Australian Government

Assessment Requirements for UEERA0014 Design ammonia refrigerated systems

Release: 1

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Modification History

Release 1. This is the first release of this unit of competency in the UEE Electrotechnology Training Package.

Performance Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions on at least one occasion and include:

- understanding required operating functions and parameters from the design specification
- developing the design within the safety, regulatory and functional requirements and budget limitations
- documenting and presenting design effectively
- negotiating design alteration requests successfully
- obtaining approval for final design
- dealing with unplanned events
- applying relevant work health and safety (WHS)/occupational health and safety (WHS/OHS) requirements, including using risk control measures
- designing ammonia refrigeration systems
- preparing to design ammonia refrigeration systems.

Knowledge Evidence

Evidence required to demonstrate competence in this unit must be relevant to and satisfy all of the requirements of the elements, performance criteria and range of conditions and include knowledge of:

- ammonia refrigeration system design, components and piping design requirements, safe working practices and relevant standards, codes and regulations, including:
  - technical standards, codes and regulations:
    - environmental and safety considerations in the use and disposal of ammonia refrigerant:
      - toxicity of ammonia, the effects on human health and the legislative limitations imposed on ammonia refrigerant as a result
      - flammability of ammonia, concentration and lower explosive limit (LEL)
      - environmental effects
      - safe disposal
      - safety data sheets (SDS)/material safety data sheets (MSDS) samples

- registration requirements for transport and on-site use
- relationship between ammonia system refrigerant charge and dangerous goods storage regulations
- engine ventilation requirements and determination of ventilation rates
- scrubbers for elimination of the harmful effects of ammonia

- ammonia refrigeration system design requirements:
  - applications of ammonia refrigerant (NH3) in industrial refrigeration:
    - introduction to industrial ammonia refrigeration applications and systems
    - applications in industrial refrigeration: cool and cold storage, food processing, beverage manufacturing plants, fertilizer plants and second compression stage of CO2 systems
    - application in environment control and air conditioning: large scale reticulated water/secondary refrigerant systems
    - advantages and disadvantages of ammonia refrigerant compared with other natural and synthetic refrigerants
  - properties, application and limitations of ammonia refrigerant:
    - general classification of ammonia refrigerant according to AS/NZS 1677 Refrigerating systems SAA refrigeration code refrigerating systems
    - common contaminants in ammonia refrigeration systems, water, oil, non-condensable and the effects of same on cycle efficiency and system wear
    - refrigeration machine oils soluble in ammonia, oil type, applications and reactions with water
    - thermal and transport properties of ammonia in comparison with other natural and synthetic refrigerants, including the behaviour in a vapour compression cycle
  - application concepts and principles:
    - single stage vapour compression cycles with dry expansion refrigerant feed
    - single and dual stage vapour compression cycles with liquid overfeed
    - single stage vapour compression cycles with screw compressors and liquid overfeed
    - cascade ammonia/CO2 systems with dry expansion and liquid overfeed
    - single and dual stage vapour compression cycles with gravity flooded refrigerant feed
    - single and dual stage vapour compression cycles with ammonia used as a volatile secondary refrigerant
    - dual stage vapour compression cycles with multiple (>2) saturation temperature levels
    - automatic defrost principles, including off-cycle air defrost, ambient air defrost, hot gas defrost, electric defrost and water defrost
    - selection and sizing of ammonia pumps for liquid overfeed systems
    - selection and sizing of high pressure and low-pressure vessels
    - refrigerant pipe sizing using ammonia refrigerant
    - selection of suitable refrigerant oil

- ammonia refrigeration system components and piping:
  - corrosion and material selection:
    - materials compatibility table
    - thermal and other properties of materials in use
    - pipe material and jointing methods/materials
    - compressors
    - pumps, impellers and seals
    - isolation and control valves
    - heat exchangers
  - pipe and insulation materials, pipe stresses and pipe suspension methods:
    - mild steel pipe
    - stainless steel pipe
    - sharpy tested pipe
    - post-installation insulation (in situ foaming, formed insulation and closed cell flexible insulation)
    - pre-insulated pipe material
    - vapour barrier – importance and maintenance
  - heat exchangers:
    - finned air coolers or evaporators - induced draught; forced draught; stainless steel/aluminium; mild steel galvanized; all aluminium; stainless steel/AlMg3; all stainless steel; description of what materials are used where and for what reason; various refrigerant feed methods including advantages/disadvantages i.e. top feed, bottom feed, vertical up flow/down flow of air; fin spacing; fin thickness and impact of geometry on fluid pressure drops
    - condensers – evaporative, air cooled, air cooled adiabatically assisted, water cooled shell and tube, water cooled plate/plate, water cooled plate and shell, cascade shell and tube, cascade plate/plate, cascade plate and shell, material selection for condensers, and importance of discharge temperature for condenser design
    - cooling towers
    - intercoolers and economisers of the closed type, sizing of liquid sub-cooling coils and tube bundles
    - liquid coolers or evaporators – plate/plate, plate/shell, shell and tube, material selections, refrigerant feed methods and oil management
    - screw compressor oil coolers – plate/plate type, shell and tube type, water cooled, refrigerant cooled and surface enhancement options
    - heat recovery – shell and tube de-superheaters, plate/plate de-superheaters and heat recovery condensers of various types
  - system control and monitoring:
    - compressor capacity control – pressure and temperature signals
    - room temperature and humidity control – understanding the principle of cooling and re-heating air streams to control absolute moisture contents

        - control of condensers – optimisation of overall plant C.O.P
        - floating condensing pressures
        - control of fluid temperatures within the system – oil, secondary refrigerants and sub-cooling
        - control of flows – thermostatic expansion valves, low pressure floats, high pressure floats, motorised valves, electronic expansion valves, hand regulating valves, and oil return systems between compressor oil separators and compressors
        - pressure controllers - evaporating pressure controllers, thermostatic controllers, hot gas bypass valves, crankcase pressure regulators, overflow valves, ammonia pump pressure control, flow controllers and defrost pressure controllers
        - defrost control
        - programmable logic controller (PLC) control systems
        - supervisory control and data acquisition (SCADA) systems
    - water treatment and desiccant dehumidifiers:
        - condenser water treatment – purpose and legislative requirement
        - treatment of secondary refrigerant loops including monitoring
        - desiccant dehumidifiers and their role in infiltration minimisation, defrost control and energy savings
    - equipment selection:
        - use computer software and manufacturers' data to select major components of an ammonia refrigeration plant
- problem-solving techniques
- relevant job safety assessments or risk mitigation processes
- relevant manufacturer specifications
- relevant WHS/OHS legislated requirements
- relevant workplace budget, quality, policies and procedures
- relevant workplace documentation.

Assessment Conditions

Assessors must hold credentials specified within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must satisfy the Principles of Assessment and Rules of Evidence and all regulatory requirements included within the Standards for Registered Training Organisations current at the time of assessment.

Assessment must occur in suitable workplace operational situations where it is appropriate to do so; where this is not appropriate, assessment must occur in simulated suitable workplace operational situations that replicate workplace conditions.

Assessment processes and techniques must be appropriate to the language, literacy and numeracy requirements of the work being performed and the needs of the candidate.

Resources for assessment must include access to:

- a range of relevant exercises, case studies and/or simulations
- relevant and appropriate materials, tools, facilities and equipment currently used in industry
- applicable documentation, including workplace procedures, equipment specifications, regulations, codes of practice and operation manuals.

Links

Companion Volume implementation guides are found in VETNet - - https://vetnet.gov.au/Pages/TrainingDocs.aspx?q=b8a8f136-5421-4ce1-92e0-2b50341431b6