DOC NUMBER: **569-DB7A-PRO-500-002**	CLIENT NUMBER: **PRD-MEC-MDE-004**
CLIENT: **TAKEDA**	
PROJECT **BURITI EPCMV PROJECT**	

FINAL DRUG PRODUCT
HEATING HOT WATER SYSTEM
DESCRIPTION REPORT

0	30JUL2021	ISSUED FOR CONSTRUCTION	JRM	LFF	MSS
A	25JUN2021	90% DD ISSUE	MSN	CCO	MSS
RE	DATE	DESCRIPTION	EXEC	CHECK	APPROV

1. REVISION HISTORY

Rev	Reason For Change
A	90% DD ISSUE
0	ANSWERING TAKEDA COMMENTS – SUBMITAL 333.0 UPDATED ACCORDING TO CALCULATION REPORT, REVISION 0

2. PURPOSE

This document is intended to describe the process characteristics for the Compressed Air generation System, Building 7A – Final Drug Product - FDP, intended to Buriti Project, located at Hemobrás site in Goania – Pernambuco state, Brazil.

3. REFERENCE

The following documents were used as reference:

Item	Number	Documents List – Building 7A
01	PRD-MEC-CLC-005	HEATING HOT WATER SYSTEM CALCULATION (HVAC) – CALCULATION REPORT
02	7A-M-0-5-47	P&I DIAGRAM DRUG PRODUCT - HEATING HOT WATER SYSTEM (HVAC) (1/4)
03	7A-M-0-5-48	P&I DIAGRAM DRUG PRODUCT - HEATING HOT WATER SYSTEM (HVAC) (2/4)
04	7A-M-0-5-49	P&I DIAGRAM DRUG PRODUCT - HEATING HOT WATER SYSTEM (HVAC) (3/4)
05	7A-M-0-5-50	P&I DIAGRAM DRUG PRODUCT - HEATING HOT WATER SYSTEM (HVAC) (4/4)

4. PROCESS DESCRIPTION

The building 7A has a Heating Hot Water Skid, located on the first floor to meet the demand at HVAC equipment located on the first and the ground floor of this building.

The water heating system consists by:

- 1 Heating skid (air separator + pumps + heat exchanger with temperature control)
- 1 Expansion tank
- 1 Chemical dosing system + make-up.

The Heating Hot Water Skid, was sized based on the following conditions:

- DESIGN CONDITION – Sizing Criterion for heating hot water skid, lines, valves and pumps - 100% of the capacity of all HVAC´s equipment and an oversizing of 21%, where the excess of flowrate is diverted to a future expansion (tie-in).

- MAXIMUM OPERATING CONDITION –100% of the capacity of all HVAC´s equipment operating at the same time.

- MINIMUM OPERATING CONDITION
  - 50%: Sizing Criterion for the Heat hot water skid (Heat Exchanger).
  - 10%: Sizing Criterion for valves and pumps – 10% of the capacity off all Reheat Coil Units capacities operating at the same time.

The system is sized for the following thermal load, required by HVAC:

- Design Capacity: 574,615.02 kcal/h kcal/h – considering future expansion with TIE-IN-M-1-19 and TIE-IN-M-1-20
- Maximum Capacity: 469,591.83 kcal/h.
- Minimum Capacity: 47,667.00 kcal/h.

The energy source to heat the water is Plant Steam through a 6” line (line 6"-IS1B-790103-CS1-HC) at 2.0 barG and to attend the thermal loads indicated above, there is a temperature control valve (TV-970005) with the following flow rates:

- Design Condition: 1,103.54 kg/h
- Maximum Operating Condition: 901.85 kg/h
- Minimum Operating Condition: 452.16 kg/h

This valve is controlled by the Temperature Transmitter (TIT/TIC- 970005) to keep the hot water flow rate after the heat exchanger HX-7A-1 at 61.1°C.

The skid has two pumps where one is operating, and the other is stand-by with the following conditions:

- Design Condition – Flow rate = 67.7 m³/h / Head = 35.0 mlc
- Maximum Operating Condition – Flow rate = 58.8 m³/h / Head = 31.7 mlc
- Minimum Operating Condition – Flow rate = 20.2 m³/h / Head = 15.7 mlc

These pumps are controlled by the differential pressure transmitter PDIT-970005 maintaining constant the pressure drop of 1.27 bar at the main distribution header. This instrument is installed at a distance of 2/3 of the main distribution pipe total length, to guarantee a good control.

The hot water circulates through the system, feeding the coils used in HVAC. The return temperature is 52.5°C at design condition and 58.7°C at minimum condition. At the suction of the pumps is installed an air separator with a capacity of 67.7 m³/h.

The characteristics of each equipment / system are shown below.

4.1 CHEMICAL FEEDING SYSTEM AND MAKE-UP

The chemical feeding system is formed by chemical dosing tank (TK-7A-6), chemical dosing pump (BM-7A-5 / M-BA-7A-5) and a spill containment pallet (CN-7A-5).

The system is efficient in the prevention of slime generation, scaling and corrosion. It is used when make-up of industrial water is required. The chemical dosing is made by flexible hose connected to the manual block valve (HV-9700420) in the inlet line of industrial water (line 1"-DW-970008-CS1-NI).

The chemical feeding system has the following instruments:

CHEMICAL DOSING SYSTEM	INSTRUMENT	FUNCTION
Containment Pallet	LSH-9700422	High Level Alarm (Chemical spill)
Motor Pump	HS-9700422	ON/OFF – Hand Switch
Chemical Dosing Tank	LSL-9700422	Low Level Alarm

The Heating Hot Water Distribution System is a closed system with make-up of Industrial Water. The make-up is supplied on the first floor from Water for Industrial System (line 1"-DW-610006-PP1-NI) with a flow rate of 67LPM (4 M3/HR), a pressure of 1.4 barG at ambient temperature. There is a manual battery limit valve with a diameter of 1" (HV-9700418).

The make-up system has the following instruments:

MAKE-UP SYSTEM	INSTRUMENT	FUNCTION
Industrial Water - Inlet Line	XV-970008	Automatic on-off valve to be opened at the low pressure (PSL-970001) and closed at high pressure (PSH-970001)

4.2 EXPANSION TANK

Pressurized expansion tank (TK-7A-5) with nominal capacity of 0,14 m³ to compensate the fluid thermal expansion due to increase of temperature in the system.

In case of loss fluid in the system, it is necessary to supply water through the make-up system.

The expansion tank has the following instruments:

PRESSURIZED EXPANSION TANK	INSTRUMENT	FUNCTION
Pressurized Expansion Tank - Outlet Line	PSV-9700419	Pressure Safety Valve for relief system

4.3 HEATING HOT WATER SKID

The Heating Hot Water Skid (HX-7A-1) consists by:

- 1 Heat Exchanger – Plate Heat Exchanger,
- 2 pumps (one operating and the other stand-by),
- 1 Air Separator
- 1 Control panel PLC for temperature and speed pump control.

4.4 HEAT EXTCHANGER

The plate heat exchanger has the conditions indicated below.

- Design Condition:

HEAT EXCHANGER - HX-7A-1		
SIDE - WATER		
Thermal Load	574,615.02	kcal/h
Flow rate	66,815.70	kg/h
Temperature Inlet	52.5	°C
Temperature Outlet	61.1	°C
SIDE – PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	1,103.54	kg/h

- Maximum Operating Condition:

HEAT EXCHANGER - HX-7A-1		
SIDE - WATER		
Thermal Load	469,591.83	kcal/h
Flow rate	57,974.30	kg/h
Temperature Inlet	53.0	°C
Temperature Outlet	61.1	°C
SIDE – PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	901.85	kg/h

- Minimum Operating Condition:

HEAT EXCHANGER - HX-7A-1		
SIDE - WATER		
Thermal Load	235,439.36	kcal/h
Flow rate	36,787.40	kg/h
Temperature Inlet	54.7	°C
Temperature Outlet	61.1	°C
SIDE – PLANT STEAM		
Operating Pressure	1.5	barG
Enthalpy of Vaporization	520.7	kcal/kg
Flow rate	452.16	kg/h

4.5 PUMPS

The pumps are horizontal centrifugal type designed for a flowrate of 67,7m3/h and a manometric height of 35m. For these operating conditions the selected pump was selection with a motor of 12.5 hp.

The pump has a pressure control with shut down in case of the low low pressure.

4.6 AIR SEPARATION

Air separator flow rate is the same from the pump 67,7 m3/h, located in the inlet line of the pump (line 4"-HHWR-970001-CS1-HC).

The air separator prevents the accumulation of air in the system, and keeps the system running efficiently, avoiding downtime and maintenance cost.

4.6.1 Temperature Control

Hot water heating skid is controlled by temperature control valve (TV-970005), controlled by the temperature transmitter (TIT-970005) at the heat exchanger outlet to maintain constant the temperature of 61.1°C. In case of high temperature, the ON-OFF valve (XV-970005) blocks the steam inlet until the temperature returns to the normal condition.

The Heating Hot Water Skid (HX-7A-1) has the following instruments:

HEATING HOT WATER SKID	INSTRUMENT	FUNCTION
Suction Line 4"-HHWR-970001-CS1-HC	PIT-970001	Pressure Indication Transmitter Low Pressure Switch – open the make-up valve (XV-970008) and start the dosing pump BM-7A-5 High Pressure Switch – close the make-up valve (XV-970008) and shut down the dosing pump BM-7A-5 High High Pressure Alarm Low Low Pressure switch - shut down the hot water pump
	TI-970002	Temperature Indication
	TIT-970003	Temperature Indication Transmitter High Temperature Alarm Low Temperature Alarm
Pump- Inlet line	PI-970001	Pressure indication
Pump- Output line	PI-970003	Pressure indication
Motor Pump	SC-970001	Control Speed Controlled by Differential Pressure Transmitter PDIT-970001.

HEATING HOT WATER SKID	INSTRUMENT	FUNCTION
Discharge Pump	PI-970002	Pressure indication
Motor Pump (stand-by)	SC-970002	Control Speed Controlled by Differential Pressure Transmitter PDIT-970001.
Discharge Pump	PI-970004	Pressure indication
Heat Exchanger – Steam Side	TV-970005	Control Valve to keep constant the water temperature.
	XV-970005	Automatic on-off valve High Temperature Blocks the steam (TIT-970005)
Heat Exchanger – Hot Water Side	PIT-970005	Pressure Indication Transmitter High Pressure - Alarm Low Pressure - Alarm
	TI-970005	Temperature Indication
	TIT/TIC-970005	Temperature Indication Transmitter Temperature Control - to keep constant the water temperature. High Temperature - Alarm Low Temperature - Alarm
	PSV-970005	Pressure Safety Valve for system relief

4.7 CONSUMERS

The Heating Hot Water Distribution System of HVAC has the following consumers in the Building 7A with their respective operational characteristic:

TAG	Vol. Flow Rate (m^3/hr)	Mass. Flow Rate (kg/hr)	P in (barG)	P out (barG)	ΔP (bar)
RH-A2001-1	1.30	1279.28	3.20	2.70	0.50
RH-A2004-1	0.97	951.83	2.69	2.19	0.50
RH-A2005-1	0.26	251.95	2.73	2.23	0.50
RH-A2007-1	0.36	349.94	2.62	2.12	0.50
RH-A2017-1	0.38	377.93	2.63	2.13	0.50

TAG	Vol. Flow Rate (m³/hr)	Mass. Flow Rate (kg/hr)	P in (barG)	P out (barG)	ΔP (bar)
RH-A2023-1	0.63	615.89	3.03	2.53	0.50
RH-A2030-1	0.23	223.96	2.77	2.27	0.50
RH-A2040-1	0.17	167.97	3.07	2.57	0.50
RH-A2041-1	1.77	1735.68	3.19	2.69	0.50
RH-A2044-1	1.42	1399.75	2.72	2.22	0.50
RH-A2044-2	1.42	1399.75	2.72	2.22	0.50
RH-A2044-3	1.42	1399.75	3.10	2.60	0.50
RH-A2046-1	0.43	419.92	2.99	2.49	0.50
RH-A2006-1	0.11	111.98	2.76	2.26	0.50
RH-A2008-1	0.13	125.98	2.63	2.13	0.50
RH-A2010-1	0.10	97.98	3.15	2.65	0.50
RH-A2011-1	0.23	223.96	2.82	2.32	0.50
RH-A2012-1	0.19	181.97	3.04	2.54	0.50
RH-A2013-1	0.19	181.97	2.83	2.33	0.50
RH-A2014-1	0.46	447.92	2.95	2.45	0.50
RH-A2015-1	0.21	209.96	2.99	2.49	0.50
RH-A2016-1	0.09	83.98	2.68	2.18	0.50
RH-A2018-1	0.09	83.98	2.91	2.41	0.50
RH-A2019-1	0.19	181.97	2.94	2.44	0.50
RH-A2020-1	0.09	83.98	3.18	2.68	0.50
RH-A2021-1	1.48	1455.74	3.04	2.54	0.50
RH-A2021-2	1.48	1455.74	3.01	2.51	0.50
RH-A2022-1	0.06	55.99	3.02	2.52	0.50
RH-A2042-1	0.34	335.94	3.17	2.67	0.50
RH-A2049-1	0.19	181.97	2.99	2.49	0.50
RH-A2003-1	1.28	1259.77	2.77	2.27	0.50
RH-A2003-2	0.28	279.95	2.82	2.32	0.50
RH-A2009-1	0.28	279.95	2.87	2.37	0.50
RH-A2028-1	0.20	195.96	2.84	2.34	0.50
RH-A2029-1	0.85	839.85	2.75	2.25	0.50
RH-A2033-1	1.07	1049.81	2.87	2.37	0.50
RH-A2033-2	1.07	1049.81	2.95	2.45	0.50
RH-A2034-1	0.19	181.97	2.64	2.14	0.50
RH-A2035-1	0.23	223.96	2.66	2.16	0.50
RH-A2036-1	1.82	1791.67	2.87	2.37	0.50
RH-A2036-2	0.17	168.96	2.88	2.38	0.50
RH-A2037-1	0.77	755.86	2.87	2.37	0.50
RH-A2037-2	0.28	279.95	2.87	2.37	0.50
RH-A2038-1	0.19	181.97	2.83	2.33	0.50
RH-A2039-1	0.23	223.96	2.86	2.36	0.50

TAG	Vol. Flow Rate (m³/hr)	Mass. Flow Rate (kg/hr)	P in (barG)	P out (barG)	ΔP (bar)
RH-A2002-1	0.97	951.83	3.02	2.52	0.50
RH-A2002-2	0.97	951.83	2.98	2.48	0.50
RH-A2002-3	0.26	251.95	3.06	2.56	0.50
RH-A2025-1	0.77	755.86	3.21	2.71	0.50
RH-A2025-2	0.77	755.86	3.19	2.69	0.50
RH-A2025-3	0.77	755.86	3.15	2.65	0.50
RH-A2025-4	0.77	755.86	3.04	2.54	0.50
RH-A2026-1	0.46	447.92	3.15	2.65	0.50
RH-A2027-1	0.46	447.92	3.19	2.69	0.50
RH-A2031-1	0.36	349.94	3.21	2.71	0.50
RH-A2032-1	0.38	377.93	3.22	2.72	0.50
RH-A1001-1	1.58	1553.72	3.97	3.47	0.50
RH-A1002-1	0.28	279.95	3.75	3.25	0.50
RH-A1003-1	0.27	265.95	3.73	3.23	0.50
RH-A1004-1	0.51	503.91	3.97	3.47	0.50
RH-A1005-1	0.25	241.37	3.83	3.33	0.50
RH-A1019-1	1.67	1637.70	3.97	3.47	0.50
RH-A1029-1	1.28	1259.77	4.00	3.50	0.50
RH-A1029-2	1.28	1259.77	4.06	3.56	0.50
RH-A1040-1	2.04	2001.64	3.97	3.47	0.50
RH-A1040-2	2.04	2001.64	3.96	3.46	0.50

The Reheat Coils are controlled by the following control valves, to supplied by the HVAC package:

Valve	Vol. Flow Rate		Mass. Flow Rate	P in	P out	ΔP
	(m³/hr)	(lpm)	(kg/hr)	(barG)	(barG)	(bar)
TV-970018	1.76	29.28	1,735.68	2.69	1.34	1.36
TV-9700216	0.09	1.42	83.98	2.68	1.34	1.34
TV-970027	0.34	5.67	335.94	2.66	1.37	1.29
TV-9700230	0.10	1.65	97.98	2.65	1.39	1.26
TV-970075	0.18	3.07	181.97	2.33	1.47	0.86
TV-970077	0.23	3.78	223.96	2.36	1.54	0.82
TV-970049	0.77	12.75	755.86	2.37	1.43	0.94
TV-9700254	0.28	4.72	279.95	2.37	1.43	0.94
TV-970025	1.81	30.22	1,791.67	2.37	1.44	0.93
TV-9700267	0.17	2.85	168.96	2.38	1.51	0.87
TV-9700281	1.06	17.71	1,049.81	2.45	1.48	0.97
TV-970045	0.20	3.31	195.96	2.34	1.48	0.87
TV-970047	1.06	17.71	1,049.81	2.37	1.55	0.82

Valve	Vol. Flow Rate		Mass. Flow Rate	P in	P out	ΔP
	(m^3/hr)	(lpm)	(kg/hr)	(barG)	(barG)	(bar)
TV-970056	0.85	14.17	839.85	2.25	1.58	0.67
TV-970069	0.18	3.07	181.97	2.13	1.61	0.53
TV-970073	0.23	3.78	223.96	2.16	1.68	0.48
TV-970058	0.23	3.78	223.96	2.27	1.68	0.60
TV-970061	0.28	4.72	279.95	2.37	1.57	0.80
TV-970063	1.27	21.25	1,259.77	2.27	1.69	0.58
TV-9700300	0.28	4.72	279.95	2.32	1.75	0.57
TV-970051	1.42	23.61	1,399.75	2.60	1.45	1.14
TV-970079	0.17	2.83	167.97	2.57	1.48	1.10
TV-970083	0.43	7.08	419.92	2.49	1.47	1.02
TV-970087	1.47	24.56	1,455.74	2.54	1.52	1.02
TV-970081	0.62	10.39	615.89	2.53	1.53	1.00
TV-970085	0.18	3.07	181.97	2.54	1.53	1.01
TV-9700320	0.06	0.94	55.99	2.52	1.55	0.97
TV-9700332	1.47	24.56	1,455.74	2.51	1.57	0.94
TV-9700106	0.21	3.54	209.96	2.49	1.59	0.91
TV-9700344	0.18	3.07	181.97	2.49	1.59	0.90
TV-9700104	0.45	7.56	447.92	2.45	1.59	0.86
TV-9700357	0.18	3.07	181.97	2.44	1.61	0.83
TV-9700369	0.09	1.42	83.98	2.41	1.63	0.78
TV-970091	0.09	1.42	83.98	2.18	1.77	0.41
TV-970071	0.38	6.38	377.93	2.13	1.84	0.29
TV-970093	0.18	3.07	181.97	2.33	1.74	0.58
TV-970095	0.23	3.78	223.96	2.32	1.75	0.57
TV-970097	0.13	2.13	125.98	2.13	1.84	0.29
TV-970099	0.35	5.90	349.94	2.12	1.96	0.17
TV-9700380	0.11	1.89	111.98	2.26	1.83	0.43
TV-9700101	0.26	4.25	251.95	2.23	1.86	0.37
TV-9700384	1.42	23.61	1,399.75	2.22	1.88	0.34
TV-9700388	1.42	23.61	1,399.75	2.22	1.89	0.33
TV-970065	0.96	16.06	951.83	2.18	1.92	0.27
TV-9700411	2.03	33.76	2,001.64	3.46	2.81	0.66
TV-9700415	2.03	33.76	2,001.64	3.46	2.82	0.63
TV-9700392	1.27	21.25	1,259.77	3.56	2.69	0.87
TV-9700115	1.27	21.25	1,259.77	3.50	2.77	0.72
TV-9700117	0.28	4.72	279.95	3.25	2.94	0.31
TV-9700398	0.27	4.49	265.95	3.23	2.96	0.27
TV-9700402	0.51	8.50	503.91	3.47	2.83	0.64
TV-9700119	1.57	26.21	1,553.72	3.47	2.84	0.64
TV-9700406	1.66	27.62	1,637.70	3.47	2.85	0.62

Valve	Vol. Flow Rate		Mass. Flow Rate	P in	P out	ΔP
	(m^3/hr)	(lpm)	(kg/hr)	(barG)	(barG)	(bar)
TV-970023	0.38	6.38	377.93	2.71	1.34	1.37
TV-970031	0.77	12.75	755.86	2.71	1.35	1.36
TV-970021	0.35	5.90	349.94	2.71	1.36	1.35
TV-970037	0.45	7.56	447.92	2.69	1.37	1.32
TV-9700155	0.77	12.75	755.86	2.68	1.37	1.31
TV-970041	0.96	16.06	951.83	2.47	1.47	1.00
TV-9700168	0.96	16.06	951.83	2.52	1.54	0.98
TV-9700180	0.77	12.75	755.86	2.65	1.42	1.24
TV-970039	0.45	7.56	447.92	2.65	1.42	1.23
TV-9700192	0.77	12.75	755.86	2.54	1.44	1.11
TV-9700204	0.26	4.25	251.95	2.56	1.51	1.05
TV-970033	1.29	21.58	1,279.28	2.70	1.48	1.22
TV-9700430	0.24	4.07	241.37	3.33	2.87	0.46