DOC NUMBER: **569-DB7A-PRO-400-005**	CLIENT NUMBER: **PRD-MEC-CLC-007**
CLIENT: **TAKEDA/BAXALTA**	
PROJECT **BURITI EPCMV PROJECT**	

INDUSTRIAL WATER DISTRIBUTION SYSTEM
CALCULATION REPORT

REV	DATE	DESCRIPTION	EXEC	CHECK	APPROV
0	13AUG2021	ISSUED FOR CONSTRUCTION	JRM	LFF	MSS
D	11FEB2021	30% DD ISSUE	MPA	CCO	MSS
C	16OCT2020	FINAL BD ISSUE	CCO	LFF	MSS
B	28AUG202	90% BD ISSUE	CCO	LFF	MSS
A	09JUL2020	50% BD ISSUE	CCO	LFF	MSS

1. REVISION HISTORY

Rev	Reason For Change
A	50% BD ISSUE
B	90% BD ISSUE
C	FINAL BD ISSUE
D	FLOWRATES AND DIAMETERS HAVE BEEN UPDATED, AS WELL AS CALCULATIONS.
E	INCLUDED EQUIPMENT LIST IN DOCUMENTS REFERENCE AND FLOWRATES THE COOLING TOWER (MAKE-UP) HAVE BEEN UPDATED.
0	FLOWRATES HAVE BEEN UPDATED (BDT-7C-1, WS-6000-1/ 2, SV-1005 AND SV-1006). NEW POINT OF USE (LIQUIDO NITROGEN AREA) INCLUDE. NEW INITIAL PRESSURE CONSIDERED, ACCORDING TO NEW ROUTE APPROVED BY HEMOBRAS

2. PURPOSE

This document aims to establish the main characteristics for sizing the Industrial Water Distribution System, Building 7A – Final Drug Product, intended to Buriti Project, located at Hemobrás' site in Goiana - Pernambuco state, Brazil.

3. REFERENCE

The following documents were used as reference:

Item	Number	Title
01	PRD-HVC-LIS-004	LIST OF EQUIPMENT
02	-	Process Equipment List – Building 7A
03	ANSI Z358.1	American National Standard for Emergency Eyewash and Shower Equipment
04	ABNT-NBR 16291	Chuveiros e lava-olhos de emergência – Requisitos Gerais
05	7A-Z-0-2-05	P&I Diagram Decontamination Autoclave, AT-9002
06	7A-Z-0-2-06	P&I Diagram Autoclave, AT-9001
07	7A-Z-0-2-08	P&I Diagram Lyophilizer N°1, LYO-1105
08	7A-Z-0-2-09	P&I Diagram Lyophilizer N°2, LYO-1106
09	7A-Z-0-2-23	P&I Diagram Pretreatment (RO) System, RO-6301
10	PRD-MEC-LIS-007	Equipment List – Black Utilities
11	PRD-ELE-TS-512	Electrical Equipment List
12	7A-M-0-5-42	P&I Diagram Drug Product Cooling Water System
13	7A-M-0-5-43	P&I Diagram Drug Product Chilled Water Generation System (HVAC)
14	7A-M-0-5-45	P&I Diagram Drug Product Chilled Water Generation System
15	7A-M-0-5-47	P&I Diagram Drug Product Heating Hot Water System (HVAC)
16	7C-M-0-5-41	P&I Diagram Boiler's Building Softened Water Skid for Boilers
17	7C-M-0-5-61	P&I Diagram Boiler's Building Plant Steam Generation System

The Brazilian Standard indicated in item 04 is equivalent to ANSI Z358.1.

4. BASIC DATA AND PREMISES

The Industrial Water Distribution System has the following consumers that are normally closed: Expansion Tank (HVAC), Re-heated Water System (make-up) and the emergency eye wash & safety showers.

System Tie-in are located on the Second Floor (El. 18,8 m) on the building 7A, available initial pressure 3.67 barG.

It has the following consumers in the Building 7A:

EQUIPMENT	TAG	VOLUMETRIC FLOWRATE		NOTES
		(m³/h)	(lpm)	
Liquid Nitrogen Area	-	1.5	25.0	*1*
Blowdown	BDT-7C-1	6.0	100.0	
Softened Water Treatment	WS-6000-1/ 2	12.0	200.0	*9*
Reverse Osmosis	RO-6301	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	4.7	77.5	*4*
Emergency Eye Wash Shower	EWS-7A-2	4.7	77.5	*5*
Emergency Eye Wash Shower	EWS-7A-3	4.7	77.5	*6*
Emergency Eye Wash Shower	EWS-7A-4	4.7	77.5	*7*
Emergency Eye Wash Shower	EWS-7A-5	4.7	77.5	*8*
Vacuum Skid	SV-1106	2.3	38.0	*1*
Vacuum Skid	SV-1105	2.3	38.0	*1*
Autoclave	AT-9001	1.5	25.0	
Autoclave	AT-9002	1.5	25.0	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	11.8	196.2	*10*
Expansion Tank (HVAC) - Make-up	TK-7A-1	4.0	67.0	*2*
Buffer tank - Make-up	BT-7A-1	9.0	150.0	*3*
Re-heated Water System - Make-up	HX-7A-1	4.0	67.0	*2*
TOTAL		**80.9**	**1,348.7**	

Notes:

1. Estimated value - flowrate for 3/4"
2. Estimated value - flowrate for 1"
3. Estimated value - flowrate for 1.1/2"
4. Room A1042 – Maintenance
5. Room A1043 – Utilities
6. Room A1040 – Ambient Storage
7. Room A2033 – Corridor
8. Room A2004 – Pre-Wash
9. According to Miura supplier
10. According to EVAPCO supplier

The main simulations had the maximum and minimum flowrates. Also, the intermediate points were opened to guarantee available pressure in each consumer. There were developed the following simulations:

4.1 SIMULATION 1 – FLOWRATE AND DIVERSITY

In this simulation, the emergency eye wash & safety showers were opened to assess the available pressure. Five simulations were carried out because this equipment are not simultaneous (Visual Report – Item 6.1.1 and Output – Item 6.2.1).

a) Maximum flowrate with EWS-7A-1 operating.

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	Y	6.0	100.0	
Softened Water Treatment	WS-6000-1/ 2	Y	12.0	200.0	
Reverse Osmosis	RO-6301	Y	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	N	-	-	
Emergency Eye Wash Shower	EWS-7A-4	N	-	-	
Emergency Eye Wash Shower	EWS-7A-5	N	-	-	
Vacuum Skid	SV-1106	N	-	-	
Vacuum Skid	SV-1105	N	-	-	
Autoclave	AT-9001	N	-	-	
Autoclave	AT-9002	Y	1.5	25.0	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	Y	11.8	196.2	
Expansion Tank (HVAC) - Make-up	TK-7A-1	N	-	-	
Buffer tank - Make-up	BT-7A-1	Y	9.0	150.0	
Re-heated Water System - Make-up	HX-7A-1	N	-	-	
TOTAL		**-**	**46.7**	**778.7**	

b) Maximum flowrate with EWS-7A-2 operating.

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	Y	6.0	100.0	
Softened Water Treatment	WS-6000-1/ 2	Y	12.0	200.0	
Reverse Osmosis	RO-6301	Y	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	N	-	-	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7A-4	N	-	-	
Emergency Eye Wash Shower	EWS-7A-5	N	-	-	
Vacuum Skid	SV-1106	N	-	-	
Vacuum Skid	SV-1105	N	-	-	
Autoclave	AT-9001	N	-	-	
Autoclave	AT-9002	Y	1.5	25.0	

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	Y	11.8	196.2	
Expansion Tank (HVAC) - Make-up	TK-7A-1	N	-	-	
Buffer tank - Make-up	BT-7A-1	Y	9.0	150.0	
Re-heated Water System - Make-up	HX-7A-1	N	-	-	
TOTAL		**-**	**46.7**	**778.7**	

c) Maximum flowrate with EWS-7A-3 operating.

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	Y	6.0	100.0	
Softened Water Treatment	WS-6000-1/ 2	Y	12.0	200.0	
Reverse Osmosis	RO-6301	Y	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	N	-	-	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7A-4	N	-	-	
Emergency Eye Wash Shower	EWS-7A-5	N	-	-	
Vacuum Skid	SV-1106	N	-	-	
Vacuum Skid	SV-1105	N	-	-	
Autoclave	AT-9001	N	-	-	
Autoclave	AT-9002	Y	1.5	25.0	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	Y	11.8	196.2	
Expansion Tank (HVAC) - Make-up	TK-7A-1	N	-	-	
Buffer tank - Make-up	BT-7A-1	Y	9.0	150.0	
Re-heated Water System - Make-up	HX-7A-1	N	-	-	
TOTAL		**-**	**46.7**	**778.7**	

d) Maximum flowrate with EWS-7A-4 operating.

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	Y	6.0	100.0	
Softened Water Treatment	WS-6000-1/ 2	Y	12.0	200.0	
Reverse Osmosis	RO-6301	Y	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	N	-	-	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	N	-	-	
Emergency Eye Wash Shower	EWS-7A-4	Y	4.7	77.5	

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Emergency Eye Wash Shower	EWS-7A-5	N	-	-	
Vacuum Skid	SV-1106	N	-	-	
Vacuum Skid	SV-1105	N	-	-	
Autoclave	AT-9001	N	-	-	
Autoclave	AT-9002	Y	1.5	25.0	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	Y	11.8	196.2	
Expansion Tank (HVAC) - Make-up	TK-7A-1	N	-	-	
Buffer tank - Make-up	BT-7A-1	Y	9.0	150.0	
Re-heated Water System - Make-up	HX-7A-1	N	-	-	
TOTAL		**-**	**46.7**	**778.7**	

e) Maximum flowrate with EWS-7A-5 operating.

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	Y	6.0	100.0	
Softened Water Treatment	WS-6000-1/ 2	Y	12.0	200.0	
Reverse Osmosis	RO-6301	Y	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	N	-	-	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	N	-	-	
Emergency Eye Wash Shower	EWS-7A-4	N	-	-	
Emergency Eye Wash Shower	EWS-7A-5	Y	4.7	77.5	
Vacuum Skid	SV-1106	N	-	-	
Vacuum Skid	SV-1105	N	-	-	
Autoclave	AT-9001	N	-	-	
Autoclave	AT-9002	Y	1.5	25.0	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	Y	11.8	196.2	
Expansion Tank (HVAC) - Make-up	TK-7A-1	N	-	-	
Buffer tank - Make-up	BT-7A-1	Y	9.0	150.0	
Re-heated Water System - Make-up	HX-7A-1	N	-	-	
TOTAL		**-**	**46.7**	**778.7**	

4.2 SIMULATION 2 – FLOWRATE AND DIVERSITY

(Visual Report – Item 6.1.2 and Output – Item 6.2.2).

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	Y	6.0	100.0	
Softened Water Treatment	WS-6000-1/ 2	Y	12.0	200.0	
Reverse Osmosis	RO-6301	Y	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	N	-	-	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7A-4	N	-	-	
Emergency Eye Wash Shower	EWS-7A-5	N	-	-	
Vacuum Skid	SV-1106	Y	2.3	38.0	
Vacuum Skid	SV-1105	Y	2.3	38.0	
Autoclave	AT-9001	Y	1.5	25.0	
Autoclave	AT-9002	Y	1.5	25.0	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	N	-	-	
Expansion Tank (HVAC) - Make-up	TK-7A-1	Y	4.0	67.0	
Buffer tank - Make-up	BT-7A-1	N	-	-	
Re-heated Water System - Make-up	HX-7A-1	Y	4.0	67.0	
TOTAL		**-**	**40.1**	**667.5**	

4.3 SIMULATION 3 – FLOWRATE AND DIVERSITY

(Visual Report – Item 6.1.3 and Output – Item 6.2.3).

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	N	-	-	
Softened Water Treatment	WS-6000-1/ 2	N	-	-	
Reverse Osmosis	RO-6301	N	-	-	
Emergency Eye Wash Shower	EWS-7A-1	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	N	-	-	
Emergency Eye Wash Shower	EWS-7A-4	N	-	-	
Emergency Eye Wash Shower	EWS-7A-5	N	-	-	
Vacuum Skid	SV-1106	N	-	-	
Vacuum Skid	SV-1105	N	-	-	
Autoclave	AT-9001	N	-	-	
Autoclave	AT-9002	N	-	-	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	N	-	-	

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Expansion Tank (HVAC) - Make-up	TK-7A-1	N	-	-	
Buffer tank - Make-up	BT-7A-1	N	-	-	
Re-heated Water System - Make-up	HX-7A-1	N	-	-	
TOTAL		**-**	**4.7**	**77.5**	

4.4 SIMULATION 4 – FLOWRATE AND DIVERSITY – MINIMUM FLOWRATE

(Visual Report – Item 6.1.4 and Output – Item 6.2.4).

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Liquid Nitrogen Area	-	N	-	-	
Blowdown	BDT-7C-1	N	-	-	
Softened Water Treatment	WS-6000-1/ 2	N	-	-	
Reverse Osmosis	RO-6301	Y	1.8	30.0	
Emergency Eye Wash Shower	EWS-7A-1	N	-	-	
Emergency Eye Wash Shower	EWS-7A-2	N	-	-	
Emergency Eye Wash Shower	EWS-7A-3	N	-	-	
Emergency Eye Wash Shower	EWS-7A-4	N	-	-	
Emergency Eye Wash Shower	EWS-7A-5	N	-	-	
Vacuum Skid	SV-1106	N	-	-	
Vacuum Skid	SV-1105	N	-	-	
Autoclave	AT-9001	N	-	-	
Autoclave	AT-9002	N	-	-	
Cooling Tower - Make-up	CT-7A-1/ 2/ 3	N	-	-	
Expansion Tank (HVAC) - Make-up	TK-7A-1	N	-	-	
Buffer tank - Make-up	BT-7A-1	N	-	-	
Re-heated Water System - Make-up	HX-7A-1	N	-	-	
TOTAL		**-**	**1.8**	**30.0**	

5. PV VALVE RESULTS

5.1 MAXIMUM FLOWRATE

Maximum flowrate: 778.7 LPM = 46.7 m³/h

Jct	Name	Valve Type	Vol. Flow (m3/hr)	Mass Flow (kg/hr)	dH (meters)	P Static In (barG)	P Static Out (barG)	dP Stag. (bar)	Cv	Kv
2	PCV-610001	PRV	46,72	46.590	13,93	3,263	1,900	1,363	46,23	39,99

5.2 MINIMUM FLOWRATE

Minimum flowrate: 30 LPM= 1.8 m³/h

Jct	Name	Valve Type	Vol. Flow (m3/hr)	Mass Flow (kg/hr)	dH (meters)	P Static In (barG)	P Static Out (barG)	dP Stag. (bar)	Cv	Kv
2	PCV-610001	PRV	1,800	1.795	20,98	3,952	1,900	2,052	1,451	1,255

The Industrial Water Distribution System was sized based on the flowrates and diversity indicated above, using the software FATHOM version 10.0 and the PID 7A-M-0-5-41 for this system was elaborated based on these calculations.

6. RESULTS

6.1 VISUAL REPORT

6.1.1 SIMULATION 1

Visual Report - 4.1-a-Maximum flow

Visual Report - 4.1-b-Maximum flow

Visual Report - 4.1-c-Maximum flow

Visual Report - 4.1-d-Maximum flow

Visual Report - 4.1-e-Maximum flow

6.1.2 SIMULATION 2

Visual Report - 4.2-Simulation 2.pdf

6.1.3 SIMULATION 3

Visual Report - 4.3-Simulation 3.pdf

6.1.4 SIMULATION 4 – Minimum Flowrate

Visual Report - 4.4-Simulation 4 - M

6.2 OUTPUT

6.2.1 SIMULATION 1

Output - 4.1-a-Maximum flow

Output - 4.1-b-Maximum flow

Output - 4.1-c-Maximum flow

Output - 4.1-d-Maximum flow

Output - 4.1-e-Maximum flow

6.2.2 SIMULATION 2

Output - 4.2-Simulation 2.pdf

6.2.3 SIMULATION 3

Output - 4.3-Simulation 3.pdf

6.2.4 SIMULATION 4 – Minimum Flowrate

Output - 4.4-Simulation 4 - M