



## **Technical Specification for Alfa Laval VVC Desalination Unit**

**Unit Type: Alfa Laval VVC-2000**

**Specification no.: VVC-2000-9-SW**

**Revision: 01**

**Date: 26-07-2004**

**Made: PMH**

**Reviewed: PMH**

**Approved: AMA**

**Alfa Laval Copenhagen A/S**

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6	Process Description for Alfa Laval VVC Desalination Units

**ATTACHMENTS:**

DOCUMENTS:

Doc. no.	
VVC-2000-9-SW-51	Design and Performance Data
VVC-2000-9-SW-52	Utilities Connections
VVC-2000-9-SW-53	Pump and Motor Data
VVC-2000-9-SW-54	Electrical Component Data
VVC-2000-9-SW-55	Dimension, Weight and Shipping Data - Provisional
VVC-2000-9-SW-57	Spare parts for 2 years Operation
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VVC-2000-9-SW-59	Consumables for 3 Month Operation
VVC-2000-9-SW-60	Seawater Analysis
VVC-2000-9-SW-61	Document List
VVC-2000-9-SW-62	Vendor List

DRAWINGS:

Dwg. no.	
PID-VVC-0003	P&I Diagram
MAT-VVC-001	Materials of Construction
EL-VVC-001	Standard Control Design

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## **1. DESIGN BASIS**

Please refer to Document no.: VVC-2000-9-SW-51.

## **2. ALFA LAVAL SCOPE OF SUPPLY**

<b><u>Item</u></b>	<b><u>Qty.</u></b>	<b><u>Description</u></b>
<b>01</b>	<b>1</b>	ALFA LAVAL desalination plant, Type: VVC-2000 <u>Nominal production capacity: 2000 m<sup>3</sup>/24 hours</u> Each plant includes all necessary equipment, as detailed below:  Each desalination plant consists of the following items for field assembly by Others:  2 Automatic filter 500 µm mesh, for filtration of the re-circulating brine flow.  1 Evaporator in AISI 316L, consisting of a double effect with titanium plate heat exchanger of the falling film type. Evaporator is supplied in 2 sections.  2 Set high efficiency chevron type poly-propylene demisters.  1 Radial fan type vapour compressor, motor driven, housing fabricated in 316L SST and impeller in Duplex SST. Compressor is supplied complete with Frequency Converter requiring 400 - 690V supply.  1 Distillate pump, centrifugal type, complete with spacer coupling and electrical motor mounted on steel base plate. Pump wetted materials are Bronze / Duplex and pump is in accordance with EN / ISO standards.  1 Brine pump, centrifugal type, complete with spacer coupling and electrical motor mounted on steel base plate. Pump wetted materials are Bronze / Duplex and pump is in accordance with EN / ISO standards.  2 Brine recirculation pump, centrifugal type, complete with spacer coupling and electrical motor mounted on steel base plate. Pump wetted materials are Bronze / Duplex and pump is in accordance with EN / ISO standards.  1 Set of seawater and brine piping in Poly-propylene (PP), in accordance with DIN norms and flange pressure rating PN 10. Supplied in spool pieces with fields welds at site by Others.

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**2. ALFA LAVAL SCOPE OF SUPPLY**  
(continued)

<b><u>Item</u></b>	<b><u>Qty.</u></b>	<b><u>Description</u></b>
1		Set of distillate piping in 316L SST, in accordance with DIN norms and flange pressure rating PN 10. Supplied in spool pieces with fields welds at site by Others.
1		Vacuum system consisting of closed loop hydro-ejector system with ejector motive pump.
1		Set of Valves & Instruments in accordance with Alfa Laval's standard vendor list and PID.
1		Set walkway to provide access to the evaporator, for operation and maintenance purposes.
1		Distillate / seawater plate type pre-heater with titanium plates.
1		Brine / seawater plate type pre-heater unit with titanium plates.
1		Set electric heaters to provide energy input during start-up.
2		Plate type vent condenser with titanium plates.
1		Local control panel with Allen Bradley PLC and MCC, together with Frequency Converter, supplied loose and located by Others in an air-conditioned environment in proximity to the plant.
1		ALFA LAVAL Chemical dosing station for anti-scalant, with one dosing pump, and plastic tank (5 days capacity).
1		ALFA LAVAL Mobile Acid cleaning station, consisting of pneumatic transfer pump, plastic hoses and plastic mixing tank.

The scope of supply is fully described in this Specification and the Quotation, amongst others the following are not included in the Alfa Laval scope of supply:

- Civil (including evaporator and compressor supports), erection, (including field welding of evaporator sections).thermal insulation, heat tracing works (if required).
- Piping or cables outside the battery limit.
- Cables, cable trays, cable glands, instrument air piping





### **3. CONSTRUCTION STANDARDS**

As per Alfa Laval's standard specifications wherever applicable, otherwise according to the following :

- 1) Quality assurance based on Alfa Laval's certified ISO 9001 system.
- 2) Electrical equipment and components based on IEC standards.
- 3) Piping in accordance with DIN norms.

### **4. PERFORMANCE TEST PROCEDURE**

After successful commissioning, a performance test will be conducted in accordance with Alfa Laval's standard test procedure.

The Performance Test will have a total duration of 24 hours with the desalination unit operating at design parameters.

During performance test following operation parameters will be registered and recorded:

- Production of Distillate Water
- Electricity consumption.
- Distillate Quality.

The above values shall be at the design values with a tolerance of +/- 5 %. It is required that all utilities will be available on an uninterrupted basis during the commissioning and testing of the unit at the specified design values.

Upon satisfactory completion of the Performance test, the performance Test Certificate will be issued and the plant Taken Over by the customer. Minor discrepancies, requiring corrections, can be noted on a Punch List attachment to the signed Performance Test Certificate with a date on which the parties have agreed that these corrections should be completed.

Should the desalination unit not meet the required guaranteed performance criteria, due to discrepancies attributable to the desalination unit, Alfa Laval shall make the necessary changes to the plant in order to rectify the problem and repeat the performance test.





## **5. PERFORMANCE CRITERIA FOR ALFA LAVAL VVC DESALINATION UNITS**

The desalination system has been designed according to the parameters outlined in the foregoing sections; however, the performance of the system is also subject to the following criteria:

- a) Raw water supply shall be seawater with a concentration of no more than 3.5%. The seawater shall be pre-filtered by the customer to remove suspended solids larger than 0.5 mm. Further, the seawater used shall not contain pollutants, such as oil, fat, detergents, organic matters, micro-organisms, algae, humic matter, mud, clay, sand, etc. Generally the allowance of such undesirable matter shall not surpass a content in the raw water supply that results in a fouling factor of the heat transfer surfaces higher than 15% of the normal practice within international desalination engineering practice. Moreover, the seawater supply shall not contain corrosive substances or gases such as H<sub>2</sub>S, free Chlorine, Fluorine, etc. higher than stated in the specification or other substances, which can alter the physical-chemical properties of the raw water.
- b) Supply of Utilities and consumables such as: Air, electric power shall be provided on a constant basis and at the values for voltage, Phases and Frequency required and specified in this quotation, and not presenting fluctuations of more than 5 %.  
The pretreatment chemicals shall be dosed in the correct amount and type recommended by Alfa Laval. The raw water shall be supplied constant and without variations at the required flow, pressure and temperature as per this quotation.
- c) The equipment shall be properly operated in accordance to the instruction manuals provided by Alfa Laval for this purpose. Critical parameters shall be kept within the design values for: flows, pressures, temperatures, chemicals dosage, evaporating temperature, water recovery factor, maximum allowed brine concentration etc. plus proper observance of the maintenance procedures included in the manuals. Recording of the operation parameters plus written logging of the preventive and corrective maintenance will be the only valid documentation for evaluation of performance of the equipment delivered.  
Improper physical handling of the equipment and components will cause immediate invalidation of guarantees of performance.
- d) No other water shall be used for the desalination plant other than that referred to in a) above.





## **6. PROCESS DESCRIPTION FOR ALFA LAVAL VVC DESALINATION UNITS**

Vapour compression refers to a distillation process where the evaporation of seawater is achieved by the application of heat from the condensation of a compressed vapour. Compression of the water vapour in the VVC type plant is by utilizing a radial fan type compressor driven by electric motor. The compressor compresses the vapour produced in the evaporation part of the evaporator, increases its pressure and temperature and then discharges this mixture as the heating media in the condensing part of the evaporator.

The VVC process operates under vacuum and is the most efficient distillation process available in the market today in terms of energy consumption and water recovery ratio. As the system is electrically driven it is considered a "clean" process, highly reliable and simple to operate and maintain.

### **WORKING PRINCIPLE IN AN ALFA LAVAL VVC SYSTEM**

The supplied seawater first enters the plant and flows in two equal streams through the plate type pre-heaters where it is pre-heated by the exiting brine and distillate streams. The re-combined feed streams pass through the vent condenser before entering the evaporator where it mixes with the circulating brine.

This circulating mixture of brine and feed water is discharged into the evaporator / condenser core in the evaporator, which is based on **plate heat exchangers**. The seawater flows over the evaporation side of the plates in an even and controlled **falling film**. While flowing down the plate surface, the seawater film is heated and partially evaporated by the heat obtained from the condensation of vapour on the other side of the plate. The released vapour passes through a demister and enters the compressor where it is re-compressed and discharged into the condensation side of the evaporator. Here the vapour condenses into pure distillate water yielding its latent heat, and thereby evaporating the seawater, which flows on a falling film on the other side of the plates.

The distillate produced is collected and is extracted by means of a distillate centrifugal pump. A portion of the brine not re-cycled is discharged by means of a brine centrifugal pump.

The evaporation process takes place at temperatures typically in the region of 70°C. Because the evaporation is done at sub-atmospheric conditions, vacuum is created by means of a closed loop ejector system, (driven by water ejector), which during start-up evacuates the air from the system, and during operation, maintains the vacuum by extracting the non-condensable gases. Those are discharged back to the sea.

The VVC plant is provided with a chemical dosing system that injects constantly a polymer based anti-scalant in order to minimize the precipitation of CaCO<sub>3</sub> and MgOH scales.

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<b>Product type:</b>		<b>VVC-2000 ( Vacuum Vapour Compression System )</b>			
<b>Doc. Title:</b>		<b>Design and Performance Data ( per unit )</b>			
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-51</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH	AMA
<b>Design Parameters</b>		<b>Value</b>		<b>Comments</b>	
Capacity per unit		2.000 m <sup>3</sup> /day			
Raw water composition		"Seawater"			
Raw water salinity (%)		3,5			
Brine disposal		Back to sea			
Site Altitude		+ / - 5 m a.s.l.			
Ambient Temperature Min. /Max.		+ 10 / 40 °C			
Type of installation		Out-doors			
Heating energy		Electric power			
<b>Performance Data</b>		<b>Value</b>		<b>Comments</b>	
<b>Distillate:</b>					
Flow		83,33 t/h			
TDS		< 10 ppm (mg/l)			
Pressure		1,5 bar (g)			
Temperature (nominal)		+ 1 - 4 °C		Above feed water temp.	
<b>Sea water (feed):</b>					
Supply flow		193,3 t/h		Including cooling water	
Supply pressure		3,5 bar (g)			
Temperature (min/max)		18 - 35 °C			
<b>Brine blow-down:</b>					
Flow		104,5 t/h			
Pressure		1,0 bar (g)			
Temperature		+ 1 - 4 °C		Above feed water temp.	
<b>Cooling Water Vacuum System</b>					
Supply flow		5,40 t/h			
Outlet Flow		5,49 t/h			
Outlet Temperature		44,9 °C			
<b>Performance:</b>					
Feed water recovery		44,4 %			
<b>Control air supply</b>		4,0 m <sup>3</sup> /h		Min press. 7 bar (g)	
<b>Electric Power supply (pumps):</b>					
Voltage		400 V		Other voltage available	
Frequency		50 Hz			
<b>Electric Power Supply (compressor):</b>					
Voltage		400 - 690 V			
Frequency		50 Hz			
Installed Electrical Load		1.394 kW			
Specific Electrical Consump. Nominal		9,0 kW/m <sup>3</sup>		Based on distillate flow	
Specific Electrical Consump. Guaranteed		10,0 kW/m <sup>3</sup>		Based on distillate flow	
<b>Consumables:</b>					
Antiscalant consumption (ALTREAT 400)		6 - 8 g/m <sup>3</sup>		Alfa Laval ALTREAT 400	

<b>Product type: VVC-2000 ( Vacuum Vapour Compression System )</b>				
<b>Doc. Title: Utilities Connections ( per unit )</b>				
<b>Std. Doc. No: VVC-2000-9 -SW-52</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision: 01</b>	26-07-2004	PMH	PMH	AMA
<b>Piping Connections</b>	<b>Connection Nom. D mm (*)</b>	<b>Pressure at B.L. bar (g)</b>	<b>Flow m<sup>3</sup>/h</b>	<b>Temp. °C</b>
Seawater supply	200	3,5	193,3	18 - 35
Blow Down discharge	150	1,0	104,5	+ 1 - 4
Distillate discharge	125	1,5	83,3	+ 1 - 4
Cooling Water Drain	100	0,0	5,49	45
Drains	50	0,0		
Control Air, dry	25	7,0	4,0	-
<b>Elec. Power Connections</b>	<b>Quantity</b>	<b>Voltage V</b>		<b>Installed Power kW</b>
Control & MCC Panel, 3P and 1N	1	3 x 400		1.394
Earthing, connection to existing installation	1			
(*) Connections according to DIN standard				

<b>Product type:</b>		<b>VVC-2000 ( Vacuum Vapour Compression System )</b>			
<b>Doc. Title:</b>		<b>Pump and Motor Data ( per unit )</b>			
<b>Std. Doc. No:</b>		<b>VVC-2000-9 -SW-53</b>		<b>Date:</b>	<b>Made:</b>
<b>Revision:</b>		<b>01</b>		<b>26-07-2004</b>	<b>PMH</b>
				<b>PMH</b>	<b>AMA</b>
<b>Pump No.</b>		PU2	PU3	PU4	PU5
		Blow down	Distillate	Brine Circ. Pump	Ejector Pump
<b>Quantity</b>	<b>Number</b>	1	1	2	1
<b>Pump Type</b>		Centrifugal	Centrifugal	Centrifugal	Centrifugal
<b>Norm</b>		ISO / EN	ISO / EN	ISO / EN	ISO / EN
<b>Medium</b>		S.W. conc.	Distillate	S.W. Conc.	S.W.
<b>Gravity (nominal)</b>	<b>kg/m<sup>3</sup></b>	1.033	990	1.033	1.024
<b>Temperature</b>	<b>°C</b>	70	70	70	18 - 35
<b>Salinity</b>	<b>%</b>	6,8	< 10 ppm	6,8	3,5
<b>Flow, nominal</b>	<b>m<sup>3</sup>/h</b>	104,5	83,3	640	100,0
<b>Head</b>	<b>m W.C.</b>	35	40	15	40
<b>NPSH</b>	<b>m W.C.</b>	3,5	3,5	3,5	3,5
<b>Pump Eta</b>	<b>%</b>	60%	60%	60%	60%
<b>Motor</b>					
<b>Speed</b>	<b>r.p.m.</b>	1.500	3.000	1.500	1.500
<b>Efficiency</b>	<b>%</b>	90%	90%	94%	90%
<b>Power absorbed</b>	<b>kW</b>	17,2	15,0	45,0	18,6
<b>Power consumed</b>	<b>kW</b>	19,1	16,7	47,9	20,7
<b>Motor rating</b>	<b>kW</b>	30,0	22,0	55,0	30,0
<b>** ) Start-up condition</b>					

<b>Product type:</b> VVC-2000 ( Vacuum Vapour Compression System )									
<b>Doc. Title:</b> Electrical Components Data ( per unit )									
<b>Std. Doc. No:</b> VVC-2000-9 -SW-54						<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b> 01						26-07-2004	PMH	PMH	AMA
Type	Description	Quantity	Power rating kW	Power installed kW	Voltage/Freq. V / Hz	Nom. Current Amp.	Peak Current Amp	Protection	Insulation
Motor	Vapor Compressor	1	750	750,00	3 x 690 / 50	738,3	-	IP 55	F
Motor	Blow Down Pump	1	30,00	30,00	3 x 400 / 50	44,3	354,4	IP 55	F
Motor	Distillate Pump	1	22,00	22,00	3 x 400 / 50	32,5	259,9	IP 55	F
Motor	Brine Circ. Pump	2	55,00	110,00	3 x 400 / 50	81,2	649,7	IP 55	F
Motor	Ejector Pump	1	30,00	30,00	3 x 400 / 50	44,3	354,4	IP 55	F
Motor	Chem. Dosing	1	0,50	0,50	1 x 230 / 50	2,7	-	IP 55	F
Heater	Electrical Heater	9	50,00	450,00	3 x 400 / 50			IP 55	F
Panel	Electrical Panel	1	1,50	1,50	3 x 400 / 50	-	-	-	-
<b>TOTAL POWER INSTALLED FOR DESALINATION UNIT</b>				1.394					

<b>Product type: VVC-2000 ( Vacuum Vapour Compression System )</b>					
<b>Doc. Title Dimension, Weight and Shipping Data - Provisional ( per unit )</b>					
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-55</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH	AMA

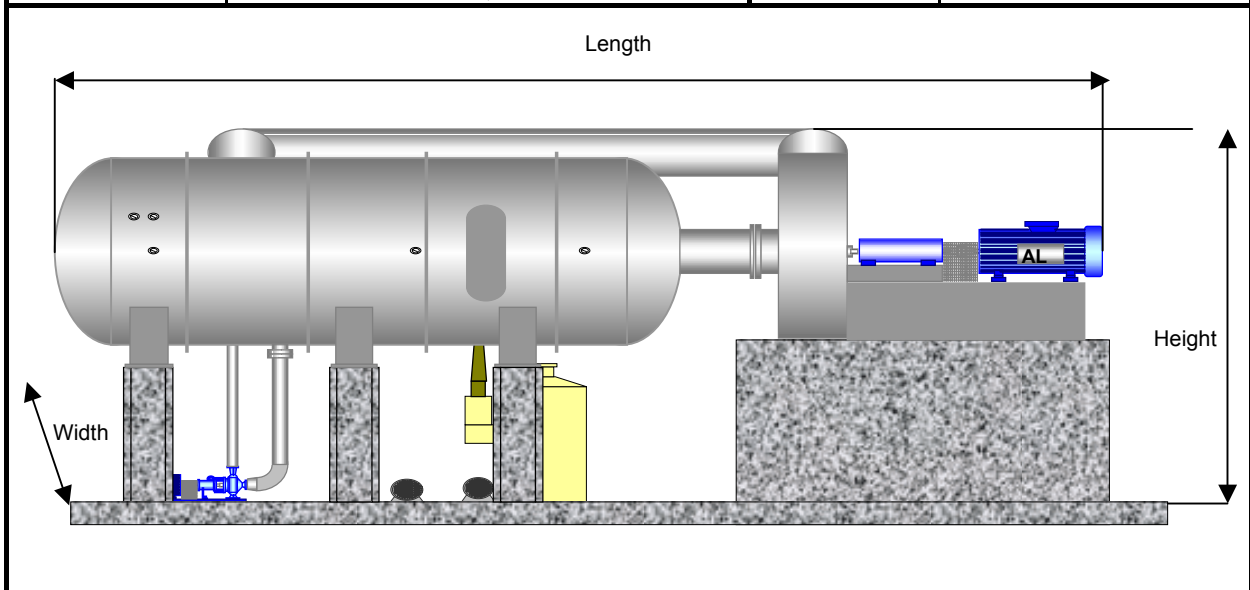
**Shipping Data**

Component	No. of consignment	Dimension l x w x h m	Consignment Weight ton	Total Weight ton	Total Volume m <sup>3</sup>
Evaporator	2	17 x 3.5 x 4.0	32,00	64,00	476
Steam pipe	in container				
Vapor compressor	1	6,0 x 4,0 x 4,2	18,00	18,00	101
40 feet container (*)	3	12.19 x 2.44 x 2.59	30,48	91,44	232
<b>SUMMATION</b>					<b>809</b>

(\*) Maximum Weight of container

**Dimension & Weight**

Dimension	m	Weight	ton
Total Length	40,5	Empty	98
Total Width	7	Water filled	355
Total Height	9,0	In operation	131
Service area around unit	2,0		



<b>Product type: VVC-2000 ( Vacuum Vapour Compression System )</b>					
<b>Doc. Title: Spare Parts for 2 years operation ( per unit )</b>					
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-57</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH	AMA
<b>Tag No.</b>	<b>Article No.</b>	<b>Description</b>	<b>Quantity</b>	<b>Notes</b>	
PU2	VVC-2000-PU2-001	<b>Blow Down Pump</b> Mechanical seal	1		
	VVC-2000-PU2-002	Set of Gaskets	1		
	VVC-2000-PU2-003	Set of motor Bearings	1		
	VVC-2000-PU2-004	Set of wear rings	1		
PU3	VVC-2000-PU3-001	<b>Distillate Pump</b> Mechanical Seal	1		
	VVC-2000-PU3-002	Set of Gaskets	1		
	VVC-2000-PU3-003	Set of motor Bearings	1		
	VVC-2000-PU3-004	Set of wear rings	1		
PU4	VVC-2000-PU4-001	<b>Brine Circ. Pump</b> Mechanical Seal	1		
	VVC-2000-PU4-002	Set of Gaskets	1		
	VVC-2000-PU4-003	Set of motor Bearings	1		
	VVC-2000-PU4-004	Set of wear rings	1		
PU5	VVC-2000-PU5-001	<b>Ejector Pump</b> Mechanical Seal	1		
	VVC-2000-PU5-002	Set of Gaskets	1		
	VVC-2000-PU5-003	Set of motor Bearings	1		
	VVC-2000-PU5-004	Set of wear rings	1		
CR	VVC-2000-CR-001	<b>Compressor</b> Carbon rings	2		
	VVC-2000-CR-002	Set of BearingsGaskets	2		
VE	VVC-2000-VE-001	<b>Vessel</b> Set of Gaskets for man holes	2		
	VVC-2000-VE-002	Set of Anodes	2		
EW	VVC-2000-EW-001	<b>Evacuation Ejector</b> Set of Gaskets	1		
CU	VVC-2000-CU-001	<b>Antiscalant Dosing Unit</b> Dosing pump	1		
	VVC-2000-CU-002	Injection nozzles	1		
	VVC-2000-CU-003	Set of Gaskets	1		
VA1	VVC-2000-VA1-001	<b>Control valve</b> Actuator	1	each type	
	VVC-2000-VA1-002	Gasket for spindle	1	each type	
	VVC-2000-VA1-003	Solenoid valve	2		
	VVC-2000-VA1-004	Positioner	1	each type	
VA	VVC-2000-VA-001	<b>Manual valves</b> Valve lining	2	each size	
	VVC-2000-VA-002	Valve disc	1	each size	
	VVC-2000-VA-003	Instrument valve	2	each size	

<b>Product type: VVC-2000 ( Vacuum Vapour Compression System )</b>					
<b>Doc. Title: Spare Parts for 2 years operation ( per unit )</b>					
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-57</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH	AMA
<b>Tag No.</b>	<b>Article No.</b>	<b>Description</b>	<b>Quantity</b>	<b>Notes</b>	
T	VVC-2000-LT-001	<b>Transmitters</b> Level Transmitter complete	1		
	VVC-2000-PT-002	Pressure Transmitter complete	1		
	VVC-2000-TT-003	Temp. Transmitter complete	1		
TI	VVC-2000-TI-001	Temperature gauge	1	each type	
PI	VVC-2000-PI-001	Pressure gauge	1	each type	
MC	VVC-2000-MC-001	<b>MCC (if applicable)</b> Set of Aux. Relays	1		
	VVC-2000-MC-002	Set of Bulbs	1		
	VVC-2000-MC-003	Circuit Breaker	1		
PA	VVC-2000-PA-001	<b>Control Panel</b> PLC battery	1		
	VVC-2000-PA-002	PLC digital input card	1		
	VVC-2000-PA-003	PLC digital output card	1		
FF	VVC-2000-FF-001	<b>Feed water filter</b> Filter basket element	1		
	VVC-2000-FF-002	Set of Gaskets	1		
	VVC-2000-FF-003	Drain Valve	1		
CM	VVC-2000-CM-001	<b>Conductivity Meter</b> Cond. Electrode element	1		

<b>Product type: VVC-2000 ( Vacuum Vapour Compression System )</b>				
<b>Doc. Title: Spare Parts for Commissioning ( per unit )</b>				
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-58</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH
		<b>Approved:</b>		AMA
<b>Tag No.</b>	<b>Article No.</b>	<b>Description</b>	<b>Quantity</b>	<b>Notes</b>
PU2	VVC-2000-PU2-001	<b>Blow Down Pump</b> Mechanical seal	1	
	VVC-2000-PU2-002	Set of Gaskets	1	
PU3	VVC-2000-PU3-001	<b>Distillate Pump</b> Mechanical Seal	1	
	VVC-2000-PU3-002	Set of Gaskets	1	
PU4	VVC-2000-PU4-001	<b>Brine Circ. Pump</b> Mechanical Seal	1	
	VVC-2000-PU4-002	Set of Gaskets	1	
PU5	VVC-2000-PU5-001	<b>Ejector Pump</b> Mechanical Seal	1	
	VVC-2000-PU5-002	Set of Gaskets	1	
CR	VVC-2000-CR-001	<b>Compressor</b> Set of Gaskets	1	
VE	VVC-2000-VE-001	<b>Vessel</b> Set of Gaskets for man holes	1	
EW	VVC-2000-EW-001	<b>Evacuation Ejector</b> Set of Gaskets	1	
CU	VVC-2000-CU-001	<b>Antiscalant Dosing Unit</b> Injection nozzles	1	
	VVC-2000-CU-002	Set of Gaskets	1	
VA1	VVC-2000-VA1-001	<b>Control valve</b> Solenoid valve	1	
	VVC-2000-VA1-002	Positioner	1	each type
VA	VVC-2000-VA-001	<b>Manual valves</b> Instrument valve	1	each size
TI	VVC-2000-TI-001	Temperature gauge	1	each type
PI	VVC-2000-PI-001	Pressure gauge	1	each type
MC	VVC-2000-MC-001	<b>MCC (if applicable)</b> Set of Aux. Relays	1	
	VVC-2000-MC-002	Set of Bulbs	1	
PA	VVC-2000-PA-001	<b>Control Panel</b> PLC battery	1	
FF	VVC-2000-FF-001	<b>Feed water filter</b> Set of Gaskets	1	
	VVC-2000-FF-002	Drain Valve	1	
CM	VVC-2000-CM-001	<b>Conductivity Meter</b> Cond. Electrode element	1	

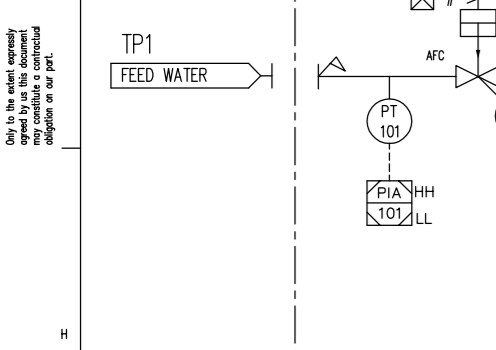
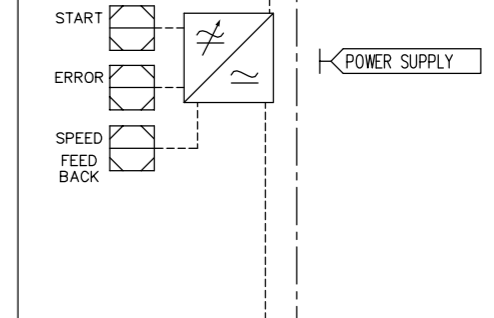
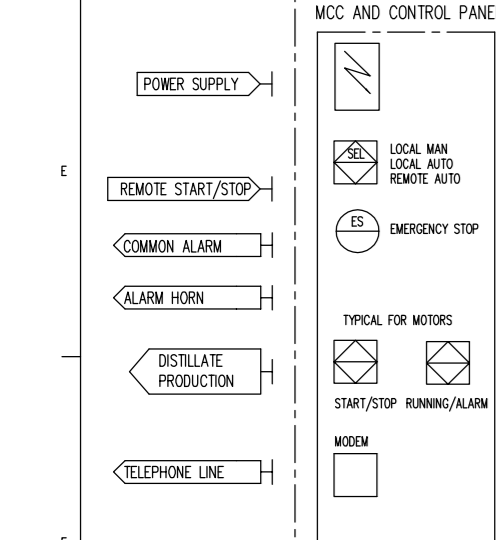
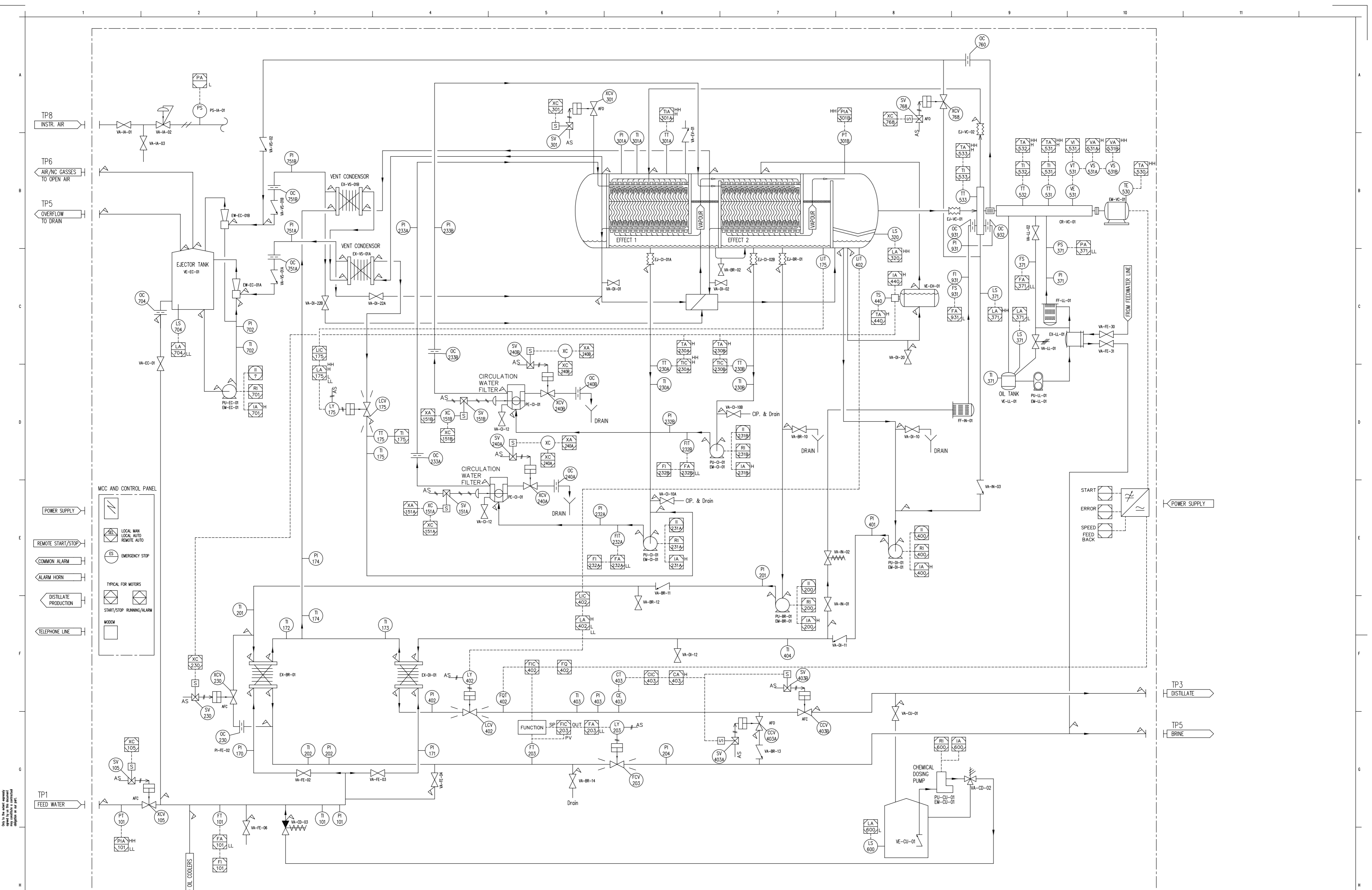


<b>Product type:</b>		<b>VVC-2000 ( Vacuum Vapour Compression System )</b>			
<b>Doc. Title:</b>		<b>Consumables for 3 month operation ( per unit )</b>			
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-59</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH	AMA
<b>Consumable</b>	<b>Type</b>				<b>Quantity kg Normal</b>
Antiscalant	ALTREAT 400				3.339
Dechlorination (**)	Sodium Metha Bisulfite				0
Cleaning agent (*)	Sulfamic acid				1.359
Grease	For pump motors				1
(*) Data for one year, others for 3 months					
(**) Only when free Chlorine in feed water is higher than 0.5 ppm.					

<b>Product type:</b>		<b>VVC-2000 ( Vacuum Vapour Compression System )</b>			
<b>Doc. Title:</b>		<b>Design Water Analysis</b>			
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-60</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH	AMA
<b>Component</b>		<b>Value</b>		<b>Comments</b>	
TSS		< 0,5	p.p.m. (mg/l)		
pH		8,26			
TDS		35.175,0	p.p.m. (mg/l)		
Sulphates	SO <sub>4</sub> <sup>2-</sup>	2.701,7	p.p.m. (mg/l)		
Chlorides	Cl <sup>-</sup>	19.360,5	p.p.m. (mg/l)		
Bicarbonate	HCO <sub>3</sub> <sup>-</sup>	142,5	p.p.m. (mg/l)		
Fluoride	F <sup>-</sup>	1,3	p.p.m. (mg/l)		
Bromium	Br <sup>-</sup>	65,9	p.p.m. (mg/l)		
Iridium	I <sup>-</sup>	0,05	p.p.m. (mg/l)		
Calcium	Ca <sup>++</sup>	408,1	p.p.m. (mg/l)		
Magnesium	Mg <sup>++</sup>	1.297,5	p.p.m. (mg/l)		
Potassium	K <sup>+</sup>	387,6	p.p.m. (mg/l)		
Sodium	Na <sup>+</sup>	10.767,8	p.p.m. (mg/l)		
Silica	Si <sup>++++</sup>	2,4	p.p.m. (mg/l)		
Barium	Ba <sup>++</sup>	0,0	p.p.m. (mg/l)		
Spec. gravity at 20 °C		1.024,0	kg/m <sup>3</sup>		
<b>Ref.</b>	<b>Standard Sea Water according to OSW 3</b>				

<b>Product type:</b>	<b>VVC-2000 ( Vacuum Vapour Compression System )</b>			
<b>Doc. Title:</b>	<b>Document List</b>			
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-61</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH
<b>Approved:</b>	AMA			
<b>Document Title</b>	<b>Comments</b>			
Quality Plan				
Inspection & Test Plan				
Monthly Progress Report				
Monthly Project Schedule				
Process Flow Diagram (PFD)				
Piping & Instrument Diagram (PID)				
Equipment List				
Foundation Plan				
Valve List				
Instrument List				
General Arrangement				
Transport & Lifting Drawing (if applicable)				
Single Line Drawing (electric)				
Wiring Diagram				
Recommended 2 years spare parts list				
O & M Manual				

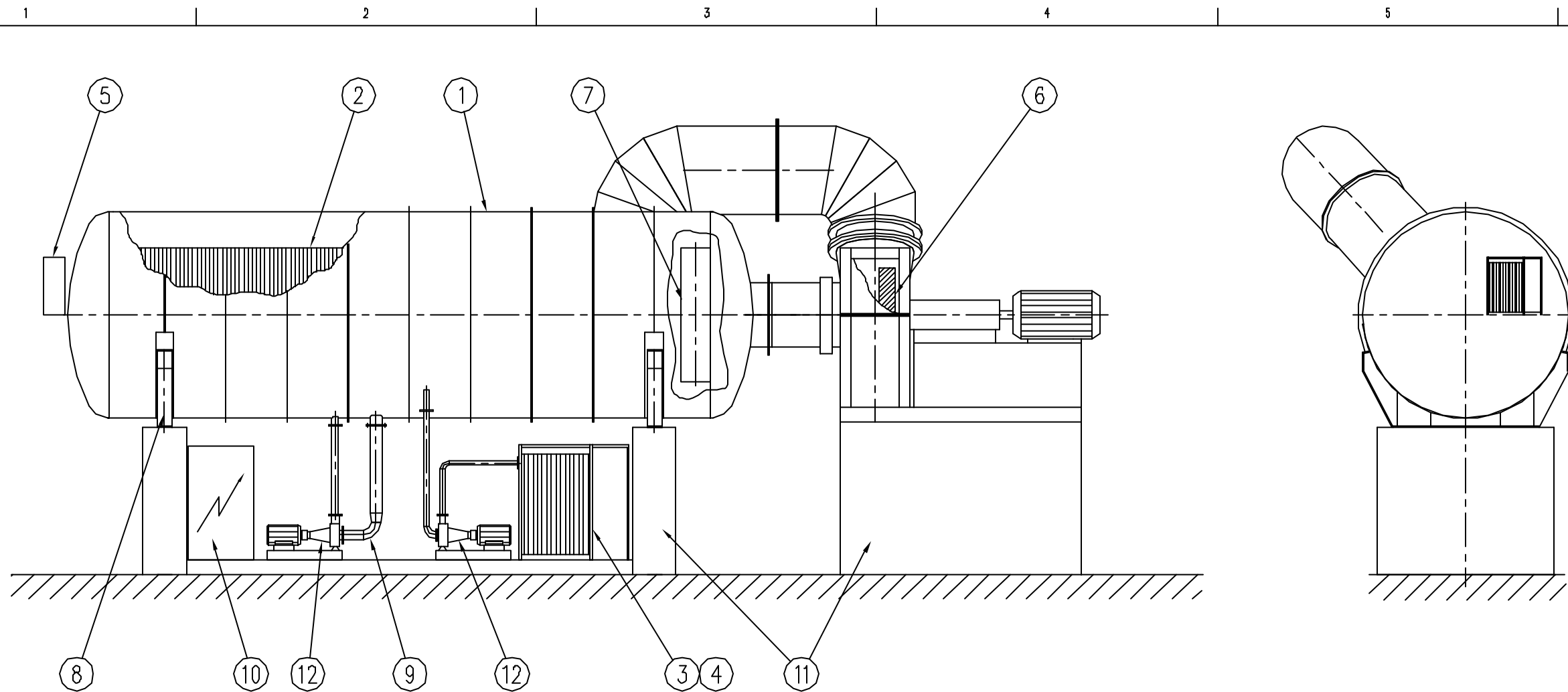
<b>Product type:</b>	<b>VVC-2000 ( Vacuum Vapour Compression System )</b>				
<b>Doc. Title:</b>	<b>Vendor List</b>				
<b>Std. Doc. No:</b>	<b>VVC-2000-9 -SW-62</b>	<b>Date:</b>	<b>Made:</b>	<b>Reviewed:</b>	<b>Approved:</b>
<b>Revision:</b>	<b>01</b>	26-07-2004	PMH	PMH	AMA
<b>Equipment Item</b>	<b>Vendor</b>				
Pumps	FAPMO, KSB				
Compressor	Piller, Flakt				
Motors	ABB, Siemens				
Vacuum Ejector	Progetti, Korting, Croll Reynolds				
Chemical Inj. Pumps	Prominent				
Filters	Alfa Laval				
Manual Valves	Alfa Laval std.				
Check Valves	Alfa Laval std.				
Control Valves	Alfa Laval std.				
Pressure Transmitters	Endress & Hauser				
Temperature Transmitters	Endress & Hauser				
Thermometers	WIKA				
Pressure Gauges	WIKA				
Level Transmitters	Endress & Hauser				
Conductivity Analyser	Endress & Hauser				
PLC	Allen Bradley SLC				
I/P Positioner	Siemens				



LIMIT OF SCOPE OF ALFA LAVAL SUPPLY

Rev. No.	Revision text	Date	Drawn	Checked	Appr.
<p>Title: STANDARD PID - VVC VVC - 2 Effect</p>					
Proj No	Proj Type	Proj Name			
ISO 2768-M or ISO 13920-B	ISO	Alfa Laval Copenhagen A/S - Denmark			
Dimensions Without Tolerances:	Size	Location			
08.06.2004	A0				
Drawn: ABH	Scale: ~	Sheet: ~			
Method E	Drawing No	Rev.			
Approved: pmh	Sheet		PID VVC 0003.00		

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	Description	Material
1	Evaporator vessel	Stainless Steel AISI 316L
2	Evaporator-condenser - heat transfer surface	Titanium
3	Distillate preheater - heat transfer surface	Titanium
4	Brine preheater - heat transfer surface	Titanium
5	Vent condenser - heat transfer surface	Titanium
6	Compressor Impeller/housing	Stainless Steel Duplex/AISI 316L
7	Demisters	PP (Polypropylene)
8	Support saddles	Stainless Steel AISI 316L
9	Piping: Sea water and Brine Distillate	PP (Polypropylene) Stainless Steel AISI 316L
10	MCC & Control Panel	
11	Foundation e)	Concrete
12	<b>Pumps</b>	
	<b>Medium</b>	<b>Housing</b>
	<b>Seawater and Brine</b>	<b>Bronze or Duplex</b>
	<b>Distillate</b>	<b>Bronze or Duplex</b>
		<b>Impeller</b>
		<b>Bronze or Duplex</b>
		<b>Bronze or Duplex</b>
		<b>Seal</b>
		<b>Single mechanical</b>
		<b>Single mechanical</b>

e) Not included in Alfa Laval's scope of supply

Rev.	Revision	Date	Revised	Reviewed	Approved
<b>Alfa Laval</b> Alfa Laval Copenhagen A/S DENMARK		Title STANDARD MATERIALS DESALINATION UNIT TYPE VVC			
Dimensions without tolerances: DS/EN 22768-M or ISO 13920-B		ISO method E	Scale	Project name STANDARD	
			Size A2	Project type Project no.	
Date 21.10.03	Drawn AJA	Reviewed PMH	Approved PMH	Drawing No. MAT VVC 001	
Replace dwg. no.				Rev. 00	

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STANDARD CONTROL DIAGRAM / DESIGN VVC

