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POLICY: BUILDING SERVICES STATEMENT OF FUNDAMENTALS FOR MECHANICAL & ELECTRICAL SERVICES DESIGN IN NEW BUILDINGS

VER 7.0 replaces Ver 6.0

Date Sept 2020

NUI Galway is committed to meeting the new Energy and Carbon targets set out in the Government Climate Action Plan of 2020 to 2030. The new 2019 Climate Action Plan has now increased the level of ambition to a 50% improvement in public sector energy efficiency and a 30% reduction in CO2e1 from the sector by 2030, "with a view to achieving carbon neutrality by 2050". The twin targets establish an integrated framework for both energy efficiency and renewable energy to decarbonise public sector energy consumption.

The energy team is committed to meeting and exceeding the energy targets set by the Government on reduction of energy usage by 33% by 2020 and 50% by 2030. Our policy ensures that the university shall:

- Use Energy in a prudent and responsible manner
- Procure Fuels at the most economic cost
- Reduce the Consumption of Fossil Fuels
- Utilise Energy from Sustainable sources where practical
- Monitor and Report Energy Performance
- Promote Energy Awareness amongst both Students and Staff
- Identify and implement Energy Efficiency measures throughout all of our Faculties
- Target a reduction in Energy Consumption and Pollution Emissions in line with Ireland's National Energy Efficiency Action Plan
- Promote Sustainable Energy Management practices, and
- Incorporate Energy Efficient and Sustainable Designs and Management for both new Build and Refurbishment Building Projects

The overall design philosophy for a building and the chosen methods for servicing the facility will have a significant influence on it's final energy performance. In terms of minimising the energy use the strategy shall be to utilise passive systems where feasible, thus reducing energy demand to the absolute minimum. The remaining energy demand shall be met by

incorporating high efficiency systems complimented with fully automated and intelligent control systems.

Energy Efficient Project Management

Energy Efficient Project Management is the key to ensuring NUI Galway builds and retrofits its facilities to the highest possible clean and sustainability standards. The key requirements shall be as follows:

- Early intervention (at conceptual design stage) to ensure energy demand management is a key objective of the completed project,
- Early communication with the relevant personnel in the Systems and Energy Teams within the Buildings & Estates Office to ensure controls and systems efficiency is a key enabler of the project,
- The Utilities Design Guide shall be issued to all designers and contractors associated with the project upon their appointment,
- Preliminary Conceptual Design Philosophy Document to be submitted to Systems and Energy Team for consideration and approval as early as possible in the project process,
- Minutes of meetings taken at each meeting which specifically deals with energy systems and controls are to be provided to the Systems and Energy Team to ensure compliance with ISO 50001,
- Early adoption of an energy efficient design methodology and the inclusion of a predicted and forecasted energy increase or decrease in the final detailed design, (a BER and DEC rating to be included for a major capital build).
- Large scale projects should include an Energy Balance as part of the design methodology and process,
- Ensure the procurement of the project complies with Green Public Procurement Guidelines (GPP)
- Sub metering of energy systems and integration with the Building Management Systems to be included for all projects, or as dictated by the Energy and Systems Team
- Regular reviews of the design during the construction works to be minuted,
- Ensure the Controls and Facilities Teams within Estates are fully involved with the commissioning of the building and its services systems,
- Demonstration of the systems to the all Facilities, Energy and Systems Teams on final completion of the project.
- Optimisation of building physics such as orientation and thermal performance
- Plant efficiencies and minimisation of losses and auxiliary loads
- Optimisation of solar gains when required whilst minimising solar gain overheating during summer months
- Holistic occupancy control and profiling of M&E systems
- Optimising the benefit of mixed mode system design including natural ventilation

The 2017 amendment to Part L (Conservation of Fuel and Energy) of the Building Regulations and the Technical Guidance Document L, for Buildings other than Dwellings, provide for the implementation of requirements of Articles 2,3 4, 6 (part of), 7, 8, 9(3,b) of the EU Energy Performance of Buildings Directive – EPBD (recast) (2010/31/EU of 19 May 2010).

They provide guidance in relation to Part L of the Second Schedule to the Regulations as inserted by Building Regulations (Part L Amendment) Regulations (S.I. No. 538 of 2017).

Part L of the Building Regulations 2017 applies to buildings other than dwellings and was published on 22 December 2017.

This sets out to the approach to be taken for Public sector projects with reference to the Building Regulations 2017 Technical Guidance Document L – Conservation of Fuel and Energy for Buildings other than Dwellings.

This design brief will be developed based

NZEB Standards
BREEAM Standards
Building Regulations Part L – Non Domestic Buildings
CIBSE Technical Design Documents
BIM – Building Information Modelling.

To ensure the longevity of this brief, specific mention of individual standards, which are continuously being updated, has generally been avoided.

Where standards are noted, it is the responsibility of Design Teams to ensure compliance with the prevailing version of that standard.

The design, installation, commissioning and handover of the project, including materials, products and workmanship shall comply with the relevant prevailing standards in the following order of preference: national standards transposing European standards, European Technical Assessments, common technical specifications, international standards, other technical reference systems established by European standardisation bodies or - when any of those do not exist - national standards, national technical approvals or national technical specifications relating to the design, calculation and execution of the works and use of the supplies and each reference shall be accompanied by the words ‘or equivalent’.

Key Energy Efficient Design and Equipment Concepts

The following design concepts shall be incorporated by Project Managers within the Buildings & Estates Office.

- Air tightness shall comply with the latest NZEB Interim specification.
- All electricity, gas and water utilities shall be sub-metered and connected to the Building and Energy Management Systems.
- Both the Conceptual and Detailed Design Stages of a project shall include for separate meetings with the Systems and Energy Teams to ensure all relevant utility standards are being met.
- Temperature set points to be selected to minimise energy usage whilst maintaining optimum environmental comfort within the building. It is accepted that occupants will accept higher temperatures in the summer period and mechanical cooling should only be adopted if a passive solution has proven not to be feasible. Where environmental control is provided a dead band of 4 deg. C shall be adopted but this should be reviewed for every individual project.
- Lighting levels to be set in accordance with similar principles to internal temperatures.
- Mechanical ventilation systems shall only be considered when strategies to provide natural ventilation have been fully explored. Where forced mechanical ventilation is deemed necessary the plant shall be sized to provide the minimum outdoor airflow rates as recommended by CIBSE. The effectiveness of the ventilation systems should be considered in the appraisal of systems at the various design stages.
- Use of high efficiency, variable speed motors to be specified for all fans and pumps where continuous running over long periods is envisaged. Motors should be Class Eff1 with the efficiency stated.
- Realistic and diversified assessment of likely internal gains from equipment, people and lighting to be included for heat loss calculations.
- Lighting systems shall consider LED as the first option. Ensure minimum 5 year warranty.
- All Toilet, Corridors, Plant-rooms, Circulation Areas and Stairwells shall include for PIR Controlled Lighting.
- External Lighting shall be photocell controlled. Specify lighting for maximum durability, energy efficiency and lifespan.

- Large scale lighting retrofits should include for BMS controlled Lighting.
- All thermal insulants selected for use with the fabric and services systems should be manufactured from products having zero ozone depletion potential.
- All building products should be selected to compliment the sustainable building strategy.
- Design to minimize life cycle costs, including the use of materials that will maximize durability and longevity.
- All WC's should have dual flush capacity.
- Consideration shall be given to utilising rainwater recovery where economically viable (yielding payback of less than five years).
- Lighting and HVAC controls to be designed to serve zoned areas as applicable to the use of the building.
- Upon completion of all refurbishment projects the PM shall include for the completion of a revised Display Energy Certificate to be included as part of the overall project cost.
- All equipment must comply and adhere to the Triple E Register.

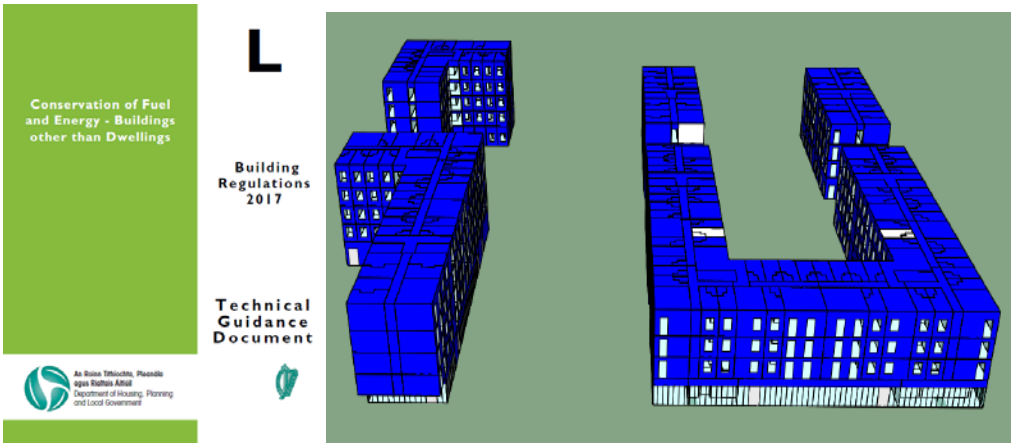
Near Zero Energy Buildings (NEZB)

- All buildings shall be designed to meet the requirements of NZEB. The European Energy Performance of Buildings Directive (EPBD) requires all new buildings to be Nearly Zero Energy Buildings (NZEB) by 31st December 2020.

  DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings (recast)

- NZEB "nearly zero-energy buildings" means a building that has a very high energy performance, as determined in accordance with Annex I. The nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby;"

- NUI Galway will therefore implement the standards and requirements set out in the Part L of the Building Regulations was updated to define the requirements in legislation and compliance with NZEB.

- 

- The Non-Domestic Energy Assessment Procedure (NEAP) is Ireland's official methodology for calculating a Building Energy Rating (BER) for non-domestic buildings

- $$EPC = \frac{\text{Primary Energy of Actual Building}}{\text{Primary Energy of reference building}}$$
  Must be equal to or less than MPEPC =1.0

- $$CPC = \frac{\text{Primary Carbon Dioxide emissions of Actual Building}}{\text{Primary Carbon Dioxide emissions of reference building}}$$
  Must be equal to or less than MPCPC =1.15

PASSIVE ENERGY MEASURES

- The use of passive energy measures to achieve a comfortable internal environment shall be employed where possible. The positioning of the building (allowing for site restrictions) should be developed to take account of the need to minimise energy consumption with particular emphasis on maximising the use of natural ventilation, daylighting, useful solar gain and minimising heat losses and unwanted solar gains.

- The designers must target an energy rating of A2 and equate to a carbon emission of <50kg CO2/m2.

- Low energy targets for a new, minimally M&E serviced, naturally ventilated building are as follows;

  - an electrical demand of less than 80kwhrs/m2/year and
  - a thermal demand of less than 100 kwhrs/m2/year.

  These targets are taken from good exemplars on NUIG campus and from SEAI 2020 energy goals.

- Low energy targets for a more heavily M&E serviced, mechanically ventilated building, such as a science building will be as follows;
  - electrical demand of less than 200kwhrs/m2/year and

- a thermal demand of less than 150 kwhrs/m2/year for both the building and equipment/contents. These targets are taken from good exemplars on NUIG campus and from SEI 2020 energy goals.

- The Design team must include relevant and beneficial sustainable/ renewable energy technologies in its preliminary and detailed designs, which must be analysed and have a full Cost Benefit Analysis (BBA) carried out. These cost-benefits shall then be compared with traditional fossil fuel solutions. This should include, but is not limited to, the analysis of available useful natural energy sources incl biomasss, wind, solar, hydro, geothermal, pump head hydro and tidal energy.

- In presenting CBA case studies to NUIG, the merits of sustainable energy solutions Vs traditional solutions shall include the capital costs of the equipment, cost of installation, the cost of maintenance ongoing, availability of any grants, and the present and likely future cost of fuel and Carbon emissions (ETS & Carbon Taxes) from both fossil fuel and sustainable/renewable technologies.

- The ongoing running cost of the building shall also be analysed by inputting the existing contracted tariffs for LV/MV power, gas and water tariffs. For future years, energy costs, an inflation index based on CSO/ CPI stats should be used. This will inform NUIG of the future running costs of both options.

- Like wise in costing fossil fuel technology options, in addition to capital and installation expense, the future availability and likely cost of the oil or gas and national inflation must be factored in - this information is widely available via CSO/EEA/EU Statistics offices. Future carbon taxation should also be included, if only as a marginal cost assumption.

Design Review Agenda Checklist

In review of design strategies and proposals for projects please note the following notes below. These notes are for guidance only to help identify the issues to be considered as appropriate for the particular building or refurbishment project:

Heating System Strategy
- Design for Maximum Energy Efficiency
- Potential and Opportunities for Waste Heat Recovery, CHP and Ground Source Heat Pumps/ Air to Water Heat Pumps
- Energy Efficient Controls

Domestic Hot Water Services
- Design for Maximum Energy Efficiency
- Storage or Non Storage Principles
- Potential for Solar Water Heating
- Energy Efficient Controls

Ventilation Systems

- Minimum Requirements Analysis
- Design for Maximum Energy Efficiency and Maximum Natural Ventilation Potential
- Opportunities for Mixed Mode Operation
- Heat Recovery
- Air Tightness
- Energy Efficient Controls

Cooling Systems

- Minimum Requirements Analysis
- Dynamic Simulation to maximize low energy cooling
- Opportunities to reduce loads to be considered in detail at conceptual design
- Realistic Design Loads
- Energy Efficient Control
- Sub metering of all Chillers

Lighting Installations

- Opportunities to maximize Daylight
- Lighting Efficacy
- Lighting Controls
- Presence Detection
- LED Technology

Water Systems

- Opportunities for Low Water Consumption
- Flushing Control
- Sub Metering
- Thermostatic Mixing Valves
- Low Flow Showers and Taps

Building/Energy Management System, Controls and Metering

- Sub Metering (pulsed and compatible)
- Design Philosophy and Strategy
- Controls Strategy (An allowance for updating BMSGraphics must be included in refurbishment budget)

Building Information Modelling and CFD Design.

CFD, Thermal modelling and daylight modelling shall be completed by suitably qualified contractors with regard to the following;

- models will test latest architectural design and with full room utilisation/equipment load and full room data sheet information available.

- where solar gain is likely to result in unacceptable internal heat gain, heavy duty white solar blinds and /or external solar film shading is preferable to mechanical or AC cooling.

- weather files for modelling and BER/DEC iSBEM models will be chosen by agreement with NUIG/design team.

- all latent and sensible heat data entry & occupancy assumptions built into the model will be agreed with NUIG/ design team & documented.

- Max/min room temperatures in sedentary areas such as offices, libraries and theatres shall be 18-22C in winter and 20-25C in summer.

- Max/min room temperatures in PC suites and data centers shall be 20-25C in winter and 20-27C in summer.

VENTILATION/HVAC/COOLING

- Natural ventilation is the preferred method in low density and narrow and medium plan spaces (up to 7meters wide).

- For more heavily services/large equipment loads Mixed mode ventilation (natural ventilation assisted with mechanical ventilation) is the next preferred method for medium plan spaces (7-10meters wide).

- Full Mechanical ventilation and/or cooling may be the only practical solution in deep plan spaces (of >10 meters width) or lecture theatres; these systems will only be acceptable where natural ventilation or mixed mode is proven ineffective.

- Air Conditioning shall only be installed for specific rigid regulatory or process related requirements or where mechanical extract proves insufficient.

- Smaller internal works spaces with high occupancy and high latent heat gains or solar gain which are modelled to result in temperatures which exceed 28°C for greater than 1% of the working year, CIBSE guidelines, are also eligible for mechanical cooling.

- Any HVAC/mechanical ventilation installed shall be tested and commissioned fully with duct leak testing being carried out. VSD controls shall be used to reduce fan energy consumption and duct overpressure while being able to achieve the required air exchange and air comfort in the spaces required.

- Passive cooling through exposed building mass/ structure should also be examined and modelled.

- The embodied energy contained in concrete, steelwork and insulation materials shall be assessed in the design process, and used in calculating the carbon load of the construction phase.

- Air tightness standard- Buildings shall be leak tested to ensure the building is well insulated and sealed.

- Air leakage from the building shall be tested and must be less than 3.0 m3/hr/ m2 @ 50Pa and a test cert shall be supplied prior to handover to NUIG.

- Air changes shall be set so as to provide the required air volume change without exceeding duct pressure limits and without unnecessarily consuming power. (using efficient motors and fans).

- Procurement of all materials and equipment shall take account of the energy rating of such, and the award criteria must reward more energy efficient equipment.

- Non essential fumehoods and extract fans shall be BMS/timer controlled where possible so they do not run 24-7. For essential fans and extracts that need to run 24-7, highly efficient fans (n=>93%) rather than standard fans must be fitted.

CHILLERS / SPLIT DX AIR CON SYSTEMS

- All new builds must only use approved refrigerant gases, HCFC and CFC free. All these gases and blends must comply with Montreal protocol and F Gases legislation.

- All cooling systems and AC systems must have an EER and COP of at least 3.9 and preferably > 4.0.

- Many HCFC based refrigerant's are now restricted or banned outright , ie R22, R-123, R-401A, R-401B, R-402A, R-402B, R-409A and R-416AR12, R22, R134.

- Refurbishment's of buildings must include for the legally required legitimate costs of collecting, removing, and legal disposal of these gases and installation of new refrigerants with lower global warming potential (GWP)

- Acceptable new refrigerant mixes incl R407, R410c, HFC R-134a and environmentally friendly HFC R-123, HC502a, (R-600a), CARE 30, (R-290) (R-1270)

BMS SYSTEM

BMS system shall be a Cylon system, which can be accessed from fixed and mobile platforms via campus LAN and fibre optic networks.
The BMS server and hardware HUBS are located in BSE Supervisors office and in Aras Moyola.

BMS system is not presently required to be CFR part 11 compliant but must have full user security logon facility.

All temp, humidity, pressure sensors shall be compatible with the Cylon system (ie UC32.net and UCC4.net application compatible).

All building utility meters and heat meters shall be picked up on the BMS system and shall record daily, weekly and monthly consumption in easily accessed graphics files.(currently .csv excel files)

BMS system shall be configured to severe weather/frost protection as follows;
-When external temperature falls to 2.5ºC, all external LPHW pumps, and AHU/FCU coil supply pumps will be automatically started to circulate water. At this time all AHU supply and return fans will be automatically interlocked off.

-When external temperature falls to 1ºC, all internal LPHW pumps, and AHU/FCU coil supply pumps will be automatically started to circulate water through coils etc.

- If internal plant room space temperature falls to -1ºC, all heating plant (boilers) will be energised and automatically started and will run until citrcuit temperatures reach their programmed set point s (eg 80ºC on main gas boiler flow temps).

All water Booster sets, Fill sets, and pressure sets will have an automatic cut off switch in the event that water pressure suddenly drops by 0.8Bar. A low pressure alarm shall light on the BMS and an audible alarm (90dB) will be activated. Manual intervention shall be required to reset system.

BMS Technical
When integrating or backing up sites onto the campus BMS network the following should be noted;

-The WN3000.ini file must NOT be altered or overwritten in any way under any circumstances. At present, such changes will affect approx 50% of the entire campus BMS network.

-The site numbers in the cylon controllers being added to the system must match the site number as per the campus configuration file.

-Existing site numbers in the campus configuration file must NOT be altered or duplicated.

-The graphics resolution and layout must not be altered on the front end PC's. All changes to layouts must be approved by Services Engineer, NUI Galway. New buildings shall be added to the overall BMS, eg not as a separate satellite BMS site.

HANDOVER

All new builds/refurbishments will not be deemed complete until all as built P&IDs, O&M manuals and associated documentation are handed over to the BO, even if Practical Completion stage (PC) has been reached..

In addition M&E systems must be walked down and snagged by the Contractor and Design team. Any changes, discrepancies must be noted and redlined on the as built drawings and added to main snagging list. Through document control, a new set of as built drawings shall be promptly issued with corrections.

LPHW/HPHW

Heating system flues shall not be carried though the building internally but should exit the building envelope at 1.5meters above ridgeline as soon as practicable.

Foul, surface water and rainwater drainage pipes shall not be carried through a plant room where possible, and certainly not through or near electrical panels, substations, transformers, switches etc..

The requirement for DHWS in buildings during Summer, must not require the LPHW systems to operate during summer season – during summer Solar thermal or timed electric immersions shall be used to heat the small volumes of water required in most buildings.

Flue dilution fans, where required, shall not be wired so as to act as master to burners, eg the flue dilution fan should be wired to activate when the burner activates (on receipt of a low voltage signal from BeMS) and they must cease to operate within 5 mins of the burner shutting off.

Cooling via AHU shall be provided where necessary via free ambient air cooling, DX air cooled refridgeration or by air cooled compressor driven chillers producing chilled water in the larger installations.

Installation of CHP shall be investigated with full cost benefit analysis; all areas of campus will have access to natural gas supplies in 2012.

BUILDING ELEMENTS

Windows shall be double or triple glazing low energy glass, and in areas of large solar gain, suncool or other glass shall be used to minimise solar gains .

An element of solar shading/brise soleil can also be incorporated into new glazing systems in areas susceptible to large solar gains (eg south facing elevations with >30% glazing in wall area.

Walls, windows and roofs shall have u-values of at least 25% better than current standards specification/planning regulations demand (Part M), so as to minimise heat loss through the fabric elements.

Insulation shall be installed so as to result in a U Value 25% greater than that demanded for insulation materials under current Building regulations.

Glazing shall be chosen having regard to the orientation of the building – eg if solar shading is required for a space because it is predominantly south facing and open plan, then overhang, brise soleil or low energy tinted glazing with the ability to reduce the solar gain shall be investigated. However this may affect external appearance of building dramatically.

WATER / WATER CONSERVATION

Potable and Drinking water shall be separated from Fire Mains/fire fighting water to maintain clean water and drinking water to EU/WHO standards and also to preserve water volumes and pressure for both potable requirements and fire fighting requirements.

Water conservation features shall be maximised where possible including the reuse and recycling of rain water and grey water for use in flushing toilets in the building – this requires a quantity of stored water fed from coarse filtered recycled water and backed up with fresh water, for use in flushing toilets.

A decision on whether rain water harvesting or low volume appliances or both, are to be employed must be made at start of project. Where the majority of the water used in the Water closets is from recycled rainwater, it is acceptable to reduce the cost and number of low water use fittings, controls and appliances.

Water closets will be fitted with option of half and full flush. Full flush will be limited to 7 litres water maximum.

Water closets should be supplied from rain water tank where RWH systems are provided.

Urinals will be fitted with flushes via 2 methods

- if rainwater harvesting is included – urinal will be flushed via infra red activation only, eg before and after use. Rinse volume shall be 0.5 -1.0 litre per rinse.
-If only potable water is being used, then a waterless urinal (using Microbiological agents) is to be used, with 4 timed flushes per 18 daytime/evening hours.

Wash hand basins will be activated by infra red activation only with extra long life batteries fitted to sensor tap controls.

Laboratory equipment and commissioning

Lab equipment shall be A rated for energy consumption and efficiency or other equivalent energy rating system.

Fumehoods should be equipped with sash controls (presence sensors) to reduce extracted air volumes to reduce loss of warm air and reduced fan energy consumption.

Laboratory waste pipes that are likely to contain strong acids, bases, oxidisers, flammables or corrosives shall be piped in Vulcathene™ or some other chemical resistant pipework which is equal and approved by NUI Galway.

Chemical waste dilution traps made of chemical resistant glass and Vulcathene™ may be required in some instances where large volumes of highly corrosive materials are being disposed down the sinks.

ELECTRICAL

Electrical supply shall conform to all National Rules for Electrical Installations I.S. 10101:2019..

Protection devices, earthing and bonding shall conform to the highest international standards at all times.

Lighting loads and daylight modelling will take into account the orientation of building, azimuth of sun, incl any existing or proposed nearby buildings.

Motor power, Chiller, AC units & Fan power must be minimised by choice of highly energy efficient motors and fans.

Internal natural lighting gains from sunlight will be included in lighting plan – where the external wall to internal wall exceeds 3 meters, lighting controls will be used to incorporate lux sensors to independently control the bank of lights in the 3 meter space from the external walls, particularly in foyers, reception areas, corridors, collision spaces, large offices and spaces. These sensors must be set to achieve a light level of 450lux minimum and 600lux maximum for occupants.

Standard 6-8 person lifts shall be fitted 6 x10watt LEDs, backed up with 180minute battery pack.

Lifts shall use low energy motors (n=93%+) with energy recovery mechanism.

LIGHTS - INTERNAL LIGHTING

The designer shall note that all Lighting in NUI Galway both internal and external must be LED Lighting, it is also a requirement that lighting be installed for function and easily accessible. The designer must highlight were specialist decorative lighting or scene lighting is proposed, this will be considered by NUI Galway.

The LED lighting shall meet the following performance specification.

Light Source	LED
Colour Rendering Index	>80
Colour Temperature	4000k
Minimum Luminaire Efficacy	125 lm/W
Median Useful Life (IEC 62717) Ta 25°C (50,000 hrs)	L80 B50
Minimum Driver Lifetime (Max ambient temp 35°C)	50,000hrs
MacAdam Step	3
UGR	<19

LIGHTING CONTROLS

Switchstart lighting in offices and classrooms is not to be included.

Lighting control shall be by mixtures of high quality Presence PIR sensors, preferably low microwave type shall be used in large areas such as corridors, labs, post grad suites, computer labs and lecture theatres where lighting loads of over 500 watts are found (eg 25x 26 watt 2 foot fluorescents).In areas with natural light Lux/Photocell sensors shall be used.

Lighting circuits shall be wired so the PIR/photocell is the master switch calling lights on and off. In the case of PIR the sensor would switch off lights after 5 minutes of non activity/movement.

Lighting controls such as photocells will be used to switch off lighting when not required eg once natural light supplies >500 lux in classrooms the photocell should switch off its bank of lights.

Lighting for visually impaired or photosensitive persons and facilities with a need for high light levels (1000+ Lux) shall be achieved T5 Fluorescent Daylight tubes with a colour temp of 6000k.

In high ceiling rooms, walls and ceilings shall be painted white or off white where possible in order to maximise the reflectance of light; and lights shall be suspended with steel wires.

Low wattage (<10W) LED Task lighting shall be used in places such as libraries and labs to maximise personal comfort while minimising energy waste through inefficient lighting design and placement and light loss off walls and ceilings through reflectance.

In long corridors and foyers etc, photocells should be located at 10 meter centres in the middle of walkways with an acuity angle of detection of 60-85 degrees.

Lights must be accessible from scaffold or ladder. Where fittings are mounted at heights greater than 3 meters, the fittings shall be capable of being lowered for relamping via motor or winch, or alternatively the design team must include for supply of a boom/lift/machine for accessing & maintenance and cleaning of lights.

Electronic lighting ballasts shall be used in preference to traditional electro-magnetic. (lower energy loss though lower heat generation)

All lighting shall be high energy efficient, this includes functional and feature lighting.

The lamps and fittings shall be recyclable under the WEEE and RoHWS waste directives. New fluorescent lamps shall be the low mercury type with a mercury content of 0-5mg maximum.

IP65 rated fittings & diffusers where wet, moist or humid conditions pertain.

External lighting

Downlighters only to be used for street lighting and car parks – no sky lighting or light scatter allowed, especially in the SAC area in Dangan and main campus. (SAC =Special area of conservation)

First preference lights are LED lamps of 50watt-90watt

Lifetime for lamps must be 30,000 hours minimum.

Uplighters are only allowed in specific instances eg to allow feature lighting on historic buildings eg Quadrangle, or recessed low wattage LED uplighters illuminating paths.

Lighting controls will be high quality photocells will be used to switch off lighting when not required and set to switch off at 25-30lux

ENERGY METERING

Metering - All new buildings will be supplied with fully commissioned and functioning electrical meters (model either Socomec Diris A10, A20 or A40). Meters will be placed on the major electrical loads, eg MMC boards, large labs and theatres and by agreement with BSE.

Where possible, each floor and major user such as fan/motor loads, equipment, laboratory loads will be metered separately.

All meters will be picked up on Cylon BMS system and will sample every 15 mins. All data will be stored in datalog files on front ends and be backed up.

Consumption data will be presented as per NUIG meter design No. 4.

COMMISSIONING

All M& E items must be balanced, commissioned and signed off by qualified personnel.

All commissioning and balancing record sheets shall be furnished to Service Engineer with all other Safety file documentation incl drawings and plant schedules, plant OEM maintenance routines etc.

At the 6 + 12 month point after handover/occupation and before end of defects liability period, the measured energy profiles for the building shall be analysed to determine if the building performs to its intended brief.

TRIPLE E REGISTER

The Triple E Products Register is a benchmark register of best in class energy efficient products. The European Union (Energy Efficient Public Procurement) Regulations 2011, SI 151 of 2011, state “a public body shall only procure equipment or vehicles which are (a) listed on the Register or (b) satisfy the published SEAI energy efficiency criteria for the equipment or vehicle concerned, and the public body shall specify this requirement in any documentation describing its procurement requirements”.

Where applicable the Building Services Consulting Engineer shall ensure that all products or equipment included in mechanical and electrical tender documentation and installed in schools are listed on the Sustainable Energy Authority Ireland’s (SEAI) Triple E lists of energy efficient equipment or are compatible with the criteria of the Triple E evaluation scheme.

MATERIALS

Materials shall be selected and all building elements designed to ensure that the building and all components are durable and low maintenance and do not present a hazard to the health and safety of the users.

In accordance with Part D of the Building Regulations all works shall be carried out with proper materials and in a workmanlike manner. “Proper materials” means materials which are fit for the use for which they are intended and for the conditions in which they are to be used, and includes materials which:

(a) Bear a CE Marking in accordance with the provisions of the Construction Products Regulation;

(b) Comply with an appropriate harmonised standard or European Technical Assessment in accordance with the provisions of the Construction Products Regulation;
Or
(c) Comply with an appropriate Irish Standard or Irish Agrément Certificate or with an alternative national technical specification of any State which is a contracting party to the Agreement on the European Economic Area, which provides in use an equivalent level of safety and suitability.

RENEWABLES

Part L of the Building Regulations 2017 requires that 20% of the energy used by a building is produced from on-site renewable energy sources. It allows this figure to be reduced to 10% where the energy performance of the building model is 10% or better than that of the reference building in Building Regulations Part L 2017.

In terms of buildings it is more cost effective to reduce the energy use to this point and provide a 10% renewable contribution rather than to provide the 20% renewable contribution. Note also requirements with regard to SBEM and calculating the renewable energy generation on site ie CHP units.

Thus where the Energy Performance Coefficient (EPC) of 0.9 and a Carbon Performance Coefficient (CPC) of 1.04 is achieved a Renewable Energy Ratio (RER) of 0.10 represents a very significant level of energy provision from renewable energy technologies.

PHOTOVOLTAICS (PV)

The design of the PV system must be considered from project inception in relation to the overall project, roof design and materials.

The ideal orientation is south facing with an angle of inclination of 30 degrees; however, circumstances may require deviation from this ideal.

It is important that a balance is struck between the various elements such as angle of roof, planning requirements, roof build up and costs when developing the building design and deviation from this ideal maybe required.
The area of south/east facing roof designated for PV panels must be indicated on drawing. If there is likely to be a difficulty in achieving sufficient south or east facing roof.

BIOMASS HEATING.

COMBINED HEAT AND POWER UNITS.

AIR TO WATER HEAT PUMP UNITS.

RAINWATER HARVESTING INSTALLATIONS.

AIRTIGHTNESS TEST REQUIREMENTS
Building Performance and Compliance Testing

The Airtightness specification for all new schools and extensions is to be less than 3.0 m3/h/m2 of measured envelope area at a test pressure of 50Pa.

The required level of air permeability for the whole building must be clearly detailed within the specification, in units of m3/hr.m2 @ 50 Pa. The main contractor's responsibility for achieving the required level of specification should be clearly stated.

The requirement to test the building at a suitable point in the programme by a competent specialist should be the responsibility of the contractor and included within the works requirements.

An example of competence would be a contractor fully accredited by INAB (Irish National Accreditation Board) or UKAS (United Kingdom Accreditation Service) Accredited calibration laboratory to ISO 17025 for airtightness testing of commercial buildings in accordance with
CIBSE TM23: 2000 'Testing buildings for air leakage',
BS EN 13829:2001 'Determination of air permeability of buildings, fan pressurisation method' ATTMA TS1 'Measuring air permeability of building envelopes'
DoES Building preparation as detailed below.
Non Accredited test Certificates will not be accepted by the DoES.
Measured envelope area shall be taken as the area of surfaces that make up the air seal boundary of the building.
External envelope area = Detailed envelope area calculation as per ATTMA TS1.
Contractor to provide Detailed envelope area and red-line drawings of measured area for agreement no less than three weeks before the date of air testing.
The test must be programmed for a weekday and should be carried out at least three weeks prior to the planned completion date to allow remedial works and re-testing to be completed before handover if necessary. Sufficient notice must be provided to allow witnessing of the test by the Design Team and Employer's Representative.

- The airtightness testing specialist must not have any involvement with the supply and/or installation of any specialist products or involved commercially or financially with any of the specialist products installed on any school buildings. If the airtightness specialist is involved with any contract works within the building this is a conflict of interest and the test certificate will be deemed invalid.
- The project manager on the main contract team is to ensure a copy of the "airtightness compliance schedule for schools" (copy at end of this Appendix) is issued as part of the handover documentation.

- The test and recording equipment including the fan test rig and manometers must have a valid calibration certificate that is less than 12 months old on date of test.
- The contractor shall liaise with the local fire brigade to ensure that they are aware of the smoke tests and to avoid unnecessary call outs. Call out costs shall be the responsibility of the contractor if incurred and this shall be stated in the works requirements.
- The testing contractor shall designate a single person to supervise all aspects of measurements with regard to air tightness at a particular school. The designated person shall liaise with Employer's Representative and the school authority until the results are provided to the Employer's Representative. The supervisor shall inspect the school and ensure that all necessary provisions are made for temporary sealing up of openings where permitted by the standard.

Building Airtightness Testing Specialist

- The airtightness works will be carried out by a recognised building airtightness specialist accredited by INAB (Irish National Accreditation Board) or UKAS (United Kingdom Accreditation Service) accredited calibration laboratory to ISO 17025 as a testing laboratory for large commercial buildings. Their appointment will be approved by the Architect/Design Team.
- The specialist company must demonstrate prior experience of works on projects of similar size and complexity. The Design Team and Contractor are to ensure that a copy of the specialists INAB/ UKAS accreditation certificate is submitted to the Employer's Representative for approval before the airtightness specialist is appointed.

For suitable specialists refer to: www.inab.ie; and www.ukas.com.

Compliance Testing

SAMPLE ROOM TEST DURING CONSTRUCTION

While this test is good practice, it is at the discretion of the Contractor and should comprise one pressure test followed by a smoke test on the external envelope during construction. It is not possible to run a complete airtightness test on a single room as there will be no air seal boundary between the room and adjacent internal spaces, however the sample room test will give an early indication of weaknesses that may be replicated throughout the building. This pressure test should be a positive test, pressurising the room from one door opening. Air intake/leaks along the external wall, floor and service points can be established thereby facilitating improved sealing techniques as the project is progressing. This test should be considered at a very early stage in the project and preferably witnessed by the Employer's Representative.

WHOLE BUILDING ACCREDITED AIRTIGHTNESS TEST

A preliminary site meeting must be held with the approved accredited specialist at the start of the project to discuss airtightness detailing, approach, programme and testing schedule.

Following this a detailed envelope area calculation shall be undertaken and issued to the Design Team before test date.
To ensure the building is properly prepared for the test, a pre-test site inspection by the Accredited Airtightness testing company must be undertaken 2-3 weeks prior to the final test date.
This final test will comprise an accredited airtightness test as detailed above with subsequent smoke tests should the specification requirements not be reached.
All further airtightness tests and smoke tests required to bring the building up to the required airtightness to be at the contractor's expense.

Building Preparation for Test
The building preparation works are not to be carried out by the airtightness testing specialist as it is deemed a conflict of interest. Preparation work is the full responsibility of the contractor.
Before the final testing the contractor should ensure the following attendances and preparations are complete.
Contractor to provide an estimate of measured area and the capacity of the proposed test rig for review by Employer's Representative no less than one week before the date of air testing.

- All external windows, trickle vents, smoke vents and doors must be closed and not artificially sealed with tape.

- If there are hit and miss vents for ventilation purposes, they have to be installed for the test and closed, they should not be artificially sealed with tape.
- All internal doors must be wedged open.
- All drainage traps must be filled with water. If traps have not been fitted then drainage pipes must be sealed with tape.
- All heating and mechanical ventilation systems must be turned off and intake/exhaust louvers closed up with plywood/ MDF board and sealed with tape/polythene or similar. This is most effectively achieved by sealing the intake and exhaust louvers for each system.
- Any combustion appliances within the airtight building envelope should be turned off and their flues sealed including fume cupboards.
- The ground floor internal and external area within 5 metres of the fan equipment/doorway must be level, clean and clear of all loose material with vehicular access to entrance doorway area.
- The vent at the top of the lift shaft where applicable must be closed but not artificially sealed with tape.
- The contractor must ensure that no external doors/windows/trickle vents are opened for the duration of the test.
- Some temporary minor carpentry works may be required to the doorway in which the fan equipment is mounted to accommodate the fan equipment.
- Notices must be posted at all entry and exit points to the building; ''AIRTIGHTNESS TEST IN PROGRESS DO NOT OPEN''.

- Suspended floor tiles and ceiling tiles (where applicable) around the perimeter of the building are to be removed for the test
- The contractor shall advise the Design Team of the proposed test date one month prior to the test date; weekend days may not be acceptable. An agreed date should be sought to enable the Employer's Representative to be present during the test, and to inspect any defects.
- Note that the air test can only be carried out during appropriate weather conditions (particularly wind speeds that must be less than 5 metres/second during the test), contractor to check weather forecast on the day before the test is due and confirm that local forecasted conditions are appropriate.

Glossary

Abbreviation	Item
AHU	Air handling unit
BMS	Building management system
BSE	Buildings Services Engineer
CHP	Combined heat & power
CHWS	Chilled water services
CO2	Carbon dioxide
COP	Coefficient of power
DHWS	Domestic hot water services
FCU	Flow control unit
HDPE	High density polyethylene
HVAC	Heating, ventilation, air conditioning
iSBEM	Simplified building energy method
LTHW	Low temperature hot water
MCC	Motor control center
MTHW	Medium temperature hot water
WHO	Word Health Organisation
VSD	Variable speed drive