DOC NUMBER: **569-DB7B-PRO-400-005**	CLIENT NUMBER: **PRD-MEC-CLC-008**
CLIENT: **TAKEDA/BAXALTA**	
PROJECT **BURITI EPCMV PROJECT**	

INDUSTRIAL WATER DISTRIBUTION SYSTEM
CALCULATION REPORT

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
RE	DATE	DESCRIPTION	EXEC	CHECK	APPROV

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 NEW CONSUMER CC-7703 (QUENCH – COOLER CIP) AND UPDATED FLOWRATE THE COOLING TOWER (MAKE-UP)
0	NEW POINT OF USE (WASTE WATER TREATMENT) INCLUDE. NEW INITIAL PRESSURE CONSIDERED, ACCORDING TO NEW ROUTE APPROVED BY HEMOBRAS (FROM 4 BARG TO 6 BARG).

2. PURPOSE

This document aims to establish the main characteristics for sizing the Industrial Water Distribution System, Building 7B – Bulk Drug Substance, 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	-	Process Equipment List – Building 7B
02	7B-Z-0-2-49	P&I Diagram – CIP System N°3, CIP-7703 Buffer Area
03	7B-Z-0-2-54	P&I Diagram – Autoclave AT-9001
04	7B-Z-0-2-56	P&I Diagram – Purified Water (RO/EDI) System, RO-6302
05	7B-Z-0-2-59	P&I Diagram – WFI Still – MES-6401
06	7B-Z-0-2-63	P&I Diagram – Clean Steam Generator – CSG-6501
07	ANSI Z358.1	American National Standard for Emergency Eyewash and Shower Equipment
08	ABNT-NBR 16291	Chuveiros e lava-olhos de emergência – Requisitos Gerais
09	PRD-MEC-LIS-007	Equipment List – Black Utilities
10	PRD-ELE-TS-512	Electrical Equipment List
11	7B-M-0-5-42	P&I Diagram Drug Substance Cooling Water System
12	7B-M-0-5-44	P&I Diagram Drug Substance Chilled Glycol Generation System
13	7B-M-0-5-46	P&I Diagram Drug Substance Heating Hot Water System (HVAC)
14	7B-M-0-5-53	P&I Diagram Drug Substance Chilled Water Distribution System

The Brazilian Standard indicated in item 07 is equivalent to ANSI Z358.1.

4. BASIC DATA AND PREMISES

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

System Tie-in are located on the Ground Floor (El. -0,452 m) on the building 7B, available pressure 6.0 barG at the Tie-in point.

It has the following consumers in the Building 7B:

EQUIPMENT	TAG	VOLUMETRIC FLOWRATE		NOTES
		(m³/h)	(lpm)	
Reverse Osmosis	RO-6302	2.6	43	
Quench - WFI	CC-6401	3.3	55	
Quench - Clean Steam	CC-6501	3.3	55	
Quench - Cooler CIP	CC-7703	3.3	55	
Cooling Tower - Make-up	CT-7B-1/ 2	4.1	68.5	*10*
Re-heated Water System - Make-up	HX-7B-1	4.0	67	*2*
Expansion Tank (Process) - Make-up	TK-7B-2	3.0	50	*2*
Buffer tank - make-up	BT-7B-1	9.0	150	*3*
Autoclave	AT-9001	1.2	20	
Utility Station - Building 7F	-	1.5	25	*1*
Emergency Eye Wash Shower	EWS-7B-1	4.7	77.5	*4*
Emergency Eye Wash Shower	EWS-7B-2	4.7	77.5	*5*
Emergency Eye Wash Shower	EWS-7B-3	4.7	77.5	*6*
Emergency Eye Wash Shower	EWS-7B-4	4.7	77.5	*7*
Emergency Eye Wash Shower	EWS-7B-5	4.7	77.5	*8*
Emergency Eye Wash Shower	EWS-7B-6	4.7	78.5	*9*
Waste Water Treatment	WWT	9.0	150	*3*
TOTAL		**72.3**	**1,204.5**	

Notes:

1. Estimated value - flowrate for 3/4"
2. Estimated value - flowrate for 1"
3. Estimated value - flowrate for 1.1/2"
4. Room B1030 – Maintenance
5. Room B1031 – Utilities
6. Room B2048 – Media Buffer Prep
7. Room B2021 – Pre-Wash
8. Room B2044 – Inoculum
9. Room B2045 – IPT
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-7B-1 operating.

EQUIPMENT	TAG	DIVERSITY	VOLUMETRIC FLOWRATE		NOTES
		(Y/N)	(m³/h)	(lpm)	
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	Y	3.3	55.0	
Quench - Cooler CIP	CC-7703	Y	3.3	55.0	
Cooling Tower - Make-up	CT-7B-1/ 2	Y	4.1	68.5	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	Y	9.0	150.0	
Autoclave	AT-9001	Y	1.2	20.0	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	N	-	-	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**40.4**	**674.0**	

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

EQUIPMENT	TAG	DIVERSITY	VOLUMETRIC FLOWRATE		NOTES
		(Y/N)	(m³/h)	(lpm)	
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	Y	3.3	55.0	
Quench - Cooler CIP	CC-7703	Y	3.3	55.0	
Cooling Tower - Make-up	CT-7B-1/ 2	Y	4.1	68.5	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	Y	9.0	150.0	
Autoclave	AT-9001	Y	1.2	20.0	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	N	-	-	
Emergency Eye Wash Shower	EWS-7B-2	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	N	-	-	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**40.4**	**674.0**	

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

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	Y	3.3	55.0	
Quench - Cooler CIP	CC-7703	Y	3.3	55.0	
Cooling Tower - Make-up	CT-7B-1/ 2	Y	4.1	68.5	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	Y	9.0	150.0	
Autoclave	AT-9001	Y	1.2	20.0	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	N	-	-	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	N	-	-	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**40.4**	**674.0**	

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

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	Y	3.3	55.0	
Quench - Cooler CIP	CC-7703	Y	3.3	55.0	
Cooling Tower - Make-up	CT-7B-1/ 2	Y	4.1	68.5	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	Y	9.0	150.0	

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Autoclave	AT-9001	Y	1.2	20.0	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	N	-	-	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	
Emergency Eye Wash Shower	EWS-7B-4	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	N	-	-	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**40.4**	**674.0**	

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

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	Y	3.3	55.0	
Quench - Cooler CIP	CC-7703	Y	3.3	55.0	
Cooling Tower - Make-up	CT-7B-1/ 2	Y	4.1	68.5	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	Y	9.0	150.0	
Autoclave	AT-9001	Y	1.2	20.0	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	N	-	-	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	
Emergency Eye Wash Shower	EWS-7B-5	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7B-6	N	-	-	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**40.4**	**674.0**	

f) Maximum flowrate with EWS-7B-6 operating.

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	Y	3.3	55.0	

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	VOLUMETRIC FLOWRATE (lpm)	NOTES
Quench - Cooler CIP	CC-7703	Y	3.3	55.0	
Cooling Tower - Make-up	CT-7B-1/ 2	Y	4.1	68.5	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	Y	9.0	150.0	
Autoclave	AT-9001	Y	1.2	20.0	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	N	-	-	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	Y	4.7	78.5	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**40.4**	**674.0**	

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
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	Y	3.3	55.0	
Quench - Cooler CIP	CC-7703	Y	3.3	55.0	
Cooling Tower - Make-up	CT-7B-1/ 2	N	-	-	
Re-heated Water System - Make-up	HX-7B-1	Y	4.0	67.0	
Expansion Tank (Process) - Make-up	TK-7B-2	Y	3.0	50.0	
Buffer tank - make-up	BT-7B-1	N	-	-	
Autoclave	AT-9001	Y	1.2	20.0	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	N	-	-	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	Y	4.7	78.5	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**34.4**	**573.5**	

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
Reverse Osmosis	RO-6302	Y	2.6	43.0	
Quench - WFI	CC-6401	Y	3.3	55.0	
Quench - Clean Steam	CC-6501	N	-	-	
Quench - Cooler CIP	CC-7703	N	-	-	
Cooling Tower - Make-up	CT-7B-1/ 2	N	-	-	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	N	-	-	
Autoclave	AT-9001	N	-	-	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	N	-	-	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	N	-	-	
Waste Water Treatment	WWT	Y	9.0	150.0	
TOTAL		**-**	**14.9**	**248.0**	

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
Reverse Osmosis	RO-6302	N	-	-	
Quench - WFI	CC-6401	N	-	-	
Quench - Clean Steam	CC-6501	N	-	-	
Quench - Cooler CIP	CC-7703	N	-	-	
Cooling Tower - Make-up	CT-7B-1/ 2	N	-	-	
Re-heated Water System - Make-up	HX-7B-1	N	-	-	
Expansion Tank (Process) - Make-up	TK-7B-2	N	-	-	
Buffer tank - make-up	BT-7B-1	N	-	-	
Autoclave	AT-9001	N	-	-	
Utility Station - Building 7F	-	N	-	-	
Emergency Eye Wash Shower	EWS-7B-1	Y	4.7	77.5	
Emergency Eye Wash Shower	EWS-7B-2	N	-	-	
Emergency Eye Wash Shower	EWS-7B-3	N	-	-	
Emergency Eye Wash Shower	EWS-7B-4	N	-	-	

EQUIPMENT	TAG	DIVERSITY (Y/N)	VOLUMETRIC FLOWRATE (m³/h)	(lpm)	NOTES
Emergency Eye Wash Shower	EWS-7B-5	N	-	-	
Emergency Eye Wash Shower	EWS-7B-6	N	-	-	
Waste Water Treatment	WWT	N	-	-	
TOTAL		**-**	**4.7**	**77.5**	

5. PV VALVE RESULTS

5.1 MAXIMUM FLOWRATE

Maximum flowrate: 674.0 LPM = 40.4 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-610050	PRV	40,44	40.326	22,41	4,192	2,000	2,192	31,55	27,29

5.2 MINIMUM FLOWRATE

Minimum flowrate: 77.5 LPM= 4.7 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-610050	PRV	4,650	4.637	23,35	4,283	2,000	2,283	3,554	3,074

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 7B-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

Output - 4.1-e-Maximum flow

Output - 4.1-f-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

Output - 4.1-f-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