

15A NCAC 02C .0223 GEOTHERMAL DIRECT EXPANSION CLOSED-LOOP WELLS

(a) "Geothermal Direct Expansion Closed-Loop Wells" means wells used to house a subsurface system of closed-loop pipe that circulates refrigerant gas for heating and cooling purposes. Only gasses that the Department of Health and Human Services' Division of Public Health determines not to adversely affect human health in compliance with G.S. 130A-5 shall be used.

(b) Permitted by Rule. Direct Expansion Closed-Loop Geothermal Wells are permitted by rule when constructed and operated in accordance with the rules of this Section.

(c) Individual Permits. If an individual permit is required pursuant to Rule .0217 of this Section, then an application for permit renewal shall be made at least 120 days prior to the expiration date of the permit.

(d) Notification. In addition to the requirements set forth in Rule .0211 of this Section, notification for systems designed to serve a single family residence shall be submitted two or more business days prior to construction and 30 days or more for all other installations. The notification shall be submitted to the Director and to the county health department. The notification shall be made using one form per operation supplied by the Director and shall include:

- (1) the well owner's name, address, telephone number, email address (if available), and whether the owner is a federal, State, private, public, or other entity. If the well operator is different from the owner then the same information shall be provided for the well operator;
- (2) the physical location of the well;
- (3) a description of the proposed injection activities;
- (4) a scaled, site specific map showing the following:
 - (A) any water supply well and surface water body; septic system including drainfield, waste application area, and repair area; and any other potential sources of contamination listed in Subparagraph (e)(6) of this Rule within 250 feet of the proposed injection wells;
 - (B) property boundaries within 250 feet of the parcel where the proposed wells are located; and
 - (C) an arrow orienting the site to one of the cardinal directions;
- (5) the type of gas to be used in the closed-loop geothermal well system. Only approved gases shall be used in any closed loop geothermal well system;
- (6) plans and specifications of the surface and subsurface construction details of the system;
- (7) the heating and cooling system installation contractor's name and certification number, address, email address (if available), and telephone number;
- (8) a description of how the items identified in Part (d)(4)(A) of this Rule will be protected during well construction; and
- (9) any other information necessary for the Department to ensure compliance with G.S. 87-84.

(e) Well Construction.

- (1) Only tubing that meets the specifications in Chapter 12 of the North Carolina Mechanical Code shall be used.
- (2) All systems shall be constructed with cathodic protection unless testing conducted in accordance with Paragraph (g) of this Rule indicates that all pH test results are within the range of 5.5 to 11.0 standard units.
- (3) Drilling fluids and water produced during well construction shall be managed to prevent direct discharges to surface waters and violations of groundwater and surface water quality standards. Plans for such preventive measures shall be retained onsite throughout the construction process.
- (4) The well shall be constructed in a manner that surface water or contaminants from the land surface cannot migrate along the borehole annulus at any time during or after construction.
- (5) The well shall be located such that:
 - (A) the injection well is not in an area where surface water or runoff will accumulate around the well due to depressions, drainage ways, or other landscape features that will concentrate water around the well; and
 - (B) the injection well is not in an area that requires a person to enter confined spaces to perform sampling and inspection activities.
- (6) The horizontal separation between the geothermal direct expansion closed-loop well and potential sources of groundwater contamination that exist at the time the wells are constructed shall be no less than as follows:

- (A) Building perimeters, including any attached structures for which a building permit is required, such as garages, patios, or decks, regardless of foundation construction type 15 feet
- (B) Septic systems, including drainfield, waste application area, and repair area 50 feet
- (C) Industrial or municipal sewage or liquid waste collection or transmission sewer mains constructed to water main standards as stated in the American Water Works Association (AWWA) Standards C600 and/or C900 15 feet
- (D) Water-tight sewer lateral lines from a residence or other non-public system to a sewer main or other wastewater disposal system 15 feet
- (E) Other industrial or municipal sewage or liquid waste collection or transmission sewer mains 25 feet
- (F) Chemical or petroleum fuel underground storage tank systems regulated under 15A NCAC 02N with secondary containment 50 feet
- (G) Chemical or petroleum fuel underground storage tank systems regulated under 15A NCAC 02N without secondary containment 100 feet
- (H) Above ground or underground storage tanks that contain petroleum fuels used for heating equipment, boilers, or furnaces, except for tanks used solely for storage of propane, natural gas, or liquefied petroleum gas 50 feet
- (I) Land-based or subsurface waste storage or disposal systems 50 feet
- (J) Gravesites 50 feet
- (K) Any other potential sources of contamination 50 feet
- (7) Angled boreholes shall not be drilled in the direction of underground petroleum or chemical storage tanks unless it can be demonstrated to the satisfaction of the Director that doing so will not adversely affect human health or cause a violation of a groundwater quality standard as specified in Subchapter 02L.
- (8) The methods and materials used in construction shall not threaten the physical and mechanical integrity of the well during its lifetime and shall be compatible with the proposed injection activities.
- (9) Drilling fluids shall contain only potable water and may be comprised of one or more of the following:
 - (A) the formation material encountered during drilling; and
 - (B) materials manufactured specifically for the purpose of borehole conditioning or well construction.
- (10) Thermally enhanced bentonite slurry grout shall be used. This grout shall consist of a mixture of not more than 22 gallons of potable water, one 50-pound bag of thermally enhanced commercial Wyoming sodium bentonite, and up to 400 pounds of clean dry 50-70 mesh silica sand. The amount of silica sand maybe varied to achieve the thermal conductivity desired of the grout. The thermally enhanced grout slurry shall only be used in accordance with the manufacturers written instructions.
- (11) Bentonite grout shall not be used:
 - (A) to seal zones of water with a chloride concentration of 1,500 milligrams per liter or greater as determined by tests conducted at the time of construction; or
 - (B) in areas of the State subject to saltwater intrusion that may expose the grout to water with a chloride concentration of 1,500 milligrams per liter or greater at any time during the life of the well.
- (12) No additives that will accelerate the process of hydration shall be used in grout for thermoplastic well casing.
- (13) Grout shall be placed the entire length of the well boring from the bottom of the boring to land surface or, if completed below land surface, to the well header or manifold connection.
- (14) The grout shall be emplaced by one of the following methods:
 - (A) Pressure. Grout shall be pumped or forced under pressure through the bottom of the casing until it fills the borehole or annular area space the casing and overflows at the surface; or

- (B) Pumping. Grout shall be pumped into place through a hose or pipe extended to the bottom of the borehole or annular space which can be raised as the grout is applied. The grout hose or pipe shall remain submerged in grout during the entire application.
 - (15) If temporary outer casing is installed, it shall be removed during grouting of the borehole in a way that maintains the integrity of the borehole and uniform grout coverage around the geothermal tubing.
 - (16) If a permanent outer casing is installed:
 - (A) The space between the interior wall of the casing and the geothermal tubing shall be grouted the entire length of the well boring from the bottom of the boring to land surface or, if completed below land surface, to the well header or manifold connection.
 - (B) The annular space between the casing and the borehole shall be grouted with a grout that is non-reactive with the casing or the formation.
 - (C) Grout shall extend outward in all directions from the casing wall to borehole wall and have a thickness equal to either one-third of the diameter of the outside dimension of the casing or two inches, whichever is greater; and
 - (D) In no case shall a well be required to have an annular grout seal thickness greater than four inches.
 - (17) Grout emplacement shall not threaten the physical or mechanical integrity of the well.
 - (18) The well shall be grouted within seven days after drilling is complete or before the drilling equipment leaves the site, whichever occurs first. If the well penetrates any water-bearing zone that contains contaminated or saline water, the well shall be grouted within one day after the casing is set.
 - (19) Prior to removing the equipment from the site, the top of the casing shall be sealed with a water-tight cap or well seal, as defined in G.S. 87-85, to preclude contaminants from entering the well.
 - (20) Well head completion shall be conducted in a manner so as to preclude surficial contaminants from entering the well.
- (f) Well Location. The location of each well boring and appurtenant underground piping leading to all heat exchangers shall be identifiable such that they may be located, repaired, and abandoned as necessary after construction.
- (1) The as-built locations of each well boring, header pit, and appurtenant underground piping shall be recorded on a scaled site-specific facility map, which shall be retained onsite and distributed as specified in Subparagraph (i)(1) of this Rule.
 - (2) Each well boring and header pit shall be located by a North Carolina registered land surveyor, a GPS receiver, or by triangulation from at least two permanent features on the site, such as building foundation corners or property boundary iron pins.
 - (3) Well boring and appurtenant underground piping locations shall be identifiable in the field by tracer wire and warning tape, concrete monuments, or any other method approved by the Director upon a demonstration that such a method provides a reliable and accurate method of detection.
 - (4) If tracer wire and warning tape are used, then tracer wire consisting of copper wire of at least 14 gauge shall be placed adjacent to all horizontal piping during pipe installation, and warning tape shall be installed directly above the horizontal piping approximately 12 inches below final grade.
 - (5) If concrete monuments are used, then each monument shall be located directly above each individual well, at the perimeter corners of each well field, or in the center of each well cluster. Each concrete monument shall be permanently affixed with an identification plate constructed of durable, weatherproof, rustproof metal or other material approved by the Director as equivalent, which shall be stamped with the following information:
 - (A) well contractor name and certification number;
 - (B) number and depth of the borings;
 - (C) grout depth interval;
 - (D) well construction completion date; and
 - (E) identification as a geothermal well or well field.
- (g) Testing.
- (1) Closed loop tubing shall pass a pressure test on-site prior to installation into the borehole. Any closed loop tubing that fails the pressure test shall either not be used or shall pass a subsequent pressure test prior to installation and after all leaks have been located and repaired.

- (2) The closed loop well system shall pass a pressure test after installation and prior to operation. Any pressure fluctuation other than that due to thermal expansion and contraction of the testing medium shall be considered a failed test. Any leaks shall be located and repaired prior to operating the system.
 - (3) When not providing cathodic protection as specified in Subparagraph (e)(2) of this Rule drilling cuttings shall be tested for pH at a frequency of at least every 10 feet of boring length using a pH meter that has been calibrated prior to use according to the manufacturer's instructions.
- (h) Operation.
 - (1) The well shall be protected against damage during construction and use.
 - (2) The well shall be operated and maintained in accordance with the manufacturer's specifications throughout its operating life. Cathodic protection, if required, shall be maintained at all times in accordance with the manufacturer's specifications throughout the operating life of the wells.
- (i) Monitoring and Reporting.
 - (1) The well owner shall submit the as-built well locations as documented in accordance with Paragraph (f) of this Rule to the Director and the appropriate county health department. The well owner shall also record these documents with the register of deeds of the county in which the facility is located.
 - (2) Upon sale or transfer of the property, the owner shall give a copy of these records to the new property owner or owners.
 - (3) The Director may require any monitoring necessary to ensure compliance with G.S. 87-84.
 - (4) The permittee shall report any leaks to the Division during the lifetime of the well.
 - (5) A record of the construction, abandonment, or repairs of the injection well shall be submitted to the Director within 30 days of completion of the specified activities.

History Note: Authority G.S. 87-87; 87-88; 87-90; 87-94; 87-95; 143-211; 143-214.2(b); 143-215.1A; 143-215.3(a)(1); 143-215.3(c);
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