UNIVERSITY OF Southampton

ESTATES & FACILITIES

Document Title

Energy Conservation

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Revision	Date of Revision	Revised by	Revision made
A	25/11/05	MCT	For review
B	31/1/06	DAG	Issued for use
C	30/1/08	DAG	Up-dated metering +w. temps

Energy Conservation for:- Mechanical Services

1. Introduction

1.1. This document outlines preferred approaches to the design of the Mechanical Services on projects for the University of Southampton.

1.2. This is not a prescriptive document and the approaches outlined may not always be the most appropriate. They should however be a starting point. All designs carried out by consultants shall be submitted for comment by the Universities Liaison Engineer in good time to allow any amendments to be incorporated without affect to either programme or cost. All deviations from the recommendations contained in this document shall be supported by a written justification.

1.3. This document does not cover all aspects of the mechanical design and further reference should be made to the “Briefing Notes for Mechanical Services.” Preferences are made for one or more of the following reasons:

- 1.3.1. To standardise on components and systems, thereby enhancing quality and efficiency of future maintenance.
- 1.3.2. To ensure that key components and parts of the system are specified where the University wishes to ensure a particular safety enhancement is incorporated.
- 1.3.3. To ensure that the designs are consistent with the high flow/return temperature delta T necessary for the efficient operation of the CHP.

1.4. This document does not relieve the Designer of his responsibilities as the Designer as defined in the CDM regulations. Where the Designer disagrees with any of the preferences laid down in this document, alternatives should be put forward, with justification as outlined in 1.2 above.

1.5. This standard must read in conjunction with the CIBSE Guide F, Energy efficiency in buildings.

2. Energy Management Budget

2.1. This budget is not available for Capital projects.

3. District Heating and CHP

3.1. The Highfield Campus is, and it is intended that in future all campuses will be, operated as variable volume, high delta T systems appropriate for CHP plant. All new and modified systems shall therefore be designed to operate in accordance with the following design philosophy:

- 3.1.1. Design flow temperature Summer and Winter shall be between 80 and 90deg C
- 3.1.2. Design return temperature shall be as low as possible and 50degC maximum (Under-floor heating is considered an appropriate means of achieving low return temperatures).
- 3.1.3. All systems shall be designed using two port valves (variable volume system) to ensure that the return temperature is at all times, kept as low as possible.
- 3.1.4. Control valves shall generally be of the modulating type with an appropriate authority (given the high delta T). On/off control *may* be acceptable in some cases (eg Unit heaters) where the additional cost of modulating control cannot be justified. In such cases, each heat emitter shall be provided with an appropriate TLD (see sketch1 legend & associated valve schedule)

3.1.5. All new buildings and major extensions connected to the existing district heating system shall be direct injection from the district heating mains wherever practicable. Each building shall be provided with a control valve set incorporating double isolation/bleed valves on flow and return, strainers, a heat meter and pressure regulating valves. They shall also be provided with high limit protection to circuits where maximum flow temperature needs to be limited for safety reasons. This is all as shown in sketch 1 of this document.

3.1.6. Compensated circuits (for radiator or other perimeter heating systems as well as for under floor heating systems) shall be fed from a compensated circuit also as shown in sketch 1.

3.1.7. Individual heat loads such as air handling unit heater batteries shall generally be connected to a constant temperature circuit after the heat metering station (as shown in sketch 1) and heat output shall be controlled via a two port control valve at the dictates of a suitably located temperature sensor using the Trend BMS. It is vital to the efficient operation of the District Heating system as a whole that return water temperature is robustly controlled at all times. The Design of the controls installation must take this into account and ensure that the physical and software arrangements are robust. Where there is any doubt it is recommended that additional TLDs are provided on the return pipe from each heat emitter. If control is not robust, it will result in other emitters in the building being starved of heat.

3.1.8. Two port control valves on CT circuits shall generally be Honeywell type V5011with a 24VAC powered, 0-10Vdc signal actuator type ML7984A .

3.1.9. Radiators shall generally be controlled using Oventrop Series AV6 valve with variable Kv. The Kv values shall be scheduled to suit the radiators outputs and it shall be specified that the Contractor shall set up the valves accordingly. [NOTE: it has been agreed that the radiator schedule may be e-mailed to mickadlam@oventrop.co.uk who will add to the schedule Kv settings for each valve.] The thermostatic head shall generally be a Uni LGH but where necessary to ensure ease of use a remote control shall be used instead and where necessary to ensure a representative temperature is measured a remote sensor shall be used (Note: TRV controls and sensors should be positioned to minimise the likelihood of their being obstructed by furniture etc.). Each head shall be set with a limit at position 3, which allows the head to be set at any temperature up to a maximum of 20DegC. In larger spaces where there are more than approximately four radiators, the radiators shall not be provided with TRVs but instead a single two port zone valve shall be provided and this shall be modulated to control temperature at the dictates of one or more suitably located space temperature sensors. In most cases this shall be carried out via the BMS.

3.1.10. Balancing valves will not normally be required except where on/off control valves are being used in which case double regulating valves or lock shield ball valves shall be used as appropriate to the particular circumstance.

3.1.11. All new and major extensions domestic hot water systems should be based upon direct heating via a plate heat exchanger wherever practicable and cost effective (see 2 above for means of applying for additional funding for incorporating this measure in place of cheaper means of providing domestic hot water). A buffer vessel may be acceptable in the case of particularly high peak demand. Immersion heaters will not normally be required and shall only be provided where a loss of domestic hot water would be critical to the operation of the building sketch 2 shows the preferred arrangements for providing domestic hot water.

4. Summer Temperatures

4.1. Control of summer time temperature shall be based upon passive means as far as possible. The following design options should be considered as part of a detailed whole life cost assessment:

4.1.1. The Engineer should liaise with the future building users as far as possible to fully understand the use of the building and work with the architect in locating rooms and equipment to optimise the use of passive cooling.

4.1.2. The Engineer should encourage the future building users to consider alternative energy efficient equipment and to apply for additional funding from the Energy Management Budget to cover the additional capital cost (see 2 above).

4.1.3. The Engineer shall consider the following in order of precedence:

4.1.4. High thermal mass construction/ground linked cooling

4.1.5. Ducted full fresh air 'free cooling'

4.1.6. Indirect adiabatic cooling

4.1.7. Operating at high flow temperatures, for example by use of chilled beams or chilled ceilings, combined with open cooling towers piped to allow "free cooling" when outside air temperature is sufficiently low.

5. Building Fabric

5.1. The engineer shall work with the design team in optimising the building fabric to provide the best whole life costing for the project. Where appropriate funding shall be applied for from the Energy Management Budget (see 2 above). In particular the following shall be considered:

5.1.1. U values in excess of the requirements of the building regulations

5.1.2. Air tightness in excess of the requirements of the building regulations

5.1.3. Infrared thermographic imaging used as a means of encouraging high quality construction standards.

5.1.4. The optimum shading shall be incorporated to reduce solar gains. The relative merits of the following should all be considered and the most appropriate option adopted:

5.1.4.1. Trees

5.1.4.2. Overhangs and recesses,

5.1.4.3. External shades

5.1.4.4. Interstitial blinds

5.1.4.5. Reduced areas of glazing

5.1.4.6. Tinted or reflective glass/films

5.1.4.7. Internal blinds

6. Public Health Installation

6.1. Shower heads shall be of the low volume type (6l/min)

6.2. Urinal Flush controls shall be battery operated and as supplied by messrs. Dart Valley Systems.

6.3. The use of spray taps should be considered and used where appropriate.

6.4. The use of percussive taps shall be considered and used where appropriate.

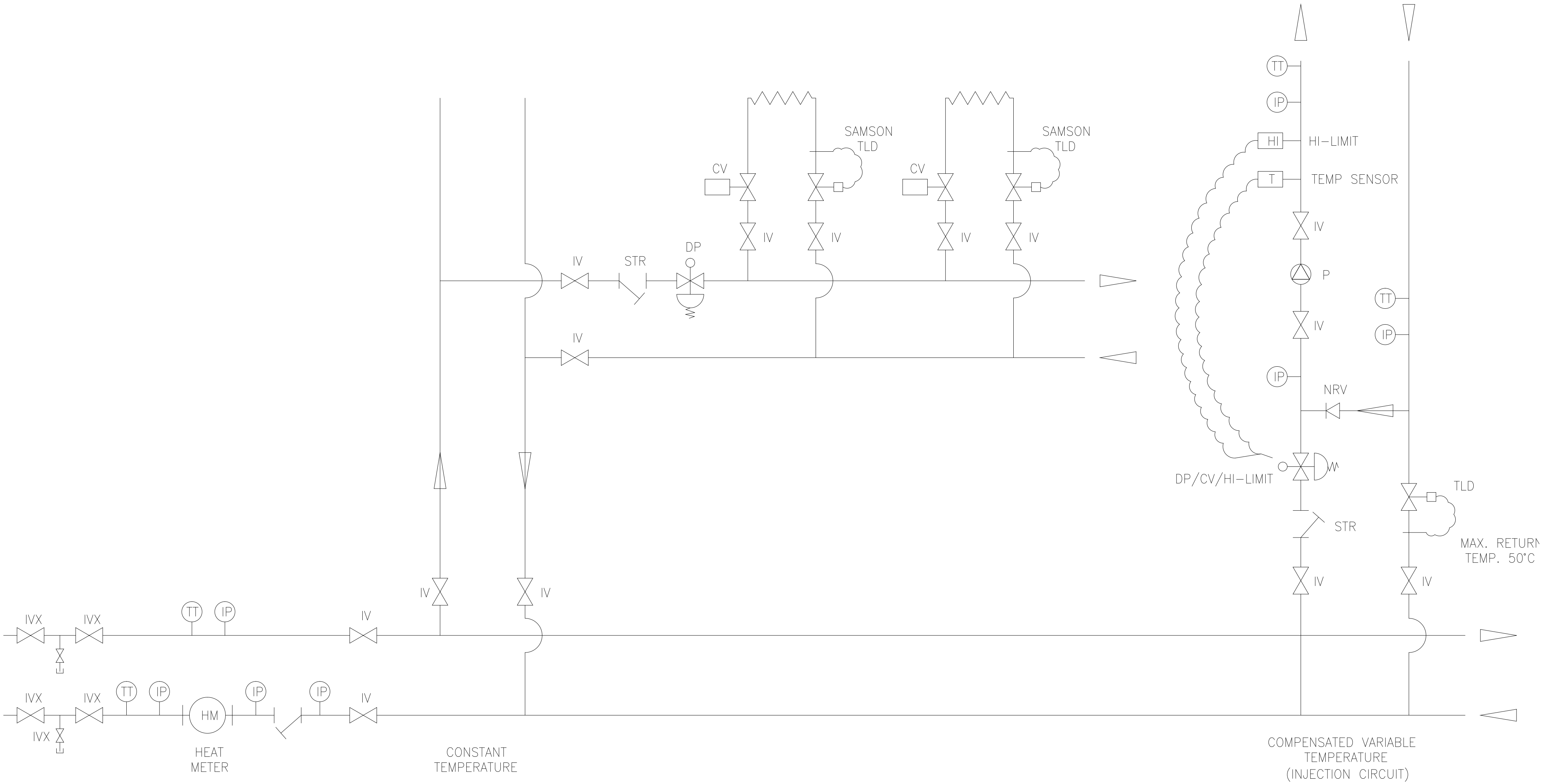
6.5. The use of low volume and dual flush cisterns (4l) shall be considered and used where appropriate.

7. Automatic Metering & Analysis (aM&A)

The University has an aM&A system with a developed infra structure to collect all data. All new meters will be connected to this system and not the Trend BMS. Details of the data loggers etc can be found in M&E standard specification ES/ 005. All electric meters shall be supplied complete with calibration and test certificates, which shall be included in the ‘As Built Documentation’, along with C.T ratios and settings.
For other services, Water, Gas and Heating the meter or integrator shall supply pulses at a rate based on the calculated minimum to maximum usage rates of between 10 and 100 pulses per half hour period. The current metering system has a maximum of 24Vdc and can cope with up to 8 pulses per second

Meter locations shall be carefully planned with due reference to the revised Building Regulations Part L ‘Metering for Energy Monitoring’ and the proposed usage and departmental split of the building. Before the metering system is fully specified a draft shall be submitted to the University Project Liaison Engineer for discussion and guidance.

It is vitally important to ensure that it is specified, in detail, that all automatic Metering from the meters on site to the setting up of the channels on the aM&A system front end software and collection of data onto the Oracle database shall be fully operational and commissioned at the time of practical completion of the Project concerned.



SKETCH 1 – STANDARD ARRANGEMENT FOR BUILDINGS CONNECTED TO DISTRICT HEATING MAINS

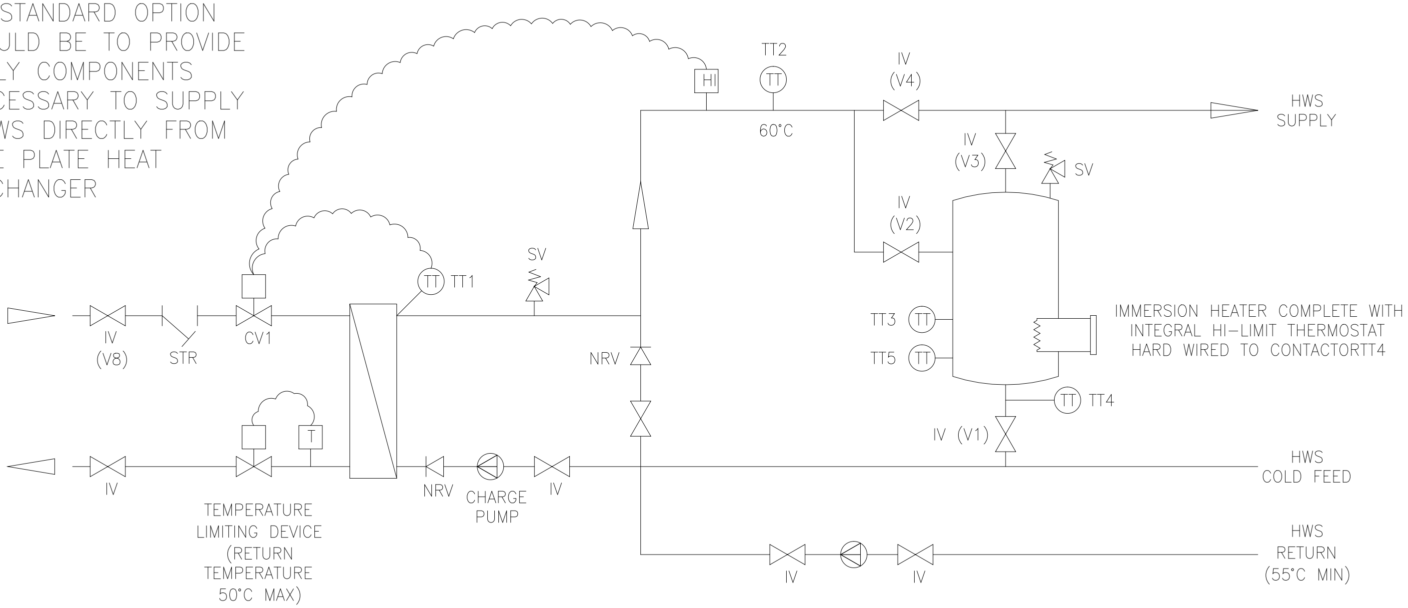
SKETCH 1 – LEGEND

REF	DESCRIPTION	TYPICAL SPECIFICATION (TO BE VERIFIED FOR EACH PARTICULAR CASE)
DP	SAMSON DIFFERENTIAL PRESSURE CONTROL VALVE WITHIN 10 METRES OF SINGLE/MULTIPLE AHU/EMITTERS	
MV	HONEYWELL 2–PORT V5011 CONTROL VALVE WITH ML7425133004 TAMPERPROOF MANUAL RESET THERMOSTAT	
TLD	SAMSON DIRECT ACTING TEMPERATURE LIMITING DEVICE (REFER TO VALVE SCHEDULE)	
P	SINGLE/TWIN HEAD PUMP INVERTER DRIVEN TO MAINTAIN REQUIRE CIRCUIT DP GRUNDFOS LM/LMD WITH INVERTER DRIVE – DP SENSOR MID–WAY ON INDEX RUN	
CV	INJECTION CONTROL VALVE – CONTROLS INJECTION OF HEATING WATER TO GIVE MIXED FLOW TEMPERATURE IN LINE WITH SCHEDULE DESCRIBED IN BMS DESIGN NOTES ACTUATOR HEAD TO BE SPRING CLOSED TYPE WITH GUARDED MANUAL RESET THERMOSTAT ON HTG FLOW SET 5C ABOVE DESIGN FLOW SET POINTT	
DP /CV /HI –LIMIT	SAMSON COMBINATION VALVE WITH TEMPERATURE, DIFFERENTIAL PRESSURE AND HI–LIMIT CONTROL (HI–LIMIT SIGNAL TO BMS)	
HM	HEAT METER COMPLETE WITH INTEGRATOR – PROVIDING ANALOGUE OUTPUT OF HEAT (kW), FLOW (Vs), FLOW TEMP (°C) AND RETURN TEMP (°C) (4 – 20mA) AND TREND DATA AND ENERGY PULSED OUTPUT CARD	MAXICAL III (Pt500) HEAT METER WITH A WESSAN S–XKA HOT WATER MECHANICAL VLOW METER
IV	ISOLATION VALVE	BALL VALVE (UP TO 50ø)/BUTTERFLY VALVE (ABOVE 50ø)
IVX	PRIMARY ISOLATION VALVE	BALL VALVE (uP TO 50ø)/VIKING JOHNSON MILLCENTRIC ECCENTRIC PLUG VALVE WITH LOCKING DEVICE (ABOVE 50ø)
IP	UNIVERSAL TEMPERATURE AND PRESSURE TEST POINT	BINDER OR EQUIVALENT
ST	STRAINER WITH DRAIN VALVE	
TT	TREND IMMERSION TEMPERATURE SENSOR	
SV	SOLENOID VALVE SPRING RETURN – NC=CLOSED WHEN ENERGISED NO= OPEN WHEN ENERGISED FED FROM 24VAC SUPPLY FROM BMS PANEL HARD WIRED TO TRIP WHEN ONE OR MORE THERMOSTATS OPEN	
Th	THERMOSTAT WITH COVERED SET POINT ADJUSTER AND MANUAL RESET BUTTON. ONE THERMOSTAT LOCATED ON EACH CIRCUIT TO BE PROTECTED AGAINST OVER TEMPERATURE (ALL DHWS CIRCUITS AND ON VT CIRCUITS WHERE IDENTIFIED AS NECESSARY FOLLOWING RISK ASSESSMENT)	
P	SINGLE OR TWIN HEAD PUMP (DEPENDENT UPON SENSITIVITY OF HEATING CIRCUIT) INVERTER DRIVEN TO MAINTAIN REQUIRED PRESS DIFFERENTIAL ON CIRCUIT	GRUNDFOS LM OR LMD WITH HONEYWELL NXS INVERTER DRIVE CONTROLLED FROM TREND WITH DP SENSOR MID WAY ALONG CIRCUIT
CV	INJECTION CIRCUIT CONTROL VALVE – CONTROLS INJECTION OF HEATING WATER TO GIVE MIXED FLOW TEMPERATURE IN LINE WITH SCHEDULE DESCRIBED IN BMS DESIGN NOTES. ACTUATOR HEAD TO BE SPRING SHUT TYPE WITH GUARDED MANUAL RESET THERMOSTAT ON FLOW PIPE SET 5°C ABOVE HIGHEST DESIGN FLOW SET POINT	HONEYWELL V5011 WITH ML7425B3004 AND TAMPERPROOF, MANUAL RESET THERMOSTAT IN SERIES
MV	MOTORISED VALVE – ON/OFF FOR WINTER/SUMMER OPERATION	HONEYWELL V5011 WITH ML7425B3004 AND TAMPERPROOF, MANUAL RESET THERMOSTAT IN SERIES

NOTES

1. IMMERSION HEATERS ONLY TO BE PROVIDED WHERE LOSS OF DHWS WOULD BE CRITICAL
2. BUFFER VESSEL ONLY / NECESSARY WHERE PROFILE OF USE HAS EXTREME PEAKS
3. STANDARD OPTION WOULD BE TO PROVIDE ONLY COMPONENTS NECESSARY TO SUPPLY DHWS DIRECTLY FROM THE PLATE HEAT EXCHANGER

CV1 – SAMSON 2 – PORT COMBINATION VALVE (TEMPERATURE CONTROL & HI–LIMIT)



ITEM	PLATE HEAT EXCHANGER/BUFFER VESSEL	PLATE HEAT EXCHANGER	IMMERSION HEATER
V1	OPEN	CLOSED	OPEN
V2	CLOSED	CLOSED	OPEN
V3	OPEN	OPEN	OPEN
V4	OPEN	OPEN	CLOSED
V5	CLOSED	OPEN	CLOSED
V6	OPEN	CLOSED	OPEN
V7	CLOSED	OPEN	CLOSED
V8	OPEN	OPEN	CLOSED
TT1	CONTROLS CV1 TO MAINTAIN DHWS SET POINT PLUS 5°C	CONTROLS CV1 TO MAINTAIN DHWS SET POINT PLUS 5°C	NOT USED
TT2	CONTROLS CHARGE PUMP SPEED TO MAINTAIN DHWS SET POINT	CONTROLS CHARGE PUMP SPEED TO MAINTAIN DHWS SET POINT	MONITORS RETURN WATER TEMPERATURE
TT3	SWITCHES CHARGE PUMP TO FULL SPEED WHEN TEMPERATURE FALLS BELOW DHWS SET POINT LESS 10°C	NOT USED	NOT USED
TT4	SWITCHES CHARGE PUMP BACK TO NORMAL CONTROL WHEN TEMPERATURE RISES ABOVE DHWS SET POINT LESS 2°C	NOT USED	NOT USED
TT5	MONITORS CALORIFIER TEMPERATURE	NOT USED	SWITCHES IMERSION HEATER TO MAINTAIN SET POINT OF 65°C

DHWS SET POINT KNOB ADJUSTABLE AND SET AT 60°C

SKETCH 2 – STANDARD ARRANGEMENT FOR DOMESTIC HOT WATER