Heating, Ventilating and Air-Conditioning System(s)

Introduction

1. This chapter provides guidelines for the selection, design and installation of heating, ventilating and air-conditioning (HVAC) system(s) for new building complexes and the refurbishment of existing building complexes. The guidelines are applicable to large systems such as all air systems and in-room terminal systems. Relevant parts of the guidelines are also applicable to unitary equipment such as split systems and room air-conditioners.

Objectives

2. The primary objective of a HVAC system is to maintain desired indoor environmental conditions and air quality in a space. The HVAC system shall be capable of maintaining the desired indoor environment within an acceptable tolerance under specified conditions and occupant activities, and providing an environment with acceptable indoor air quality. Secondary objectives include, but are not limited to, supporting a process (where required) such as the operation of computer equipment or laboratory equipment.

3. This guidance shall be read in conjunction with:

a. Corporate Services and Infrastructure Group (CSIG) OH&S Policy Statement;

b. Defence Occupational Health and Safety Manual (DOHSMAN), Defence Safety Manual (SAFETYMAN) (currently in draft form), in particular, the chapters about 'Safe Techniques For Welding, Brazing and Soldering', 'Thermal Conditions', 'Legionnaires Disease, Humidifier Fever and Pontiac Fever', 'Working In Confined Spaces', 'Indoor Air Quality', 'Laboratory Safety' and 'Office Safety'; and

c. The following chapters of the Infrastructure Manual (IM):

i. Management of Fixed Plant and Equipment Requiring Special Licences within Infrastructure Division.
ii. Energy Management.
iii. Microbial Control in Air Handling and Water System(s) of Facilities.
iv. Environment Impact Assessment.
v. Commissioning of Facilities (under preparation).
vi. Building Management Systems (under preparation).

Compliance

4. The design, installation, testing, commissioning and maintenance of HVAC system(s) shall comply with all relevant Australian Standards that include, but are not limited to, the listing in Annex A. The HVAC system(s) shall also comply with the relevant State and Territory laws or regulations, and Codes of Practice, unless the Defence requirements are more stringent. All the relevant Australian and International Standards, Defence Standards and Instructions, Statutory laws or regulations, and Codes of Practices that are referred to in this guidance shall be of the current edition including amendments.

5. The Design, installation, testing, commissioning and maintenance of the HVAC system(s) should also follow the best practice in the industry, and applicable handbooks, guidelines and application manuals established by:

a. NATSPEC specifications for general specification;

b. The Australian Institute of Refrigeration, Air-conditioning and Heating (AIRAH);

c. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE);

d. Chartered Institution of Building Services Engineers (CIBSE); and

e. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

Selection Criteria

6. In most applications, a number of options may be available to the designer to achieve the aforesaid objectives. The designer shall consider the following criteria to achieve the functional requirements associated with the objectives. All these criteria are inter-related and the designer shall consider how they affect each other.

a. Outdoor environmental conditions. Appropriate weather data from local weather stations should be obtained and appropriate outdoor design conditions should be selected. Also, prevailing wind direction and velocity, and the relationship of a project site to the selected weather station should be considered.

b. Indoor environmental conditions. Appropriate indoor environmental conditions such as temperatures, relative humidity, ventilation rates, space pressure and noise level requirements should be selected. Permissible variations and control limits should be considered. Any condition that will not be controlled and associated reasons should be stated.

c. Capacity requirements. The capacity requirements are to be determined from heating and cooling loads. In addition to indoor and outdoor environmental conditions, data should be obtained for building characteristics and configuration, operating schedules, number of occupants, activities, sources of heat gain and heat loss, and peak and partial load requirements. Loading diversity factors should be considered in reducing the installed capacity where possible. Spare capacity should be allowed for in accordance with the confirmed users' requirements and relevant best industry practice.

d. Redundancy. The HVAC system(s) should cater for the continuity of service as required by users. Backup or stand-by equipment should be provided based on the analysis of the users' requirements, where cost and space permit.

e. Space requirements. Location and space for equipment and distribution services (including equipment rooms) access and space constraints should be considered. Refer to Annex A (v.) and (z.) for the requirements for access and equipment room design.

f. Life cycle cost analysis. Supply, installation, operating, maintenance and replacement costs shall be considered as a whole when comparing HVAC system(s). The analysis period should be based on the economic design life of the building that the HVAC system(s) serve. Capital expenditure compared to operation and maintenance should be cost-effective.

g. Energy efficiency. Low energy consumption and high distribution efficiency in heating and cooling shall be considered as the first option.

h. Reliability. The HVAC system(s) shall be reliable. Reliability should be built into design and achieved by implementing an appropriate maintenance programme. Expected service life of each HVAC system should be considered in the system comparison.

i. Flexibility. Ability to be changed to suit the re-configuration of space and users' future expansion requirements should be considered within space and cost constraints.

Constraints in Selection

7. System constraints shall be determined and documented in the selection process. The constraints, that shall be considered, include, but are not limited to:

a. Performance limitations. Each type of HVAC system has its performance limitations in temperature, relative humidity and space pressure. A HVAC system shall be selected for meeting required indoor environmental conditions.

b. Available capacity. Heating and cooling loads are used to establish capacity requirements. The required capacity shall be checked against the available capacity of a HVAC system in order to determine the adequacy of the system and size range.

c. Available space, building architecture and structure. A HVAC system and associated distribution system(s) shall suit the available space to house the equipment, and the horizontal and vertical distribution services. The location of an equipment relative to occupied space or process should be considered to determine flow resistance, noise attenuation, etc. All equipment and components visible from occupied space, such as grilles, diffusers, louvres, air terminal units, and exposed pipework and ductwork (both inside and outside) should be visually acceptable. Structural design shall consider special support for major equipment. Refer to Annex A (p). For the requirements in noise and vibration control.

d. Zoning. Heating and air-conditioning loadings vary with time due to changes in day and night, weather, occupancy, activities and solar exposure. Different zone control may be required in each space with a different use and/or exposure. The extent of zoning, the degree of control required in each zone, and the space required for individual zones shall be fit for the indoor environment and usage of individual space. Zoning design should be cost-effective and be justified by life cycle costing. Supplementary system(s) of the main system(s) or dedicated system(s) may be required in areas which have regular extended hours of operation, intermittent occupancy, ancillary facilities with different design requirements or hours of operations, or special processes.

e. Available utility supply such as water, gas and electricity. Water supply is required for heating water, cooling water and chilled water systems. Quality of water is important to scale, corrosion, fouling and microbial control in the systems. Water treatment is normally required and AIRAH application manual DA18 'Water treatment' should be used as a guide. Gas or electricity may be used for spacing heating and water heating. Whether one form or the other is used will require life cycle costing in order to determine which is energy-efficient. Gas supply may not be available in some areas and the provision will need to be justified in terms of practicality and cost-effectiveness.

f. Activities. The design should consider planned activities that will be provided for in the facility, and whether the facility will serve purpose other than its primary activities. The relationship of the facility to other activity areas should also be taken into account.

g. Budget.

Other Design Considerations

8. Other design considerations of HVAC system(s) shall include, but are not limited to:

a. Offices. HVAC system(s) in offices shall comply with the requirements of 'Air-conditioning and Thermal Comfort in Australian Public Service Offices – An Information Booklet for Health and Safety Representatives, COMCARE Australia'.

b. Air ventilation and exhaust. The provision of air ventilation and exhaust shall comply with the Building Code of Australia, and AS1668 Part 1 and Part 2.

c. Fire and smoke control. The requirements for fire and smoke control, and interface with fire detection system shall comply with the Manual of Fire Protection Engineering, Building Code of Australia and AS1668 Part 1 or AS2665 as appropriate.

d. Microbial control. Microbial control shall comply with the IM chapter 'Microbial control in air handling and water system(s) of facilities', and AS3666 Parts 1, 2 and 3.

e. Refrigerants. Refrigerants used for air-conditioning system(s) shall have a zero or low ozone-depletion potential (ODP), a low global-warming potential (GWP), a short estimated atmospheric life (EAL) and a low total equivalent warming impact (TEWI). SAA HB40 Parts 1, 2 and 3 should be referred to for acceptable refrigerants with regards to the ODP, GWP and EAL parameters. TEWI, comprising the direct effect of refrigerant emissions and indirect effect caused by the energy to drive the refrigeration system, should be considered in system design. Refrigerant charge monitor(s) or leak detector(s) should be provided in accordance with SAA HB40 Parts 1, 2 and 3, and should be included in retro-fit and expansion programs.

f. Indoor air quality. Indoor air quality shall be maintained by controlling gaseous contaminants, particulate contaminants and bio-aerosols generated inside and outside a building complex to acceptable concentrations. Control strategies should comprise:

i. Elimination of sources.
ii. Local exhaust with make-up air.
iii. Dilution through general ventilation with make-up air where there is no local control of contaminants.
iv. Air cleaning (non-circulated or re-circulated) if strategies (1), (2) or (3) cannot control contaminants, or only partially effective.

g. Control of particulate contaminants. Particulate contaminants shall be removed from both ventilating air and recirculated air. The selection of air filters and cleaners shall be suitable for a particular application. The following factors, which are also applicable to cleaning other types of contaminants, should be considered:

i. Degree and type of air-cleanliness required.
ii. Disposal of dust and/or contaminants after it is removed from the air.
iii. Amount and type of dust and/or contaminants in the air to be filtered.
iv. Type of air filters and cleaners.
v. Stages of filtration.
vi. Sealing effectiveness of air filters and cleaners.
vii. Velocity and pressure drop across air filters and cleaners.
viii. Efficiency and arrestance.
ix. Space available for installation and maintenance.
x. Initial cost and cost of maintaining and replacing the equipment.

h. Control of gaseous contaminants. Gas cleaning system(s) shall be installed where one or more of the following functions need to be performed in industrial/working processes:

i. An industrial/working process requires compliance with the Statutory laws or regulations for air pollution control.
ii. Nuisance or physical damage from generated contaminants to persons, equipment or adjacent properties is to be avoided.
iii. Fire, explosion or other hazards are to be avoided. Delineation of hazardous zones shall be in accordance with AS2430 Series.

i. Control of bio-aerosols. Combinations of proper ventilation and filtration shall be used to control indoor bio-aerosols. The type of air filters and cleaners shall be compatible with applications, and type(s) and size(s) of contaminants to be controlled.

j. Industrial ventilation. Industrial ventilation, where required, shall comply with the Statutory laws or regulations for occupational health and safety, and air pollution control. ACGIH 'Industrial ventilation: A manual of recommended practice' should be used as a guide in designing ventilation systems.

k. Air filters. Air filters shall comply with AS1324 Part 1 and AS 1324 Part 2 or AS4260 as appropriate. AIRAH application manual DA15 'Air filters' and ASHRAE handbooks should be used as a guide where appropriate. Refer also to Annex B Clause 8. Air filters should be installed in the outdoor air intake ducts of the HVAC systems and in the recirculation and bypass air ducts. Pre-filters should be provided to protect intermediate filters, and high efficiency and HEPA filters. Pre-filters should also be located ahead of heating or cooling coil and other HVAC equipment in the system to protect that equipment from dust. Where high efficiency filters and HEPA filters protect critical areas, the filters should be installed as close to the room as possible to prevent the pickup of particles between the filters and the outlet. These filters generally have pre-filters located upstream of the HVAC equipment and intermediate filters located downstream of the HVAC equipment for additional protection. Unitary split systems and window air-conditioners incorporate mainly proprietary filters, and this limitation should be considered in the design. Where air filtration of high efficiency is utilised to minimise outdoor air quantities within the limits of AS1668 Part 2, the design and installation of the related air-handling system(s) should ensure that these high efficiency filters are incorporated.

l. Air intake(s) and exhaust discharge(s). The separation between air intake(s) and exhaust discharge(s) shall comply with AS1668 Part 2 and AS3666 Part 1. Re-circulation of air flow between air intake(s) and exhaust(s) shall be prevented by proper design and installation.

m. Space pressure. Space pressure shall be designed in such a way that contaminants generated in one area such as bathroom and kitchen will not be transferred to other areas such as offices. Space pressure should also be controlled so that it will not obstruct the operation of doors.

n. Air relief. Air relief design from each space shall observe the audio security requirements. Special acoustic treatment for air relief should be considered.

o. Space air diffusion. Design of air diffusion in the HVAC system(s) shall create a proper combination of temperature, humidity and air motion in the occupied zone of the areas served. The design should avoid discomfort caused by lack of uniform conditions within the space, excessive air motion (draught), excessive room air temperature variations, failure to deliver or distribute air according to the load requirements, and excessive noise. In areas with high ceiling such as sport hall, the design should ensure that temperature stratification within the space will not adversely affect the performance of the HVAC system(s).

p. Noise and vibration control. Selection of equipment and design of equipment space and associated distribution services shall provide acceptable noise and vibration levels in the occupied space of the building complex in which the equipment and associated distribution services are located. The noise levels in both the areas served by the HVAC system(s) and adjacent to the HVAC plant shall be acceptable. Indoor noise rating shall comply with AS2107. Where possible, plant rooms should not be located at noise-sensitive areas and plant room doors should not be opening into these areas. Outdoor plant shall be selected and located appropriately to minimise noise impacts into the environment in accordance with AS1055 Part 2. In an airport environment, steady indoor noise rating shall comply with AS2107. Dynamic rating (with aircraft flyover) in the airport environment shall comply with AS2021, unless otherwise approved by Defence.

q. Thermal insulation. Heating and cooling pipes, ducts and equipment shall be insulated. The selection, installation and finish of thermal insulation shall comply with AS4426. The thickness of insulation materials should be determined from the guidance in AS4426. Thermal insulation should serve the following functions:

- i. Conserve energy by reducing heat loss or gain.
- ii. Control surface temperatures for personal protection.
- iii. Help control the temperature of cooling or heating process.
- iv. Prevent vapour condensation on surfaces with a temperature below the dew point of the surrounding temperature.
- v. Provide fire protection.
- vi. Where applicable, provide protection from weather, chemical exposure, mechanical damage, termite and mould growth, and provide acceptable appearance.

r. Ductwork. Performance, materials, construction and installation of ductwork (both rigid and flexible) shall comply with AS4254. Duct liner (for noise control and thermal insulation) and thermal insulation shall also comply with AS4254 in additional to the requirements in Annex A (q). Flexible ductwork is commonly used to connect mixing boxes, diffusers and other terminals to an air distribution system. As unnecessary length, offsetting and compression of the flexible ductwork significantly increase airflow resistance and air-flow generated noise, it should be kept as short and straight as possible, fully extended, and supported to minimise sagging. Due to potentially high breakout sound levels associated with flexible ductwork, care should be taken when using it above noise-sensitive areas.

s. Pipework. Materials, design, installation and testing of pipework shall generally comply with AS4041. AIRAH application manual DA16 ‘Water piping for air-conditioning’ should also be used as a guide.

t. Passive defence measures and security measures may be required for the equipment and components of a HVAC system. Masking of infra–red signature from heat dissipation and blast protection structures for ventilating air shafts shall be considered in sensitive areas such as EO facilities, command posts and communication facilities. Security measures may be required for grilles, louvres and air-ducting. These measures are usually site specific and will require specialist advice from the appropriate security agency and ETS (CSIG).

u. Energy conservation. HVAC system design shall incorporate energy conservation measures in the design. Energy conservation concepts such as variable air volume, heat pump, energy recovery, free cooling and thermal storage in system design should be considered where practicable. Conference rooms, meeting rooms, lecture rooms and the like should be designed to provide outdoor air quantities in accordance with AS1668 Part 2 under variable occupancy conditions. Where practicable, air filtration of high efficiency should be utilised to minimise outdoor air quantities within the limits of AS1668 Part 2. CO2 demand control ventilation may be considered in spaces of high population density that are subject to variable or intermittent occupancy. Dry-bulb indoor air temperature may be reduced in spaces of high population density in order to reduce latent load and the need for reheat. Areas with regular extended hours of operation or intermittent occupancy may require supplementary system(s) of the main system(s) or dedicated system(s). Kitchen ventilation conservation design and spot cooling (instead of full air-conditioning) should be considered in commercial kitchen design where required. Natural ventilation should be considered as the first option, if practicable, for ventilating non air-conditioned space. Natural ventilation should be assisted by mechanical ventilation where necessary. A multi-speed exhaust system should be provided in areas such as bathrooms, change rooms and toilets. The system should normally operate at low speed while high-speed boost can be initiated by push button or similar with programmable, pre-set timer control. Refer also to Annex A (g.) and the IM chapter

'Energy management'.

v. Access. Adequate access shall be provided to ensure that equipment and components can be inspected, operated, maintained, overhauled, tested and commissioned. AS1657 shall be complied. Equipment rooms should be properly designed to allow for movement of large, heavy equipment in, out and through the building complex. The access route should be sheltered from weather where possible. The designer shall ensure that structural design along the access route has allowed for the loadings of the equipment. Where possible, the access route should minimise disruption to occupied space environment and process. The access should include fixed ladders, platforms, handrails, and lighting (where required) and shall comply with all relevant OH&S requirements including DOHSMAN and SAFETYMAN. A minimum headroom of 2000mm and a minimum width of 650mm in service corridors between plant should be provided. The dimensions of the equipment to be transported, installed or replaced should also be considered. A minimum depth of 900mm to service plant in a squatting position, and 750mm in a standing position should be provided. Permanent facilities for delivering or replacing equipment and components, such as lifting beams, bolts and lugs, should be provided as required. Adequate isolating and demountable facilities should be provided in the system(s) to isolate and remove individual items of plant while the operation of the remaining system(s) is retained.

w. Materials. Materials to be selected for equipment and components shall be suitable for the operating environment. When an outdoor equipment or component is to be installed in a corrosive environment such as salty environment at seaside, under direct sunlight or where hail may damage the equipment, the materials for the equipment or component, and supports should be properly selected to maintain the expected service life. Protective measures should be provided where required.

x. Centralised or decentralised systems. HVAC system(s) may be centralised or decentralised, dependent on application(s) in a project. System selection should be addressed in the selection report against the selection criteria and constraints.

y. Equipment room space. Where possible, most equipment should be kept together to:

i. Reduce the length and size of distribution services such as duct, pipe and conduct.
ii. Simplify duct shafts layout.
iii. Centralise maintenance and operation.
iv. Reduce equipment operation costs due to lower power consumption.

z. Plant/Equipment room design. Plant/Equipment room design should consider:

i. The size and weight of equipment.
ii. Access for installation and replacement of equipment.
iii. Space for future expansion.
iv. Compliance with relevant Australian Standards, Codes of Practice, and State and Territory laws or regulations in combustion air and ventilation criteria, safety for refrigeration, pressure vessels , boilers, OH&S, etc.
v. Possible risk of water spill from equipment and distribution services. (Plant/Equipment room that has been assessed to have a high risk level should not be located above any electrical or electronic equipment rooms.)

aa. Duct shafts for distribution services. A vertical distribution system with minimal horizontal distribution is desirable, especially for a multi-storeyed building. The number of duct shafts will depend on the building size, shape and cost-effective use of space. Additional shaft space should be allowed for future expansion.

bb. Interface and Inter-operability. The design of a HVAC system shall consider the interface, compatibility and inter-operability of other mechanical, electric control and management system(s). The management system(s) may include building management system(s), fire alarm system(s), communication system(s) and maintenance management system(s).

cc. Outdoor installation of air-cooled condensers. Air-cooled condensers shall be installed in accordance with manufacturers' instructions in order to provide adequate clearance and airflow surrounding the equipment. For vertical face condensers, it should ensure that prevailing winds blow towards the air intake, or discharge shields should be installed to deflect opposing winds where practicable. When multiple condensers are grouped together, they shall be properly located to ensure adequate airflow and prevent recirculation of hot discharge air. The equipment shall be installed clear of ground water levels. Congested or unusual locations shall be prevented.

dd. Tropical air-conditioning. A number of Defence facilities are located in tropical areas and care shall be given in designing and installing ventilating and air-conditioning systems that are suitable to tropical climates. AIRAH application manual DA20 'Humid tropical air conditioning' should be used as a guide. Particular attention shall be given to the selection of materials. The finishes of outdoor equipment and supports shall withstand the tropical climates. Condenser coils and fins need to be pacified. Also, the impacts of high air-entering dry-bulb temperature on the rating, compressor discharge pressure and power of the condenser shall be considered to prevent unexpected shut-down. The density and thickness of insulation need to be significantly increased above standard provision in the equipment.

ee. Electrical requirements. Selection and installation of electrical equipment, and design and testing of electrical installations shall comply with AS/NZS3000. HVAC equipment shall be provided with phase failure relays or under-voltage release to cater for unreliable power supply, eg. brown outs. The equipment should also be configured to have auto-reset or manual reset, which shall be determined in the design phase. Lightning protection shall comply with AS1768. Appropriate transient or surge protection shall be required to protect sensitive electronic equipment against lightning or other potential interference in tropical climates or areas with high occurrences of lightning.

ff. Close control of air temperature and relative humidity. Areas for storing and/or operating sensitive electronic equipment or computer installation may require close control of air temperature, relative humidity and even contaminants. The control may also include maximum rate of change of temperature and relative humidity per hour. The designer shall consult users, examine equipment specifications and observe the best practice in industry to establish the requirements. A holistic approach shall be adopted in the design, installation, testing and commissioning of the HVAC system(s) and controls, in particular, to ensure that all specific conditions can be maintained within acceptable tolerances.

gg. Living in accommodation (LIA).When approved, LIA units should be provided with individual, separately controlled split-type fan coil unit(s) within each bedroom and common room. This allows control of indoor environmental conditions within preset limits to match each person's comfort requirements. Each common room is to have a local control using a push button to start the air-conditioning units. A remote control, which has a programmable pre-set time controller, is used to shut down the units. In each bedroom, key switch should be located in position where access is not restricted by the location of furniture such as bed. The preferred location for the key switch is at room entry immediately adjacent to light switches.

hh. Protection of equipment. Activities in areas such as sport hall are likely to have physical impacts on HVAC equipment exposed in spaces. Any device positioned at low level within the occupied spaces, eg. thermostats and heating devices, should be recessed and/or provided with covers or grilles. The protection should not adversely affect the performance and functions of the equipment, be sufficiently robust to withstand inadvertent impact and cognisant of the need for not creating an OH&S hazard. Equipment located at high level should be protected where required.

ii. Building management system and control strategy. The design of a HVAC system should allow central monitoring and control by the building management system and/or site management system where practicable. The designer shall determine an appropriate control strategy for each HVAC system, considering the type of the system, the usage of the areas served, energy conservation, tolerances in control, variation in occupancy, operation schedule and current practice in similar facilities. The strategy shall address the requirements for local control (including temperature adjustment and after hour operation), group remote control and central control.

Selection Report

9. The designer shall provide a selection report of the HVAC system(s). The report should start with an overview followed by a detailed account of HVAC system analysis and selection. The overview should highlight the key points and findings that lead to recommendation(s). The detailed analysis should begin with objective(s) that the system(s) need to achieve. It should then address the relevant selection criteria, constraints in selection, design considerations, and advantages and disadvantages of each system. Life cycle costing should be provided as required in Clause Annex A (f). This process should reduce the selection to one or two system(s) that best suit the project objectives. The reasons for eliminating those that are unacceptable should be stated. The report should provide reference of successful installation(s) to endorse the final recommendation if possible.

Users' requirements

10. The designer shall obtain, thoroughly investigate, fully understand and critically examine all users' requirements in order to ensure that all important parameters, requirements and design criteria have not been overlooked and they reflect actual needs within the project scope. The designer shall pro-actively co-ordinate with CSIG and users at various phases of a project. Design solutions shall be cost-effective in satisfying the confirmed users' requirements within the project scope.

Co-ordination

11. The design, installation, testing and commissioning of HVAC systems shall be coordinated with the works of other engineering services, civil, structure and architecture.

Commissioning

12. Commissioning shall comply with the requirements of the IM. Testing and balancing of HVAC system should follow the requirements in:

a. ASHRAE Guideline – The HVAC Commissioning process
b. ASHRAE - Standard – Practices for measurement, testing adjusting and balancing of building HVAC&R
c. SMACNA - HVAC Systems – Testing, adjusting and balancing.

Certification

13. Where required in the Building Code of Australia, State and Territory laws or regulations, or the IM, the design, installation, testing and commissioning of a HVAC system shall be certified by a practising engineer registered with the National Engineering Registration Board (NPER) to the level of NPER-3 and registered to practice in the areas of mechanical engineering or building services engineering.

Re-use of existing system or equipment

14. An existing system or equipment maybe re-used to serve a building complex which is to be refurbished, a new extension of an existing building complex or a new building complex. This system shall be technically examined and tested to confirm

that it can satisfy the required capacity, performance, functional requirements, OH&S requirements and expected service life. The system shall also comply with the requirements as stated in this guide. The HVAC system or equipment may be overhauled to meet the required conditions if the designer confirms that it is cost-effective when compared with installing a new system or equipment. The HVAC system or equipment shall be properly serviced, cleaned, tested, commissioned before use.

Disposal of existing system or equipment

15. An existing system or equipment shall be properly decommissioned and disposed if the aforesaid examination and testing in Clause 14 confirm that it cannot be re-used. The disposal shall comply with the relevant Australian Standards, Codes of Practice, and State and Territory laws or regulations. Special care shall be required in handling and storing refrigerants, lubricating oil and fuels.

Underground services

16. When underground services are to be designed and installed, the route shall be carefully selected. Particular attention should be given to services integrity, consequences of escape of fluid, public safety, proximity to (buildings, existing cathodic protection ground-beds, sources of stray currents, and other underground services), easement width, access and maintenance, environmental impact, present and future land use, topography and geology. Any existing services shall be detected and located to ensure that they will not be disturbed. If diversion of any existing services is deemed necessary, the work shall be properly planned, coordinated and carried out to ensure safety and minimal disturbance to the operations of the services. The design and installation of underground services shall consider all external interference, thermal insulation, electrical bonding, lightning, static electricity and protection against corrosion. Any redundant services that cannot be removed due to technical difficulties shall be decommissioned and terminated in a safe manner and protected for corrosion.

Builder's work

17. Where practicable, all builder's work for equipment and distribution services should be provided by licensed builder(s) to ensure that integrity with structures is not compromised and workmanship is guaranteed. The builder(s) should be responsible for making good. Engineering services contractor(s) should co-ordinate with the builder(s) to carry out information exchange and confirm the location, dimensions and loadings (static and dynamic, where required) of the builder's work. Where practicable, the engineering services contractor should provide sleeves to the builder(s) for installation at services penetrations. The engineering services contractor(s) shall ensure that fire stopping of services penetrations in fire rated construction complies with the requirements of the Building Code of Australia. Both the sleeves and sealants shall be compatible with the fire resistance level (FRL) of the related building elements.

Design parameters and practice

18. In addition to complying the requirements in the Building Code of Australia, Codes of Practice, Statutory laws or regulations, and relevant Australian Standards, parameters and practice of HVAC system design should follow the best industry practice and applicable references of the organisations in Clause 5. Annex B also contains some design parameters and practice recommended by ETS (CSIG).

Functional design brief

19. Functional design brief of HVAC system(s) should define the scope of work, establish design intent and address all general and specific requirements which include, but are not limited to:

- a. Compliance with Australian Standards, Codes of Practice, and Statutory laws or regulations.
- b. Compliance with the Defence requirements in Clause 1003.
- c. Environmental impact assessment and contamination management.
- d. Users' requirements.
- e. Objectives of system(s).
- f. Selection criteria of system(s).
- g. Constraints in selection.
- h. Design considerations.
- i. Life cycle costing.
- j. Selection report (if not covered in design reports).
- k. Co-ordination.
- l. Certification.
- m. Existing services.
- n. Underground services.
- o. Builder's work.
- p. Items that need further investigation.
- q. Requirements for design reports.
- r. Any other functional, performance and technical requirements to complete the brief.

Design reports

20. Design reports should confirm and further develop the functional design brief, and provide design details. A selection report of the HVAC systems should be included if it is not covered in the functional design brief.

Sponsor: ETS (CSIG)

References

a. AIRAH application manuals
b. ASHARE handbooks

Annexes

Annex A General
Annex B Recommended Design Parameters and Practice