1.0 Introduction

The IS4L building on The Pirbright Institute (TPI) campus was originally engineered to provide a SAPO4 containment facility. The building has since been declassified and is due to have a refit to accommodate the expansion of Insectary science. Scitech have been engaged to carry out a technical study and design assessment for the replacement of the ISL4 existing supply and extract AHU fans, for more energy efficient and direct drive arrangements. The assessment scope includes the following Air Handling and General Exhaust Systems:

- AHS01 - AH77001 Supply Air Handling Unit
- AHS01 - AH77011 Supply Air Handling Unit
- GEX01 - FN77021 Extract Air Handling Unit
- GEX01 - FN77031 Extract Air Handling Unit
- GEX01 - FN77041 Extract Air Handling Unit

It is proposed to replace the existing belt driven centrifugal fan assemblies with an up-to-date energy efficient direct drive arrangement which can cater for the repurposed building airflow requirements.

TPI have requested the consideration of EC motors and a comparative assessment of energy saving with alternative fan selection such as AC fans, with variable speed drive (VSD) controls, commonly used on critical HVAC systems.

2.0 Study Objective

The objective of this study is to confirm:

- The new duty for each fan system,
- The selection of new energy efficient replacement fans
- Assessment of energy saving arrangement
- Conclusion

3.0 Fan duties

3.1 Existing Fans - Design Duty

	Supply	Extract
Total Air flow rate (m^3/s)	5.0	4.0
Air flow rate (m^3/s) per AHU	5.0 (per fan)	4.0 (per fan)
Fan Total Pressure (Pa)	1496	1521

3.2 Existing Fans - Current Operation

Currently, the air handling systems are operating at reduced airflow rate and static pressure due to the omission of the original terminal HEPA filters when the building was used as a SAPO4 facility. Baseline commissioning airflow tests were carried out in April 2020 (documented in 30420-RE-0001-A2 IS4L Infrastructure and Survey Report) and are summarised as follows:

	Supply	Extract
North air flow rate (m³/s)	2.388	2.044
South air flow rate (m³/s)	1.709	1.884
Total Air flow rate (m³/s)	**4.097**	**3.928**
Air flow rate (m³/s) per AHU	2.049 (per fan)	1.309 (per fan)
External Static Pressure (Pa)	522	687

3.3 New Fan - Design Duty

The revised supply and extract air flow rates for the proposed re-purposed building were established during the detailed design phase completed in October 2020. The basis of which was to satisfy the TPI user requirement specification and room data sheets to generally achieve a minimum of 6 air change rates per hour.

The revised external static pressure requirement for the new fans have been estimated using Fan Laws and based on the baseline commissioning data detailed in the previous section. The AHU new total static pressures have been based on the initial manufacturers data (Moducel Data).

The results are summarised as follows:

	New Supply	New Extract
North (m³/s)	1.980	2.150
South (m³/s)	1.400	1.230
Total Air flow rate (m³/s)	3.380	3.380
Total Air flow rate (m³/s) incl. 20% margin	**4.056**	**4.056**
Air flow rate per AHU (m³/s)	**2.028**	**2.028** (1)
External Static Pressure (Pa)	563	989
Fan Total Pressure (Pa)	**1100**	**1150**

(1) Airflow rate per fan based on two extract fans operating on a duty share arrangement. Based on the reduced proposed new duty (from the initial design for SAPO4), it is proposed that only two out of the three existing exhaust fans shall be replaced.

Each supply and extract fan would normally operate in a duty share arrangement delivering 2.028m³/s or 50% of the building airflow requirement. However, each single supply and extract unit will be selected and capable of delivering the full 4.056m3/s or 100% of the building airflow load. The two units will provide N+1 redundancy on both the supply and extract air handling units, refer to Fan schedule in Appendix 1.

It is proposed that only two out of the three GEX systems will have the fans replaced, the third system will be remain with the existing centrifugal fan, be de-commissioned, but available for to operate manually in the event of a complete failure of the new replacement units.

7.0 Outline Scope of Works

On the basis of a direct AC fan motor replacement the following scope of works should be considered. Additional works may be required should an EC fan motor be arrangement be chosen.

7.1 Mechanical Scope

Item	Scope of Works
1	Undertake site survey to confirm scope to suit the selected fans.
2	Fan replacement on existing supply air handling units: AHS01 - AH77001 and AHS01 - AH77011 Supply Air Handling Units Fan replacement on existing extract air handling units: GEX01 - FN77031 and GEX01 - FN77041 Extract Air Handling Units. GEX01-FN77021 shall be retained in its current configuration and de-commissioned (by others). New fans shall be selected in accordance with the Fan schedule 30420-BS-SC-0011-B3
3	On each of the existing 4 AHU units, disinvest and dispose of the existing centrifugal supply fan, motor, pulleys, belt drives, fan installation frame and AHU bulkhead
4	Supply, instal and commissioning of new direct drive fans Fans shall be supplied with antivibration mounts.
5	Modify each AHU fan section and provide a new fan bulkhead and AHU casing as necessary to allow the new fan installation.
6	Clean the refurbished AHU

7.2 BMS Scope

Item	Scope of Works
1	Re-programme existing ABB variable speed drives to suit new reduced motor electrical rating and re-commission.

7.3 Electrical Scope

Item	Scope of Works
1	Disconnect existing motor power supplies (4 no.)
2	Re-instate, test and commission existing power supplies to new motor terminals

8.0 Appendix 1 – Scitech Fan Schedule

30420-BS-SC-0011
Fan Schedule

TAG No.	System	Room No	Systems and/or services	Application	Design Air flow @100% Duty @50% Flow	FTP @100% Duty @50% Flow	Fan							Motor						Comments
							Type	Impeller	Arrangement, rotation, and discharge	Diameter	Specific fan power	Weight	Drive	Motor	Power	Phase	Volt	RPM	Speed Control	
					m^3/s	Pa				mm	W/l/s	kg		No.	kW					
FN77001	AHS01	Plantroom	AHU Supply Fan	Duty	4.056 2.028	1100 1100	Plug	VTA	VTA	VTA	1.605	146	Direct	1	7.5	3	400	1770	VSD	To replace the existing AHU supply fan.
FN77011	AHS01	Plantroom	AHU Supply Fan	Duty	4.056 2.028	1100 1100	Plug	VTA	VTA	VTA	1.605	146	Direct	1	7.5	3	400	1770	VSD	To replace the existing AHU supply fan.
FN77031	GEX01	Plantroom	AHU Extract Fan	Duty	4.056 2.028	1150 850	Plug	VTA	VTA	VTA	1.676	VTA	Direct	1	7.5	3	400	1770	VSD	To replace the existing AHU extract fan.
FN77041	GEX01	Plantroom	AHU Extract Fan	Duty	4.056 2.028	1150 850	Plug	VTA	VTA	VTA	1.676	VTA	Direct	1	7.5	3	400	1770	VSD	To replace the existing AHU extract fan.

Note
1. The fans shall normally operate at 50% duty but should be capable of running at 100% duty in the event of the failure of the other (within the other AHU). The new fans shall be mounted in the existing fan section for each AHU
2. Contractor shall include for the following works: site survey, disinvestment and disposal of the existing 4 No. AHU fans (2 supply and 2 extract), supply of the 4No. Replacement fans, installation of the 4No. Fans, modifications to the AHU (new bulkheads, support frames etc), and the provision of AV mounts (spring type). All electrical and controls works, including the supply and installation of the frequency inverters shall be by the BMS Contractor.
3. Fans shall be selected to operate at 50% of the Design Airflow rate on the basis that the AHUs will operate on a duty-share basis.
4. Vendor to Advice (VTA) grey cells.