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DESIGN QUALIFICATION FOR HVAC SYSTEM (QUALITY CONTROL LABORATORY)

PROJECT: ESTABLISHMENT OF PHARMANIAGA HALAL VACCINE
MANUFACTURING FACILITY, QUALITY CONTROL LABORATORY,
ADMINISTRATIVE BUILDING AND INSULIN MANUFACTURING FACILITY FOR
MESSRS PHARMANIAGA LIFESCIENCE SDN. BHD. (PUCHONG)

APPROVAL OF PROTOCOL

Signatures below signify that both vendor and client have read, understand, and agree with the content of this document. Approval of protocol must be granted by both parties before its execution.

This document was prepared and approved by the below representatives from Lufter Sdn. Bhd.

Name	Job Title or Role	Signature	Date (dd-mmm-yyyy)
Authored by: Siti Norhana Fatehah	Validation cum QA Executive		20-Jun-2022
Reviewed by: Mohd Fahmi Abd Majid	Design, Quality & Special Project Manager		20-Jun-2022
Reviewed by: Mohd Suhaimi Ishak	Senior Project Manager		20-Jun-2022
By signing below, Pharmaniaga LifeScience Sdn. Bhd. confirms that all their requirements for this project have been reflected in this document.			
Name	Job Title or Role	Signature	Date (dd-mmm-yyyy)
Reviewed by: Mohd Fadhli Bin Jaafar	Head of Technical Service		21-Jun-2022
Reviewed by: Nurul Saadiah Abdul Muttalib	Head of Engineering		21-Jun-2022
Reviewed by: Zuraidah Abd Wahab	Head of Quality Control		22-Jun-2022
Reviewed by: Noor Zuraihan Mohamed Noor	Head of Project		22-Jun-2022
Approved by: Abkariah Azhari	Head of Quality Assurance		23-Jun-2022

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1.0 Reference Documents

No.	Document No.	Document Title
1.	URS-083-R02 (160322)	User Requirement Specification (HVAC System for Quality Control Laboratories)
2.	L-PLS03-VP&IF-VD-FSDS-HVAC-01	Functional Specification and Design Specification for HVAC System (Quality Control Laboratory)

2.0 Version History

Revision No.	Date	Revised By	Reason for Revision
00	23 JUN 2022	Siti Norhana Fatehah	New

3.0 Purpose

The purpose of this document is to verify that the system has been designed in way that all measures in the User Requirement Specification have been taken into consideration.

4.0 Scope

This Design Qualification is applicable to the design of the HVAC System supplied by AHU-F3, AHU-F3a and AHU-F5 of the Halal Vaccine Manufacturing Facility, Quality Control Laboratory, Administrative Building and Insulin Manufacturing Facility at Pharmaniaga LifeScience Sdn. Bhd. (Puchong).

5.0 Review Methodology

Design Qualification is performed by scrutinizing technical data sheets such as engineering drawing, specifications and manuals provided by the equipment vendors. Careful attention is given to ensure that all user requirements have been considered and fulfilled whenever possible.

Under Section 9: Design Verification, a verification checklist is used to verify the design specification against the user requirements. The content of this checklist is extracted directly from the URS (reference no **URS-083-R02**). The availability of supporting documents and their locations must be indicated in the checklist.

For every deviation between the design specification and URS, assessment shall be performed and corrective action will be taken.

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6.0 Roles & Responsibility

The following personnel have been designated to prepare, execute, review and approve the protocol.

Company	Job Title	Responsibility
Pharmaniaga LifeScience Sdn. Bhd.	Client Representative	To review the DQ protocol/report. To provide approval to the submitted DQ protocol/ report. To review vendor's specification against the URS. To provide approval to the submitted documents. To ensure all relevant technical specifications in vendor's documents are correct.
Luffer Sdn. Bhd.	Validation Executive Project Manager Project Engineer	To prepare the DQ protocol. To evaluate vendor's design against the URS.

7.0 Abbreviations

No.	Term/Abbreviation	Definition
1.	AHU	Air Handling Unit
2.	AMCA	Air Movement and Control Association
3.	CNC	Clean Non-Classified / Controlled Non-Classified
4.	DQ	Design Qualification
5.	EMS	Environmental Management System
6.	FSDS	Functional Specification Design Specification
7.	GAMP	Good Automated Manufacturing Practice
8.	GMP	Good Manufacturing Practice
9.	HEPA	High-Efficiency Particulate Air
10.	HVAC	Heating, Ventilation & Air-Conditioning
11.	N/A	Not Applicable
12.	N/D	Not Defined
13.	NEC	National Electrical Code
14.	NFPA	National Fire Protection Association
15.	PAHU	Pre-Air Handling Unit
16.	PLS	Pharmaniaga LifeScience Sdn. Bhd.
17.	SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
18.	URS	User Requirement Specification
19.	VFD	Variable Frequency Drive
20.	A	Attachment

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8.0 System Description

8.1 Heating, Ventilation & Air Conditioning System (HVAC)

The HVAC System designed to serve the Grade D and CNC area consists of three (3) units of AHU which are:

No.	AHU
1.	AHU-F3
2.	AHU-F3a
3.	AHU-F5

Table 1: AHUs supplying Grade D and CNC area

All AHUs supply recirculated air to the rooms as listed in Table 3.

AHU-F3 and AHU-F5 consists of two separate sections. The first section draws in fresh air and forces it through the primary (grade G4-washable) filter for the first stage of filtration. The fresh air is then conditioned in the chilled-water pre-cooling coil to reduce its temperature and moisture content. In the second section of the AHU unit, the conditioned air is allowed to mix with the return air before passing through a set secondary (grade G4 (washable) and F9) filter. Following the second stage of filtration, the mixed air will then be further cooled down at the chilled-water post-cooling coil section. After exiting the AHU unit, the post-cooled air will flow through an electrical heater to be heated to the required temperature as stated in the URS.

As for AHU-F3a, it consists of two separate sections and have similar filtration system as AHU-F3 and AHU-F5 do. However, the post-cooled air will flow through the built-in electric heater to be heated to the temperature required before exiting the AHU unit. The supply air enters the grade D cleanrooms via a network of ducting/branch ducts and flexible duct then further filtrated by HEPA (grade H14) (efficiency of >99.995%) filters at the HEPA Filter Terminal before being released into the rooms.

For all AHU, air control devices like aluminum blade volume control dampers are strategically installed along the main duct and branch duct to throttle the supply, return air as well as the exhaust air. Manual dampers are installed at each of the supply air diffusers and return air grilles for fine adjustment.

Air exiting from all rooms served by these AHUs will return to the AHU to be recirculated except for the rooms listed below where the air will be exhausted out either via process exhaust or room exhaust.

No.	AHU	Process Exhaust	Room Exhaust
1.	AHU-F3	Hot, Wash & Decontamination (L211)	Personnel Airlock In/Out (L216)
2.		Media Preparation Room (L213)	
3.	AHU-F3a		Personnel Airlock In/Out (L217)
4.	AHU-F5	General Chemistry Laboratory (L201)	Hot & Wash Room (L204)
5.		AAS/ICP-OES Room (L203)	
6.		Biochemistry Laboratory (L206)	
7.		Chemical/Solvent Room (L207)	
8.		Fume Hoods Room (L220)	

Table 2: Rooms with air being exhausted out

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8.2 Cleanrooms Operating Conditions

Table 3 below shows the cleanroom parameters designed to meet the design parameters required for Grade D and CNC areas as stated in the URS document (URS-083-R02; under section 4.3) and as per existing condition with latest room name given by Pharmaniaga LifeScience Sdn. Bhd.

a) Temperature, Relative Humidity & Air Change

The temperature, relative humidity and air change parameters for Grade D and CNC cleanroom area as below:

AHU	Room/Area	Room No.	Room Grade	Relative Humidity (%)	Temperature (°C)	Minimum Air Change Required	Design Air Change (As Per Consultant Approval)
AHU-F3	Microbiology Laboratory	L209	CNC	< 80	< 25	≥ 10	11
	Sample Receipt	L210	CNC	< 80	< 25	≥ 10	38
	Hot, Wash & Decontamination	L211	CNC	< 80	< 25	≥ 10	31
	Glassware	L212	CNC	< 80	< 25	≥ 10	16
	Media Preparation	L213	CNC	< 80	< 25	≥ 10	38
	MLT	L214	CNC	< 80	< 25	≥ 10	20
	Incubation	L215	CNC	< 80	< 25	≥ 10	22
	Personnel Airlock In/Out	L216	CNC	< 80	< 25	≥ 10	17
	Personnel Airlock In/Out	L217	D	50-60	18-24	≥ 20	20
	Sterility Room	L218	D	50-60	18-24	≥ 20	25
AHU-F5	QC Office	B201	CNC	< 80	< 25	≥ 10	10
	General Chemistry Laboratory	L201	CNC	< 80	< 25	≥ 10	13
	FTIR / Balance Room	L202	CNC	≤ 65	< 25	≥ 10	22
	AAS/ICP-OES Room	L203	CNC	< 80	< 22	≥ 10	51
	Hot & Wash	L204	CNC	< 80	< 25	≥ 10	15
	Glassware	L205	CNC	< 80	< 25	≥ 10	14
	Biochemistry Laboratory	L206	CNC	< 80	< 25	≥ 10	21
	Chemical / Solvent Room	L207	CNC	< 80	< 25	≥ 10	10
	Quality Control Corridor	L208	CNC	< 80	< 25	≥ 10	13
	Fume Hood	L220	CNC	< 80	< 25	≥ 10	20

Table 3: Cleanroom parameter



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b) Room Pressurization and Airflow Direction

The room pressurization and airflow direction for the cleanroom area are as below:

Adjacent Room		Air Differential Pressure (Pascal)
From	To	
Sterility Room (L218)	Personnel Airlock In/Out (L217)	≥ 5
Personnel Airlock In/Out (L217)	Personnel Airlock In/Out (L216)	≥ 15
Personnel Airlock In/Out (L216)	Microbiology Laboratory (L209)	≥ 5

Table 4: Pharmaniaga Design Room Differential Pressure

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9.0 Design Verification

URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U1	The HVAC system shall be designed and constructed to operate continuously and reliable for 24 hours per day, 7 days per week, 52 weeks per year.	A01-A03: Design Table, - AHU-F3 (L-PLS03-VP&IF-DT-01-R2) - AHU-F3a (L-PLS03-VP&IF-DT-02-R2) - AHU-F5 (L-PLS03-VP&IF-DT-03-R2) A04-A05: Airflow Schematic, - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01)	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U2	Air handler components such as coils, humidifiers, dehumidifiers, dampers, fans, motors and filters should be designed and constructed to provide 115% of design capacity to accommodate potential increased demand or future expansion.	A01-A03: Design Table, - AHU-F3 (L-PLS03-VP&IF-DT-01-R2) - AHU-F3a (L-PLS03-VP&IF-DT-02-R2) - AHU-F5 (L-PLS03-VP&IF-DT-03-R2) A26-A28: AHU Fan Details - AHU-F3 - AHU-F3a - AHU-F5	✓	Complied with URS. Refer to A38 for calculation.
U3	All rooms/areas shall be designed with air recirculation concept. Whereby the theoretical rule of thumb shall be 80% recirculation and 20% makeup air but this may vary depends on the room leakages or exhaust capacity. Any rooms that will contribute to contamination or great heat load then the make-up air condition will require a 100% exhaust out air and 100% make up air in.	A01-A03: Design Table, - AHU-F3 (L-PLS03-VP&IF-DT-01-R2) - AHU-F3a (L-PLS03-VP&IF-DT-02-R2) - AHU-F5 (L-PLS03-VP&IF-DT-03-R2) A04-A05: Airflow Schematic, - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01)	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
		- AHU-F5 (L/PLS03-VP&IF/SD/HVAC/MI/10/R01)		
U4	Total air leakage rate from the AHU casing shall be <0.5% of rated flow at 150% of the design pressure or 50CFM (1.42m ³ /min), whichever is greater.	A06-A08: AHU Data Sheet - AHU-F3 (L-PLS03-VP&IF-HVAC-SIT-17-R01) - AHU-F3a (L-PLS03-VP&IF-HVAC-SIT-18-R01) - AHU-F5 (L-PLS03-VP&IF-HVAC-SIT-19-R01)	✓	By refer to AHU Data Sheet, casing strength is test according to the Eurovent Standard Casing Class D1 (M). Higher class indicates that the casing of the AHU can withstand higher pressure with minimal deflection on the panel. Refer to A38 for calculation.
4.2.1	Air Handler Unit (AHU)/Pre-Air Handler Unit (PAHU)			
U5	Removable wall panels shall be made available for removal of large components that would not fit through the AHU access door if requires.	A06-A08: AHU Data Sheet - AHU-F3 (L-PLS03-VP&IF-HVAC-SIT-17-R01) - AHU-F3a (L-PLS03-VP&IF-HVAC-SIT-18-R01) - AHU-F5 (L-PLS03-VP&IF-HVAC-SIT-19-R01) A23: AHU Installation, Operation & Manual (Section 1.9.9 Page 20)	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
		A29: AHU Catalog (Section Accessibility Page 4)		
U6	The panel should be removable with simple hand tools to avoid cutting or sawing and creating a leakage issue after reassembly.	A23: AHU Installation, Operation & Manual (Section 1.9.9 Page 20) A29: AHU Catalog (Section: Accessibility Page 4)	✓	Complied with URS.
U7	Interior lights shall be installed in the AHU and controlled with a one 6-hour maximum waterproof, light switch timer as a minimum.	A06-A08: AHU Data Sheet - AHU-F3 (L-PLS03-VP&IF-HVAC-SIT-17-R01) - AHU-F3a (L-PLS03-VP&IF-HVAC-SIT-18-R01) - AHU-F5 (L-PLS03-VP&IF-HVAC-SIT-19-R01)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
4.2.3	Condensate Pan			
U8	The pan should slope to enhance total drainage (minimum 1.5%) with a minimum depth to prevent overflow during normal operation. Its length should extend beyond the coil's downstream face a minimum of 12 inches (30cm) or half the height of the coil, whichever is greater, and a minimum of 6 inches (15cm) beyond its upstream face.	A09-A11: AHU Shop Drawing - AHU-F3 - AHU-F3a - AHU-F5 A36: ANSI ASHRAE Addenda 61t (Page 2, clause 5.11.1)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U9	Each stacked cooling coil should have a drain pan with drainage into the lower coil section. The length of the stacked cooling coil should extend beyond its downstream face of 12 inches (30cm)	N/A	N/A	The cooling coil of the AHU is design for one stack only.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
	or half the height of the coil, whichever is greater, and a minimum of 15 inches (40cm) beyond its upstream face.			
U10	Condensate drain traps should be tall enough to prevent air movement into or out of the AHU during operating conditions.	A04-A05: Airflow Schematic - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01) A23: AHU Installation, Operation & Manual (Section 1.5 Installation Page 4)	✓	Complied with URS.
U11	Condensate drain pans should not leave puddles. Drain pans should slope a minimum of 1:100 (1%) toward the drain outlet. Connections should be piped through the casing wall and sealed.	A09-A11: AHU Shop Drawing - AHU-F3 - AHU-F3a - AHU-F5 A36: ANSI ASHRAE Addenda 61t (Page 2, clause 5.11.1)	✓	Complied with URS. Based on the ASHRAE Drain pan guideline, the pan intended to collect and drain liquid water shall be sloped at least 10 mm per meter (1/8 inch per foot) from the horizontal towards the drain outlet or shall be otherwise designed to ensure that water

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
4.2.4	Access Door			drains freely from the pan whether the fan is on or off.
U12	Doors should be installed on each section of the AHU e.g., coils, filters, fan etc., sufficiently wide to allow entry by the operator for cleaning and maintenance.	A06-A08: AHU Data Sheet (Access Door Section) - AHU-F3 (L-PLS03-VP&IF-HVAC-SIT-17-R01) - AHU-F3a (L-PLS03-VP&IF-HVAC-SIT-18-R01) - AHU-F5 (L-PLS03-VP&IF-HVAC-SIT-19-R01)	✓	Complied with URS.
U13	Doors should be of a double gasket compression design to minimize leakage.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U14	Each access doors shall be fitted with an instrument test port to allow temperature and pressure readings to be collected without drilling into the casing during air balancing commissioning.	A09-A11: AHU Shop Drawing - AHU-F3 - AHU-F3a - AHU-F5	✓	Complied with URS.
U15	The doors shall be fitted with a clear viewport to allow visual inspection on the interior without opening the access doors.	A06-A08: AHU Data Sheet - AHU-F3 (L-PLS03-VP&IF-HVAC-SIT-17-R01) - AHU-F3a (L-PLS03-VP&IF-HVAC-SIT-18-R01)	✓	Complied with URS.

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		- AHU-F5 (L-PLS03-VP&IF-HVAC-SIT-19-R01) A09-A11: AHU Shop Drawing - AHU-F3 - AHU-F3a - AHU-F5		
4.2.5	Fans			
U16	Fan pressure performance and construction shall at least meet the AMCA Class II standard.	A37: Refer to AMCA Efficiency Grades	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U17	Fan wheels should be fully welded and non-overloading. Wheels should be both statically and dynamically balanced.	A29: AHU Catalog (Section: Fan & Motor Section Page 5)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
4.2.6	Cooling Coils			
U18	The coils should have a maximum average face velocity of 450 fpm (2.29 m/s) to eliminate condensate carry over and optimize heat transfer capacity.	A06-A08: AHU Data Sheet - AHU-F3 (L-PLS03-VP&IF-HVAC-SIT-17-R01) - AHU-F3a (L-PLS03-VP&IF-HVAC-SIT-18-R01) - AHU-F5 (L-PLS03-VP&IF-HVAC-SIT-19-R01)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U19	Coil piping should have shut off valves and union fittings to facilitate coil removal or repair.	A04-A05: Airflow Schematic	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
		- AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01)		
4.2.7	Ductworks			
U20	Ductwork should be following SMACNA and the HVCA standards.	A12: Method of Statement – Ducting Installation & Insulation (L-PLS03-VP&IF—MOS-04-R0)	✓	Complied with URS.
U21	Ductwork should be adequately supported to easily carry its weight and insulation along with in-line equipment and controls.	A12: Method of Statement – Ducting Installation & Insulation (L-PLS03-VP&IF—MOS-04-R0) Refer to Page 18 – e. Bracket and Support Installation)	✓	Complied with URS.
U22	In-line silencers shall be installed ahead of HEPA filters if there is a concern on the noise produced.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U23	Flexible support and connections should be considered if there is a concern about vibration.	A12: Method of Statement – Ducting Installation & Insulation (L-PLS03-VP&IF—MOS-04-R0) - Page 31 Flexible Duct	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U24	If flexible ductwork is required to tie the branch to the terminal air device, its length should be kept to a minimum and should not exceed 3 m.	A12: Method of Statement – Ducting Installation & Insulation (L-PLS03-VP&IF—MOS-04-R0) Page 31 Flexible Duct	✓	Complied with URS.
U25	Duct leaving fans and AHU should be straight, and if elbows are required near the fan, it should not reduce system performance and consume horsepower.	A12: Method of Statement – Ducting Installation & Insulation (L-PLS03-VP&IF—MOS-04-R0) - Page 26	✓	Complied with URS.
U26	Ductwork should be sealed with approved fire and smoke rated sealant following NFPA 255 or UL 723 or equivalent.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U27	Ductwork should have no more than 1% leakage (with 0% leakage on positive pressure exhaust duct and positive pressure duct carrying hazardous materials).	Refer Commissioning & Qualification Plan (L-PLS03-VP&IF-VD-CQP) - Duct Leak Test Report	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
4.2.8	Dampers and Louvers			
U28	The outdoor air intake, return, exhaust and relief dampers should be rated for low leakage to prevent the infiltration of air when the systems are off or during hostile weather conditions.	A04–A05: Airflow Schematic - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01) A22: Sample Identification Tag (SIT)	✓	Complied with URS

URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
		Volume Control Damper Catalog (L-PLS03-HVAC-SIT06-R00)		
U29	Low leakage dampers should have vinyl seals that are mechanically attached to the damper blade and jamb seals to prevent leakage around the ends of clamper blades.	A22: Sample Identification Tag (SIT) Volume Control Damper Catalog (L-PLS03-HVAC-SIT06-R00) - Page 6	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U30	Damper jackshaft should be extended to the exterior of the AHU casing for actuator mounting.	N/A	N/A	All the damper are located at the external of the AHU.
U31	Outside air inlet velocities should prevent drawing in rain through the louver's free area.	A01-A03: Design Table, - AHU-F3 (L-PLS03-VP&IF-DT-01-R2) - AHU-F3a (L-PLS03-VP&IF-DT-02-R2) - AHU-F5 (L-PLS03-VP&IF-DT-03-R2)	✓	Complied with URS. Refer to A38 for calculation.
4.2.9	Diffusers and Registers			
U32	The devices shall be properly positioned to provide good distribution and a sweeping action of the air from the supply to the return side of the space to deliver uniform air patterns.	A13: Microlab Ductwork Layout AHU-F3 & AHU-F3a (First Floor) (L/PLS03/VP&IF/SD/HVAC/MI/05/R0) 3) A14: Microlab Ductwork Layout AHU-F5 (First Floor) (L/PLS03/VP&IF/SD/HVAC/MI/06/R0) 2)	✓	Complied with URS. The airflow visualization test will be conducted during Operation Qualification to ensure good distribution and uniform airflow patterns.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
4.2.10	Filter Installation			
U33	Filter frames should have closed cell rubberized/neoprene-type gaskets to prevent shedding.	A22: Terminal HEPA Filter (H14) Catalog (L-PLS03-VP&IF-HVAC-SIT-07-R01)	✓	The gasket used for the filter frame is polyurethane gel that consider as non-shedding material which will prevent moisture.
U34	A separation of at least 1 inch (25 mm) should exist between the filters in the pre-filter section to reduce static pressure drop, increase the performance of the filters and permit pressure measurement between the filters.	N/A	N/A	Not applicable because there is one layer of filter only on the pre-filter section.
U35	Each filter bank within AHU and ductwork should have a DP gauge to monitor the increase in pressure drop because of loading.	A04-A05: Airflow Schematic - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01)	✓	Complied with URS.
U36	Permanent downstream media protective screens should be included to prevent physical damage to the filter medium.	A22: Terminal HEPA Filter (H14) Catalog (L-PLS03-VP&IF-HVAC-SIT-07-R01)	✓	Complied with URS. Refer to No. 8 Faceguard on Terminal HEPA Filter Catalog.
U37	Individual filters in filter banks should be capable of replacement without disruption of adjacent filters.	A09-A11: AHU Shop Drawing - AHU-F3	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
		- AHU-F3a - AHU-F5 A29: AHU Catalog (Section: Filter Sections Page 5)		
4.2.11	Air Filtration			
U38	Grade D areas are to be provided with in-plant HEPA (H14) protection.	A04-A05: Airflow Schematic - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01)	✓	Complied with URS.
U39	All AHU shall be fitted with pre-filter (class G3), primary (class G4) and secondary filters (class F8).	A04-A05: Airflow Schematic - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
4.2.12	Control & Monitoring System			
U40	The system shall be designed to be able to support a wide range of industry platforms and protocols to enable seamless integration with existing equipment, control systems and IT environments especially to the existing EMS in PLS.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U41	The control system shall provide the following function but not limited to: ➤ Alarms ➤ Independent safety interlock ➤ The output of system status	A15: Input/Output List	✓	Complied with URS.
U42	VFDs shall be installed to control the volume of air delivered.	A15: Input/Output List A16-A18: Microlab Control Panel Layout - AHU F3 (L/PLS03/VP&IF/SD/HVAC/MI-19/R00) - AHU F3a (L/PLS03/VP&IF/SD/HVAC/MI-20/R00) - AHU F5 (L/PLS03/VP&IF/SD/HVAC/MI-21/R00)	✓	Complied with URS.
U43	All system/equipment control system legends and operator message display configuration will be in English.	N/A	✓	Complied with URS. All documentation will be in English.
U44	All control system (if any) supplied are to be fully validate-able and following the requirements of current Goods Automated Manufacturing Practice (GAMP).	N/A	N/A	This is only applicable for EMS system.
4.2.13	Label			

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U45	The ducts shall be labelled with directional arrows and type of air passing through i. e., fresh air supplied air and returned air.	Installation verification will be carried out.	✓	Complied with URS. Refer Commissioning & Qualification Plan (L-PLS03-VP&IF-VD-CQP)
U46	The equipment and instruments ID and specification shall be labelled clearly on the equipment or panel.	Installation verification will be carried out. A30: Sample Picture of Equipment & Instrument ID	✓	Complied with URS. Refer Commissioning & Qualification Plan (L-PLS03-VP&IF-VD-CQP)
4.2.14	Utility & Electrical Specification			
U47	Volts: 415/3 Phase, 240/1 Phase. Phase reversal protection must be supplied if there is any chance of damaging the machine if it is run in reverse. Equipment shall be arranged for connection to 3 phase supply with separate N and E.	A16-A18: Microlab Control Panel Layout - AHU F3 (L/PLS03/VP&IF/SD/HVAC/MI-19/R00) - AHU F3a (L/PLS03/VP&IF/SD/HVAC/MI-20/R00) - AHU F5 (L/PLS03/VP&IF/SD/HVAC/MI-21/R00)	✓	Complied with URS. Refer Commissioning & Qualification Plan (L-PLS03-VP&IF-VD-CQP) for Megger/Continuity Test
U48	Junction boxes should be weatherproof and conduit penetrations should be sealed airtight.	A19: Method of Statement – Electrical & Wiring Installation (L-PLS03-VP&IF—MOS-13-R0)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U49	Electrical components, wiring and terminals should be tagged. High voltage terminals must be labelled as such. Internal power cabling should be shielded.	A31: Sample Picture for Tagging for Electrical Component	✓	Complied with URS.
U50	Materials and installation methods should comply with NFPA and NEC or the local electrical code.	A19: Method of Statement – Electrical & Wiring Installation (L-PLS03-VP&F-MOS-13-R0) – Page 2	✓	Complied with URS.
U51	Symbols and Colours of pushbuttons, lamps, display screens etc. shall follow EN 604171 & 2: 1999 Graphical Symbols for Use on Equipment.	A16-A18: Microlab Control Panel Layout - AHU F3 (L/PLS03/NP&F/SD/HVAC/MI-19/R00) - AHU F3a (L/PLS03/NP&F/SD/HVAC/MI-20/R00) - AHU F5 (L/PLS03/NP&F/SD/HVAC/MI-21/R00)	✓	Complied with URS.
4.2.15	Material			
U52	The interior panel surfaces and joints of AHU should be smooth and continuous, constructed of a material such as aluminum, galvanized steel or stainless steel that can be wiped clean and will not easily rust or corrode.	A09-A11: AHU Shop Drawing - AHU-F3 - AHU-F3a - AHU-F5	✓	Complied with URS.
U53	The cooling coil condensate drain pan should be of 304L SS.	A29: AHU Catalog – Page 4 A09-A11: AHU Shop Drawing	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
		- AHU-F3 - AHU-F3a - AHU-F5		
U54	Screws, nuts, washers etc. should be corrosion resistant with flexible washers to minimize air leakage in the exterior. Materials that oxidize or promote rust should not be used in the construction of the equipment.	A32: Sample Picture of Screw & Nuts	✓	Complied with URS.
U55	Fan wheels should be of aluminum construction to reduce weight and rusting.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U56	The coil casing and frame shall at least fabricate from 304L SS for a longer lifespan and no rust.	A09-A11: AHU Shop Drawing - AHU-F3 - AHU-F3a - AHU-F5	✓	Complied with URS.
U57	Supply and general return air ductwork should be constructed of galvanized steel. Stainless steel should be used when corrosion or continual cleaning occur, such as inside of the cleanroom.	A20: Sample Identification Tag (SIT) - Steel Sheet Metal Catalog (L-PLS03-HVAC-SIT14) – Page 10.	✓	Complied with URS.
U58	Interior insulation that can add particles or harbour growth is not allowed to be used. A smooth interior is preferred to ensure low friction and low resistance to airflow.	N/A	N/A	No interior insulation installs for AHU and ducting.
U59	Dampers should be made of corrosion-resistant materials.	A21: Sample Identification Tag (SIT) - Volume Control Damper Catalog (L-PLS03-HVAC-SIT06) – Page 3.	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U60	The diffusers and registers shall be fabricated from stainless steel, to eliminate corrosion and rusting resulting from wash downs with aggressive cleaning agents.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U61	Pre and final filtration mounting grid systems should be of rigid construction (aluminum or 304L SS) with exposed trim inside of the cleanroom shall be stainless steel.	A22: Sample Identification Tag (SIT) HEPA Terminal Filter Catalog (L-PLS03-HVAC-SIT07) – Page 1	✓	Complied with URS. The frame of the Terminal HEPA Filter is made of anodized extruded aluminum.
4.2.13	Maintenance			
U62	Fans and motors shall be provided with vibration sensors to provide early warning and trending of bearing performance.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U63	Automatic bearing lubricators for fan and motor's bearing shall be installed to increase bearing life and reduce maintenance.	N/A	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)
U64	Sufficient space should be provided for operation and maintenance purpose.	A09-A11: AHU Shop Drawing - AHU F3 - AHU F3a - AHU F5 A23: AHU Installation, Operation & Manual (Section 4.1 Page 34)	✓	Complied with URS.

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks																																						
U65	The chilled water supply and return to/from the HVAC system shall be controlled automatically. Vendor may propose the use of actuated modulating valves or circulator pumps to improve the flow efficiency.	A04–A05: Airflow Schematic - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) - AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)																																						
U66	Room Classification <table><thead><tr><th colspan="2" rowspan="2">Parameters</th><th colspan="4">Room Grade</th></tr><tr><th>A</th><th>B</th><th>C</th><th>D</th></tr></thead><tbody><tr><td rowspan="2">Max. limits for particulates $\geq 0.5 \mu\text{m}/\text{m}^3$</td><td>At Rest</td><td>3,520</td><td>3,520</td><td>352,000</td><td>3,520,000</td></tr><tr><td>In Operation</td><td>3,520</td><td>352,000</td><td>3,520,000</td><td>N/D</td></tr><tr><td rowspan="2">Max. limits for particulates $\geq 5.0 \mu\text{m}/\text{m}^3$</td><td>At Rest</td><td>N/A</td><td>N/A</td><td>2,900</td><td>29,000</td></tr><tr><td>In Operation</td><td>N/A</td><td>2,900</td><td>29,000</td><td>N/D</td></tr><tr><td colspan="2">Air sample, CFU/m³</td><td><1</td><td>10</td><td>100</td><td>200</td></tr></tbody></table> * N/D = Not Defined, N/A = Not Applicable	Parameters		Room Grade				A	B	C	D	Max. limits for particulates $\geq 0.5 \mu\text{m}/\text{m}^3$	At Rest	3,520	3,520	352,000	3,520,000	In Operation	3,520	352,000	3,520,000	N/D	Max. limits for particulates $\geq 5.0 \mu\text{m}/\text{m}^3$	At Rest	N/A	N/A	2,900	29,000	In Operation	N/A	2,900	29,000	N/D	Air sample, CFU/m ³		<1	10	100	200	Will be conducted during Operational Qualification for HVAC System (Quality Control Laboratory) (L-PLS03-VP&IF-VD-IQ-HVAC-01)	✓	Complied with URS.
Parameters				Room Grade																																						
		A	B	C	D																																					
Max. limits for particulates $\geq 0.5 \mu\text{m}/\text{m}^3$	At Rest	3,520	3,520	352,000	3,520,000																																					
	In Operation	3,520	352,000	3,520,000	N/D																																					
Max. limits for particulates $\geq 5.0 \mu\text{m}/\text{m}^3$	At Rest	N/A	N/A	2,900	29,000																																					
	In Operation	N/A	2,900	29,000	N/D																																					
Air sample, CFU/m ³		<1	10	100	200																																					
U67	Room Environment Condition <table><thead><tr><th>Room No.</th><th>Room Description</th><th>Room Grade</th><th>Air Change Rate/Hour</th><th>Temperature (°C)</th><th>RH (%)</th></tr></thead><tbody><tr><td colspan="6">Microbiology Laboratory</td></tr><tr><td>L209</td><td>Microbiology Laboratory</td><td>CNC</td><td>≥ 10</td><td>< 25</td><td>< 80</td></tr><tr><td>L210</td><td>Sample Receipt</td><td>CNC</td><td>≥ 10</td><td>< 25</td><td>< 80</td></tr><tr><td>L211</td><td>Hot, Wash & Decon</td><td>CNC</td><td>≥ 10</td><td>< 25</td><td>< 80</td></tr><tr><td>L212</td><td>Glassware</td><td>CNC</td><td>≥ 10</td><td>< 25</td><td>< 80</td></tr></tbody></table>	Room No.	Room Description	Room Grade	Air Change Rate/Hour	Temperature (°C)	RH (%)	Microbiology Laboratory						L209	Microbiology Laboratory	CNC	≥ 10	< 25	< 80	L210	Sample Receipt	CNC	≥ 10	< 25	< 80	L211	Hot, Wash & Decon	CNC	≥ 10	< 25	< 80	L212	Glassware	CNC	≥ 10	< 25	< 80	A01-A03: Design Table, - AHU-F3 (L-PLS03-VP&IF-DT-01-R2) - AHU-F3a (L-PLS03-VP&IF-DT-02-R2) - AHU-F5 (L-PLS03-VP&IF-DT-03-R2)	✓	Complied with URS.		
Room No.	Room Description	Room Grade	Air Change Rate/Hour	Temperature (°C)	RH (%)																																					
Microbiology Laboratory																																										
L209	Microbiology Laboratory	CNC	≥ 10	< 25	< 80																																					
L210	Sample Receipt	CNC	≥ 10	< 25	< 80																																					
L211	Hot, Wash & Decon	CNC	≥ 10	< 25	< 80																																					
L212	Glassware	CNC	≥ 10	< 25	< 80																																					

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URS Clause	Design Requirement							Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks				
	Room No.	Room Description	Room Grade	Air Change Rate/Hour	Temperature (°C)	RH (%)		A04-A05: Airflow Schematic - AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R01) AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R01) A24: Microlab Room Temperature and RH Layout (First Floor) (L/PLS03/VP&IF/SD/HVAC/MI/03/R01)						
	L213	Media Preparation	CNC	≥ 10	< 25	< 80								
	L214	MLT	CNC	≥ 10	< 25	< 80								
	L215	Incubation	CNC	≥ 10	< 25	< 80								
	L216	Personnel Airlock In /Out	CNC	≥ 10	< 25	< 80								
	L217	Personnel Airlock In /Out	D	≥ 20	18-24	50-60								
	L218	Sterility	D	≥ 20	18-24	50-60								
	Chemistry / Biochemistry Laboratory													
	L201	Chemistry Laboratory	CNC	≥ 10	< 25	< 80								
	L202	FTIR / Balance & Reference Standard	CNC	≥ 10	< 25	≤ 65								
	L203	AAS/ ICP-OES	CNC	≥ 10	< 22	< 80								
	L204	Hot & Wash	CNC	≥ 10	< 25	< 80								
	L205	Glassware	CNC	≥ 10	< 25	< 80								
	L206	Biochemistry Laboratory	CNC	≥ 10	< 25	< 80								
	L207	Chemical/ Solvent	CNC	≥ 10	< 25	< 80								
	L208	Quality Control Corridor	CNC	≥ 10	< 25	< 80								
	L220	Fume Hood	CNC	≥ 10	< 25	< 80								
	B201	Quality Control Office	CNC	≥ 10	< 25	< 80								
	U68	The pressure for the laboratory is positively pressurized to the adjacent areas. The air differential pressure for the same grade area is 5 Pa, whereas different grade area is 15 Pa.									A25: Microlab Room Pressure Differential Layout (First Floor) (L/PLS03/VP&IF/SD/HVAC/MI/04/R01)	✓	N/A	

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URS Clause	Design Requirement					Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
	Room No.	Room Description	Room Grade	Air flow Direction	Adjacent Room/Passage ID	Differential Pressure (Pa) to the Adjacent Room or Passage ('In Operation Condition')		
	L216	Personnel Airlock In/Out	CNC	←	L217	15		
				→	L209	5		
	L217	Personnel Airlock In/Out	D	←	L218	5		
	L218	Sterility	D	→	L216	15		
				→	L217	5		
U69	Critical instrumentation that is installed shall be calibrated to ensure the reliability of the data that is provided.					Will be included in Installation Qualification for Environmental Monitoring System (LMS-22047S-1-IQ)	✓	Complied with URS.
U70	Each secondary AHU must be fitted with a duct mounted smoke detector, which will shut down the individual AHU in the event of an alarm, stopping the fan and closing the dampers on the ductwork distribution system.					A29: AHU Catalog (Page 7)	✓	Complied with URS. Each AHU comes with duct mounted smoke detector linked to fire alarm system panel. If fire alarm system triggered will shut off the AHU system. Each of the duct penetrating

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
				firewall come with the fire damper.
U71	The combined sound emission not to exceed 82 dBA decibels measured under standards established by Malaysian Department Safety and Health (DOSH) and ISO 14644-4.	N/A	N/A	By refer to the Occupational Safety and Health (Noise Exposure) Regulations 2019, the daily noise exposure level should not exceed 82 dB(A). The requirements of the Noise Exposure Regulations is applicable in the construction projects not limited to the AHU system.
U72	Positive pressure sections of the AHU should have doors labelled as such to protect operators if opened during AHU operation.	A23: AHU Installation, Operation & Manual (page 16) A33: Sample Picture for AHU Warning Sign	✓	Complied with URS.
U73	Doors should have latch handles located inside of the AHU to prevent personnel from becoming trapped inside of the unit.	A29: AHU Catalog (Section Accessibility Page 4)	✗	Refer to Deviation Report (Report No.: PLS03-DQ-DR-01)

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URS Clause	Design Requirement	Design Reference to Meet the URS Design Requirement	Complied with URS? (✓, ✗ or N/A)	Remarks
U74	Sections with fans and moving parts should have warning signs, such as 'isolate before entry' affixed to the doors.	A23: AHU Installation, Operation & Manual (page 16) A33: Sample Picture for AHU Warning Sign	✓	Complied with URS.
U75	In the event of power failure, the system shall capable to recover / restart automatically without human intervention.	N/A	✓	The system is under Building Management System (BMS) which able to call the unit to resume once the power recovered.

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10.0 Post-Execution Approval

Name	Job Title or Role	Signature	Date (dd-mmm-yyyy)
Reviewed by: Mohd Fadhli Bin Jaafar	Head of Technical Services		07-Jul-2022
Reviewed by: NOOR ZURAIHAN MOHAMAD NOOR	Head of Project	F. 	07-Jul-2022
Reviewed by: Nurul Sa'adah Abdul Muttalib	Head of Eng.		07-Jul-2022
Reviewed by: Zuraidah Abd Wahab	Head of Quality Control		07-Jul-2022
Approved by: Abkariah Azhari	Head of Quality Assurance		07-Jul-2022

11.0 Deviation List

Summary of all the deviations documented throughout the execution of the Design Qualification.

No.	Deviation Ref.	Deviation Description	URS Section No.	Date Resolved (dd-mmm-yyyy)	Initial & Date
1	PLS03-DQ-	The design of the HVAC system is not	47, 48, 413,	06-Jul-2022	HA 06-Jul-2022
	DR-01	complied to the URS clause 47, 48,	416, 417, 418,		
		413, 416, 417, 418, 422, 426, 427, 429,	422, 426, 427,		
		439, 440, 448, 455, 460, 462, 463, 465	429, 439, 440,		
		and 473	448, 455, 460,		
			462, 463,		
			465 and		
			473		
		N/A			
				06-Jul-2022	



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DEVIATION REPORT	Report no.: PLS03-DQ-DR-01
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A. Description of Deviation:
The design of the HVAC System is not complied to the URS Clause U7, U8, U13, U16, U17, U18, U22, U26, U27, U29, U39, U40, U48, U55, U60, U62, U63, U65, and U73
Documented By: Siti Norhana Fatehah
Date: 20-Jun-2022

RESPONSE		
A. Reason of Deviation		
Refer to the Attachment 39 for the reason of deviation.		
B. Correction/Preventive action to be taken		
1) Issue deviation report to capture the non-compliant URS clause.		
2) Exclude non-applicable clause in the revise URS.		
3) Revise URS for clause U7, U8, U13, U16, U17, U18, U22, U26, U27, U29, U39, U40, U48, U55, U60, U62, U63, U65 and U73 as these requirements are not comply to the installed system.		
Evaluation by:	Signature	Date (dd-mmm-yyyy)
Reviewed By: MUHAMMAD SMIR REDJAN		05-Jul-2022

ACCEPTANCE		
C. Corrective/Preventive action taken:		
1) The deviation report is issued to capture the non-compliant URS clause.		
2) The non-applicable clause is excluded in the revised URS.		
3) URS is revised for clause U7, U8, U13, U16, U17, U18, U22, U26, U27, U29, U39, U40, U48, U55, U60, U62, U63, U65 and U73 as these requirements are not comply to the installed system.		
Performed by:	Signature	Date (dd-mmm-yyyy)
Reviewed By: Mohd Fadhli Bin Jaafar		06-Jul-2022
Reviewed By: Noor Zuraihan Mohamad Noor	F. 	06-Jul-2022
Reviewed By: Nurul Sa'adiyah Abdul Muttalib		06-Jul-2022
Reviewed By: Zuraidah Abd Wahab		06-Jul-2022
Approved By: Abkariah Azhari		06-Jul-2022

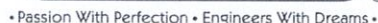
Note: This page to be re-printed as required

Design Qualification	Doc. No.	L-PLS03-VP&IF-VD-DQ-HVAC-01	Effective Date	23 JUN 2022
	Rev. No.	00	Total Page(s)	32 of 33

12.0 List of Attachments

List of attachments should include all the supporting evidence and deviation reports.

No.	Attachment Title/Description	Number of Pages
01	Design Table (AHU-F3) (L-PLS03-VP&IF-DT-01-R2)	1
02	Design Table (AHU-F3a) (L-PLS03-VP&IF-DT-02-R2)	1
03	Design Table (AHU-F5) (L-PLS03-VP&IF-DT-03-R2)	1
04	Airflow Schematic AHU-F3 & AHU-F3a (L/PLS03/VP&IF/SD/HVAC/MI/09/R02)	1
05	Airflow Schematic AHU-F5 (L/PLS03/VP&IF/SD/HVAC/MI/10/R02)	1
06	AHU-F3 Data Sheet (L-PLS03-VP&IF-HVAC-SIT-17-R01)	15
07	AHU-F3a Data Sheet (L-PLS03-VP&IF-HVAC-SIT-18-R01)	16
08	AHU-F5 Data Sheet (L-PLS03-VP&IF-HVAC-SIT-19-R01)	15
09	AHU-F3 Shop Drawing	1
10	AHU-F3a Shop Drawing	1
11	AHU-F5 Shop Drawing	1
12	Method of Statement (Ducting Installation & Insulation) (L-PLS03-VP&IF-MOS-04-R0)	40
13	Microlab Ductwork Layout AHU-F3 & AHU-F3a (First Floor)	1
14	Microlab Ductwork Layout AHU-F5 (First Floor)	1
15	Input/ Output List	1
16	Microlab Control Panel Layout (AHU-F3)	1
17	Microlab Control Panel Layout (AHU-F3a)	1
18	Microlab Control Panel Layout (AHU-F5)	1
19	Method of Statement (Electrical & Wiring Installation) (L-PLS03-VP&IF-MOS-13-R0)	44
20	Steel Sheet Metal Catalog (L-PLS01-VP&IF-HVAC-SIT-14-R00)	21
21	Volume Control Damper Catalog (L-PLS03-VP&IF-HVAC-SIT-06-R00)	15
22	Terminal HEPA Filter Catalog (L-PLS03-VP&IF-HVAC-SIT-07-R00)	4
23	AHU Installation, Operation & Manual	67
24	Microlab Room Temperature & RH Layout (1 st Floor) (L-PLS03-VP&IF-SD-HVAC-MI-03)	1
25	Microlab Pressure Differential Layout (1 st Floor) (L-PLS03-VP&IF-SD-HVAC-MI-04)	1
26	AHU-F3 Fan Details	1
27	AHU-F3a Fan Details	1

23 JUN 2022

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05-Jul-2022