

Environmental Protection Agency

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fluid movement in the form of diverging holes are not created during drilling; and

(2) Before and upon installation of the surface casing:

(i) Resistivity, spontaneous potential, and caliper logs before the casing is installed; and

(ii) A cement bond and variable density log to evaluate cement quality radially, and a temperature log after the casing is set and cemented.

(3) Before and upon installation of the long string casing:

(i) Resistivity, spontaneous potential, porosity, caliper, gamma ray, fracture finder logs, and any other logs the Director requires for the given geology before the casing is installed; and

(ii) A cement bond and variable density log, and a temperature log after the casing is set and cemented.

(4) A series of tests designed to demonstrate the internal and external mechanical integrity of injection wells, which may include:

(i) A pressure test with liquid or gas;

(ii) A tracer survey such as oxygen-activation logging;

(iii) A temperature or noise log;

(iv) A casing inspection log; and

(5) Any alternative methods that provide equivalent or better information and that are required by and/or approved of by the Director.

(b) The owner or operator must take whole cores or sidewall cores of the injection zone and confining system and formation fluid samples from the injection zone(s), and must submit to the Director a detailed report prepared by a log analyst that includes: Well log analyses (including well logs), core analyses, and formation fluid sample information. The Director may accept information on cores from nearby wells if the owner or operator can demonstrate that core retrieval is not possible and that such cores are representative of conditions at the well. The Director may require the owner or operator to core other formations in the borehole.

(c) The owner or operator must record the fluid temperature, pH, conductivity, reservoir pressure, and static fluid level of the injection zone(s).

(d) At a minimum, the owner or operator must determine or calculate the

following information concerning the injection and confining zone(s):

(1) Fracture pressure;

(2) Other physical and chemical characteristics of the injection and confining zone(s); and

(3) Physical and chemical characteristics of the formation fluids in the injection zone(s).

(e) Upon completion, but prior to operation, the owner or operator must conduct the following tests to verify hydrogeologic characteristics of the injection zone(s):

(1) A pressure fall-off test; and,

(2) A pump test; or

(3) Injectivity tests.

(f) The owner or operator must provide the Director with the opportunity to witness all logging and testing by this subpart. The owner or operator must submit a schedule of such activities to the Director 30 days prior to conducting the first test and submit any changes to the schedule 30 days prior to the next scheduled test.

§ 146.88 Injection well operating requirements.

(a) Except during stimulation, the owner or operator must ensure that injection pressure does not exceed 90 percent of the fracture pressure of the injection zone(s) so as to ensure that the injection does not initiate new fractures or propagate existing fractures in the injection zone(s). In no case may injection pressure initiate fractures in the confining zone(s) or cause the movement of injection or formation fluids that endangers a USDW. Pursuant to requirements at § 146.82(a)(9), all stimulation programs must be approved by the Director as part of the permit application and incorporated into the permit.

(b) Injection between the outermost casing protecting USDWs and the well bore is prohibited.

(c) The owner or operator must fill the annulus between the tubing and the long string casing with a non-corrosive fluid approved by the Director. The owner or operator must maintain on the annulus a pressure that exceeds the operating injection pressure, unless the Director determines that such requirement might harm the integrity of the well or endanger USDWs.

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(d) Other than during periods of well workover (maintenance) approved by the Director in which the sealed tubing-casing annulus is disassembled for maintenance or corrective procedures, the owner or operator must maintain mechanical integrity of the injection well at all times.

(e) The owner or operator must install and use:

(1) Continuous recording devices to monitor: The injection pressure; the rate, volume and/or mass, and temperature of the carbon dioxide stream; and the pressure on the annulus between the tubing and the long string casing and annulus fluid volume; and

(2) Alarms and automatic surface shut-off systems or, at the discretion of the Director, down-hole shut-off systems (e.g., automatic shut-off, check valves) for onshore wells or, other mechanical devices that provide equivalent protection; and

(3) Alarms and automatic down-hole shut-off systems for wells located offshore but within State territorial waters, designed to alert the operator and shut-in the well when operating parameters such as annulus pressure, injection rate, or other parameters diverge beyond permitted ranges and/or gradients specified in the permit.

(f) If a shutdown (*i.e.*, down-hole or at the surface) is triggered or a loss of mechanical integrity is discovered, the owner or operator must immediately investigate and identify as expeditiously as possible the cause of the shutoff. If, upon such investigation, the well appears to be lacking mechanical integrity, or if monitoring required under paragraph (e) of this section otherwise indicates that the well may be lacking mechanical integrity, the owner or operator must:

(1) Immediately cease injection;

(2) Take all steps reasonably necessary to determine whether there may have been a release of the injected carbon dioxide stream or formation fluids into any unauthorized zone;

(3) Notify the Director within 24 hours;

(4) Restore and demonstrate mechanical integrity to the satisfaction of the Director prior to resuming injection; and

(5) Notify the Director when injection can be expected to resume.

§ 146.89 Mechanical integrity.

(a) A Class VI well has mechanical integrity if:

(1) There is no significant leak in the casing, tubing, or packer; and

(2) There is no significant fluid movement into a USDW through channels adjacent to the injection well bore.

(b) To evaluate the absence of significant leaks under paragraph (a)(1) of this section, owners or operators must, following an initial annulus pressure test, continuously monitor injection pressure, rate, injected volumes; pressure on the annulus between tubing and long-string casing; and annulus fluid volume as specified in §146.88 (e);

(c) At least once per year, the owner or operator must use one of the following methods to determine the absence of significant fluid movement under paragraph (a)(2) of this section:

(1) An approved tracer survey such as an oxygen-activation log; or

(2) A temperature or noise log.

(d) If required by the Director, at a frequency specified in the testing and monitoring plan required at §146.90, the owner or operator must run a casing inspection log to determine the presence or absence of corrosion in the long-string casing.

(e) The Director may require any other test to evaluate mechanical integrity under paragraphs (a)(1) or (a)(2) of this section. Also, the Director may allow the use of a test to demonstrate mechanical integrity other than those listed above with the written approval of the Administrator. To obtain approval for a new mechanical integrity test, the Director must submit a written request to the Administrator setting forth the proposed test and all technical data supporting its use. The Administrator may approve the request if he or she determines that it will reliably demonstrate the mechanical integrity of wells for which its use is proposed. Any alternate method approved by the Administrator will be published in the FEDERAL REGISTER and may be used in all States in accordance with applicable State law unless its use is restricted at the time of approval by the Administrator.