IGSHPA 101: Professional Qualifications Standard for the Residential/Light-Commercial Ground Source Heat Pump System Designer

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List of subcommittee members that worked to produce this document:

Ryan Carda
Lisa Meline
Cary Smith
Mark Metzner
Rick Clemenzi
Allan Skouby
Joe Parsons
Carl Orio
Jim Cusack
Tom Wyer
Dennis Koop
Don Penn
Garen Ewbank
Erin Portman
Cindy Rice
John Dolezal
Ed Kirtley
Roshan Revankar

IGSHPA Standards Committee members:

Ryan Carda, Chair
Lisa Meline
Brett Sweeney
Nick Mitchell
Tom Wyer
Jim Cusack
Trey Austin
Joe Parsons
Ken Brew
Steve Curtiss
Jerry Lewis
Allan Skouby
Howard Newton
Seth Parker
Chad Martin

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This Professional Qualifications Standard is intended to serve as a source of minimum qualifications for the Residential/Light-Commercial Ground Source Heat Pump System Designer. The Standard identifies the various Job Performance Requirements that a system designer must be able to complete.

This standard is an important part of the complete set of guides and manuals available through the International Ground Source Heat Pump Association, including the Residential and Light Commercial Design and Installation Manual, Closed-Loop/Ground-Source Heat Pump Systems Installation Guide, Soil and Rock Classification for the Design of Ground-Coupled Heat Pump Systems Field Guide, Grouting for Vertical Geothermal Heat Pump Systems, the Closed-Loop/Geothermal Heat Pump Systems SLINKY™ Installation Guide, and the ANSI/CSA/IGSHPA C448 Series-16 Bi-National American–Canadian Standard .

The principle reason for the existence of industry standards is to ensure quality products and installation, as well as the safety of the consumer. They are generated by the IGSHPA Standards Committee, which consists of representatives from throughout the industry. The standards are subject to peer review for accuracy and completeness.

All standards are developed with funds from members of the International Ground Source Heat Pump Association. Through the strength of its membership, which now numbers over 5,000, IGSHPA has consistently played a vital leadership role in the ground-source heat pump industry.

This Professional Qualifications Standard is intended to be used for residential and light-commercial installations unless otherwise referenced in this document.

CHAPTER 1: ADMINISTRATION

1.1 Scope: This Professional Qualifications Standard, herein referred to as the Standard, identifies the minimum job performance requirements for a Residential/Light-Commercial Ground Source Heat Pump System Designer. The Standard is consistent with the requirements set forth in Section 4.2 of the U.S. Department of Energy National Certification Standard for Ground Source Heat Pump Personnel, 2013 edition.

1.2 Purpose: The purpose of this professional qualifications document is to provide minimum job requirements for individuals designing residential and light-commercial ground source heat pump systems. The Standard may be used for training, education, and professional development. In addition, the Standard may be adopted by an Authority Having Jurisdiction (AHJ) for the purpose of professional certification.

1.3 Continuing Education: Any individual certified under the Standard shall maintain their competence through continuing education. The individual shall complete continuing education hours as prescribed by the International Ground Source Heat Pump Association (IGSHPA), or AHJ, whichever is more stringent.

1.4 Voluntary Standard: The requirements of the Standard are voluntary until the Standard is adopted by the AHJ.

CHAPTER 2: DEFINITIONS

2.1 The following definitions shall be applied to the Standard. These definitions are based upon current terms accepted by the industry and other Codes and Standards Developing Organizations.

Authority Having Jurisdiction (AHJ): "Federal, provincial, state, or municipal ministry, department, board, agency, or commission that has responsibility for regulating by statute the use of products, materials, or services within its jurisdiction."

Design load data: Peak heating and cooling loads for a structure determined by location of the structure, construction quality, envelope thermal properties, building orientation, size and usage of the structure.

Designer: A trained individual engaged in the design, development and/or inspection of a residential/light-commercial ground source heat pump system, as defined or required by the AHJ.

Direct expansion (DX) heat pump: A heat pump unit that is specified and tested in accordance with AHRI 870/AHRI 871 performance standard in the USA or Canadian Standards Association-CSA C748 performance standard in Canada

Direct expansion (DX) system: DX systems consist of three parts: a refrigerant-charged ground heat exchanger, the DX heat pump unit, and the air or hydronic delivery system.

Education: The process of facilitating learning or the instilling of knowledge.

Engineer: Professional engineering licensure in the state or province having jurisdiction.

Ground source heat pump (GSHP): A heat pump unit that is specified and tested in accordance with AHRI/ASHRAE/ISO 13256-1 and 13256-2 performance standards in the USA or the CAN/CSA-13256-1 and 13256-2 performance standards in Canada.

Ground source heat pump (GSHP) system: GSHP systems consist of three parts: the ground or source heat exchanger, the ground source heat pump unit, and the air or hydronic delivery system.

Ground heat exchanger, vertical loop ground heat exchanger, horizontal loop ground heat exchanger, submerged heat exchanger: A continuous, sealed, underground heat exchanger consisting of a closed-loop through which a heat-transfer fluid passes to and returns from a heat pump or manifold.

Job performance requirement (JPR): A written statement that describes a specific job task, lists the items necessary to complete the task, and defines measurable or observable outcomes and evaluation areas for the specific task

Licensure: Established by various jurisdictions of the world to encourage public welfare, safety, well-being and other interests of the general public, and to define the licensure process through which a designer becomes authorized to practice and/or provide design services to the public.

Light commercial system: A GSHP system for a small, non-residential building that is either defined to be light-commercial by the AHJ, falls under residential code or occupancy criteria, uses Air Conditioning Contractors of America (ACCA) Manual N, latest edition to determine thermal loads in the United States or HRAI SAR-C2 in Canada, and/or does not require a stamp by a licensed engineer.

Open-loop (surface water or ground water) system: A system designed to use ground water or surface water for the purpose of extracting or rejecting heat by use of a water-source heat pump.

Professional certification: An authoritative attestation; the issuance of a document that states that an individual has demonstrated the knowledge and skills necessary to function in a particular job field

Professional Qualifications Standard (PQS): Identifies and defines minimum job performance requirements (JPRs).

Residential system: A GSHP system for a one- or two-family dwelling or town house where thermal loads are generally determined using ACCA Manual J, latest edition

Source heat exchanger: The method used to transfer heat to/from the heat pump system, which could be comprised of a closed-loop, open-loop, standing column well or direct expansion (DX) ground connection.

Standing column well (SCW): A vertical bore in near surface bedrock wells permitting recirculation of well water from one end of the well to the other end of the well after passing through a GSHP. The open well water serves as the heat transfer medium to bed rock surface for heat transfer.

Training: The process of achieving proficiency through instruction and hands-on practice in the operation of equipment and systems that are expected to be used in the performance of assigned duties.

AND/OR

An organized learning activity provided by an employer for employees or for individuals to gain useful knowledge and/or skill development for performing work tasks to standards.

CHAPTER 3: REFERENCED AND SUPPORTING DOCUMENTS

3.1 The following documents are referenced in the Standard.

- Air Conditioning Contractors of America (ACCA)
  - ACCA Manual D – Residential Duct Design, Latest Edition
  - ACCA Manual J - Residential Load Calculation, Latest Edition
  - ACCA Manual N – Commercial Load Calculation, Latest Edition
  - ACCA Manual S – Residential Equipment Selection, Latest Edition
- Association of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
  - ASHRAE Applications Handbook, Chapter 34, Geothermal Energy, Latest Edition
- Canadian Standards Association (CSA)
  - ANSI/CSA/IGSHPA C448 Series-16 Bi-National American–Canadian Standard, Design and installation of ground source heat pump systems for commercial and residential buildings, Latest Edition
  - CSA F280, Determining the required capacity of residential space heating and cooling appliances, Latest Edition
- Geothermal Exchange Organization (GEO)
  - National Certification Standard for Ground Source Heat Pump Personnel, Geothermal Heat Pump Consortium, 2013
- Heating, Refrigeration and Air Conditioning Institute of Canada (HRAI)
  - HRAI SAR-R1, Residential Heat Loss & Heat Gain, Latest Edition
  - HRAI SAR-R2, Residential Air System Design, Latest Edition
  - HRAI SAR-C2, Small Commercial Heat Loss & Heat Gain Calculations, Latest Edition
  - HRAI SAR-C3, Small Commercial Air System Design, Latest Edition
- International Code Council (ICC)
  - International Residential Code (IRC) for One- and Two-Family Dwellings, Latest Edition
- International Ground Source Heat Pump Association (IGSHPA)
  - Closed-Loop / Geothermal Heat Pump Systems Design and Installation Standards, 2017
  - Grouting for Vertical GHP Systems, 2000
  - Residential and Light Commercial Design and Installation Manual, 2009
- National Ground Water Association (NGWA)
  - NGWA/ANSI 01 – 14 – Water Well Construction Standard

CHAPTER 4: GENERAL REQUIREMENTS

4.1. In addition to the Sections that follow establishing the Job Performance Requirements for the Residential/Light Commercial GSHP System Designer, all positions share responsibilities and attributes generally accepted as essential to the successful performance of their assigned tasks.

4.1.1 CODE OF ETHICS

4.1.1.1. Ethical design and commissioning

Given a recognized code of ethics in conjunction with the related certification process; *act ethically in the design and commissioning of GSHP systems* so that health, safety and welfare of the public is maintained, conduct brings credit to the profession, conflict of interests are avoided, practice is only performed within areas of competence and licensure, confidentiality of the client is maintained, and the owner/resident is treated with fairness and respect.

(A) Requisite Knowledge. Ethical principles; licensing requirements; applicable local and state/provincial regulations; awareness of criminal and tort liability pertaining to ethical breeches.
(B) Requisite Skills. Interpersonal communication; listening for understanding.

4.1.2 SAFETY

4.1.2.1. Site safety

Given information on a jobsite and a copy of applicable OSHA, CANOSH or other governmental safety regulations; *ensure conformity with the site safety plan* so that all applicable governmental health and safety regulations are met including use of personal protective equipment, signage, trenching protection, etc.

(A) Requisite Knowledge. Applicable local and state/provincial regulations and codes; OSHA requirements in the United States/CANOSH in Canada, procedures and guidelines; proper use of Personal Protection Equipment (PPE) under OSHA/CANOSH; informed of relevant equipment, policies, procedures, and strategies to promote effective local, state, provincial or national security operations for the protection of people, property and institutions

(B) Requisite Skills. Inspection of safety practices and procedures; interpret written work procedures for the operation, safe use and inspection of a construction site

4.1.3 CODE OF STANDARD BUSINESS PRACTICES

4.1.3.1. Communication

Given the agreed upon scope, intent and expectations for the design and installation of the system; *effectively and professionally communicate with all involved stakeholders* so that project timeline, construction schedules, system performance, capabilities and operational characteristics are fully understood.

(A) Requisite Knowledge. Understanding of HVAC systems; understanding of GSHP systems; local, state/provincial codes and regulations; available local installation and construction resources and limitations; use of contracts and legal agreements.

(B) Requisite Skills. Interpersonal communication; listening for understanding; read and interpret plans and specifications.

4.1.3.2. Design and installation management and/or oversight

Given the specifics of the project itself as well as the role of the designer on the project; *manage and/or oversee the design and installation process* so that project planning, resource allocation, human resources, leadership techniques, production methods and coordination of people and resources applicable to assigned duties are met.

(A) Requisite Knowledge. Understanding of HVAC contracting; understanding of GSHP contracting; local, state/provincial codes and regulations; available local installation and construction resources and limitations; use of contracts and legal agreements.

(B) Requisite Skills. Provide or review shop drawings, submittals, substitutions, construction change orders, requests for information (RFI) as needed.

4.1.4 NECESSARY SKILLS

4.1.4.1. Experience and proficiency

Given the need to perform basic calculations and generate plans and/or specifications; *demonstrate experience or proficiency in basic design principles* so that assigned duties are met.

(A) Requisite Knowledge. Basic understanding of mathematics, algebra and trigonometry.

(B) Requisite Skills. Computer and/or calculator skills appropriate to assigned duties.

CHAPTER 5: RESIDENTIAL GROUND SOURCE HEAT PUMP SYSTEM DESIGNER

5.1 The Residential/Light-Commercial (RLC) Closed-Loop, Open-Loop, Standing Column Well (SCW) or Direct Expansion (DX) GSHP System Designer, herein referred to as the RLC GSHP Designer, is responsible for the design and specification of the GSHP system including site evaluation, the closed-loop ground heat exchanger, open-loop, SCW or DX system design and layout and the balance of the GSHP system design.

5.1.1 GENERAL PREREQUISITE CERTIFICATIONS AND LICENSURE

5.1.1.1 - License as required by the AHJ, including professional engineer, contractor, or architect.

5.1.1.2 - Certification as required by the AHJ, which may include the International Ground Source Heat Pump Association (IGSHPA) Certified Residential Designer (CRD) or Certified GeoExchange Designer (CGD), or other third-party, nationally recognized certification program.

5.2 The RLC GSHP Designer shall be able to perform each of the applicable Job Performance Requirements defined by the Standard as they pertain to GSHP system design.

5.2.1 RLC GSHP DESIGNER: SYSTEM DESIGN JOB PERFORMANCE REQUIREMENTS

5.2.1.1. Design and installation planning

Given applicable codes and regulations, local ground water quality protection and preservation requirements, including breach of foreshore requirements and riparian zones for submerged closed-loop heat exchangers or open-loop surface water systems; *develop a plan* so that the design and installation of the system complies with the applicable AHJ requirements pertaining to closed-loop, open-loop, SCW or DX GSHP systems.

(A) Requisite Knowledge. Understand federal, state/provincial and local codes as they relate to the design and installation of closed-loop, open-loop, SCW, or DX ground heat exchangers.

(B) Requisite Skills. Ability to ensure and verify compliance of system design and installation with federal, state/provincial and local codes.

5.2.1.2. Design and energy load calculations

Given details about the building, including its design, construction, location, occupancy and use; *perform design and energy load calculations* so that HVAC equipment selection, source heat exchanger design and interior distribution system design can be performed.

(A) Requisite Knowledge. Understand traditional HVAC system design and installation in addition to GSHP systems as a subset of a larger HVAC system expertise; understanding of basic heat transfer principles; envelope thermal properties; construction characteristics of residential structures; home usage characteristics; understand ANSI/CSA/IGSHPA C448 and at minimum, ensure compliance with Sections C448.0 and C448.2 for residential applications and Sections C448.0 and C448.1 for light-commercial applications.

(B) Requisite Skills. Understand and apply ACCA Manual J calculations for residential buildings in the United States and CSA F280 in Canada, ability to understand and apply ACCA Manual N for light commercial buildings in the United States and HRAI SAR-C2 in Canada, or some other standard load calculation method accepted by the HVAC industry and the AHJ; ability to calculate internal heat load profile based on building use.

5.2.1.3. Heat pump sizing and corrections

Given design load data, zoning characteristics of the building, GSHP manufacturer equipment ratings and performance data as well as anticipated heat pump operating conditions; *determine heat pump sizing and apply necessary correction factors* so that the GSHP system can provide the desired level of comfort to the building.

(A) Requisite Knowledge. Understanding of manufacturer's operational specifications and methodologies for analyzing GSHP system performance; understanding of equipment selection principles according to ACCA Manual S or CSA/ANSI/IGSHPA C448; well versed in understanding and identifying performance characteristics of GSHP equipment.

(B) Requisite Skills. Ability to select heat pump equipment that is corrected for site conditions based on equipment operating parameters, zoning characteristics, and peak design flow rates per ACCA Manual S or CSA/ANSI/IGSHPA C448.

5.2.1.4. Ground thermal properties and performance testing

Given project location and information about local soil/rock and/or available groundwater resources, *calculate ground thermal properties, and review results of performance testing for thermal conductivity and/or thermal resistance of closed-loop ground heat exchangers, when applicable; review results of performance testing for open-loop wells and SCW systems,* so that the source heat exchanger can be properly designed.

(A) Requisite Knowledge. Understanding of ground thermal properties, including various sources of information to obtain thermal properties and soil/rock types; knowledge of testing methods used to measure or identify pertinent soil properties. For open-loop and SCW systems, knowledge of pumping and draw down tests.

(B) Requisite Skills. Research soil information for a site; provide a site feasibility assessment to include environmental considerations, site geology, formation thermal properties (conductivity, diffusivity and temperature), aquifers characteristics including groundwater quality (confined, unconfined, flowing etc.) and drilling/ground-coupling installation techniques; ability to prepare specifications for test bores, groundwater supply wells, groundwater recharge wells, and oversee installation for same, when applicable.

5.2.1.5. Construction plans and specifications

Given project location, design plans and site inspection checklist; *review construction plans and specifications,* so that strategy is developed for the design and installation of the source heat exchanger.

(A) Requisite Knowledge. Knowledge of general construction techniques, including source heat exchanger design and installation, system hydraulics, proper water/environmental sealing, and basic geology in addition to the traditional subset of HVAC systems design.

(B) Requisite Skills. Ability to read and interpret site plans; ability to recognize site hazards and assets.

5.2.1.6. Source heat exchanger design

Given design loads, annual energy and ground loads, ground thermal properties, corrected equipment performance, and peak ground loop flow rates; *perform source heat exchanger design calculations for closed-loop, open-loop, SCW or DX systems, incorporating calculations for long-term ground effect, where applicable, based on industry standards or best practices*, so that source heat exchanger is properly sized to meet system demand.

(A) Requisite Knowledge. Understanding of the calculation methodologies and procedures outlined by the ASHRAE, IGSHPA, and/or other applicable governing bodies; knowledge of the various types of source heat exchangers including characteristics, limitations and relative costs of underground installation methods; understand variables of ground heat exchanger calculations; understand characteristics of basic components used in construction; understanding of interrelationship between design variables.

(B) Requisite Skills. Ability to use design software; ability to optimize design through iteration.

5.2.1.7. Supply-return circuit piping design

Given the GSHP schedule, source heat exchanger configuration and design, and peak flow requirements; *perform supply-return/circuit piping design* so that fully operational and well-functioning ground loop can be installed.

(A) Requisite Knowledge. Knowledge of fluid properties, fluid dynamics, antifreeze types used by industry, pipe characteristics, and pumping strategies. For open-loop systems, knowledge of submersible pumps, surface pumps, well screens, well casing impact of water quality on equipment, identification of aquifer type (confined, unconfined, flowing etc.) if encountered, well construction parameters, pumping and draw-down testing. For SCW systems, knowledge of Porter shroud assemblies and application, pitless adapters, sanitary well caps, back pressure devices and bleed valves.

(B) Requisite Skills. Perform pumping system design calculations, including the calculation of closed-loop ground heat exchanger and interior piping head losses; read and interpret pump curves; provide circulating pump schedule. For open-loop and SCW systems, testing and measurement of water well yield and quality to supply both domestic and heat pump requirements; ability to read and accurately interpret existing water well logs. For SCW systems, calculate return temperature control bleed percentages based on flow.

5.2.1.8. Interior load distribution system design and layout

Given the GSHP schedule, zone configuration and building load distribution method; *provide design for the building load distribution system* so that heating and cooling can be properly delivered to the building/space.

(A) Requisite Knowledge. Knowledge of refrigeration, machines, motors and tools, including their designs, uses, repair and maintenance; knowledge of duct design principles in accordance with ACCA Manual D in the United States or HRAI SAR-R2 for residential applications and HRAE SAR-C3 for light commercial applications in Canada; knowledge of hydronic distribution sizing and layout principles.

(B) Requisite Skills. Specify the HVAC system for the delivery of heating and cooling energy within the building, including but not limited to: ACCA Manual D/HRAI SAR-R2/HRAI SAR-C3) duct design, hydraulic design of pumps and design of piping systems, hydronic storage, manifold design and zone layout.

5.2.1.9. System controls

Given the completed system design, including intended operation and zoning characteristics; *articulate, design and document controls system requirements*, so that system operation and control capability satisfies owner expectations and intended use and the HVAC system meets all requirements of codes identified in 5.2.1.1.

(A) Requisite Knowledge. Understanding of HVAC controls for residential applications; manufacturer's recommendations.

(B) Requisite Skills. Provide system control specifications, system and equipment sequence of operation and control algorithms.

5.2.1.10. Design documents and drawings

Given the completed system design, including source heat exchanger, supply-return/circuit piping design, and interior load distribution system design; *produce design documents and/or drawings as necessary* so that the installing contractor clearly understands the scope of work and design intent for the project, and is able to prepare construction estimates and plans based on the provided documentation.

(A) Requisite Knowledge. Well-versed in the profession's standard of care defined by ASHRAE, IGSHPA and/or other applicable governing bodies.

(B) Requisite Skills. Provide detailed design and construction documents and/or scopes of work to install a complete GSHP system, including sizing of the source heat exchanger.

5.3 The RLC GSHP Designer shall be able to perform each of the applicable Job Performance Requirement defined by the Standard as they pertain to GSHP system construction/installation oversight.

5.3.1 RLC GSHP DESIGNER: CONSTRUCTION/INSTALLATION OVERSIGHT JOB PERFORMANCE REQUIREMENTS

5.3.1.1. Construction verification and oversight

Given system design plans and specifications; *provide source heat exchanger, manifold, supply-return line and header trench construction verification and oversight* so that conformity to design plan and specifications can be documented.

(A) Requisite Knowledge. Knowledge of drilling and preservation of ground water quality, grouting procedures and requirements, proper trenching practices, trench compaction procedures and requirements; knowledge of pipe pressure testing, flow testing, system flushing and purging, antifreeze addition and system pressurization practices and procedures. For DX systems, knowledge of manufacturer guidelines and refrigerant line-set installation procedures.

(B) Requisite Skills. Oversee the installation of source heat exchanger, header trench and mechanical equipment (pumps, valves, etc.) per manufacturer's guidelines, including pressure testing, flush and purge of the complete closed-loop ground heat exchanger, antifreeze addition and system pressurization, when applicable. For DX systems, oversee the installation of line-set trench per manufacturer's guidelines, including pressure testing, nitrogen purge of the complete closed-loop ground heat exchanger and corrosion prevention or protection.

5.3.1.2. Source heat exchanger and equipment integration

Given the complete HVAC system schedule, system design plans and specifications; *oversee the process of integrating the source heat exchanger and heat pump equipment with the appropriate distribution system (ductwork, fan coils, radiant heating and cooling systems, domestic hot water heating system, process piping, etc.)* so that proper form and function of the interior distribution system can be documented.

(A) Requisite Knowledge. HVAC installation experience; understanding of duct and hydronic design and installation principles; information contained in heat pump schedule and operating parameters; working knowledge of manufacturer's guidelines for proper equipment installation; knowledge of proper duct sizing principles according to Manual D.

(B) Requisite Skills. Read and interpret HVAC equipment, fan, and pump schedules; use design software. For DX systems, oversee the installation of compressor unit, air handler or hydronic heat exchanger, refrigerant line-set connection, refrigerant

system evacuation, refrigerant charging, indoor heat exchanger air or water flow, and connection of the corrosion prevention or protection system per manufacturer guidelines.

5.3.1.3. System testing and balancing

Given manufacturer performance data, system design plans and specifications; *specify and review initial testing and balancing of the system (load and source side) to verify proper system functionality and performance, ensure that commissioning/system start-up documents are complete, and that system temperatures and pressures are within the normal operating range as defined by the manufacturer*, so that proper system operation is verified at time of startup.

(A) Requisite Knowledge - Methods and tools for air flow measurement, methods and tools for water pressure drop and flow calculation, methods for GSHP performance measurements and calculations, standard formats for testing & balancing reporting.

(B) Requisite Skills - Review final system commissioning and validation report. Provide post-construction validation services to ensure conformity to the design intent. Provide and/or specify system training for the owner or owner's representative.

APPENDIX A: EXPLANATORY INFORMATION

Additional information pertaining to the respective section as indicated.

EXPLANATORY INFORMATION FOR CHAPTER 1: ADMINISTRATION

1.3 As approved by the AHJ, continuing education credit/hours may be obtained through one or more of the following:

- Continued employment in ground source industry
- Professional education and training
- Service in a professional or regulatory organization
- Attendance at professional conference, symposium, or workshop
- Instruction of ground source training course
- Presentation or publication of peer reviewed research or technical article

1.4 If this Standard is used for professional certification or licensure it should be formally adopted by the appropriate AHJ. Typically, the AHJ has legal authority to issue professional certifications or licenses. This may include local, state, provincial, or federal government agencies. Private industry or non-government organizations may also adopt the Standard as a requirement for their personnel performing the duties of a GSHP designer.

1.4 The AHJ may add job performance requirements to the Standard. This may be required due to specific characteristics or situations governing the design of local GSHP systems, specific equipment used in the installations systems, environmental issues, etc.

EXPLANATORY INFORMATION FOR CHAPTER 2: DEFINITIONS

2.1 Per the International Residential Code, latest edition, a residential system is defined to be a one- or two-family dwelling or townhouse.

EXPLANATORY INFORMATION FOR CHAPTER 3: REFERENCED AND SUPPORTING DOCUMENTS

N/A: None identified

EXPLANATORY INFORMATION FOR CHAPTER 4: GENERAL REQUIREMENTS

4.1 These job performance requirements are required for all levels of designers. The requirements in Chapter 4 may be addressed as an individual module through on-line training, or built into individual courses that address the JPRs of Chapter 5.

EXPLANATORY INFORMATION FOR CHAPTER 5: RLC GSHP SYSTEM DESIGNER

5.2 Before certification as a residential/light-commercial designer, the candidate must verify the ability to conduct a load calculation. This may be obtained through a certification course or -documented experience. It is the responsibility of the candidate to provide such verification to the authority having jurisdiction and to meet those requirements.

5.2.1 The residential/light-commercial designer must consider factors such as occupancy, lighting, equipment, weather, local resources, building design and construction, etc. This information should be obtained from the owner and a through survey of the site prior to system design. The residential/light-commercial designer is responsible for gathering the pertinent information; the owner or resident cannot be expected to know what information needs to be communicated.

5.3.1.1 A site inspection checklist should include, at a minimum, the following items: site access points, overhead obstructions, utility location and easement, site slope, final grade, property lines, special jurisdictional restrictions, planned features and areas to avoid, availability of potable water, and environmental restrictions. Any special restrictions unique to the site should also be addressed during the site inspection.

5.3.1.3 Commissioning may be performed by the designer or installer. However, the residential/light-commercial designer should be capable of commissioning a system. Commissioning documents should include as-built drawings, antifreeze type and concentration (by volume), documented pressure test and flush/purge/flow measurement results, and requirements for startup/commissioning of the mechanical equipment. Refer to CSA/ANSI/IGSHPA C448 for additional documentation requirements.