section DN200 L=1500 mm	1	4.856,25 €
		Main gas condenser for the reactor 0,7 m^2 in borosilicate (M-HECH 80/7)	1	3.230,77 €
		Stainless steel tank 250 l with jacket, isolation and magnetic agitator	2	90.300,62 €
		Process gas buffer (50 l) in stainless steel	1	7.847,41 €
		Feeding and Harvesting pumps of liquid. Mod. Ecodos 0,55kW - Sanitary. Manufacturer: Lewa	3	10.237,50 €
		Acid and base pumps - Mod. 521Vi/R2C with freq. Variator. Manufacturer: Watson Marlow	2	3.525,00 €
		Gas compressor to discharge tank - Manufacturer: KNF (Double diaphragm)	1	4.656,25 €
		Vacuum pump for plant inertization (pump/filter/oil/others)	1	1.808,61 €
		Post cooler for gas analysis - Manufacturer: Sick Maihak	1	6.043,75 €
		Expansion vessel of reactor temperature control circuit	1	1.666,67 €
		Plate heat exchanger for heating/cooling reactor	2	6.622,52 €
		Circulation pump for reactor temperature control circuit	1	384,62 €
		Glass vessels 2 l capacity (acid and base)	2	270,00 €
		Exterior jacket for reactor refrigeration with air	1	2.533,33 €
		Transport and inspection of equipments	1	3.875,00 €
		TOTAL COST EQUIPMENTS		**220.930 €**
		SUPPLY AND MECHANICAL ASSEMBLING		
		Assembling of equipments. Construction and assembling of pipes and accessories/fittings	1	62.142,86 €
		Materials for pipes construction and accessories. Metalic support structure AISI 304.	1	41.600,00 €
		Platform . Structure in AISI304.	1	5.625,00 €
		Small modifications at assembling	1	4.375,00 €
		Orbital welding works	1	1.764,71 €
		Sterilizable gas filters - Manufacturer: Dominick Hunter	9	11.769,23 €
		Sterilizable liquid filters - Manufacturer: Dominick Hunter	7	7.107,69 €
		Filters for acid/base vents - Manufacturer: Dominick Hunter	2	350,77 €
		Filters (flow meters) - Manufacturer: HOKE	6	933,23 €
		Valves		
		Diaphragm valve 1/2"	47	10.480,37 €
		Diaphragm valves for argon inlet, steam inlet or condensate outlet	33	6.820,00 €
		Diaphragm valves 1/2" with steam inlet or condensate outlet valve	29	16.715,60 €
		Diaphragm valves 1/2" with double steam inlet valves	2	1.729,20 €
		Diaphragm valves 1" with condensate outlet valve	6	3.729,20 €
		Diaphragm valves 1 1/2" with steam inlet valve (feed/harvest tanks outlet)	2	1.413,33 €
		Ball valves 1/2"	22	6.776,00 €
		Ball valves 3/4"	6	1.973,36 €
		Ball valves 1"	12	4.720,00 €
		Ball valves 1/2" in PP	2	214,80 €
		Ball valves 1" in PP	2	270,13 €
		Diaphragm valves DN10 (gas filters purgue)	9	1.384,20 €
		Diaphragm valve 1/4" (liquid filters purgue)	7	728,00 €

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CUSTOMER:	**UAB**		DATE	30/09/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		Sampling valve	3	5.413,60 €
		Check valves for liquids	2	1.006,00 €
		Check valves in PP (acid/base)	2	446,45 €
		Sanitary check valves for gases - FLUIVAL	2	392,80 €
		Check valves for gases (HOKE)	10	718,40 €
		Pressure reducing for gases with pressure indicator	8	384,00 €
		Safety Valves - Sanitary design	4	2.240,00 €
		Safety Valves	10	1.840,00 €
		Steam traps - Manufacturer: SARCO	6	1.296,00 €
		Other valves	1	1.933,33 €
		Certificates of materials 3.1B, FDA	1	1.062,50 €
		Partial dismantle and re-assembling in MPP	1	3.529,41 €
		Coordination of assembling works at field		
		Assembling coordinator	1	9.222,00 €
		Engineer supervision	1	3.125,00 €
		Diets and other expenses	1	777,78 €
		TOTAL COST (SUPPLY AND MECHANICAL ASSEMBLING)		**226.009,96 €**
		SUPPLY AND ELECTRICAL ASSEMBLIES		
		1-Electrical works		
		a) Power and control cabinet: See detail description in point 3.3 of quotation EXS-M0072 rev. 1	1	44.985,33 €
		b) Installation and electrical connection.	1	27.363,75 €
		c) Phoenix materials	1	8.550,00 €
		TOTAL COST (SUPPLY AND ELECTRICAL ASSEMBLING)		**80.899,08 €**
		INSTRUMENTS / FIELD CONTROL EQUIPMENTS		
		Level detector for feeding tank. Guided microwave type. Manufacturer: Vega	1	1.552,94 €
		Scales for acid/base vessels. RS232 Signal. Manufacturer: Mettler Toledo	2	1.588,24 €
		Differential pressure system for reactor level control (2 x presure transmitters and special connection)	1	2.401,53 €
		Scale for harvesting tank. Manufacturer: Mettler Toledo	1	3.880,00 €
		Foam detection system. Manufacturer: Charis	1	*excluded
		Biomass Analyzer, model InPro 8200 from Mettler Toledo	2	15.176,47 €
		Solved Oxygen analyzer. Manufacturer: Mettler Toledo	1	3.564,71 €
		pH Analyzer. Manufacturer: Mettler Toledo	2	10.176,47 €
		Redox Analyzer. Manufacturer: Mettler Toledo	1	3.518,82 €
		Outlet gas analyzer	1	*excluded
		Coriolis mass flowmeter for reactor liquid inlet. Manufacturer: E&H	1	5.764,71 €
		Gas flowmeter/regulation (3 x inlet gases, 1 x reactor total inlet gas, 1 x circulated gas)	5	8.823,53 €
		Gas flowmeter for the reactor outlet gases	1	1.342,35 €
		Pressure transmitter (1 x reactor, influent, effluent, buffer, gas analyzer, compresor)	6	5.261,79 €
		Differential Pressure transmitter for filters blockage detection	3	5.279,22 €
		Pressure switches with LCD indication	6	2.645,29 €
		Pressure switch for pump's membrane breakage detection	3	765,88 €
		Pressure gauge (lines, filters)	22	4.506,12 €
		Temperature transmitter for influent/effluent tanks, gas analyzer, water circuit and condensate manifold	7	1.323,58 €
		Temperature sensor (PT-100) + transmitter for PBR	1	396,47 €
		Pod stainless steel for the temperature transmitters	1	235,29 €
		Proportional valve for PBR pressure control and compressor bypass	2	729,41 €
		Automatic diaphragm valves 1/2"	15	5.723,29 €
		Automatic ball valves	4	2.415,67 €
		Configuration and start-up for instruments that need it	1	2.117,65 €
		Certificates of materials 3.1B, FDA	1	1.352,94 €

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CUSTOMER:	**UAB**		DATE	30/09/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		Transport / inspection	1	1.171,76 €
		TOTAL INSTRUMENTS /EQUPMENT OF CONTROL IN FIELD		**91.714 €**
		OTHER CONCEPTS		
		GENERAL REVISION AFTER ASSEMBLING	1	2.266,67 €
		INSULATION (PIPES OF STEAM, CONDENSATE AND GLYCOL)	1	3.733,33 €
			COST	**6.000 €**
		DETAIL ENGINEERING + COMMISSIONING		
		DETAIL ENGINEERING (P&I´d definition, Lay-out, Detail drawings)		
		Technical designer	320	14.080,00 €
		Engineer	340	18.610,75 €
		Technical Manager	60	5.235,00 €
		Technical meetings with MPP for project advance control	40	2.250,00 €
		Paper work	1	1.750,00 €
		MANUAL AND FINAL DOSSIER		
		Technical designer	40	1.760,00 €
		Engineer	210	11.494,88 €
		Technical Manager	15	1.308,75 €
		Partial "As built"		
		Technical designer	60	2.640,00 €
		Engineer	40	2.189,50 €
		COMMISSIONING		
		(3.5.1.1) Mechanical FATs		
		Assembling coordinator	24	1.479,00 €
		Engineer	24	1.313,70 €
		(3.5.1.2) Electrical FATs		
		Engineer	24	1.313,70 €
		Electrical technician	40	1.750,00 €
		(3.5.2.1) Mechanical SATs		
		Assembling coordinator	120	7.395,00 €
		Engineer	120	6.568,50 €
		Mechanic official	120	4.500,00 €
		(3.5.2.2) Electrical SATs		
		Assembling coordinator	80	4.930,00 €
		Engineer	80	4.379,00 €
		Electrical technician	80	3.500,00 €
		(3.5.2.3) Communication comissioning		
		Engineer	40	2.189,50 €
		Electrical technician	40	1.750,00 €
		(4) Run test		
		Engineer	40	2.189,50 €
		Diets and other expenses	1	3.706,25 €
		CERTIFICATE FOR THE WHOLE INSTALLATION ACCORDING TÜV SPECIFICATIONS	1	6.250,00 €
		COSTE INGENIERIA		**114.533 €**
		TOTAL COST OF THE PROJECT		**740.086 €**
		OPTIONAL:		
		MEDIA PREPARATION TANK:		
		Atmospheric stainless steel tank: 300 l with agitator	1	13.618,95 €
		Centrifugal pump to fill up feeding tank - Sanitary pump	1	1.666,67 €
		Electrical cabinet	1	3.312,82 €
		Pressure switch with LCD indication	1	440,88 €
		Required manual valves	2	573,39 €

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Av. Príncep d'Asturies 43-45, 1r-5a
E-08012 BARCELONA

CUSTOMER:	**UAB**		DATE	30/09/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		Assembling works	1	971,43 €
			TOTAL COST	**20.584 €**

De Dietrich Equipos Químicos, S.L.
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E-08012 BARCELONA

CUSTOMER:	**UAB**		DATE	18/10/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		EQUIPMENT		
		New Foto-Bioreactor		**69.604,88 €**
		Agitation group: Electrical motor 0, 18 kW, nominal speed 250 (variable), shaft length: 1750 mm, double mechanical seal, 10 stages of axial turbines (impeller type) with 4 blades. ***Note: The agitator has been designed for being modificated if necessary. Modifications on the design are not included in this quotation.*	1	
		Jacketed pipe section DN200 L=1500 mm	1	
		Reactor bottom/top in AISI 316 with required nozzles	1	
		Lighting system and cabling (power cabinet included in supply and electrical assembling section)	1	
		Ingold connection and caps for required nozzles	1	
		Gas sparger	1	
		Others	1	
		Pre-assembly, package and transport	1	
		FAT's tests (tightness and agitation tests with water only)	1	3.466,67 €
		Spare part: Jacketed pipe section DN200 L=1500 mm	1	4.856,25 €
		Main gas condenser for the reactor 0,7 m^2 in borosilicate (M-HECH 80/7)	1	3.230,77 €
		Stainless steel tank 250 l with jacket, isolation and magnetic agitator	2	83.312,67 €
		Process gas buffer (50 l) in stainless steel	1	7.281,71 €
		Feeding and Harvesting pumps of liquid. Mod. Ecodos 0,55kW - Sanitary. Manufacturer: Lewa	3	10.237,50 €
		Acid and base pumps - Mod. 521Vi/R2C with freq. Variator. Manufacturer: Watson Marlow	2	3.525,00 €
		Gas compressor to discharge tank - Manufacturer: KNF (Double diaphragm)	1	4.656,25 €
		Vacuum pump for plant inertization (pump/filter/oil/others)	1	1.808,61 €
		Post cooler for gas analysis - Manufacturer: Sick Maihak	1	6.043,75 €
		Expansion vessel of reactor temperature control circuit	1	1.666,67 €
		Plate heat exchanger for heating/cooling reactor	2	6.622,52 €
		Circulation pump for reactor temperature control circuit	1	384,62 €
		Glass vessels 2 l capacity (acid and base)	2	270,00 €
		Exterior jacket for reactor refrigeration with air	1	2.533,33 €
		Transport and inspection of equipments	1	3.875,00 €
		TOTAL COST EQUIPMENTS		**213.376 €**
		SUPPLY AND MECHANICAL ASSEMBLING		
		Assembling of equipments. Construction and assembling of pipes and accessories/fittings	1	62.142,86 €
		Materials for pipes construction and accessories. Metalic support structure AISI 304.	1	41.600,00 €
		Platform . Structure in AISI304.	1	5.625,00 €
		Small modifications at assembling	1	4.375,00 €
		Orbital welding works	1	1.764,71 €
		Sterilizable gas filters - Manufacturer: Dominick Hunter	9	11.769,23 €
		Sterilizable liquid filters - Manufacturer: Dominick Hunter	7	7.107,69 €
		Filters for acid/base vents - Manufacturer: Dominick Hunter	2	350,77 €
		Filters (flow meters) - Manufacturer: HOKE	6	933,23 €
		Valves		
		Diaphragm valve 1/2"	47	10.480,37 €
		Diaphragm valves for argon inlet, steam inlet or condensate outlet	33	6.820,00 €
		Diaphragm valves 1/2" with steam inlet or condensate outlet valve	29	16.715,60 €
		Diaphragm valves 1/2" with double steam inlet valves	2	1.729,20 €
		Diaphragm valves 1" with condensate outlet valve	6	3.729,20 €
		Diaphragm valves 1 1/2" with steam inlet valve (feed/harvest tanks outlet)	2	1.413,33 €
		Ball valves 1/2"	22	6.776,00 €
		Ball valves 3/4"	6	1.973,36 €
		Ball valves 1"	12	4.720,00 €
		Ball valves 1/2" in PP	2	214,80 €
		Ball valves 1" in PP	2	270,13 €
		Diaphragm valves DN10 (gas filters purgue)	9	1.384,20 €
		Diaphragm valve 1/4" (liquid filters purgue)	7	728,00 €

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Av. Príncep d'Asturies 43-45, 1r-5a
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CUSTOMER:	**UAB**		DATE	18/10/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		Sampling valve	3	5.413,60 €
		Check valves for liquids	2	1.006,00 €
		Check valves in PP (acid/base)	2	446,45 €
		Sanitary check valves for gases - FLUIVAL	2	392,80 €
		Check valves for gases (HOKE)	10	718,40 €
		Pressure reducing for gases with pressure indicator	8	384,00 €
		Safety Valves - Sanitary design	4	2.240,00 €
		Safety Valves	10	1.840,00 €
		Steam traps - Manufacturer: SARCO	6	1.296,00 €
		Other valves	1	1.933,33 €
		Certificates of materials 3.1B, FDA	1	1.062,50 €
		Partial dismantle and re-assembling in MPP	1	3.529,41 €
		Coordination of assembling works at field		
		Assembling coordinator	1	9.222,00 €
		Engineer supervision	1	3.125,00 €
		Diets and other expenses	1	777,78 €
		TOTAL COST (SUPPLY AND MECHANICAL ASSEMBLING)		**226.009,96 €**
		SUPPLY AND ELECTRICAL ASSEMBLIES		
		1-Electrical works		
		a) Power and control cabinet: See detail description in point 3.3 of quotation EXS-M0072 rev. 1	1	44.985,33 €
		b) Installation and electrical connection.	1	27.363,75 €
		c) Phoenix materials	1	8.550,00 €
		TOTAL COST (SUPPLY AND ELECTRICAL ASSEMBLING)		**80.899,08 €**
		INSTRUMENTS / FIELD CONTROL EQUIPMENTS		
		Level detector for feeding tank. Guided microwave type. Manufacturer: Vega	1	1.552,94 €
		Scales for acid/base vessels. RS232 Signal. Manufacturer: Mettler Toledo	2	1.588,24 €
		Differential pressure system for reactor level control (2 x presure transmitters and special connection)	1	2.401,53 €
		Scale for harvesting tank. Manufacturer: Mettler Toledo	1	3.880,00 €
		Foam detection system. Manufacturer: Charis	1	*excluded
		~~Biomass Analyzer, model InPro 8200 from Mettler Toledo~~ Transmitter for biomass sensor	2	4.592,80 €
		~~Solved Oxygen analyzer. Manufacturer: Mettler Toledo~~ Transmitter for solved oxygen sensor	1	1.352,94 €
		~~pH Analyzer. Manufacturer: Mettler Toledo~~ Transmitter for pH sensor	2	2.705,88 €
		~~Redox Analyzer. Manufacturer: Mettler Toledo~~ Transmitter for redox sensor	1	1.235,29 €
		Outlet gas analyzer	1	*excluded
		Coriolis mass flowmeter for reactor liquid inlet. Manufacturer: E&H	1	5.764,71 €
		Gas flowmeter/regulation (3 x inlet gases, 1 x reactor total inlet gas, 1 x circulated gas)	5	8.823,53 €
		Gas flowmeter for the reactor outlet gases	1	1.342,35 €
		Pressure transmitter (1 x reactor, influent, effluent, buffer, gas analyzer, compresor)	6	5.261,79 €
		Differential Pressure transmitter for filters blockage detection	3	5.279,22 €
		Pressure switches with LCD indication	6	2.645,29 €
		Pressure switch for pump's membrane breakage detection	3	765,88 €
		Pressure gauge (lines, filters)	22	4.506,12 €
		Temperature transmitter for influent/effluent tanks, gas analyzer, water circuit and condensate manifold	7	1.323,58 €
		Temperature sensor (PT-100) + transmitter for PBR	1	396,47 €
		Pod stainless steel for the temperature transmitters	1	235,29 €
		Proportional valve for PBR pressure control and compressor bypass	2	729,41 €
		Automatic diaphragm valves 1/2"	15	5.723,29 €
		Automatic ball valves	4	2.415,67 €
		Configuration and start-up for instruments that need it	1	1.764,71 €
		Certificates of materials 3.1B, FDA	1	1.117,65 €

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CUSTOMER:	**UAB**		DATE	18/10/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
		Transport / inspection	1	1.171,76 €
		TOTAL INSTRUMENTS /EQUPMENT OF CONTROL IN FIELD		**68.576 €**
		OTHER CONCEPTS		
		GENERAL REVISION AFTER ASSEMBLING	1	2.266,67 €
			COST	**2.267 €**
		DETAIL ENGINEERING + COMMISSIONING		
		DETAIL ENGINEERING (P&I´d definition, Lay-out, Detail drawings)		
		Technical designer	320	14.080,00 €
		Engineer	340	18.610,75 €
		Technical Manager	60	5.235,00 €
		Technical meetings with MPP for project advance control	40	2.250,00 €
		Paper work	1	1.750,00 €
		MANUAL AND FINAL DOSSIER		
		Technical designer	40	1.760,00 €
		Engineer	210	11.494,88 €
		Technical Manager	15	1.308,75 €
		Partial "As built"		
		Technical designer	60	2.640,00 €
		Engineer	40	2.189,50 €
		COMMISSIONING		
		(3.5.1.1) Mechanical FATs		
		Assembling coordinator	24	1.479,00 €
		Engineer	24	1.313,70 €
		(3.5.1.2) Electrical FATs		
		Engineer	24	1.313,70 €
		Electrical technician	40	1.750,00 €
		COSTE INGENIERIA		**67.175 €**
		TOTAL COST OF THE PROJECT		**658.304 €**

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CUSTOMER:	**UAB**		DATE	18/10/2010
PROJECT:	**MELiSSA - COMPARTMENT C II**		REF.	
DRAWING:	**DD-8550-Z1-100-02**		PREPARED	RdM
TAG	**REF.**	**DESCRIPTION**	**QUANT.**	**COST**
OPTIONAL 1: 2nd STAGE OF THE PROJECT.				
		SUPPLY AND ELECTRICAL ASSEMBLIES		
		1-Electrical works		
		Electrical assembling works pending (sensors to transmitter)	1	1.062,50 €
		TOTAL COST (ELECTRICAL ASSEMBLING)		**1.062,50 €**
		INSTRUMENTS / FIELD CONTROL EQUIPMENTS		
		Biomass analyzer (transmitter excluded)	2	10.583,67 €
		Solved Oxygen analyzer (transmitter excluded)	1	3.139,85 €
		pH analyzer (transmitter excluded)	2	7.470,59 €
		Redox sensor + cable + InTrac777	1	2.460,00 €
		Configuration and start-up for instruments that need it	1	529,41 €
		Certificates of materials 3.1B, FDA	1	235,29 €
		Transport / inspection	1	147,06 €
		TOTAL INSTRUMENTS /EQUPMENT OF CONTROL IN FIELD		**24.566 €**
		OTHER CONCEPTS		
		INSULATION (PIPES OF STEAM, CONDENSATE AND GLYCOL)	1	3.733,33 €
		COST		**3.733 €**
		COMMISSIONING		
		(3.5.2.1) Mechanical SATs		
		Assembling coordinator	120	7.395,00 €
		Engineer	120	6.568,50 €
		Mechanic official	120	4.500,00 €
		(3.5.2.2) Electrical SATs		
		Assembling coordinator	80	4.930,00 €
		Engineer	80	4.379,00 €
		Electrical technician	80	3.500,00 €
		(3.5.2.3) Communication comissioning		
		Engineer	40	2.189,50 €
		Electrical technician	40	1.750,00 €
		(4) Run test		
		Engineer	40	2.189,50 €
		Diets and other expenses	1	3.706,25 €
		CERTIFICATE FOR THE WHOLE INSTALLATION ACCORDING TÜV SPECIFICATIONS	1	6.250,00 €
		COSTE INGENIERIA		**47.358 €**
		TOTAL COST OF THE PROJECT (2nd STAGE)		**76.719 €**
OPTIONAL 2: MEDIA PREPARATION TANK				
		Atmospheric stainless steel tank: 300 l with agitator	1	12.938,00 €
		Centrifugal pump to fill up feeding tank - Sanitary pump	1	1.666,67 €
		Electrical cabinet	1	3.312,82 €
		Pressure switch with LCD indication	1	440,88 €
		Required manual valves	2	573,39 €
		Assembling works	1	971,43 €
		TOTAL COST		**19.903 €**

De Dietrich
PROCESS SYSTEMS

OFERTA EXS-M0127 Rev. 3

PROPOSAL FOR THE SUPPLY OF MELiSSA PILOT PLANT COMPARTMENT C-II, INCLUDING: DETAIL ENGINEERING WORKS, EQUIPMENT SUPPLY, PLANT ASSEMBLY AND COMMISIONING OF THE UNIT

UAB / MELiSSA Pilot Plant
Mr. Francesc Gòdia
Barcelona, October 1st 2010

De Dietrich Equipos Quimicos, S.L.
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ROSENMUND
De Dietrich

INDICE

1.- SUBJECT AND ANTECEDENTS

The Universitat Autònoma de Barcelona, hereafter UAB, takes part in the MELiSSA Project of the European Space Agency (ESA) and the European Space Research and Technology Centre (ESTEC). The Project objective is to study and define parameters to achieve life conditions in the space during long journeys.

Included in this research project there is a pilot plant installed in the Departament d`Enginyeria Química de l'Escola Tècnica Superior d`Enginyeria (ETSE) of the UAB. This pilot plant is based in several compartments linked together in a close loop to process and recycle the ambient air, water, food and feces.

De Dietrich Equipos Químicos, hereafter DDEQ, was commissioned by the UAB for the basic designing of compartment C-II of the pilot plant, according to DDEQ quotation DDE-K1764-SI.

The present proposal EXS-M0127 Rev. 1 for the construction and delivery of the skid corresponding to compartment C-II, is based in the documentation and designs generated during this basic engineering project development, the Design Review conclusions during June 2.010 and MPP/ESA subsequent decisions.

The proposal includes the following concepts:

- Carry out the required detailed and constructive engineering works to build up the plant
- Delivery of all the materials, equipments and goods.
- Carry out the assembly (mechanical and cabling) of the plant
- Commissioning of the plant (DDEQ scope)
- Delivery of operation manual and technical dossier of the plant

2.- QUOTATION BASIS

To make this proposal the following documents (Data package) coming from the basic designing works of MELISSA – Compartment II Pilot Reactor, have been used:

P&ID Diagram DD-8550-Z1-100-01 Rev. J modified as per Basic Design Review conclusions based on meeting hold on June 7th, telecom hold on June 8th, mail from E. Peiro dated June 28th and last changes included in telecom hold on September 30th

Control Loops Diagram DD-8550-Z1-100-02 Rev. F (not up-dated until constructive engineering)

Main Equipments list Rev. B

Valves, filters and accessories list Rev. A (not up-dated until constructive engineering)

Piping list Rev. A (not up-dated until constructive engineering)

Instruments list Rev. A (not up-dated until constructive engineering)

Motor list Rev. A (not up-dated until constructive engineering)

Main Equipments Technical Specification Rev. B

Instruments Specification Rev. A (not up-dated until constructive engineering)

Electrical & Control Signals List Rev. A (not up-dated until constructive engineering)

Nevertheless, it has to be understood that a Prototype Pilot Plant might have some uncertainties that will not be clarified until the start up of the unit, and agreed changes might be required at that stage.

3.- SCOPE OF SUPPLY

3.1.- Constructive Detail Engineering Contents

The Investment Budget has been calculated considering a Constructive Detail Engineering packet of 780h to execute the following works:

1. Definition and Execution of Final P&I'd.
2. Definition of utilities required and estimated consumptions.
3. Definition and Execution of Final Control Loops Diagram.
4. Final Lay-out drawing.
5. Final list of: Sensors, valves, lines and components.
6. Datasheets of sensors, valves and main equipments.
7. Constructive drawings of:
   - Liquid storage tanks and accessory vessels
   - Reactor
   - Lighting arrangement and supports
   - Frame, supports and skid
8. Sufficient drawings for the pipe assembly, including isometric drawing of process lines.
9. Final detailed control functional description.

As soon as this first Data package is ready it will be sent to MPP for revision and approval. Once the approval is received, the rest of the Detail Engineering will be carried out and the purchases orders to suppliers will star to be released.

At this stage MPP will deliver the detailed control functional description plus the sensor and motor list with their datasheets to the control supplier (Sherpa) to star working on the PLC definition and program, as well as the scada control screens.

A *"kick off meeting"* with the MPP´s control contractor will be held at the UAB in order to clarify all the information provided by DDEQ to this contractor in the Data Package with points 1 to 9 (sensor list, motor list, automatic valves list, data sheets, control loops definitions, and final detailed control functional description). The estimated duration of this meeting is about one day and will be held with project engineers involved in the project.

10. HAZOP Analysis over final lay-out and P&ID
11. Prepare the "Test Protocols" for DDEQ Test and Commissioning as per stated in point 3.5. The protocols will be agreed with MPP.
12. Electrical diagrams for the electrical cabinet. CE marking and legalization of the new cabinet.
13. CE marking and legalization of liquid storage tanks and buffer.
14. Machines and Equipment Safety Evaluation, made by ICICT, S.A. (TÜV Rheinland Group), for a Pilot Plant module installed at the UAB facilities in Cerdanyola del Vallès.

    Like for the C-IVa module the notified body will do a Study over Machines and Equipment security based on:
    - R.D. 1215/97 about Minimum Security and Health Measures for the use of equipments.
    - R.D. 1644/2008 about Safety in Machines, transposition of directive 2006/42/EC

- UNE-EN norms of application

The notified body will execute the following works:

- Hazards identification
- Risk analysis according the hazards detected
- Consensus about safety technical solutions based on UNE-EN norms

Final conclusions report and Machinery Conformity / Non Conformity Certificate emission.

NOTE: The delivery of points 10-14 will be according the attached planning.

To assure the traceability and control over the design, DDEQ will implement a *"Design Changes Record"*. The objectives of this record are:

a. Assure traceability over design changes: date, problem detected, reason, decision, final change introduced, possible delays, cost.
b. Assure approval from both MPP and DDEQ.
c. Decision about who will take the cost of the change.

NOTE: This document will be prepared by DDEQ and shared with MPP for approval.

3.2.- Mechanical Turn-key supply of the compartment C-II

It is included the mechanical turn-key supply of the mechanical and electrical equipment corresponding to the Compartment C-II of the Melissa Pilot Plant in accordance with the "Quotation basis" shown in point 2 and the Detail Engineering to be carried out according to point 3.1.

Previously to any purchase DDEQ will inform UAB which is the selected supplier or contractor. Should the UAB has any inconvenience regarding a supplier or contractor DDEQ will change to another one, unless this might have an economic impact on the project or cause a delay in the schedule.

Mechanical Erection and installation of the unit at DDEQ warehouse and UAB laboratories at Cerdanyola del Vallés

2 Copies of the final dossier

3.3.- Electrical supply for the compartment C-II

Following we provide a description of the power and control system that is foreseen for the for the compartment II of MELiSSA Pilot Plant.

Documents of reference:

- *Control Loops P&ID (DD-8550-Z1-100-02 rev. F)* (not up-dated until constructive engineering)
- *Electrical and control signals list rev. A* (not up-dated until constructive engineering)
- *Room Lay-Out (DD-8550-Z1-102-02 rev. 0)* (not up-dated until constructive engineering)

3.3.1.- Situation of the electrical cabinet

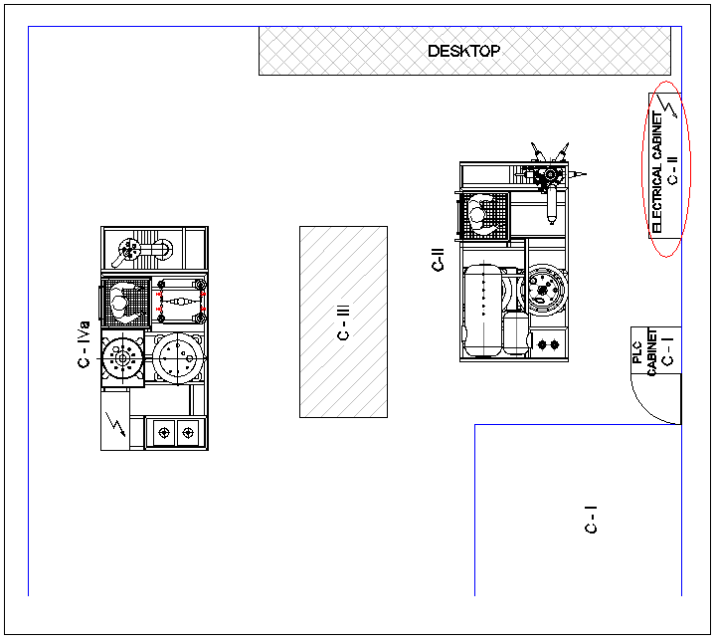
The electrical cupboards are foreseen by DDEQ out of the skid in order to save space in it and considering the room constraints.

MPP mentioned that the C-I PLC cabinet could be moved to the corner near the GC in order to have more space for the C.II skid (to be confirmed by NTE).

The designed electrical cabinet is 1800x2600x400 (height, width, depth) and it is conceptually divided in two different parts: power and control. By control we mean concentrate all the control signals from site instruments to the cabinet, to communicate with the main PLC and supervisor (delivered and programmed by others).

It can be physically divided too in order to be able to go through the pilot plant door.

The situation in the plant of the electrical cabinet is the next:



NOTE: For further details about dimensions *refer to Room Lay-Out (DD-8550-Z1-102-02 rev. 0) included in the ANNEX II of the Engineering dossier.*

3.3.2.- Power and control panel

Supply of power and control panel, dimensions 1800 height, 2600 width and 400 depth, mechanized, mounted, connected and with the following elements and devices:

1 Base panel and accessories
1 Mounting board
1 Cooper bar and accessories
1 Overvoltage protection Class D IEC 1024-1
1 Light switch “On service”
1 General switch
1 Main ground-fault protection and thermal-magnetic circuit breaker
1 Emergency stop push button
1 “Emergency stop activated” indicator (red led)
1 White light indicator “Voltage in”
1 Acknowledge push button
1 Security check push button
1 Safety relay PREVENTA
2 Power supply 24Vdc/10 A
1 Single ground-fault protection for all frequency converters

1 General ground-fault protection for all the instrumentation
1 DIMMER 3-phase to control lightning columns
1 Transformer 3-phase 5KVA
1 Single thermal-magnetic protection for 10 lightning columns
1 Current metering and 4-20mA conversion
1 DIMMER protection security circuit against low load in the output
1 RS232/Ethernet converter
1→ Wiring of the following control signals:

- 71 Digital inputs
- 52 Analogical inputs
- 49 Digital outputs
- 19 Analogical outputs

6 Galvanic isolators
1→ Set of thermal-magnetic circuit breakers
6 → Single-phase frequency converters 1,5KW
1 Set of Contactors
1→ Fan and filter
1 → Set of circuit breaker auxiliary switch
1 → Set of connection strips
1 → Elements and devices mounted and connected according CE directive
1 → Design, technical managing and documentation

IMPORTANT NOTES:

- **It is not foreseen the connection to the plant main power/pneumatic supply.**
- **All consumers will be equipped with ground-fault protection and thermal-magnetic circuit breaker.**
- **The material included in these lists is the necessary for the electrical and control signals according to the Basic Engineering Design and conclusions arose from the Design review done in June.**

3.3.3.- Electrical erection and commissioning of compartment C-II

The estimated materials which are required are:

- 20 m galvanized cable tray 60x60 mm (without cover).
- 20 m galvanized cable tray 300x60 mm (without cover).
- Trays mounting accessories.
- 160 m shielded cable 4x0,5 mm²
- 20 m blue shielded cable 8x0,5 mm²
- 250 m cable 4x0,5 mm²
- 200 m shielded cable 4x1,5 mm²
- 300 m shielded cable 3x1,5 mm²

- 250 m flexible conduit.
- 10 m heat-shrinkable tubing.
- Other connection and mounting accessories.
- Cable signalling.
- 100 m pneumatic tubing.
- 3 emergency stop pushbuttons.
- Other pneumatic accessories.

IMPORTANT NOTES:

- **If it is physically possible the power cables will be installed as separated as possible from the signal ones.**

3.3.4.- Photo-bioreactor Lighting system

The illumination system consists of 250-270 halogen lamps which surround the glass jacketed pipe section (DN200, L=1500m).

The type of lamps used will be the specified in the technical note 62.2 and are: OSRAM 12V, 20W BAB 38°.

3.3.5.- Lighting system structure

The lights will be set-up on a portable structure made of stainless-steel with 270 lamps of 20W 12V each, surrounded by a hybrid stainless steel – transparent plastic fairing, through which the cooling air can circulate.

It will include 2 or 3 connection boxes sited on the half height of the structure.

These boxes will receive the cables from the lamps to link in 2 o 3 cables all the power to the main electric panel.

3.3.6.- Phoenix material

Set of Phoenix materials:

- Analogical cable FLK 50/EX-DR/800
- Digital cable FLK 50/4X14/EZ-DR/800
- Interface modules VARIOFACE FLKM50/MOFI-TSX.
- Connectors PLC-V8/FLK14/OUT.
- Connectors PLC-V8/FLK14/IN.
- Relay PLC_RSP-24UC/21AU (24VDC).
- Plug-in bridges FBST 500-PLC BU
- Separating plates PLC-ATP-BK.

IMPORTANT NOTES:

- **We have included Phoenix Contact cables of 8 m. These cables will have in both sizes de connectors for flat cable BUT WILL NOT INCLUDE THE ADAPTERS TO CONNECT TO THE QUANTUM MODULES. These adapters must be supplied by the PLC cabinet manufacturer.**

3.4.- Manuals:

The manuals will be issued in English once points 1 to 9 of the Detail Engineering are approved by the MPP and while the module skid is pre-assembly in DDEQ´s warehouse. The Operation Manuals should be delivered to MPP the latest at the same time the pilot skid is installed in the UAB´s laboratories and the Technical Dossier no later than two months after the skid is installed.

3.4.1.- Operation Manual:

The Operation Manual will contain:

1. INTRODUCTION – SYSTEM DESCRIPTION
2. COMPONENT DESCRIPTION
3. PLANT CONTROL DESCRIPTION
4. PLANT SAFETY
5. GENERAL PROCEDURES
6. INSTALLATION START - UP
7. INSTALLATION SHUT - DOWN
8. NOMINAL OPERATION
9. SIP (STERILIZATION SEQUENCES)
10. SERVICE ON HARDWARE
11. PROCESS FOLLOW UP
12. CALIBRATIONS

3.4.2.- Technical Dossier

The Technical Dossier will contain

- Final P&I'd. ("as built" one)
- Final Control Loops Diagram.
- Final Lay-out drawing.
- Constructive drawings of:
    - Liquid storage tanks and accessory vessels
    - Reactor
    - Lighting arrangement and supports
    - Frame, supports and skid
- Sufficient drawings for the pipe assembly, including isometric drawing of process lines.
- Final list of: Sensors, valves, lines and main equipments, and the corresponding Datasheets
- Final detailed control functional description.
- Electrical diagrams for the electrical cabinet. CE marking and legalization of the cabinet.

- CE marking and legalization of the liquid storage tanks.
- Welding controls and welding certificates for the storage tanks.
- Certificate issued by ICICT, S.A. (TÜV Rheinland Group) after the "Machines and Equipment Security Evaluation" for the Pilot Plant module installed at the UAB facilities in Cerdanyola del Vallès.
- Compilation of operation, maintenance manuals and technical documents provided by the different suppliers of the equipment installed in the plant. Whenever it is possible this information will be supplied in electronic format as well.
- Spare part list for two years operation

3.5.- Test and commissioning of the Pilot Unit

3.5.1.- FAT by DDEQ

3.5.1.1.- Mechanical

Once the skid is pre-assembled at DDEQ´s warehouse and before the shipment to UAB´s laboratories MPP will assist to FAT verification consisting in:

- Verify that final approved P&I´d diagram has been observed in the assembly
- Verify that the sensors, valves and equipments used are the specified ones according the project datasheets.
- Verify supports robustness.
- Test certificates and protocols filled up with the results.

NOTE: For the mechanical FAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1. At the end of mechanical FAT a record will be signed both by MPP and DDEQ and the shipment date to UAB´s laboratories will be agreed. The duration of this FAT test will be 2 or 3 working days.

No test with fluids will be included in the mechanical FAT as there are not such services at DDEQ´s warehouse.

3.5.1.2.- Electrical

The cabling of the C-II module will be executed at UAB premises. Therefore the Electrical FAT will focus only in the power and control cabinets delivered by DDEQ. This FAT will take place at DDEQ´s electrical contractor premises.

The Electrical FAT will consist in:

- Verify that all the sensors, automatic valves and equipments included in the P&I´d appears in the electrical diagrams.
- Verify that the electrical diagrams have been observed during the manufacturing of the cabinets.
- Test the power and control cabinets simulating the signals.
- Test the lighting system for the photo bio-reactor
- Test certificates and protocols filled up with the results.

NOTE: For the electrical FAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1, and tests will be done by DDEQ and electric

supplier. An electrical FAT record will be signed both by MPP and DDEQ and the shipment date to UAB´s laboratories will be agreed. The duration of this FAT test will be 3 working days.

3.5.2.- SAT by DDEQ

3.5.2.1.- Mechanical

The following tests have been considered for the plant commissioning based on a scheduled commissioning of fifteen (15) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Erection Manager (DDEQ)
- Mechanic official (DDEQ Contractor)
- MPP (permanent dedication of plant operator and technical staff)

The works to be done are:

- Pressure test with water for the liquid tanks and lines, as well as the reactor.
- Pressure test with compressed air of the Gas lines and buffers.
- Pressure test with steam of the steam and condensate lines. After that a resume of sterilization sequences will be done. Resume means:
  - Not waiting all the sterilization time required until the temperature is reached
  - Reactor, tanks and complete sections between reactor and tanks will be tested with steam during the accorded and defined time. Sequences for individual equipment will not be checked.
- Pressure test with water of the heating / cooling circuits of the jacketed equipment.
- Test certificates and protocols filled up with the results

NOTE: For the mechanical SAT commissioning of the pilot unit DDEQ will perform the tests using its own protocols, elaborated as per point 11 in paragraph 3.1. At the end of the mechanical SAT a record will be signed both by MPP and DDEQ.

3.5.2.2.- Electrical

The following tests have been considered for the plant commissioning based on a scheduled commissioning of ten (10) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Erection Manager (DDEQ)
- Electrical official (DDEQ Contractor)
- MPP (permanent dedication of plant operator and technical staff)

The works to be done are:

- Check of the spin direction of motors.
- Check the power supply to all the instruments.
- Check the output signals from the instruments to the cabinet.
- Check alarms contacts in the cabinet and signals to be sent to the PLC.
- Simulate PLC input signals from the cabinet to instruments and control valves.

- Test of the lighting system of the reactor and the air cooling equipment.
- Initial configuration (settings and range definition) of instruments and sensors with process parameters supplied by MPP to the control supplier. The optimization and fine adjustment of the settings will be responsibility of the MPP and therefore its implementation over the equipments on site.
- Test certificates and protocols filled up with the results.

NOTE: For the electrical SAT commissioning of the pilot unit DDEQ will use its own protocols, elaborated as per point 11 in paragraph 3.1 and tests will be done by DDEQ and electrical supplier. At the end of the mechanical SAT a record will be signed both by MPP and DDEQ.

3.5.2.3.- Communication commissioning

The communication commissioning will not be started until the mechanical and electrical commissioning (as per indicated in points 3.5.2.1 and 3.5.2.2) is finished and all the interconnecting cabling between DDEQ´s cabinet and the PLC cabinet (supplied by others) is done. The interconnecting cabling is also out from DDEQ´s scope.

The following tests have been considered for the plant commissioning based on a scheduled commissioning of five (5) working days. The foreseen test team is:

- Project Engineer (DDEQ)
- Project Engineer (Sherpa)
- MPP (permanent dedication of plant operator and technical staff)
- Electrical official (DDEQ Contractor + Sherpa Contractor)

The works to be done are:

- Verify the arrival of the inputs signal from DDEQ´s cabinet to the PLC cabinet
- Verify the arrival of PLC commands to DDEQ´s cabinet
- Verify consistency in the measurements in the onsite instruments with the PLC lectures.

We do not include any verification about the control loops program stability or performance, which is fully responsibility of the control supplier.

NOTE: For the electrical communication commissioning of the pilot unit DDEQ will use Sherpa´s protocols. At the end of the electrical communication commissioning a record will be signed by MPP, SHERPA and DDEQ

At the conclusion of all the Test and Commissioning process as stated in points 3.5.1 and 3.5.2 a “Pilot Unit Acceptance Document” will be signed between MPP and DDEQ. From that moment, the risk and responsibility of the unit will be transferred to MPP, being then authorized to operate the plant alone or with other suppliers. At the same time, the guarantee period of twelve (12) months will start.

For further assistance or more extensive test and checks DDEQ will provide in point 6 “Price and Payment conditions” a daily net rate for engineers and technicians.

4.- RUN TEST OF THE MODULE

As an additional service to MPP, DDEQ is ready to assist to a complete run test of the pilot module when the control supplier has finalized the delivery and test of its scope of supply.

We have considered the assistance during five (5) working days of our Project Engineer to help MPP staff during the integration under operation of the control with the hardware.

Leadership and execution of the Run Test is MPP responsibility and our task is to resolve doubts and give advices during the Trials. We will also take care of failures of the hardware but not accept any responsibility because of misuse, (in manual or automatic operation), of the hardware.

If additional presence over the five (5) foreseen days is required DDEQ will charge MPP according the rates indicated in point 6 "Price and Payment conditions".

5.- EXCLUSIONS

The following services and works have not been taken into account in the present quotation and, therefore, are explicitly exclude of the scope of supply:

- Mechanical connections to UAB utilities nets (steam, air, CO_2, water,…)
- Fan, filter and coolant battery for the lighting cooling system. Its installation (air tubes to the side of the C-II skid) and electrical connection (cabling to our cabinet) is not included. **The electrical maneuver will be in our cabinet and the control ins Sherpa´s scope.**
- Gas analyzer connection different of what was implemented in Module C-IVa. If additional requirements are demanded by MPP DDEQ will implement a Design change in the ***"Design Changes Record"*** as indicated in point 3.1.
- Electrical interconnecting cabling from DDEQ´s electrical cabinet for compartment C-II and the PLC cabinet, and from the PLC cabinet to the control room computer. Neither the main power supply from UAB´s general line to DDEQ´s cabinet is included.
- Carrying out the control commissioning neither commissioning of the PLC program and the supervisor system implemented in the control room computer. The operation manual of these elements is also out of our scope.
- Changes over design as per MPP Hazop analisys. If additional requirements are demanded by MPP DDEQ will implement a Design change in the ***"Design Changes Record"*** as indicated in point 3.1.
- Plant star-up with process fluids.
- Plant validation and/or qualification.
- Further engineering works, out of what is clearly stated in the present proposal, as per example:

  Note: If any or the following works/tasks (or other not listed here) is required by the UAB, they will be invoiced separately accordingly to the "Daily rates" shown in point 5.2

  - Isometric drawings of the pipes but the process ones.
  - Engineering works to accommodate UAB facilities or utilities to the requirements of the unit (connections, modifications in services nets,...)
  - Drawings "as built" of the equipment showing the changes implemented over the approved detail constructive project but the P&ID.
  - Control Commissioning of the plant.
  - Engineering works to assure the right integration of the different modules of the Melissa loop.
  - Environmental engineering concerning liquid or gaseous effluents
  - Edition of Plant Operation Protocols for the field Operator
  - Edition of Operational Emergencies and Alarms Management Protocol
  - Edition of Sensor and Instrument Calibration Protocol

- Any legalization or CE marking of the pilot unit exceeding the Study over Machines and Equipment security edited by ICICT, S.A. (TÜV Rheinland Group)
- External sub-supplier management outside the scope of supply of the unit described in this proposal

- Official or legal projects, if necessary or required, as per example: Pressure Equipment Installation Project, Low Voltage Project, ….
- Further assistance services, out of what is clearly stated in the present proposal, as per example:
  - Commissioning of the equipment with real process fluids.
  - Validation of the unit
  - Once the commissioning phase is finished:
    - Optimization of the initial Control Settings and Alarm Set Points
    - Optimization of the Maintenance sequences and Cleaning instructions
  - Others

6.- PRICE AND PAYMENT CONDITIONS

6.1.- Price of the plant

The price of the Pilot Unit corresponding to Compartment C-II of the Melissa Pilot Plant according to the base equipment described in the Budget Rev. 3 included as Attachment 1, and considering the tanks are manufactured by BIOPROCESS/TECALSA, is:

NET PRICE (VAT excluded): -.742.777€.-

The tank for media preparation and its electrical cabinet, pump, required instrumentation and manual valves as well as the assembling of this set has been quoted separately. The price for this system, according to the base equipment described in the Budget Rev. 2 included as Attachment 1 is:

NET PRICE (VAT excluded): -.20.584€.-

If the tanks are manufactured by TALLERES AJA the price is:

NET PRICE FOR THE PLANT (VAT excluded): -.735.637€.-

NET PRICE FOR MEDIA TANK (VAT excluded): -.18.885€.-

If the tanks are manufactured by EQUINOX the price is:

NET PRICE FOR THE PLANT (VAT excluded): -.721.205€.-

NET PRICE FOR MEDIA TANK (VAT excluded): -.18.195€.-

Note: The above price are a "fix price" according to *"2.- Quotation Basis"*, that will allow the UAB/MPP to place an order to DDEQ in order to fulfill the required delivery schedule. If during the constructive detail engineering the relevant changes in the design appear they will be reflected in the ***"Design Changes Record"*** and the economic impact must be agreed between both parties.

6.2.- Daily rates for special assistance or test

Any further assistance, out of what is clearly stated in points 3.1 and 3.5 of this quotation, required by the MPP both, during the detail engineering (supervision of control engineering, other suppliers,…) or during the commissioning of the plant, will be invoiced according to the following daily rates:

Project Engineer (mechanical or electrical/control):	740 €/day
Assembling coordinator:	560 €/day
Mechanic:	485 €/day
Electrician:	485 €/day
Travel expenses:	According to destination

6.3.- Order and Payment conditions

DDEQ proposes the following payment conditions:

20% down payment with the order, payment at 60 days after invoicing

25% at delivery of points 1 to 9 of the Detail Engineering as stated in point 3.1, payment at 60 days after invoicing

5% at delivery of points 10 to 13 of the Detail Engineering as stated in point 3.1, payment at 60 days after invoicing

20% at conclusion of mechanical FAT test as stated in point 3.5.1.1, payment at 60 days after invoicing

10% at conclusion of electrical FAT test as stated in point 3.5.1.2, payment at 60 days after invoicing

10% at delivery of manuals as stated in point 3.4.1, payment at 60 days after invoicing.

10% at the conclusion of the SAT commissioning as stated in point 3.5.2, payment at 60 days after invoicing.

7.- PROPOSAL VALIDITY

This proposal is valid for a period of two natural months.

8.- PROJECT PLANNING

In practice the development of the Project will be mainly influenced by UAB/MPP final purchasing decision and the administrative delays in order to place the order and contract writing. Also delays in intermediate approvals will cause a longer delivery time for the skid.

Assuming an optimal schedule in the development of the project, the schedule would be as shown in the annex.

9.- GUARANTEE

DE DIETRICH EQUIPOS QUÍMICOS S.L., guarantees for one (1) operation year, against manufacturing defects or material failures, all the equipment supply and the erection and assembly works executed by its contractors. The guarantee applies only to the repair or the reposition of the defect element or equipment, once the defect is verified, checked and accepted as guarantee issue.

Elements subjected to wear and/or ageing are not covered by the present guarantee. For example (but not limited) mechanical seals, measurement probes, joints,...Neither is covered negligence in the operation of the equipment and normal maintenance or cleaning operations over the equipment, as well as, accidental failures of the unit.

As mentioned before, the guarantee covers only the repair / replacement of the damaged/defect equipment. No other service or compensation is covered. For third party components or equipments, if any, the guarantee will be provided by the manufacturer.

10.- GENERAL PROJECT CONDITIONS AND LIABILITY LIMITATION

- The works covered under this proposal will be considered finished as soon as the commissioning tests stated in point 3.5 are finished satisfactorily and the "Pilot Unit Acceptance Document" is signed between MPP and DDEQ.
- Design will be implemented under the guidelines and process requirements provided by the UAB, and according to the good engineering practices known by DDEQ.
- A design review was conducted in June 2.010 to verify that the basic design elaborated fulfills the Technical Requirements (MPP/TN/2005/01 Version 1) and the Technical Note 62.2 edition 1. Some changes emerged from that review agreed between MPP and DDEQ and a new P&I´d version has been released, being the main basis for the current proposal. Again, it has to be understood that a Prototype Pilot Plant might have some uncertainties that will not be clarified until the real start up of the unit, and agreed changes might be required at that stage.
- The engineering works executed by DDEQ, and consequently equipment supply, do not mean that DDEQ has any liability in case the throughout put of the unit is less or different from the foreseen one. Process responsibility is charge of the MPP.
- DDEQ will not accept any liability for direct or indirect damages causes without the intention to harm as per example: production looses, third part claims, prestige looses, overall project delays,… DDEQ will not be responsible either for defects or damages arising from wrong or incomplete information delivered by the UAB/MPP.
- The MPP will designate a main interlocutor to evacuate through all the correspondence, question, doubts,..The same person will concentrate all the information and questions from the MPP to DDEQ.

11.- CONFIDENTIALITY

All documents, data and information of the Project shared between MPP and DDEQ will be considered as confidential unless it is explicitly agree between both parts, is of public domain at the date of signing the contract or its use is necessary for the normal development of the project (inquiries or contracts to suppliers or contractors).Nevertheless, main contractors with access to relevant information must sign the confidentiality agreement too.

12.- ANNEX

Investment Budget Rev.3

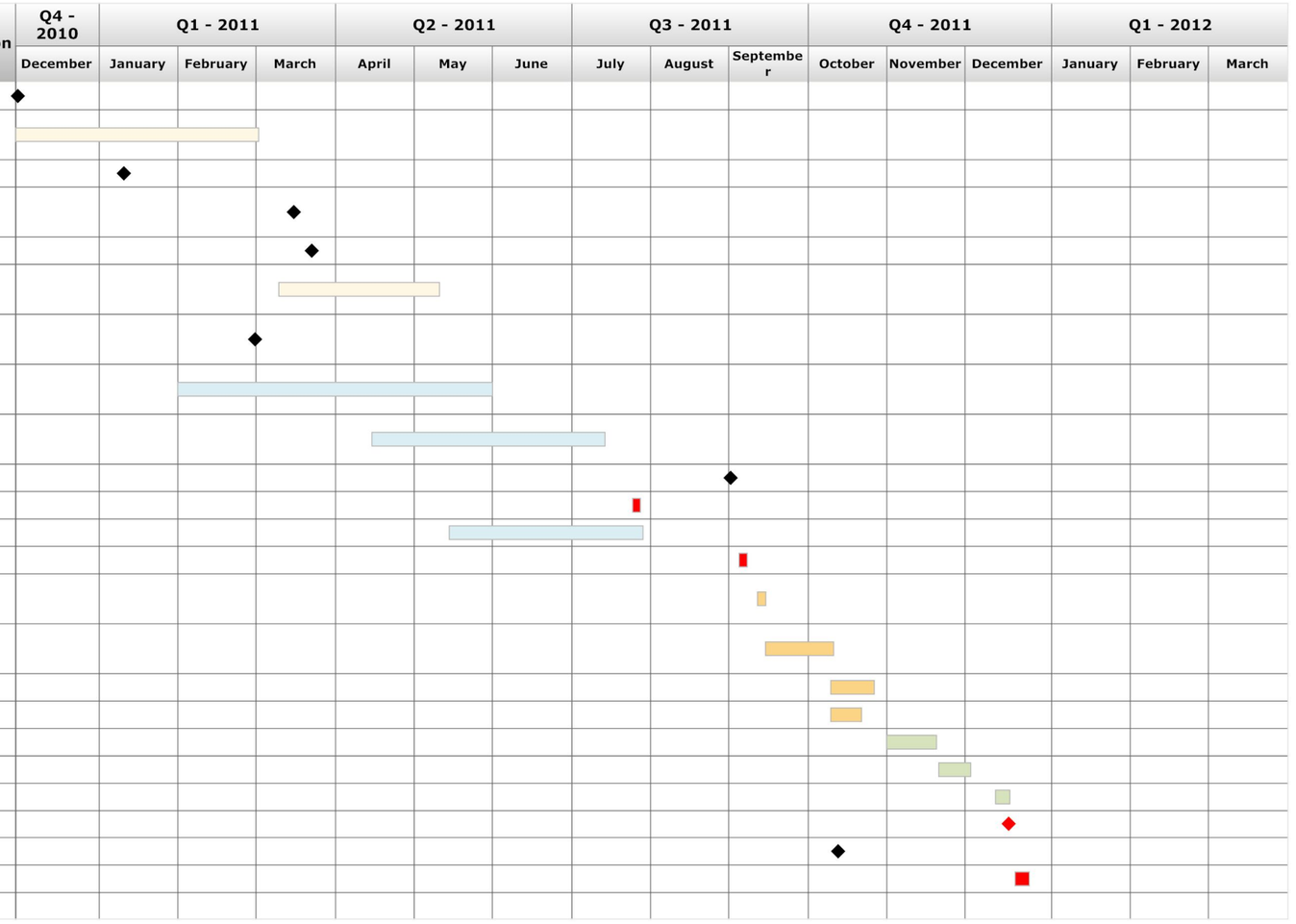
Project planning

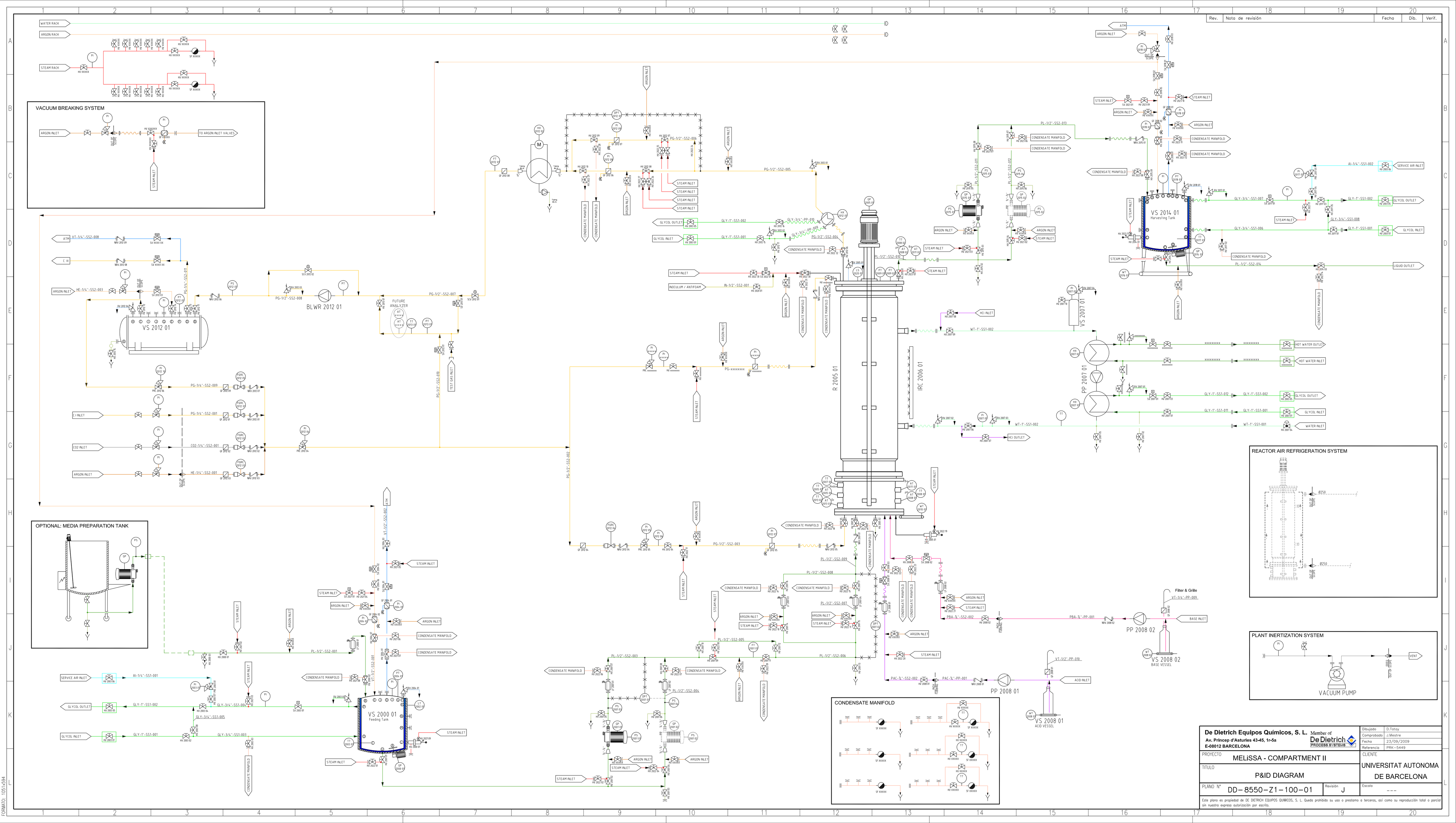
Barcelona, October 1st 2010
DE DIETRICH Equipos Químicos, S.L

Fdo. Roberto de Miguel
Managing Director

Fdo. Josep Mestre
Technical manager

Number	Task	Start	End	Duration
1	Order	1/12/2010	1/12/2010	1
2	Constructive Detail Design (CDD): Points 1 to 9	1/12/2010	1/3/2011	65
3	Approval Final P&Id	10/1/2011	10/1/2011	1
4	Approval Data package of CDD: Points 1 to 9	15/3/2011	15/3/2011	1
5	Kick off meeting with SHERPA	22/3/2011	22/3/2011	1
6	Constructive Detail Design (CDD): Points 10 to 13	10/3/2011	10/5/2011	44
7	Approval Data package of CDD: Points 10 to 13	28/2/2011	28/2/2011	1
8	Instruments & Equipments purchases and reception	1/2/2011	31/5/2011	86
9	Mechanical assembly at DDEQ warehouse	15/4/2011	13/7/2011	64
10	Manuals delivery	1/9/2011	1/9/2011	1
11	Mechanical FAT test	25/7/2011	27/7/2011	3
12	Electrical cabinets manufacturing	15/5/2011	28/7/2011	54
13	Electrical FAT test	5/9/2011	7/9/2011	3
14	Delivery of mechanical and electrical equipment to UAB laboratory	12/9/2011	14/9/2011	3
15	Complete assembly and cabling of the skid	15/9/2011	10/10/2011	18
16	Interconnecting cabling to PLC by UAB	10/10/2011	26/10/2011	13
17	Utilities connection by UAB	10/10/2011	21/10/2011	10
18	Mechanical SAT test	1/11/2011	18/11/2011	14
19	Electrical SAT test	21/11/2011	2/12/2011	10
20	Communication commissioning	12/12/2011	16/12/2011	5
21	Pilot Unit Acceptance Document	16/12/2011	16/12/2011	1
22	Call out to TÜV to execute CCD Point 14	12/10/2011	12/10/2011	1
23	RUN TEST OF THE MODULE	19/12/2011	23/12/2011	5





Rev.	Nota de revisión	Fecha	Dib.	Verif.

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Fecha	23/09/2009
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CLIENTE	UNIVERSITAT AUTONOMA DE BARCELONA
TITULO	P&ID DIAGRAM
PLANO Nº	DD-8550-Z1-100-01
Revisión	J
Escala	---

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14. MOM OF THE DESIGN REVIEW AND FINAL DECISIONS

14.1. Design Review MOM

14.2. Final Decisions

MINUTES OF MEETING

Our reference: MPP-MOM-10-2002(0)-EP-20100608

Date : 08-Jun-10

Meeting place: DEDIETRICH, SHERPA and ESA by teleconference with MPP

SUBJECT: Basic design review CII

Attendees:

Company	MELiSSA Pilot Plant	MELiSSA Pilot Plant	MELiSSA Pilot Plant	DDEQ	SHERPA	ESA
Names	E. Peiro (EP)	A. Fossen (AF)	F. Godia (FG)	R. de Miguel (RM)	O. Gerbi (OG)	B. Lamaze (BL)

Distribution list: the attendees and the following listed persons

Company	ESA	
Names	C. Lasseur	

Main conclusions:

- A requirements compliance matrix has been prepared describing DDEQ CII design proposal, that should be agreed upon for the contract signature, including verification tasks and scheduling.
- MPP/ESA will update the CII Technical specifications as basis for the design, incorporating the agreed modifications.
- The main critical points were discussed and comments incorporated in the compliance matrix; final decisions from MPP/ESA will be taken during week 25.
- DDEQ will update the proposal and corresponding quotation accordingly.

Approval by all attendees:

Company	MPP	MPP	MPP	DDEQ	SHERPA	ESA
Name	E.Peiro	A. Fossen	F. Godia	R. De Miguel	O. Gerbi	B. Lamaze
Visa	Approved by e-mail	Approved by e-mail	Approved by e-mail	Approved by e-mail	Approved by e-mail	Approved by e-mail

Our reference: MPP-MOM-10-2002(0)-EP-20100608

Item	Action #	Resp	Date
Agenda : 1. Introduction 2. Critical design points to be discussed 3. Agreed actions			
Discussion : **1. Introduction** The purpose of the telecom was for MPP and DDEQ: 1- to share with SHERPA and ESA: - the main points of the design where there is a main change from the preliminary proposal from DDEQ, - The main points where decisions have to be taken by MPP/ESA,giving the opportunity to raise questions to understand properly the proposed solutions 2- check in detail the latest DDEQ proposal before a final decision is taken. Some general remarks were stated and agreed: - AF mentioned that the document Design acceptance_CII_V1.xls sent to the attendees ahead of the meeting including all the requirements described in the CII Technical Specifications doc. is in reality a compliance matrix (Annex 1) that should be agreed upon ahead of the contract and compiled along the manufacturing to demonstrate the compliance of the requirements. - The verification tasks should be clearly identified and scheduled in that matrix. **2. Critical design points to be discussed** EP explained that the main critical points refer to the following requirements (as they appear in the attached excel file, based on the CII Technical Specifications doc. numbering): - Req. 3 and 11: lighting system			

- Req. 5: PBR gas loopgas and headspace inlet - Req. 7 and 16.6: gas analysers - Req. 9 and 25: agitator - Req. 13: control (tests) - Req. 14: redundancy of probes - Req. 16.3 and 16.3bis: level - Req. 18: sampling fee of cells - Req. 30: resistance of glass - Req. 34 and 35: aux. tanks gas loop management The comments and decisions on these points are included in the compliance matrix (Annex 1, highlighted in blue colour)			
3. Agreed actions			
- The requirements included in the Technical Specifications doc. will be updated by MPP/ESA in order to reflect the current status of the requirements on which CII manufacturing should be based.	1	MPP/ESA	
- A discussion on the main points will be held by MPP with UBP, in order to get their feedback a) Need of an additional gas inlet direct to headspace vs. unique inlet to the bottom of the bioreactor b) CO2 and VFA analysis on-line c) Lack of redundancy of pH probe during batch phase (due to the availability of only one pH probe inside the PBR): criticity of this phase (duration, requirements) d) Alternative Gas loops management (PBR gas loop and auxiliary tanks gasloop)	2	MPP	18.06
- MPP and ESA will decide next week on the above mentioned points, and beside these the illumination and level measurement issues, and will inform DDEQ in order that they can update and finalise the proposal.	3	MPP/ESA	18.06
- DDEQ will update the proposal accordingly.	4	DDEQ	30.06
- MPP will discuss with SHERPA about the points of the specification regarding control.	5	MPP	
SHERPA will prepare in the following weeks a proposal (joined with NTE) for			

the delivery of the control hardware and software for CII, to be harmonized with the manufacturing proposal of DDEQ. - MPP will check if the redox fitting cam welcome a pH probe, in case a redundant pH probe will be finally required in the bottom	6 7	SHERPA MPP	

Annex 1

Nº	SPECIFICATION	PRIORITY	VERIFICATION METHOD	VERIFICATION SCHEDULE OPTION	DESCRIPTION	REMARKS	DECISION	COMPLIANCE
1	The C-II will produce around 60-70 g *R. rubrum* DW/day consuming the volatile fatty produced in C-I (around 50 g/day). As a result, the total working liquid volume of the photobioreactor will be around 40 L		Productivity to be demonstrated during PQ tests (MPP responsibility) Volume: Bioreactor layout and glass drawing		Total Vol. 47L illuminated+9 non-illuminated (total 56L); working vol. 40L illuminated+9 non-illuminated	Cooling air need to be filtered to comply with MPP ambient conditions (HEPA filtration for the axenic compartments)		YES
2	The illuminated zone of the photobioreactor will have a diameter around 0.20 m and the height will be 1.0 m i.e. at least 0.6 m^2.		Diameter and height: Bioreactor layout and glass drawing		Height to be consistent with requirement nº1 and nº4		Requirement to be rephrased: height at least of …	YES
3	There will be a regulable illumination system that will provide a light intensity at the external walls of the bioreactor between 0- 300 W/m2 (around 200 lamps). Lamp active spectrum will be in the R. rubrum active photosynthetic range.		Lighting system: dedicated layout and facility layout Blower efficiency: calculations Coherence with calculations of lighting needs provided by the MPP	Lighting system layout Pending on discussion with architecture area	270 lamps available distributed as in ClVa; 1 cm distance from the glass jacket, 1700 m3/h cooling airflow, diameter 260 mm; the cooling is only dedicated to the lamps cooling, NOT AS AN ALTERNATIVE FOR THE COOLING WATER LOOP. The cooling air needs to be refrigerated in order to reduce flow and pipe diameter and filtered, taking into account: - The ventilation supply is too hot in summer, it's OK in winter - The exhaust cannot be used w/o affecting the current ventilation system for comfort - Filtration of the air needs to be also considered - Dedicated commercial systems are available	The cooling air needs to be refrigerated in order to reduce flow and pipe diameter and filtered, taking into account: - The ventilation supply is too hot in winter, it's OK in summer - The exhaust cannot be used w/o affecting the current ventilation system for comfort	Lighting system: sheel material needs to be transparent (DDEQ to modify) Discussion with Architecture Area (Enric font) will be held in order to check the availability of the current cooling machines and layout in the facility for the ubication of conducts and blower and cooler if necessary	
4	The non-illuminable volume of the bioreactor (i.e. the dark volume of the headspace or the "bottom" space) has to be minimum. Therefore, the design should maximize the volume fraction that can be illuminated. The photobioreactor walls in the illuminated section will be made of a transparent material for the active photosynthetic range mentioned above.		PBR manufacturing drawing Glass material datasheet		Percentage of illuminated/non-illuminated around 80% (see Req.1)			YES

Our reference: MPP-MOM-10-2002(0)-EP-20100608

5	There will be a gas circuit that will allow the recirculation of a fraction of the gas flow rate through the photobioreactor and the rest through the headspace. This fraction has to be variable. The gas of the photobioreactor will not be exchanged with the atmosphere. The impulse for the gas flow will be provided by means of a gastight compressor	PID Compressor datasheet		Compressor: a second loop around the compressor is added (2 bar) to maintain pressure constant in the compressor inlet in order to avoid vacuum considering the gasflow is in a range quite wide (0-120L/h); double-membrane; higher robustness,		Headspace inlet: requirement to be reconsidered, as the supply in the BR top could be not needed, if the supply for the bottom is guaranteed To be discussed internally MPP/ESA	TBC
6	The volatile fatty acids should not escape from the compartment. The photobioreactor will have a high efficiency gas condenser in order to minimize the water vapour losses and condensation in the gas connecting devices.	Equipment datasheet of the cooler Design calculations based on 10% liquid evaporated and assuming organics boiling point at 80ºC Calculations to be revised including real data of VFA (to be supplied by MPP)		Condenser and post-cooler are included in the design	Data on Volatile compounds to be sent to DDEQ in order to validate the efficiency on VFA condensation	Calculations to be double-checked	
7	The compartment will have the necessary number of liquid and gas inlets and outlets to operate both connected to compartment I and compartment III and consuming synthetic gas and culture media. Special attention should be given to liquid medium and gas sampling nozzles.	PID		gas inlet and outlet lines are connected to the future gas analyser; "tees" will be needed if additional VFA analysis on line will be incorporated		Decision on gas analysers to be taken by MPP/ESA: - CO2 - VFA in gas phase - VFA in liquid phase - need of liquid sampling in the harvesting line?	
8	The compartment II will operate under anaerobic conditions. Any air inlet will be completely avoided. Argon and/or CO2 gas inlets will be provided. All the equipment of the gas loop will be gastight.	PID Equipment datasheet SAT tests: tightness tests to be included	SAT schedule				YES

9	The photobioreactor will have good radial homogeneity (e.g. 5 rushton turbines of 2.5 or 2.3/4 inch).	Agitator datasheet and layout Agitator FAT (DDEQ workshop) SAT	FAT schedule SAT schedule	Proposal includes 3 Rushton + 3 axial turbines; this week proposal for CFD simulation in DeDietrich France To be manufactured by DD engineering	Previous manufacturer proposed (SOLARIS) has not the expertise on CFD simulation	Base the proposal on DeDietrich France inputs	TBC
10	The radial gradients of temperature between the wall surface and the bulk liquid of the illuminated column should be minimized and will be less than 1°C. The photobioreactor will have the liquid temperature controlled and the maximum allowed temperature difference between the culture temperature and its set point in any point of the photobioreactor will be 1 ºC, knowing that the viscosity of liquid medium is in the order of magnitude of water viscosity (1 to 20 mPa.s)	Calculations by DeDietrich based on the agitation system when defined					TBC
11	There will be a system devoted to the removal of the hot air associated to the heat dissipation of the illumination system around compartment II. The total heat power to remove would reach 2 to 3 kW.	Lighting system: dedicated layout and facility layout Blower efficiency: calculations	Pending on discussion with architecture area	270 lamps available distributed as in CIVa; 1 cm distance from the glass jacket, 1700 m3/h cooling airflow, diameter 260 mm; the cooling is only dedicated to the lamps cooling, NOT AS AN ALTERNATIVE FOR THE COOLING WATER LOOP. The cooling air needs to be refrigerated in order to reduce flow and pipe diameter and filtered, taking into account: - The ventilation supply is too hot in winter, it's OK in summer - The exhaust cannot be used w/o affecting the current ventilation system for comfort - Filtration of the air needs to be also	The cooling air needs to be refrigerated in order to reduce flow and pipe diameter and filtered, taking into account: - The ventilation supply is too hot in winter, it's OK in summer - The exhaust cannot be used w/o affecting the current ventilation system for comfort	Requirement to be rephrased: 5,4 KW, 4,8 considered to be released as heat Discussion with Architecture Area (Enric font) will be held in order to check the availability of the current cooling machines and layout in the facility for the ubication of conducts and blower and cooler if necessary	YES
12	The photobioreactor liquid flow rate will be in the range of 0.25-10 L/h. The gas flow rate in the gas loop will be between 0-120 L/h.	Gas: compressor datasheet Liquid: pump datasheet			Flow requirement (low range) to be potentially reconsidered taking into account the characteristics of the available pump		YES

13	The control system for this bioreactor is done at different levels. At level 0, a number of variables will need to be controlled via a selected Programmable Logic Controller at the local bioreactor level. At levels 1 and 2 (not comprised in this ITT) the general set-points for the local controllers at level 0 will be established according to the general control laws for the Melissa loop.	Control SAT	For the gas loop SAT, DDEQ considers a requirement to have the PLC program completed; SAT could be divided in two parts if necessary	To be checked with SHERPA especially the Gas loop control	YES
14.1	pH in the photobioreactor liquid Nominal value: 6.9 pH units Min/max operational values: Maximum deviation around Closed loop response time: Possible disturbances: the	pH probe datasheet	Only one probe but retractible	Not redundant pH probe during batch phase (top probe located in the harvest line), considered enough if homogeneus mixing is provided. To check internally MPP/ESA the criticality of batch phase (pH evolution, duration) SHERPA to check SHERPA to check	
14.2	Temp. Set point range: 20-40 ºC Minimum/maximum Nominal value: 30ºC Maximum deviation around Closed loop response time: Possible disturbances: the Information about the disturbances: the heat generated by the lamps will depend on the number of lamps and their light intensity. The inlet of liquid flow-rate will vary around 0.25-10 L/h and the temperature of the liquid will be around 4 ºC.	PT100 datasheet	Depending on homogeneity requirements	Not redundant PT 100 (temp. Measurements of pH, DO and redox sensors is considered enough) SHERPA to check SHERPA to check	

14.3	Gas pressure in the top of the PBR Set point: To be defined accurately as part of the proposed design and close to 100 kPa (normal operating relative pressure foreseen around 10 kPa). Maximum deviation around Closed loop response time at Possible disturbances: Information about the	P sensor datasheet		Redundant	Requirement to be updated (200 mBar foreseen) SHERPA to check SHERPA to check
14.4	Gas mass flow rate in gas loop Set point: Depending on the test carried out. The working interval will be 0 - 120 L/h. Maximum deviation around Closed loop response time Possible disturbances: Not Information about de	Flowmeter datasheet		2% precision is feasible except around zero flow	Requirement to be updated for new volume SHERPA to check SHERPA to check
14.5	Liquid mass flow rate in the PBR inlet Set point: Depending on the test carried out. The working interval will be 0.25-10 L/h. Maximum deviation around Closed loop response time Possible disturbances: Not Information about	Flowmeter datasheet		2% precision is feasible	Requirement to be updated for new volume Careful layout needs to be provided (air purge) SHERPA to check SHERPA to check
14.6	Gas mass flow rate in external gas inlet Set point: 10-20 L/h Maximum deviation around Closed loop response time: Possible disturbances: Not Information about the	Gas massflow datasheet	Foreseen 10-20L/h in all the inlets	Flow is not needed bigger to start the plant (not recirculating in the beginning)	Requirement to be updated for new volume SHERPA to check SHERPA to check

14.7	Gas pressure drop in critic filters Set point: To be defined Maximum deviation around the set-point: 5 % of the set-point value in nominal conditions Closed loop response time of gas pressure drop control: less than 5 sec. Possible disturbances: Sources of filter clogging Information about de disturbances: Foams production and liquid outlet by the gas outlet line.			Proposed DeltaP measurement as in CIVa SHERPA to check SHERPA to check	
14.8	Light flux Set point: Defined by level 2 control loop and varying between 0 and 300 Wm^{-2} Maximum deviation around the set-point: 5 % of the set-point value Closed loop response time: less than 10 sec (time to go to min/max light flux) Possible disturbances: Not available Information about de disturbances: Not available	'		Requirement to be updated (0-300 W/m2 depending on nº of lamps) SHERPA to check SHERPA to check	
15	The architecture of this control loops should be embedded in the general control architecture of the Melissa pilot plant. To allow this, the sensors' and actuators' electrical connections should be compatible with those of the quantum Schneider PLC.	Instrument datasheet		pH retractible biomass: non retractible (not available) temperature: non retractible (non available)	YES
16	The following parameters should be measured:				
16.1	pO_2 in the photobioreactor liquid	Instrument list Instrument datasheet PID			YES
16.2	Redox potential in the photobioreactor liquid	Instrument list Instrument datasheet PID			YES
16.3	Liquid level in the photobioreactor	CHARIS sensor to be tested	ahead of the manufacturing (TBD)	Potential inclusion of differential pressure measurement -new PT in the bottom, 2 inches port-, as alternative to the loadcells, and a redundant level measurement on the top part based on CHARIS sensor To check influence of gas bubbling and foam on the level meas. by the CHARIS	TBC

16.3bis	Optionally, the proposed design can consider the total weight of the reactor (shear gauges) which enables a			First approach: Loadcells (3) and BR foreseen standed on the floor, not on the skid, to reduce the disturbances Delta P as an alternative		Taking into account the experience in CIVa, an alternative option is proposed	N.A.
16.4	Biomass concentration in the photobioreactor (0-4 g DW/L)	Instrument list Instrument datasheet PID					YES
16.5	Foam detection system	CHARIS sensor to be tested	ahead of the				
16.6	Gas phase composition, at least CO_2 partial pressure					See Req. 7	TBC
17	The pH, biomass concentration and culture temperature parameters will be redundant at the sensor level. All these probes (on line ones) will be retractile.	Instrument List Instrument datasheet Housing datasheet		PT100 non retractible; redundant with pH, O2 and redox probes Probes in exhaust line non retractible (can be sterilised in situ)		pH retractible biomass: non retractible (not available) temperature: non retractible (non available) probes in exhaust line non retractible (sterilised "in situ")	TBC
18	The photobioreactor will have installed a device to allow the automatic free-cell sampling . In addition, it will be possible to take			Not checked by DeDietrich (not previous info)	This device is not defined yet, so the requirement maybe not fullfilled	Needed fro VFA analysis? Needed automatic? To be confirmed by ESA/MPP Location?	NO
19	The gas loop will have two possible bypasses to allow the gas flow to an analyzing circuit. One located close to the output of the reactor and the other one at the point of	PID				To be maybe rephrased, although it's understood in the inlet, but after the buffer, anyway the highest pressure point	YES
20	The system will have reliable liquid and gas mass flow meters. As an example, electromagnetic flow meters or Coriolis flow meters could be used.	Flowmeters datasheet					YES
21	The system will minimize any liquid condensation in the non-sterile equipment, and it will include easy removal and potential recovery of the condensates.	Cooler + condensate removal filters datasheet				Add condensate filters in MELiSSA gas loop inlet	YES

22	The proposal should consider the needs associated to the following operation modes, all of them to be performed under axeny : Steady state continuous operation (as a basis for the design) Batch operation mode Start-up of the operation of the reactor Stop of the operation of the reactor Changes in operation set points and control of the reactor Occurrence of perturbations and potential accidents (malfunctions of part of the equipment, power failure, etc.) Recovery of the normal operation after a perturbation Interfaces between the equipment and personnel in charge of its operation, such as access to the different parts of the equipment, feeding operation, discharge of the liquid outlet, sampling for analytical control, on line maintenance and troubleshooting, cleaning, calibration, supervision, and general operation. Alarms monitoring	Control loops definition SAT Detail Eng datapackage HAZOP	SHERPA to check Cooling: to include an external cleaning pipe foreseen+1,5-2 inch (to be checked) port on the top of the tank	TBC
23	The sterile parts have to be able to be sterilized using water filtered steam at 1.2 kg/cm^2 for 45 minutes.	Membrane datasheet SS datasheet and certificates Sensors and instruments datasheet Pumps datasheet Filter datasheet		YES
24	The number of mechanical devices such as pumps and compressors that can compromise the sterility of the system must be minimized.	PID Equipment list		YES

25	In the photobioreactor, the propeller closure (axis seal) has to be of a sterile type. If possible, magnetic coupling would be preferable.	Agitator datasheet	When agitator design is available	In principle, single mechanical seal -gastight- (magnetic probably not feasible for the size of the top lid)		Magnetic stirrer: to be checked with DDE France, during the agitator discussion.	TBC
26	All the critic gas and liquid filters will be doubled in parallel, with possibility of sterilization and replacement.	PID Equipment list				OK but not AUTO replacement	YES
27	There will be an automatic system to switch the operating filter to its twin, when filter clogging is detected (a given increase in the pressure drop across the A solution should be provided in case that for any cause rapid clogging of the two filters will occur (such as interruption of gas feeding or pressure release).	Alarms thresholds and actions definition	TBD			See previous: not automated Control action but not for both filters SHERPA to check	NO
28	The increase in pressure drop across the filter due to partial clogging should be considered in the system controlling the gas pressure in the headspace of the PBR.	Pressure control loop definition	TBD			SHERPA to check	
29	The photobioreactor will have an outlet liquid system that will avoid any losses of gas through it (hydraulic seal).					Substituted by a dip tube inmersed in the liquid phase	YES
30	The photobioreactor column walls have to be rigid to sustain a gas overpressure up to 200 kPa (including safety margin during sterilization). Normal operating pressure around 10 kPa relative pressure.	Glass datasheet		Special design to be resistant to 1,5 bar	Resistance higher than 1,5 bar is not feasible for a double-jacket 20 cm diameter glass column	glass resistant up to 1,5 barg	TBC

31	There will be a feeding vessel to store the liquid to feed the photobioreactor.	Equipment list and PID					YES
32	There will be a discharge vessel to store the outlet liquid of the photobioreactor.	Equipment list and PID					YES
33	Characteristics of feeding and discharge vessels: 33.2 Capacity to be sterilized 33.3 Mechanically stirred	Equipment datasheet		250L working vol. Magnetic stirrer like in CIVa	Mistake in RT calculation? Mistake in conversion of units?	25h at max. Rate; 48h at medium flow Magnetc stirrer	TBC
	33.4 The following parameters will be controlled via a PLC with Alarm monitoring: 33.4.1 pressure 33.4.2 Temp. 33.4.3 Liquid level Discharge vessel: 33.4.4 Pressure 33.4.5 Temperature 33.4.6 Liquid level	PLC software description	TBD	 Similar to CIVa: guided microwave Load cells	 Level %: Configured by software	SHERPA to check (all 33.4) 0-200 Kpa is considered enough for steril., overpres. Discharged to buffer 10ºC for the moment 10ºC for the moment	TBC
34	The feeding vessel will have the capability to allow sterile external gas (argon) inlet or the photobioreactor gas inlet.	PID		Alternative loop including two compressors for two different operations: feeding (low flow) vs. filling feed tank and emptying harvest tank (high flow) Defined sequence during filling/emptying is needed		Requirement to be updated: two different loops, from ext. gas as well DDEQ to double-check the need of two different compressors, or a unique one of different characteristics (more than 2 bar), working potentially discontinuously	TBC
35	The discharge vessel will have the capability to discharge the overpressure to the atmosphere or to the photobioreactor gas loop , for pressure compensation.	PID		See Req. 34		Requirement to be updated: different loop, but to atm. OK	TBC
36	Power supply required will be either 220V 50 Hz or triphasic 360V 50 Hz	MPP Facilities description			380V, not 360V		YES
37	Control interface: - Analogical signals - Digital signals 24 V	instruments datasheet					YES

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38	Gas lines: compressed air, technical gas CO_2 and Ar at 4 bar.	MPP Facilities description	He to be included as alternative to Ar	He as an alternative to Ar	TBC
39	Liquid cooling: cool water at 10 °C ; Flow rate to be defined in order to remove heat from the process (up to 500 W from the reacting volume) and the condenser	MPP facilities description Calculations of cooling PID Equipment datasheet Pipelines list	Not considered "500 W reacting volume", but agitator heat in stead		YES
40	Waste discharge connection to a waste vessel in 30 minutes.	Bottom valves datasheet			YES
41	Steam line: 7 bar	MPP facilities description		To be updated: 6 bar	TBC

14.2 Final Decisions on the critical aspects of CII Design

During the Design Review of CII held on 08.06.10, the main critical points were discussed and comments incorporated in a dedicated compliance matrix, and it was agreed that final decisions from MPP/ESA would be taken during week 25, in order that DDEQ would update the proposal and corresponding quotation accordingly.

In the Progress meeting held in UAB between MPP and ESA on 17.06.10 (MPP-MOM-10-0001) a detailed analysis of C-II design was done, mainly to cover a short number of pending aspects to be finally defined to DDEQ, and therefore progress to a final proposal from their side. The main points discussed and decided where:

- the feeding of gas phase to the bioreactor will be maintained at two points: bottom and top of the reactor
- the gas loop to compensate gas phase changes when auxiliar tanks are filled or emptied has been discarded, and an auxiliar gas will be used instead. The use of N2 for this purpose was discarded (reasons: mass balance closure and potential uptake by *R.rubrum)*
- the on-line gas analysis line will not be defined at this point. A T connection will be installed, and initially only off-line analysis will be performed.
- It was confirmed the location of the pH probes, although in the start-up of the compartment (batch phase) this will not allow redundancy in the measurements.
- Level measurement will be finaly defined after the results of the tests on the load cells of Compartment IVa. If the tests are positive, load cells will be also considered for C-II. If the tests are negative, then the same alternative to load cells will be used in both reactors, such as differential pressure measurement, and an alternative system for measurement of both level and foam (CHARIS sensor) will be evaluated for redundancy.

After taking this decisions, MPP informed accordingly DDEQ, so that the final proposal would be prepared and submitted for approval (e-mail from E. Peiro on 28.06.10):

"- Conclusions of the lighting issue: the proposed 250-270 lamps is considered enough, provided that the distribution is compatible with the minimum distance needed for adequate design and maintenance and with the required positioning of sensors, tubing, valves, etc. around the reactor.

- Additional gas inlet direct to headspace vs. only to the bottom: as it is still a issue to be confirmed during the characterisation of the bioreactor (impact on level management, complete utilisation of VFA vs. potential stripping of compounds, etc.), we prefer to maintain, on top of the bottom inlet, the option of recirculating a fraction of the gas flow rate through the photobioreactor and the rest through the headspace, fraction to be variable.

- CO2 and VFA analysis on-line: as we still don't have a clear picture of the need of on-line measurement (potentially CO2 and VFA), the conclusion is of course to provide the adequate drying of the exhaust gas (cooler) and instrumentation for flow calculation, and to provide a "t" for future analyser connection for both inlet and outlet gas streams, and the space for a gas analyser like the one in CIVa (CO2) in case it will be finally installed; for VFA it would be probably just a connection with the existing GC, so space for a new analyser would not be required.

- Lack of redundancy of pH probe during batch phase: in principle the impact on this phase is not considered critical; anyway the possibility of replacing redox sensor by the pH sensor in the bottom is considered enough if redundancy is required in future for the batch phase.

- Gas loop management:

a) Bioreactor gas loop: having into account that a new loop around the compressor has been included in order to guarantee a stable flow, with a new regulating solenoid valve, it could be that the previous "safety" loop through the valve SV-2012-02 to be removed, taking into account that the new loop is already providing this safety, not based on a threshold but in a continuous way.
b) Auxiliary tanks gas loop: having into account the complexity of the overall design of this loop, with two oversized compressors and a big buffer tank, with the need of refrigeration, the limitation in the sequence of filling and emptying tanks, etc., and considering as well that the assurance of anaerobiosis in other compartments is managed

nowadays with external compressed gases (in the future closure of the MELiSSA loop could be different), we prefer to to the same in this case, so to provide the corresponding inert gas supply within the MPP Utilities frame for the hydraulic management of both the feeding and harvesting tank. We are requesting an offer for the installation of Argon bottles in the Department gas Station, and the corresponding pipelines up to the MPP. In that case, Argon in stead of helium would be used for both gasloops, in order to save costs.

- Level measurement: we need immediately a double feedback from METTLER: a) regarding the CIVa issue and b)from METTLER position, to propose or not the loadcell solution for CII. In case this is not existing or not clear, we'll install the differential pressure system and an alternative level instrument(CHARIS if tests are succesful, otherwise another system will be investigated and installed). If METTLER proposes the loadcells, the differential pressure system would be cancelled, and the loadcells would be installed provided that METTLER and DDEQ share with the MPP the risks of a potential failure of the system."