ENERGY EFFICIENCY NEED STATEMENT

CAWAGAN ALAM SEKITAR & KECEKAPAN TENAGA

ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
ACMV	Air-Conditioning and Mechanical Ventilation
AHU	Air Handling Unit
BEI	Building Energy Index
CCTV	Closed-Circuit Television
COP	Coefficient Of Performance
EMAL	Electrical Material Approval List
EnMCS	Energy Management Control System
ESCOs	Energy Service Companies
HAP	Hourly Analysis Program
IES	Integrated Environmental Solutions
IT	Internet Telecommunication
JKR	Jabatan Kerja Raya
CKE	Cawangan Kejuruteraan Elektrik
CKM	Cawangan Kejuruteraan Mekanikal
LCC	Life Cycle Cost
OTTV	Overall Thermal Transfer Value
RTTV	Roof Thermal Transfer Value
SHGC	Solar Heat Gain Coefficient
TRACE	Trane Air-Conditioning Economics
UPS	Uninterruptable Power Supply
VLT	Visible Light Transmission

kWh/m^2/year	Kilo Watt hour per square meter per year	**CO_2**	Carbon dioxide
W/m^2	Watt per square meter	**W/m^3/h**	Watt per cubic meter per hour
W/m^{2}K	Watt per square meter Kelvin	**lm/W**	Lumens per Watt
ach	Air change	**m^3/min**	Cubic meter per minutes
kWr	Kilo Watt refrigeration	**m^2**	Square meter
kWe	Kilo Watt electric	**m^3/h**	Cubic meter per hour
CO	Carbon monoxide	**ppm**	Parts per Million
^{0}C	Degree Celcius	**A**	Ampere

1.1 The building shall be design to be a sustainable and green to the extent possible brief current availability of building materials and M & E components and systems.

1.2 Building Energy Intensity (BEI) shall be proven in the design phase using advance computer modeling tools, the IES software, ECOTECT or similar, as concurred by JKR'S approval.

1.3 The overall efficiency of lighting and maintained illuminance levels for general building areas shall comply with the latest version of MS 1525.

1.4 The building shall be designed according to the relevant standards, guidelines, policies and directives pertaining to energy efficiency and green technology as follows:

a) Uniform Building By-Laws

b) MS 1525:2007 "Standard for Energy Efficiency and Use of Renewable Energy in Non-Domestic Buildings" shall be used as a guide with assumption that energy efficiency performance will achieve Building Energy Intensity (BEI) ≤150 kWh/m^2/year as indicated in (c).

c) Garis Panduan dan Peraturan Bagi Perancangan Bangunan oleh Jawatankuasa Standard dan Kos, Unit Perancang Ekonomi, Jabatan Perdana Menteri, edisi tahun 2008, Bab 4.

d) Energy Efficiency and Conservation Guidelines for Malaysian Industries, Part 1: Electrical Energy – use Equipment, July 2007 and Part 2 : Thermal Energy-use Equipment, June 2010, Kementerian Tenaga, Teknologi Hijau dan Air (KETTHA)

e) National Green Technology Policy, Kementerian Tenaga, Teknologi Hijau dan Air (KETTHA), 2009

f) Handbook On Passive Design Strategies For Energy Efficient Building, Cawangan Arkitek, 2010 (JKR20802-0012-09)

g) Design Strategies for Energy Efficiency in New Buildings (Non-Domestic), Kementerian Tenaga Komunikasi dan Multimedia (KTKM), JKR and Danida, 2004

h) Energy Efficiency Guidelines For CKE Design

1.5 Energy Efficiency is to be achieved, however, without compromising users comfort.

1.6 The cost of incorporating energy efficiency into the design is deemed to be included and no separate cost shall be entertained.

1.7 In addition to this, the following design criteria shall be fulfilled in order to increase energy efficiency of the building.

1.8 In the event of differences between the General Need Statement and Energy Efficiency Need Statement versions of this statement, it is noted and agreed that the higher requirements from either General Need Statement or Energy Efficiency Need Statement shall prevail.

1.9 The contractor shall submit all the necessary documents as below;

a) Architectural conceptual design drawing (A3).
b) Air conditioning zoning drawing (A3).
c) Lighting Zoning drawing (A3).
d) Daylight zoning drawing (A3).
e) Energy simulation file (softcopy).

2.1 Objective

The objective of this *Architectural Energy Efficiency Need Statement* is to encourage architects to apply passive design strategies through creativity, innovation and varying envelope components. This effort in the long run will give high impact reduction and low operational cost in building's energy consumption. By controlling and cutting down on heat transfer shall reduce air-conditioning loads. Similarly, if daylight is optimized, then it can be an important energy saving feature by displacing electric lighting demands.

2.2 Requirements

The overall building design shall incorporate and comply with the latest version of *MS 1525: Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings*. The Tenderers shall submit an Energy Efficient Design Report on items pertaining to Section 4 (Architectural and Passive Design Strategies) and Section 5 (Building Envelope).

a) Site planning and orientation;
For the analysis of the local microclimate condition (air temperature, radiant temperature, relative humidity, air velocity and precipitation) reliable climate data (of at least 20 years) for the site shall be used. The building's main longitudinal orientation shall be on an axis of 5º Northeast.

b) Daylighting;
Daylight penetration must be optimised but glare and heat shall be minimised (refer Table 1a. and Table 13 in MS 1525). Daylight Factor Diagram® or Df-TOOL® shall be used as daylight prediction tool.

c) Facade design;
The glass windows/fenestration system shall be protected from direct sunlight during the day's most solar heat gain and hottest months of the year.

d) Natural ventilation;
The orientation of the building shall be facing the most prevailing wind. Lobby areas, corridors, lift cores, toilets and staircases shall be naturally ventilated.

Alternatively, if performance based approach is used, then compliance pertaining to Section 10 (Building Energy Simulation) from the latest version of MS 1525 must be met.

Additionally these targeted figures shall be established;

e) The *design building annual energy use* must demonstrated at least 6% improved energy savings from the *baseline building annual energy use* using the same simulation program.

f) To achieve thermal performance compliance, out of 8,760 hours time step per year, 60% of the simulated indoor temperature (without active means) of the occupied space shall be between comfortable indoor temperature range in Malaysia (24.5 – 28º Celsius).

2.3 Submittals

The following information for energy report shall be provided by a Professional Architect or Professional Engineer, which includes but not limited to the following:

a) Submit a drawing showing building configuration, site planning and orientation
b) Submit a drawing showing daylight penetration 3 metres from external wall and image capture of Daylight Factor Diagram® or Df-TOOL® results. The windows used for the calculation must be coloured red in the drawing.
c) Submit a drawing showing sun path analysis where the shadows cast on the glass windows/fenestration system from 9:30 am until 5:00 pm during the months of March to July.
d) Submit a wind rose of the site and a drawing showing the building to be facing the most prevailing wind.
e) Submit a drawing showing the naturally ventilated spaces in red.
f) Submit a drawing showing strategic landscaping; trees to help reduce heat gain
g) Submit calculations of the OTTV calculation; (≤ 45W/m2) and
h) The RTTV calculation (≤ 20W/m2) of the roof assembly, if provided with skylights. The BEIT software shall be used.
i) Calculations of U-values for roof and walls.
j) Submit a drawing showing the cross sections of typical parts of the roof construction, giving details of the type and thickness of basic construction materials, insulation and air space.
k) Submit a proposed glazing specifications on Shading Coefficient, U-values and Visible Light Transmission

2.4 Reference

a) *MS 1525:2014:Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings*
b) *ASHRAE Standard 90.1 – 2004*
c) *Building Energy Efficiency Technical Guideline for Passive Design 2013, BSEEP*
d) *Handbook on Passive Design Strategies for Energy Efficiency Buildings, Cawangan Arkitek*
e) *Manual Penarafan Hijau pH JKR*

3.1 Air-Conditioning and Mechanical Ventilation (ACMV) Design

3.1.1 Load calculations

3.1.1.1 Cooling system design loads for the purpose of sizing systems and equipment shall be determined in accordance with the procedures described in the latest edition of the ASHRAE handbook, or other equivalent publications.

3.1.1.2 Computerized load calculations shall be conducted on hourly basis using tools such as Hourly Analysis Program (HAP), TRACE 700, E-20 or equivalent.

3.1.1.3 Design conditions (outdoor and indoor) of air conditioned space for comfort cooling shall be as recommended by the latest version of MS 1525.

3.1.1.4 Alternative ACMV system (air system and refrigeration plant) comparison and its corresponding energy demand shall be conducted. If not specified elsewhere in this document, ACMV system with the least energy consumption shall be selected.

3.1.1.5 A comprehensive design report shall be submitted comprises all design input data, design output and energy simulation result. The design report shall be endorsed by professional engineer.

3.1.2 System/ Equipment Sizing and efficiency

3.1.2.1 Air conditioning systems and equipment shall comply to the latest version of MS 1525.

3.1.2.2 Where chillers are used and when the design load is greater than 1000kWr, a minimum of two chillers should be provided to meet the required load. Should consider standby chillers as well.

3.1.2.3 Minimum chiller efficiency (COP) shall be as set by the MS 1525 in order to have an energy efficient system.

3.1.2.4 Individual air-cooled or water cooled direct expansion (DX) units greater than 35 kWr (reciprocating compressor) or 65kWr (scroll compressor) should consist of either multi compressors or single compressor with minimum step/variable unloaders. Refrigerant type used should have Ozone Depletion Potential of zero (ODP=0).

3.1.2.5 Maximum allowable flow rate in pipes shall follow Ashrae 90.1 – 2007.

3.1.2.6 A presentation of pipe routing shall be made during the concept design stage to show that the most efficient route has been selected for the chill water pipe system.

3.1.2.7 Detailed pump head computation shall be provided together with all supporting documentation of pressure losses; i.e.

a. Friction losses in pipes
b. No. of bends
c. Valves and fittings k-value

3.1.2.8 Pump Electricity Input Ratio (EiR) of chilled water pump and condenser water pump shall be provided.

$$Pump\ EiR = \frac{Design\ Pump\ Power\ (watt)}{Design\ Cooling/Heat\ Load\ Delivered\ (kWcooling)}$$

3.1.2.9 Chilled Water and Condenser Water Pump EiR shall be less than 21.0 Wpump/kWcooling provided, where building peak load is higher than 100 ton of cooling.

3.1.2.10 Chiller Efficiency to be provided as well:

a. COP at rated condition.
b. COP at design condition.

3.1.2.11 Finally, System COP (SCOP) shall be provided as well at design condition:

$$SCOP = \frac{kWcooling}{kWchiller + kWcwpump + kWchwpump + kWcooling\ tower}$$

3.1.2.12 ACMV system components shall have minimum energy performance as stipulated in the latest of MS 1525.

3.1.3 Separate Air Distribution System

3.1.3.1 Zones which are expected to operate non-simultaneously for more than 750 hours per year shall be served by independent air conditioning systems.

3.1.3.2 Separate air distribution systems shall be provided for areas of the building having substantially different cooling characteristics and usage, such as perimeter zones in contrast to interior zones.

3.1.3.3 Zones with special temperature and/or humidity requirements shall be served by independent air conditioning system/separated air distribution system/s from those serving zones requiring only comfort cooling.

3.1.3.4 For air conditioned space requiring exhaust air volume in excess of 3400m^3/h, heat recovery system shall be provided that will recover the coolness of the exhaust air to extract heat from the fresh air intake.

3.1.3.5 A presentation of duct routing shall be made during the detailed design stage to show that the most efficient route has been selected for the duct system.

3.1.3.6 Detailed Fan Total Pressure computation shall be provided together with all supporting documentation of pressure losses; i.e.

a. Total Duct Static Pressure Loss
b. Air Filter Pressure Loss
c. Cooling Coil Pressure Loss

3.1.3.7 AHUs drainage shall be fitted with tap-off point fitted with valve at highest point possible location. This tap-off point will be used for measurement of condensate water rate to compute latent load of AHU system.

3.1.4 Energy Recovery

3.1.4.1 Individual fan systems that have both a design supply air capacity of 5000 cfm or greater and have a minimum outdoor air supply of 70% or greater of the design supply air quantity shall have an energy recovery system with at least 50% recovery effectiveness. Fifty percent energy recovery effectiveness shall mean a change in the enthalpy of the outdoor air supply equal to 50% of the difference between the outdoor air and return air at design conditions.

3.1.4.2 Building shall be designed air-tight for an allowable maximum exfiltration rate of 0.15 ach (to provide positive pressure in the building to prevent infiltration). If the fresh air intake due to air quality requirement is more than 0.15 ach, the exhaust air

system shall be designed to exhaust the additional air from the building and channel it to the heat recovery where the following conditions are met:

a. The total exhaust air volume is more than 70% of the fresh air intake volume.
b. Areas where total exhaust and 100% fresh air is required, such as Operating Theatre, Autopsy Rooms, etc.

3.1.5 Control

3.1.5.1 Temperature control.

Each system should be provided with at least one thermostat for the regulation of temperature. Each thermostat should be capable of being set by adjustment or selection of sensors over a minimum range of between 22°C to 27°C.

3.1.5.2 Humidity control.

3.1.5.2.1 In a system requiring moisture removal to maintain specific selected relative humidity in spaces or zones, no new energy (such as electric reheat) shall be used to produce a space relative humidity as stated in the latest version of MS 1525.

3.1.5.2.2 Air conditioning system for spaces primarily designed for non comfort cooling purposes, which require precise control of humidity (such as Operation Theatre, Library, Drug Store), reheat system utilizing recovered energy such as from condenser water, de-superheater, heat recovery wheel, heat pipe and other energy recovery technology shall be used. Use of electric reheat can only be considered if the use of above technologies is not technically feasible due to site or building conditions.

3.1.5.3 Zoning for Temperature Control.

At least one thermostat for regulation of space temperature shall be provided for each separate system and each separate zone. As a minimum, each floor of a building should be considered as a separate zone. On a multi-storey building where the perimeter system offsets only the transmission gains of the exterior wall, an entire side of uniform exposure may be zoned separately.

3.1.5.4 Control Setback and Shutoff.

Each system shall be equipped with a readily accessible means of shutting off or reducing the energy used during periods of non-use or alternate uses of the building spaces or zones served by the system The following are examples that meet these requirements:-

a) Manually adjustable automatic timing devices
b) Manual devices for use by operating personnel
c) Automatic control system
d) Occupancy Sensors

3.1.5.5 Off hour control.

ACMV system shall be equipped with automatic controls i.e weekly timers, scheduler for use during periods of non-use or alternative use of the spaces served by the system. Equipment with connected load less than 2kWe each may be controlled by readily accessible manual switch.

3.1.5.6 Outdoor and Exhaust air control.

Outdoor air supply and exhaust systems with design capacity more than 1800 m^3/h shall be provided with motorized dampers interlocked with equipments operation. Outdoor air supply motorized damper shall be modulated based on level of CO_2 measured in the return air stream. Maximum allowable CO_2 level in the manned spaces is 1000 ppm. Use of gravity damper is not allowed.

3.1.5.7 Mechanical Ventilation Control.

Each mechanical ventilation system (supply and/or exhaust) shall be equipped with a readily accessible switch or other means for shut-off or volume reduction when ventilation is not required. Examples of such devices would include timer switch control, thermostat control, duty cycle programming and CO/CO_2 sensor control.

3.1.6 Fan System Efficacy

3.1.6.1 Fan system with air flow rate exceeds 17,000 m^3/h and operating for more than 750 hours per year shall have overall fan efficacy of not more than 0.35 W/m^3 of air flow rate.

3.1.6.2 Minimum Fan Efficiency shall be in accordance to 'Energy Efficiency and Conservation Guideline for Industrial Electrical Equipments – Part 1, published by Pusat Tenaga Malaysia.

3.2 High Efficiency Motors/Booster Pumps

All motors used for any mechanical system should be energy efficiency motor according to the latest version of MS 1525.

3.3 Lift System

3.3.1 The lift shall be of energy efficient type, driven by variable velocity variable frequency (VVVF) motors.

3.3.2 The lift motor rooms shall be designed with minimum requirement of cooling (if any) and ventilation system.

3.3.3 All motor used for lift drive shall be of high efficiency motor complied with MS 1525.

3.3.4 Regenerative drives which are systems that can convert or store braking energy from a moving lift car.

3.3.5 Switch off car lighting and ventilation fan when idling more than 2 minutes.

3.3.6 Energy efficient lighting such as LED lighting, compact fluorescent, etc.

3.4 Need Statement and other technical documents of Cawangan Kejuruteraan Mekanikal of JKR for Mechanical Services take precedence should there be any contradiction.

4.0 The energy saving criteria shall be incorporated in all design, installations and equipment.

4.1 Zoning of lighting system

4.1.1 The lighting system in the building shall be designed with multiple zones according to:

a) Daylight availability especially for rooms or area near the façade.
b) Controls of artificial lighting system.
c) Reasonable number of beds per lighting zones (for hospital / clinic)

4.1.2 The purpose of having multi zones of lighting system is to provide flexibility to control the operation of the artificial lighting system thus to eliminate energy wastage in the system.

4.1.3 The zoning might also be associated with automatic lighting control system such as sensors, controllers and building control system.

4.1.4 Office rooms near the façade shall have a minimum of two separate lighting circuits. The lighting circuits shall be designed parallel to the façade or perimeter of the building.

4.2 Lighting control system

4.2.1 The electrical lighting control panel shall have contactors for interfacing and control by the building control system / energy management system. All lighting control schedules and zoning shall reside in the system.

4.2.2 In those areas, outside or inside, where daylight is available, lighting shall be controlled by a daylight photocell and occupancy sensors. The control of the lighting circuit with photocell shall be designed according to the daylight availability. All lighting circuits shall have a motion sensor that would cut off lights if motion is not detected during a preset time period (1 – 10 minutes).

4.2.3 The switching of lights at temporary habitable areas such as corridors, waiting areas, toilets, surau, staircases and open public area, shall have the most practical lighting control strategy to eliminate energy wastage, but at the same time shall comply with safety requirement such as CCTV.

4.2.4 The lighting control shall be fully user programmable and allows time-of-day, day-of-week, and holiday scheduling of all lights. It shall also allow for user's temporary

after-hours lighting needs through the use of Telephone Dial-in Operator or computer interface system commands.

4.3 Lighting System

4.3.1 The lighting system shall use energy efficient lighting such as:

a) Energy efficient tubes for general office area (T5, LEDs, CCFL or better). However other type of lighting tubes are allowable to be installed at other area (example: store, utility area, service room, etc)
b) Use of low loss magnetic ballast or electronic ballast.

4.3.2 The lux lighting level shall be accordance to the latest version of MS 1525. Fluorescent tube lamps with efficacies of at least 70 lm/W and for compact fluorescent lamps, the minimum efficacies are as shown below.

Table 1: **Lamps integrated with ballasts**

POWER RATING (W)	EFFICACY (lm/W)
<9	36
9-15	48
16-24	53
>24	60

Table 2: **Non-integrated lamps**

POWER RATING (W)	EFFICACY (lm/W)
≤10	50
11-50	65
≥51	75

4.3.3 Lamp efficacy in Lumens per Watt (lm/W) shall be based on tests done in accordance with MS IEC 60969:2006 (Self-ballasted lamps for general lighting services – Performance requirements) for fluorescent lamps.

4.3.4 LED lamp with efficacy of at least 55 lm/W for integrated lamps excluding the transformer. LED efficacy shall be based on the latest test accordance to the accepted standard if any.

4.3.5 The luminaires shall be of type approved by JKR Electrical Material Approval List (EMAL). The luminaires shall comply with IEC 60598, IES LM-79-08, IEC 62471, IEC 61547, IEC 61000-3-2, and BS EN 55015.

4.3.6 The common corridor, public areas etc. shall have two levels of illuminance (evening/night) such that after midnight, the lighting can be reduced to a lower level.

4.3.7 The switching of these lights shall be by automatic time switches complete with 24 hours spring reserve and manual override or by other appropriate methods.

4.3.8 Dual timer switches for compound lighting to allow reduced illumination levels.

4.4 Fan

4.4.1 All ceiling fans shall be energy saving. All fans should have Coefficient of Performance (COP) value of at least 2.66 for ceiling fans. COP based on tests done in accordance with MS1220:2001.

4.4.2 Ceiling fans offered shall be complying with MS 1219, MS 1220 and JKR EMAL. For 1500mm sweep ceiling fan, the power consumption at full speed shall not be more than 80 watts at rated voltage, and the minimum air delivery shall not be less than 210m^3/min. Safety thermal fuse (130 ^{0} C, 2A) shall be incorporated against power surge and overheat.

4.5 Power Factor & Harmonic Distortion

4.5.1 An adequate automatic capacitor compensate system shall be installed to regulate the power factor of the electrical power supply. The power factors shall not be less than 0.85 for low voltage system and high voltage system.

4.5.2 To maintain good power quality in the electrical network distribution, the maximum Voltage of Total Harmonic Distortion (THD) shall not be more than 5%.

4.6 Electrical power distribution system.

4.6.1 The design of electrical power distribution system shall be reflected according to energy monitoring requirement.

4.7 Low Losses Transformer

4.7.1 The substation for the main electrical supply intake shall have low losses transformer system. The transformer shall be able to reduce the losses automatically according to the power supply demand in the buildings. The transformer shall be of low iron loss and low copper loss cast resin type dry type complying with the relevant Malaysian Standard or IEC recommendations. The no-load loss and total losses shall not exceed the values specified. The tolerance shall be in accordance with MS IEC 60076-1.

5.1 Digital Electrical Energy Meters shall be installed at sub-switch board serving, but not limited to the following:

a) Central air-conditioning
b) Lift and escalator system
c) Major water pump system
d) General power supply
e) Lighting supply
f) Data Centre/Server Room

6.1 The Contractor shall propose a comprehensive energy management component within the building automation system. Continuous monitoring of the energy performance and the comfort perimeter use is vital achieving energy savings in building.

6.2 The Building Management System shall include a comprehensive Energy Management Control System (EnMCS), comprising of both software and hardware, which shall be able to provide monitoring (including graphics interface), control and reporting of the whole building energy status.

6.3 According to the MS 1525:2007 – Section 9.1:Energy Management System (EMS), the EnMCS shall be considered for buildings having area greater than 4000m² of air-conditioned space where it is a subset of the building automation system function.

6.4 Comprehensive Energy Management Control System shall be implemented as part of the Building Control and Automation System. The energy management system shall monitor all energy flows in the building, floor by floor. The minimum energy management features shall be as listed below:

a) Monitoring and trending of electricity consumption for plug loads per floor
b) Monitoring and trending of electricity consumption for general office lighting per floor.
c) Monitoring and trending of fan energy consumption per AHU.
d) Monitoring and trending of electricity consumption for chilled water pump and condenser water pump.
e) Monitoring and trending of the chiller Coefficient of Performance with breakdown of cooling power delivered and electricity consumed.
f) Monitoring and trending of AHU on-coil and off-coil temperature and static pressure.
g) Monitoring and trending of CO_2 from the return air.
h) Monitoring and trending of supply and return chill water temperature of each AHU.
i) Monitoring and trending of Room temperatures per VAV zones.
j) Monitoring and trending Air temperature and humidity level for every zone; the supply from 1 AHU is considered as 1 zone.
k) Monitoring and trending of Electricity consumption of lifts (and escalators if used).
l) Monitoring and trending of Miscellaneous electricity consumption, including toilets
m) Displaying the energy trending on screen and printout.

6.5 The EnMCS system shall provide hourly load profile, daily, weekly and monthly energy consumption in kWh/m^2 per floor, and projected annual energy consumption in kWh/m^2 based on current day energy consumption of the building.

6.6 All energy flows, temperatures and radiation data shall be stored in the computer, and reports of the performance on a daily, weekly and monthly basis shall be computed automatically. Also, trending of all parameters shall be provided automatically.

6.7 A comprehensive 2 years monitoring program shall be implemented covering the energy consumption for:

a) Refrigeration plant
b) Lighting
c) Computers
d) Other plug loads
e) Electricity consumption for AHU
f) Miscellaneous electricity consumption including toilets

6.8 The building management system shall be reliable, easy to operate and maintain. The system shall be open protocol type such as using TCP-IP, Lon Works, ModBus (or equivalent) communication system, integrated with web-based interface feature and shall be operated remotely through intranet and internet using common web internet software such as Microsoft Internet Explorer, Firefox, Netscape, Opera, etc.

6.9 The building management system shall have maximum demand control incorporated into the system for ensure that building does not incur high maximum demand cost.

6.10 Furthermore, the following indoor climate and comfort parameters shall be assessed and evaluated:

a) Air temperature, mean radiant temperature, relative humidity, CO2 levels and air velocity for the various areas of the building.
b) Illumination and glare for the various areas of the building.

6.11 The various controls energy for M&E systems shall be evaluated and compared to the design/ideal controls strategies:

a) Control of electrical lighting, according to the occupancy and daylight availability.
b) Control of the ventilation and the cooling system according to variations in inner loads, exterior loads and occupancy.
c) Control of cooling input and stability of temperatures
d) Any other control strategies (depending on the final design chosen)

6.12 Measured performance data shall be normalized to the standard design condition so that the actual performance can be compared with the predicted performance. On the monthly basis, analysis of the monitoring data shall be done so that it is possible to verify how much off target the energy consumption and the indoor comfort conditions are. Also, proposal for improved performance shall be given on a monthly basis and after the next month, follow up of the measures shall be made to see whether the goals have been achieved.

6.13 For each month, and energy performance report shall be presented to the management of the building owner. This report shall include but not restricted to the following areas.

a) Energy index of the month, actual and normalized.
b) Assessment of energy consumption for each category.(lights, computers etc.)
c) Assessment of the indoor comfort parameters (temperature, humidity, light, etc.)
d) Proposal for measures to improve energy efficiency
e) Follow up on previous initiative for improving energy efficiency.
f) Overall assessment of energy performance and indoor comfort of the building

6.14 The Contractor shall follow all guidelines by the relevant agencies and refer to the latest version of MS 1525. The Contractor shall propose and demonstrate clearly the overall concept of EE with the appointed consultant for JKR’s approval.

7.1 The data centre, telecommunications and IT system shall be designed with preference to energy efficiency approach.

7.2 Supporting IT equipment generating heat such as UPS and transformers shall be isolated from the IT equipment rooms.

7.3 The cooling and ventilation of these systems shall be designed to minimum requirements of the specification and comply with the latest version of ASHRAE Environmental Guidelines for Datacom Equipment.

8.1 The overall Building Energy Intensity shall not exceed ____*____ kWh/m^2/year which subject to the following condition:

a) Installed lighting load for general lighting : 12 W/m^2 (providing mean 350 lux)
b) Plug loads (small power load) : 12 W/m² (during office hours for office),
c) Indoor design temperature : 24 ^{o}C
d) The Building Energy Intensity (BEI) is defined as:

General BEI

$$BEI = \frac{\text{Total Building Energy Consumption}}{\text{Gross Floor Areas}}$$

Normalize BEI for hospital to compare with office building

$$BEI = \frac{\text{Total Building Energy Consumption}}{\text{Gross Floor Areas x Rated Hours}} \text{ x } 2700\text{hours}$$

Where; BEI = Building Energy Intensity as measured [kWh/m²/year]

8.2 Gross floor area is measured on the overall dimensions of the building or part of the building on each floor below and above ground and includes internal and external walls.

It includes:

a) Stairs and lifts shafts.
b) Corridors and covered passages by which there is no public right of way.
c) Conference rooms, board rooms, director rooms, assembly rooms and libraries.
d) Computer rooms.
e) Changing rooms and lavatories.
f) Canteens, restaurants, cafeterias, kitchens, restrooms, recreation rooms, etc.
g) Basements with activity generating uses.

It excludes:

a) Basement car and cycle parking accommodation.
b) Car parking above ground.
c) Space for commercial vehicles awaiting loading or unloading.
d) Roof top garden.
e) Pedestrian linkage to Transit Stations (direct subterranean/underground pedestrian linkage).

8.3 The energy consumption shall be verified using the “Virtual Environment Software “ from IES, ECOTECT, Energyplus, Design Builder or other compatible software, subjected to JKR’s approval

** will be decide on project basis*

9.1 The Contractor shall provide two levels of training and awareness on the use of the building:

a) Level 1 is meant to provide awareness and concept of energy savings and environmental management to users & building occupants, the building's O&M crew, and Facility Management.

b) Level 2 is meant to guide users & building occupants on the actual operations and on the use of the facilities provided for in the building.

10.1 Complete operations & maintenance (O&M) document which shall include, but not limited to, building specifications, proposed O&M schedules, trainings and list of respective equipment suppliers, shall be provided.

10.2 The manual shall be written and diagramed for easy understanding by technician level people that will be operating the building.

10.3 The project shall implement good project documentation in softcopy and hardcopy which include the design, implementation, testing & commissioning and fine-tuning (if any) of the building system. The documents shall contain, but not limited to the following;

a) Design and feasibility studies reports.
b) Construction and As-Built drawings.
c) Detailed information of building materials.
d) Life cycle cost analysis of energy efficient system; this includes making comparative analysis between costs in installing Energy Efficiency features and costs without Energy Efficiency features.

11.1 The Facility Management (on behalf of building's owner) shall be involved during installation, testing and commissioning works of the active and passive Energy Efficiency features.

12.0.1 The building energy intensity of ___*___ kWh/m^2/year shall be proven with 1 full year of actual measurement made from the building within 2 years of handing over the building to the client and the result should be certified by Energy Manager registered with Suruhanjaya Tenaga. The contractor shall have maximum of 1 year of fine-tuning period before the start of actual measurement is made. Adjustment may be made to the actual building if there are any special operating conditions such as unusually high occupancy density, unusually high small plug load or any other circumstances beyond the control of the contractor. The adjusted calculation methodology to be employed has to be mutually agreed upon.

12.0.2 If the 1 full year of actual measurement made of the building energy intensity exceeds the requirement, it will be considered as a building defect that will need to be rectified by the Contractor.

12.0.3 Prior to occupancy, after construction ends, with all interior finishes installed, the Contractor shall perform a building flush out.

12.0.4 The Contractor shall conduct an air-sampling test after the flush out consistent with an approved testing protocol.

12.0.5 A commissioning agent shall be appointed and be subjected to JKR approval. The commissioning agent shall be knowledgeable about building mechanical and electrical systems and be appointed from one of the following:

a) Building Services Consultant or,
b) M&E Contracting Engineer or,
c) Energy Consultant or,
d) Third party Energy Service Companies (ESCOs) or,
e) JKR's qualified personnel.

12.0.6 The commissioning agent shall not be the same person as the design engineer for the project.

12.1 Objective

12.1.1 Commissioning agent shall provide commissioning services to JKR. Commissioning applies a systematic investigation process for improving and optimizing a building's operation and maintenance (O&M).

12.1.2 Commissioning ensures system functionality. It is an inclusive and systematic process intended not only to optimize how equipment and systems operate, but also to optimize how the systems *function together*. The commissioning process must focuses on the dynamics of energy-using systems with the goal of reducing energy wastages, obtaining energy cost savings for the owner, and identifying and fixing existing and potential problems.

** will be decide on project basis*

12.1.3 The commissioning agent shall be fine-tuning the building for a minimum of 1 (one) full year after the handing over of the building to the client.

12.2 Commissioning Tasks

12.2.1 The commissioning process consists of four primary phases:

12.2.1.1 Planning phase

a) Develop commissioning objectives.
b) Review available documentation.
c) Develop commissioning plan.
d) Deliverables: Commissioning plan, on the following areas:

(i) Chillers & pumps efficiencies
(ii) Cooling Tower efficiencies
(iii) AHU fan efficiencies
(iv) VAVs & VSDs
(v) Lighting control system.
(vi) Daylight control system (if available)
(vii) Daylight Factors measurement at Daylit spaces
(viii) Standby-power of building and all major equipments
(ix) Other Hydraulic systems
(x) Lift and escalators
(xi) Façade & outdoor lighting
(xii) Carpark ventilation & lighting efficiencies
(xiii) Infiltration measurement
(xiv) CO_2 & motorized fresh air damper

12.2.1.2 Commissioning phase

a) Perform site assessment
b) Obtain or develop missing documentation
c) Develop and execute diagnostic monitoring and test plans
d) Develop and execute functional test plans
e) Analyze result
f) Develop Master List of deficiencies and improvements
g) Recommend improvements for implementation
h) Deliverables: Commissioning report with Master List of Deficiencies, recommended improvements and energy saving calculations

12.2.1.3 Tune-up phase

a) Implement repairs and improvements
b) Retest and re-monitor for results
c) Fine-tune improvements if needed
d) Revise estimated energy saving calculations
e) Deliverables: Tune-up report with improvement made, Master List of Deficiencies (for unresolved items), recommended improvements and energy saving calculations.

12.2.1.4 Project hand-off and integration phase

a) Prepare and submit final report
b) Perform deferred tests (if needed)
c) Develop building operation and maintenance plan/schedule/guidelines
d) Deliverables:

(i) Final report with Master List of Deficiencies (for unresolved items), recommended improvements, energy saving calculations.
(ii) The original and corrected (if any was made) commissioning plan
(iii) Develop an O&M document that can be understood by the building operators, facility managers or energy managers. Include full written sequences of operation for the building and all equipments within it.
(iv) Develop guidelines for implementing a preventative maintenance plan.
(v) Develop a comprehensive training plan for appropriate building staff to attend training in general O&M concepts and for specific equipment and systems. This will include both building operators and facility managers or owners.
(vi) Conduct overall system level training of maintenance staff to communicate the design intent, theory of system operation, delineate the function of individual components in the system, and intersystem functional operations
(vii) Develop guidelines and recommendations for maintaining an energy accounting and tracking system.
(viii) Develop an operations assessment program and systems tune-up and re-commissioning schedule.

13.1 All energy efficient system that has been proposed shall include financial analysis calculation, of minimum of Simple Payback Period method.

$$\text{Simple Payback Period (SPP), Years} = \frac{\text{Total Amount of Investment}}{\text{Annual Saving}}$$

13.2 Selection of the proposed system shall be based on financial analysis calculation and subjected to JKR's approval.

Contractor Checklist

Project Name:	

No.	Items	Submitted (√/X)
1.	To check inclusion of all necessary documents as listed below in tender submission:	
a.	Compulsory drawings (A3): i. All floor plans ii. Front elevation, Back elevation iii. 2 side elevations iv. Architectural conceptual design v. Air conditioning zoning vi. Lighting Zoning vii. Daylight zoning drawing All drawings shall be endorsed by professional engineer or architect, follow each discipline.	
b.	Documents related to Energy Efficiency features (i.e product catalog and etc)	
c.	Energy consumption simulation using Virtual Environment Software from IES, Energy plus, Designbuilder or compatible softwares.	

TABLE A: ENERGY EFFICIENCY DATA	
Building Information	**Please fill in the blanks**
Total Floor Area in m^2:	
Air Conditioned Floor Area in m^2:	
Gross Floor Area (follow GFA definition as stated in Need Statement)	
Estimated Total Energy Consumption (kwh):	
Estimated Weighted Operating Hours/Rated Hours (hrs/year):	
Estimated Building Energy intensity (kwh/m^2/year):	
Architectural Energy Data	
Estimated OTTV (W/m^2)	
Estimated RTTV (W/m^2)	
Targeted Infiltration rate:	
Daylit spaces (%):	
Mechanical Energy Data	
Chiller plant system COP:	
Peak cooling load provided for building (kWcooling):	
COP of chiller:	
Chill water pump power (kW):	
Condenser water pump power (kW):	
Cooling tower power (kW):	
VRV chiller used (Yes/No):	
VSD chill water pump used (Yes/No):	
VSD condenser water pump used (Yes/No):	
VSD cooling tower used (Yes/No):	
VAV system used (Yes/No):	
Average combined fan, motor and belt efficiency for AHU(%):	
Fan total pressure (Pa):	
Other mechanical system, total energy consumption (kw):System.....	
Other mechanical system, total energy consumption (kw):System.....	

Contractor Checklist

Electrical Energy Data		
Average motor efficiency for whole building (%):		
Lighting power density (W/m²):		
Plug load (W/m²):		
Energy Management System (Yes/No):		
Tenderer's Signature	**Address (With Stamp)**	**Date**
Name:		