15A NCAC 05H .0XX1 WELL CONSTRUCTION REQUIREMENTS

History Note: *Authority*
Eff.

15A NCAC 05H .0XX2 DEFINITIONS

The terms used in this Section shall have the definitions assigned by § 113-389. In addition, the words defined in this Section shall have the following meanings:

(1) "Blowout" means an uncontrolled flow of gas, oil, or other well fluids from the well.

(2) "Blowout Preventer (BOP)" means one or more valves installed at the wellhead to prevent the escape of pressure either in the annular space between the casing and the drill pipe or in open hole during drilling or completion operations.

(i) "Annular blowout preventer" means a large valve that forms a seal in the annular space between the pipe and wellbore.

(ii) "Shear ram blowout preventer" means a closing element fitted with hardened tool steel blades designed to cut the drill pipe when closed.

(3) "Casing" means one joint of steel pipe placed in a well to prevent the wall of the wellbore from caving in and to prevent movement of fluids from one formation to another.

(4) "Casing String" means the entire length of all the connected joints of casing inserted into the wellbore.

(5) "Cellar" means a dug-out area to provide additional height between the drilling rig floor and the wellhead to accommodate the installation of blowout preventers.

(6) "Cement basket" means a slip-on style device made of high strength, flexible steel staves, mounted on a steel slip-on ring with heavy-duty canvas liners riveted to staves.

(7) "Cement Bond Log" means a geophysical tool that uses sound attenuation to determine bonding of cement to the casing.

(8) "Centralizer" means a mechanical device used to position the casing concentrically in the wellbore.

(9) "Conductor casing" means a string of casing used to support unconsolidated surface deposits and to prevent the subsurface infiltration of surface water or fluids into the wellbore.

(10) "Drill pipe" means

(11) "Float collar" means a component that is installed near the bottom of the string of casing on which wiper plugs land during the primary cementing operation.

(12) "Float joint" means a joint of casing placed at the bottom of the production string of casing.

(13) "Float shoe" means a rounded profile component attached to the down hole end of the production string of casing to prevent reverse flow of cement slurry into the string of casing.

Comment [AP1]: This purpose statement needs to be specific to these rules. I deleted as written because the language was too general to be applicable here.

Comment [AP2]: Language will need to be refined once Subchapter is fully drafted.

(14) "Formation Integrity Test" means a pressure test applied to the formation directly below the base of the string of casing to determine the maximum pressure that may be applied without risk of formation breakdown.

(15) "Intermediate casing" means a string of casing that is set in place after the surface casing and before the production casing;

(16) "Lost circulation material (LCM)" means solid material intentionally introduced into a mud system to reduce and eventually prevent the flow of drilling fluid into a weak, fractured, or vugular formation.

(17) "Master gate" means a valve used to control the flow of oil and gas from a well.

(18) "Mousehole" means a shallow boring under the drilling rig floor, lined with casing, in which joints of drill pipe are temporarily suspended for future connection to the drill string.

Comment [RC3]: Define terms

(19) "Packer" means a device that can be run into a wellbore with a smaller initial outside diameter that then expands externally to seal the wellbore.

(20) "Production casing" means a string of casing that is set across the reservoir interval and within which the primary completion components are installed

(21) "Production tubing" means a string of tubing used to produce reservoir fluids.

(22) "Rathole" means a hole in the drilling rig floor, which is lined with casing that projects above the floor into which drilling apparatus is placed when hoisting operations are in progress.

(23) "Rotating diverter system" means a system that provides an annular seal around the drill pipe during drilling and tripping operations.

(24) "Surface casing" means a large diameter, string of casing set in shallow yet competent formations.

(25) "Wellbore" means the hole drilled by the bit.

(26) "Wellhead" means the upper terminal of the well including adapters, ports, valves, seals, and other attachments.

(27) "Wiper plug" means a rubber plug used to separate the cement slurry from other fluids.

History Note: *Authority*
Eff.

15A NCAC 05H .0XX3 SETBACK DISTANCES

15A NCAC 05H .0XX4 RESTRICTED DRILLING UNITS

15A NCAC 05H .0XX5 DRILLING FLUID AND DRILLING FLUID ADDITIVES

History Note: *Authority*
Eff.

15A NCAC 05H .0XX6 CASING AND EQUIPMENT REQUIREMENTS

(a) All casing or tubing installed in oil or gas wells shall be steel, steel alloy or other material that has been approved by the American Petroleum Institute (API). Casing and tubing material must be manufactured according to API and all used casing shall comply with design parameters for the well, pass a hydrostatic test, drift test, and wall thickness test pursuant to API Specification 5CT "Specification for Casing and Tubing" and API Specification 5B "Specification for Threading, Gauging, and Thread Inspection of Casing, Tubing, and Line Pipe Threads," which are incorporated by reference, including subsequent amendments and editions. These documents, published by API, may be purchased at a cost of two hundred thirty seven dollars ($237.00) at http://www.techstreet.com/api/products/1802047 and one hundred eighteen dollars ($118.00) at http://www.techstreet.com/api/products/1555125 respectively, or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108. The casing shall be marked to verify the test results and the permittee shall provide a copy of the test results to the Department before the casing is installed in the well

(1) Casing shall be designed to have a minimum internal yield pressure rating that is 20 percent greater than the maximum anticipated pressure to which the casing may be subjected during drilling, production or stimulation operations;

(2) Where subsurface reservoir pressure is unknown and cannot be reasonably anticipated, the permittee shall assume a pressure gradient of 0.433 pounds per square inch per foot in a fully evacuated hole, under shut-in conditions; and

(3) All casing and tubing connections shall be torqued to the manufacturer's specifications and shall comply with API Recommended Practice 5A3 "Recommended Practice on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements" and API Recommended Practice 5C5 "Recommended Practice on Procedures for Testing Casing and Tubing Connections," which are incorporated by reference, including subsequent amendments and editions. These documents, published by API, may be purchased at a cost of one hundred forty five dollars ($145.00) at http://www.techstreet.com/api/products/1657246 and one hundred sixty three dollars ($163.00) at http://www.techstreet.com/api/products/1087582 respectively, or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108.

(b) To verify casing integrity, the permittee shall pressure test each cemented string of casing greater than 200 feet in length in accordance with the following test method as required by this section. Prior to drilling the cement plug or stimulating the well, the permittee shall test the string of casing at a minimum pump pressure, in pounds per square inch, that is calculated by multiplying the length of the string of casing, in feet, by 0.2; but in no event shall the pressure test exceed 1,500 pounds per square inch. This pressure test shall be conducted for 30 minutes; if the pressure has dropped by more than 10 percent, then the string of casing has failed to meet the integrity requirements and the permittee shall not resume further operations until the condition has been corrected. If after a subsequent pressure test of 30 minutes, the pressure drop is equal to or less than 10 percent, this is evidence that the condition has been corrected.

Comment [AP4]: FLAG General Concern: Whether this amount of incorporation of non-public material runs afoul of the APA rulemaking because provides inadequate notice to the public, whether public records law has any guidance on level of incorporation beyond which interferes with public notice of substance of rule.

(c) To verify proper cement displacement, the permittee shall pressure test the wiper plug and float collar assembly as follows: once the wiper plug is seated on the float collar, the permittee shall increase displacement pressure by at least 500 pounds per square inch.

(d) Casing shall be centralized to allow cement to fill the annular space back to the surface in order to isolate critical zones including; aquifers, flow zones, voids, lost circulation zones, coal layers, and hydrocarbon production zones. Strings of casing shall be centralized to comply with API Recommended Practice 10D-2 "Recommended Practice for Centralizer Placement and Stop Collar Testing," which is incorporated by reference, including subsequent amendments and editions. This document, published by API, may be purchased at a cost of seventy seven dollars ($77.00) at http://www.techstreet.com/api/products/1173247 or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108.

(1) All bow-spring centralizers shall comply with API Specification 10D "Specification for Bow-Spring Casing Centralizers," which is incorporated by reference, including subsequent amendments and editions. This document, published by API, may be purchased at a cost of eighty nine dollars ($89.00) at http://www.techstreet.com/api/products/957236 or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108; and

(2) All rigid centralizers shall comply with API Technical Report 10TR4 "Considerations Regarding Selection of Centralizers for Primary Cementing Operations," which is incorporated by reference, including subsequent amendments and editions. This document, published by API, may be purchased at a cost of sixty one dollars ($61.00) at http://www.techstreet.com/api/products/1568067 or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108.

(e) All other casing hardware not specifically referenced above (such as float shoes, float collars, cement baskets, centralizers, packers, and wiper plugs) shall comply with applicable API standards, and the design parameters for the well as outlined in the permit application.

Comment [RC5]: FLAG- reference permit application approval/conditions

History Note: *Authority*
Eff.

15A NCAC 05H .0XX7 CEMENT STANDARDS

(a) All cement placed into the wellbore shall be Portland cement that is manufactured pursuant to API Specification 10A "Specification for Cements and Materials for Well Cementing" or the American Society for Testing and Materials (ASTM) Standard Specification "C150/C150M Standard Specification for Portland Cement," which are incorporated by reference, including subsequent amendments and editions. Specification 10A, published by API, may be purchased at a cost of one hundred forty five dollars ($145.00) at http://www.techstreet.com/api/products/1757666 or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108. Specification C150/C150M, published by ASTM, may be purchased at a cost of forty one dollars ($41.00) at

http://www.astm.org/Standards/C150.htm or by mail at 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

(b) The permittee shall ensure that only freshwater is used to mix cement slurries. The permittee, or an authorized representative of the permittee, shall be on site for all cement mixing and placement operations to monitor the cement mixing equipment and to ensure that cement slurry design parameters are followed. Cement shall be pumped at a rate and in a flow regime that minimizes channeling of the cement in the annulus.

(c) Cement mixtures for which published performance data are not available shall be tested by the permittee, or the company providing the cementing services, prior to the commencement of cementing operations. The permittee shall submit the proposed cement design, testing parameters, and test results to the Department for approval prior to use.

(d) The density of the cement slurry shall be based upon a laboratory free fluid separation test demonstrating an average fluid loss no more than 3 milliliters per 250 milliliters of cement tested in accordance with API Recommended Practice 10B-2 "Recommended Practice for Testing Well Cements," which is incorporated by reference, including subsequent amendments and editions. This document, published by API, may be purchased at a cost of two hundred twenty dollars ($220.00) at http://www.techstreet.com/api/products/1855370 or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108. The cement slurry should be mixed and pumped at a rate that ensures consistent slurry density.

(e) The Department may require, by permit condition, a specific cement mixture to be used in any well.

(f) No operations may be resumed until all cement has reached a compressive strength of at least 500 pounds per square inch.

(g) A Cement Bond Log (CBL) shall be conducted following the installation of intermediate and production casing, to the point of refusal. The CBL will be used in conjunction with data collected, by the permittee, during cementing operations, as specified in Section .0X14 of this Rule, to help ensure the cementing operation was completed in accordance with Section .0XX8 of this Rule and to locate casing collars and centralizers for future reference.

History Note: *Authority*
Eff.

15A NCAC 05H .0XX8 WELL INSTALLATION

(a) The Department may establish by permit conditions additional well construction standards that provide greater protection of human health, safety and the environment.

(b) The permittee shall notify the Department at least 48 hours prior to setting and cementing any string of casing, in order to allow the Department to participate in pre-job safety and procedural meetings, independently test cement mix water, evaluate casing condition, and observe and document the execution of the cementing operation.

(c) If a mousehole or rathole is used, it shall be constructed of liquid-tight steel pipe with a welded-basal plate.

(d) A permittee shall drill a wellbore using air, freshwater, freshwater-based drilling fluid, or a combination of the above until all freshwater zones have been isolated.

(1) The permittee shall not use drilling fluids or drilling fluid additives that cause a violation of standards established in 15A NCAC 02L, which is incorporated by reference including subsequent amendments, shall be used while constructing oil or gas wells.

(2) Only fresh groundwater, as defined in 15A NCAC 02L .0102, which is incorporated by reference including subsequent amendments, and freshwater, as defined in 15A NCAC 02B .0101, which is incorporated by reference including subsequent amendments, shall be used for mixing all drilling fluids.

(e) The permittee shall drill a wellbore providing a minimum of a one inch annulus, as measured from the casing, unless otherwise approved by the Department. The wellbore diameter shall be consistent with manufacturer's recommendations for all float equipment, centralizers, packers, cement baskets, and all other devices set into the wellbore.

(f) Prior to cementing, the permittee shall condition the wellbore to ensure an adequate cement bond between the casing and the formation by circulating the total volume of drilling fluid in the wellbore a minimum of two times, adjusting drilling fluid rheology to optimize conditions for displacement of the drilling fluid, and ensuring that the wellbore is stable.

(g) The permittee shall rotate and reciprocate all strings of casing during the emplacement of cement to circulate the cement surrounding the string of casing to fill the annulus.

(h) The permittee shall take appropriate measures to prevent surface water infiltration into the wellbore by crowning the location around the wellbore to divert fluids to a ditch.

(i) Conductor casing design and setting depth shall be based on the geological conditions at the wellbore location, including the presence or absence of hydrocarbons, and potential drilling hazards.

(1) Conductor casing shall be cemented from bottom to top. If cement does not return to the surface, the permittee shall consult with and obtain approval from the Department to determine the appropriate method to emplace cement;

(2) Conductor casing shall:

(i) Stabilize unconsolidated sediments;

(ii) Isolate and seal off shallow freshwater zones;

(iii) Isolate any shallow drilling hazards, hydrocarbon bearing zones, or coal formations;

(iv) Provide a stable platform for well construction; and

(v) Provide solid structural anchorage for a diverter system in air drilling operations;

(3) A mechanical or cement seal shall be installed at the surface to block downward migration of surface pollutants.

(j) Surface casing shall be set into competent bedrock to a depth of at least 100 feet below the base of the deepest freshwater zone, but above any hydrocarbon strata containing fluids or gases that could negatively impact the quality of the cement or proper functioning of the well.

(1) Surface casing shall be cemented from bottom to top. If cement does not return to the surface, the permittee shall consult with and obtain approval from the Department to determine the appropriate method to emplace cement;

(2) Surface casing shall:

(i) Isolate and seal off shallow freshwater zones;

(ii) Provide a stable platform for well construction; and

(iii) Contain pressures and fluids from subsequent drilling, completion and production operations;

(3) Surface casing shall be set deep enough and into a competent formation to ensure the BOP can contain any formation pressure that may be encountered when drilling the next section of the wellbore below the base of the surface string of casing;

(4) Correlation logs and samples shall be collected by the permittee to identify freshwater, zones of formational instability, and competent bedrock to be submitted with the well completion report. (Reference Record Keeping/Data Collection Rule);

Comment [AP6]: Who is responsible? What format for collection? How long are records required to be kept? Where? *The format for collection, records retention, and location will be addressed with the requirements for submitting a well completion report.*

(5) Surface casing shall be cemented before drilling through hydrocarbon bearing flow zones;

(6) If a shallow-gas hazard is encountered, drilling shall stop, and casing shall be set and cemented before drilling continues; and

(7) A formation integrity test (FIT) shall be completed after drilling out below the base of the surface casing, into at least 20 feet, but not more than 50 feet of new formation. The FIT shall be completed in accordance with API Standard 65-Part 2 "Isolating Potential Flow Zones During Well Construction," which is incorporated by reference, including subsequent amendments and editions. This document, published by API, may be viewed online at no charge at http://publications.api.org/default.aspx or may be purchased at a cost of one hundred thirty dollars ($130.00) at http://www.techstreet.com/api/products/1757706 or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108. If the FIT fails, the permittee shall consult with the Department to determine remedial or corrective actions necessary before operations continue.

(k) If intermediate casing is used, the casing shall be set into competent bedrock to a depth of at least 200 feet below the deepest freshwater zone or to a depth consistent with the well design parameters in consideration of the planned kick off point for horizontal drilling and the length of the horizontal run or to mitigate unanticipated geologic hazards encountered in the wellbore such as heaving shale, abnormal pressure, or flow zones that require sealing off.

(1) Intermediate casing installed to isolate a zone other than freshwater shall be cemented from bottom to 200 feet above the base of the previous string of casing, unless otherwise approved by the Department.

(2) If intermediate casing is installed to isolate a freshwater zone, the string of casing shall be cemented from bottom to top, ensuring the one-inch annular space is filled by the return of cement to the surface. If cement does not return to the surface, the permittee shall consult with and obtain approval from the Department to determine the appropriate method to emplace cement.

(3) Intermediate casing shall:

(i) Isolate freshwater that has not been isolated by the surface casing; and

(ii) Isolate flow zones, lost circulation zones, or other geologic hazards, unless otherwise required by the approved permit.

(4) Correlation logs and samples shall be collected by the permittee to identify freshwater, zones of formational instability, and competent bedrock to be submitted with the well completion report. (Reference Record Keeping/Data Collection Rule);

Comment [AP7]: Who is responsible? What format for collection? How long are records required to be kept? Where?

Comment [AP8]: Same comment as above. Who is responsible for collecting? Are there requirements for maintenance of logs and samples?

(5) If the intermediate wellbore penetrates one or more flow zones, the cement used to control annular gas migration from the flow zones shall be designed to comply with API Standard 65-Part 2.

(6) A CBL shall be completed after cement has reached a compressive strength of 500 pounds per square inch to help ensure the cementing operation was completed in accordance with Paragraph (k)(1) or (k)(2). Drilling may not commence until the CBL is complete.

(7) If cement evaluation indicates failure to isolate freshwater zones, permittee shall submit a plan of remediation to the Department for approval and implement such plan by performing remedial operations prior to continuing drilling operations. If the deficiencies cannot be remedied, the well shall be plugged and abandoned.

(8) A FIT shall be completed after drilling out below the base of the intermediate casing, into at least 20 feet, but not more than 50 feet of new formation. The FIT shall be completed in accordance with API Standard 65-Part 2. If the FIT fails, the permittee shall consult with the Department to determine remedial or corrective actions necessary before operations continue.

(9) If operations, such as fluid returns, lift pressure, and displacement, indicate inadequate coverage of any flow zones, lost circulation zones, or any strata containing freshwater, the permittee shall identify the top of cement and submit a plan of remediation to the Department for approval and implementation.

(l) Production casing shall be installed and cemented from bottom to 600 feet above the uppermost perforation, a potential corrosive zone, an oil or gas bearing zone, or a potential water supply, ensuring the minimum one-inch annular space is filled. Notwithstanding the foregoing, zone of production may be completed using a non-cemented production liner. Zone of production means…

(1) A production liner may be hung from the base of the intermediate casing and used as production casing as long as the surface casing is used as the freshwater isolation casing and the intermediate casing is set for a reason other than isolation of freshwater. The production liner shall be cemented with a minimum of 200 feet of cement above the base of the previous string of casing. The liner top must be pressure tested to at least 500 pounds per square inch, for a period of 30-minutes, above the maximum anticipated pressure in the wellbore during well completion and production operations. If after 30-minutes the pressure has dropped by more than 10 percent, the permittee shall not resume operations until the condition has been corrected and verified by a subsequent passing 30-minute pressure test.

(2) Wireline logging of the wellbore shall be completed prior to installation of the production casing to measure and evaluate the rock sections;

(3) A CBL shall be completed after the cement has reached a compressive strength of 500 pounds per square inch to help ensure the cementing operation was completed in accordance with Paragraph (l). Upon completion of the CBL, well construction activity may continue.

(4) If cement evaluation indicates failure to isolate freshwater zones, permittee shall submit a plan of remediation to the Department for approval and implement such plan by performing remedial operations prior to continuing drilling operations. If the deficiencies cannot be remedied, the well shall be plugged and abandoned.

(5) For cemented well completions, the base of the production casing shall be cemented into or below the productive horizon(s). For open-hole well completions, the base of the production casing shall be cemented into or above the productive horizon(s).

History Note: *Authority*
Eff.

15A NCAC 05H .0XX9 WELL STIMULATION AND ENHANCED RECOVERY

15A NCAC 05H .0XX10 CHEMICAL TREATMENT

15A NCAC 05H .0XX11 WELLHEAD REQUIREMENTS

15A NCAC 05H .0XX12 WELL CONTROL AND BLOWOUT PREVENTION

(a) During drilling, all wells shall be equipped with a well-control system to include a BOP and a properly sized flow line valve.

(1) The entire well-control system shall be in good working condition at all times and shall have been tested to working pressures at least 50 percent above the hydrostatic pressures anticipated in the well;

(2) BOP equipment shall be in compliance with API Standard 53 "Blowout Prevention Equipment Systems for Drilling Wells," which is incorporated by reference, including subsequent amendments and editions. This document, published by API, may be viewed online at no charge at http://publications.api.org/default.aspx or may be purchased at a cost of one hundred fifty five dollars ($155.00) at http://www.techstreet.com/api/products/1846173 or by mail at Techstreet, 3916 Ranchero Drive, Ann Arbor, MI 48108;

(3) The BOP shall be installed and tested prior to drilling the surface-casing cement plug;

(4) During drilling operations, the shear-ram BOP shall be tested by closing at least once each trip; the annular BOP shall be tested by closing on the drill pipe at least once each week; and

(5) The permittee shall notify the Department at least 48 hours prior to testing the BOP. Test results must be posted at the well site for review by the Department.

(b) Drilling fluid of sufficient weight and supply to maintain well control shall be located on the well site.
(c) If drilling with a mud system, the drilling-fluid system must be designed to maintain control of the well to minimize the potential of a hydrostatic pressure surge when the drilling assembly is run into or pulled out of the wellbore. The fluid drilling system shall remain functional at all times.
(d) If drilling with air, a rotating diverter system shall be installed to divert any wellbore fluids and gases away from the rig floor to a circulation pit at least eighty (80) feet from the wellbore. The rotating diverter system shall be secured and remain functional at all times.
(e) The permittee shall have an individual certified from an accredited well control training program, such as International Association of Drilling Contractors (IADC) WellCAP, on site during the installation and completion of an oil or gas well.
(f) A master gate valve shall be installed after drilling operations are complete and the BOP has been removed.

History Note: *Authority*
Eff.

15A NCAC 05H .0XX13 WELL MAINTENANCE

15A NCAC 05H .0XX14 COMPLETION REPORT AND MAPS

15A NCAC 05H .0XX15 LAND OWNER REQUEST FOR SURVEY

15A NCAC 05H .0XX16 FILING OF DRILLING LOGS

15A NCAC 05H .0XX17 PLUGGING AND ABANDONMENT

15A NCAC 05H .0XX18 LIMITATION OF PRODUCTION AND ALLOCATION

15A NCAC 05H .0XX19 SPECIFIC NOTIFICATIONS
(a) The permittee shall report defective casing or cementing within 24 hours of discovery and shall immediately correct the defect, unless the Department determines that the defect does not warrant immediate repairs to protect human health, safety and the environment and can safely be completed within a time period approved by the Department.
(b) The permittee shall immediately report a blowout to the Department.

History Note: *Authority*
Eff.

15A NCAC 05H .0XX20 RECORD KEEPING AND REPORTING

15A NCAC 05H .0XX21 VARIANCE AUTHORITY

(a) The Department may grant a variance from any construction standard under the rules of Section **.0XX8**. The permittee of a well for which a variance is sought, shall submit the variance in writing to the Department for review. The Department may grant the variance if human health, safety, and the environment are not endangered.

(b) The Department may require the variance applicant to submit such information as the Department deems necessary to make a decision to grant or deny the variance. The Department may impose such conditions on a variance or the use of a well for which a variance is granted as deemed necessary to protect human health and welfare and all water resources. The findings of fact supporting any variance under this Rule shall be in writing and made part of the variance.

(c) The Department shall respond in writing to a request for a variance within 30 days from the receipt of the variance request.

(d) A variance applicant who is dissatisfied with the decision of the Department may commence a contested case by filing a petition pursuant to G.S. 150B-23 within 60 days after receipt of the decision.

History Note: *Authority*
Eff.

Comment [AP9]: Statutory authority?

Comment [RC10]: Perhaps G.S. 113-391 (a)(2) provides the statutory authority.

Comment [AP11]: Substantially identical to 15A NCAC 02C. 0241, except for "reasonable cost," which may be too vague for RRC.