

Attachment E

**Plugging and Abandonment Plan (40 CFR §§ 144.31, 144.51 & 146.34)
Application for Class III Underground Injection Control Permit**

**Florence Copper Project
Florence Copper Inc.**

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List of Exhibits

Exhibit No.	Title
E-1	Form 7520-19, Schematic Diagrams of Planned Class III ISCR Wells by Resource Block
E-2	Plugging and Abandonment Forms for Non-Class III Wells and Shafts within AOR
E-3	Plugging and Abandonment Forms for Core Holes within AOR
E-4	Plugging and Abandonment Forms for BHP Class III Test Wells

Application for Class III Underground Injection Control Permit Florence Copper Project

Attachment E: Plugging and Abandonment Plan (40 CFR §§ 144.31, 144.51 & 146.34)

E.1 INTRODUCTION

This Attachment describes the plugging and abandonment procedures and individual well and core hole details.

This Attachment has been prepared in support of an application (Application) by Florence Copper Inc. (Florence Copper) to the United States Environmental Protection Agency (USEPA) for an Underground Injection Control Class III Permit (UIC Permit) for the planned In-Situ Copper Recovery (ISCR) facility at the Florence Copper Project (FCP) in Pinal County, Arizona. With this Application, Florence Copper seeks authorization to construct and operate a commercial-scale ISCR facility at the FCP site. Florence Copper proposes to incorporate the pilot-scale Production Test Facility (PTF), which is currently operating under UIC Permit R9UIC-AZ3-FY11-1, into the planned commercial-scale ISCR facility at the FCP site.

This plugging and abandonment plan is based on Appendix C of UIC Permit R9UIC-AZ3-FY11-1, with revision and updates as necessary to reflect the proposed operations and operational experience at the PTF.

E.2 PLUGGING AND ABANDONMENT

E.2.1 Applicability

This plugging and abandonment plan is applicable to proposed Class III wells, existing Class III wells, and non-Class III wells, core holes, and shafts within the FCP ISCR area and the associated Area of Review (AOR) located at the FCP site. This plan applies to all wells, core holes, and shafts within the AOR because the corrective action for each of the wells and core holes within the AOR is to plug and abandon them using Class III well standards. The AOR is defined in Attachment A of this Application as a 500-foot circumscribing area around the planned commercial-scale ISCR well field.

This plugging and abandonment plan has been designed to ensure that all existing and future wells and core holes located within the AOR will be plugged and abandoned (1) in a manner that will prevent or stop the migration of injected solutions into Underground Sources of Drinking Water (USDW) through a penetrating core hole or well, and (2) in accordance with applicable permits and regulations administered by the USEPA, the Arizona Department of Environmental Quality (ADEQ), and Arizona Department of Water Resources (ADWR).

Plugging and abandonment of existing non-Class III wells, core holes within the AOR will occur prior to commencement of injection within 500 feet of the well or core hole. Plugging and abandonment of Class III wells will occur during closure, or when an individual Class III well is retired or closed. Retirement of a Class III well may occur if the well fails to pass mechanical integrity testing or if the well becomes damaged beyond repair.

Florence Copper plans to convert Conoco Shaft No. 1 for the recovery of ISCR solutions. The Conoco Airshaft (Shaft No. 2) will be abandoned prior to commencement of ISCR operations within 500 feet of the shaft. Conoco Shaft No. 1 will be plugged and abandoned in accordance with this Plugging and Abandonment Plan at the conclusion of ISCR operations.

All abandonment notifications, approvals, procedures, documentation, and reporting required under this plan apply to all wells constructed within the commercial-scale AOR, which includes the Class III PTF wells and BHP test wells.

E.2.2 Objectives

The objectives of the Plugging and Abandonment Plan are to ensure that wells, core holes, and shafts will be plugged and sealed in a manner that will prevent the migration of injected fluids into or between USDWs, and to ensure compliance with the applicable requirements of the ADWR (Arizona Administrative Code [A.A.C.] R12-15-816 [Abandonment], and ADWR Well Abandonment Handbook) and the USEPA (40 Code of Federal Regulations [CFR] 146.10 [Plugging and Abandoning Class I-V Wells]).

E.2.3 Hydrogeologic Setting

The saturated geologic formations underlying the FCP site have been divided into three distinct water-bearing hydrostratigraphic units referred to as the Upper Basin Fill Unit (UBFU), Lower Basin Fill Unit (LBFU), and the Bedrock Oxide Unit. The UBFU and LBFU are separated by a thin, regionally extensive aquitard referred to as the Middle Fine-Grained Unit (MFGU). The injection and recovery wells will be completed in the Bedrock Oxide Unit, the uppermost zone of the bedrock complex underlying the FCP site. The injection zone extends from a point 40 feet below the top of the Bedrock Oxide Unit to the oxide/sulfide contact at the base of the Bedrock Oxide Unit. The uppermost 40 feet of the Bedrock Oxide Unit is excluded from injection and is referred to as the exclusion zone.

E.2.4 Overview of ISCR Operations

The ISCR area will be prepared for injection and recovery operations through a three-step process that includes: (a) the abandonment of core holes and existing wells (except Class III wells) within the active well field area and within 500 feet of the planned active ISCR well field area; (b) installation of injection, recovery, and observation wells as required; and (c) installation of ancillary facilities such as power and conveyance infrastructure.

The planned ISCR process involves injecting raffinate (approximately 99.5 percent water mixed with 0.5 percent sulfuric acid) through injection wells into the oxide zone of the bedrock beneath the site for the purposes of dissolving copper minerals from the ore body. The estimated injection zone is between approximately 500 feet below ground surface (bgs) to 1,185 feet bgs. The resulting copper-bearing solution will be pumped by recovery wells to the surface where copper will be removed from the solution in a solvent extraction electro winning (SX/EW) plant. The barren solution from the SX/EW plant will be re-acidified and re-injected back into the oxide zone.

Once copper concentration in the solution declines to a predetermined level, well closure will begin. Closure will consist of circulation of fresh water through the wells until groundwater has been restored to a quality that meets criteria specified in Aquifer Protection Permit (APP) No. P-101704 (the APP) and the UIC Permit. Depending on copper content, solutions produced during closure operations will be withdrawn through the recovery wells and conveyed to the SX/EW plant for processing or neutralized and pumped to one of the water impoundments.

Injection will be discontinued and the ISCR wells undergoing closure will be provisionally considered closed once constituent concentrations in groundwater pumped from the injection zone meet the closure criteria specified in the APP and the UIC Permit. Not more than 2 years following the provisional closure of an ISCR well, the well will be abandoned in accordance with procedures outlined in this plan and requirements set forth in the UIC Permit and the APP.

At the conclusion of ISCR operations, proposed Class III wells within the AOR will remain open for use in monitoring groundwater conditions until ADEQ and USEPA give approval to plug and abandon the wells. FCP ISCR Class III wells will not be plugged and abandoned until written authorization to do so has been received from both ADEQ and USEPA. Florence Copper proposes to keep one ISCR well open per resource block following rinsing to facilitate rebound monitoring of Level 1 parameters on an annual basis. These wells may also be used as recovery wells for additional rinsing if monitoring indicates additional rinsing is required. The proposed monitoring duration is 5 years, after which time the wells will be abandoned in accordance with this Plugging and Abandonment Plan.

Post-closure monitoring at the point of compliance (POC) wells, supplemental monitoring wells, and verification wells will continue following completion of formation rinsing for the period of time specified in the APP and the UIC Permit. Observation wells are installed specifically for the purpose of monitoring hydraulic control during ISCR observations. Once ISCR operations cease and formation rinsing is complete, the observation wells will no longer be required to monitor hydraulic control. No monitoring is proposed at the observation wells following the cessation of rinsing and cessation of hydraulic control. The POC wells will remain open for the period of time necessary to complete closure and post-closure monitoring specified in the APP and the UIC Permit.

E.2.5 Licenses, Notifications, and Approvals

E.2.5.1 Licensed Drillers

Abandonment procedures are described in this document and will only be performed by well drillers licensed by the ADWR pursuant to Arizona Revised Statutes § 45-595(B), or under the direction of such licensed well drillers.

E.2.5.2 Abandonment Notification and Authorization

Florence Copper will convey notice of intent to abandon a well or core hole to ADWR using Form 55-38 (*Notice of Intent to Abandon a Well*) approximately 30 days prior to the planned commencement of abandonment activities for a well or core hole. Form 55-38 will include information describing the

location, type, and construction of the well or core hole, and the proposed plugging or abandonment method.

In addition, Florence Copper will convey notice of proposed abandonment of Class III and non-Class III wells and all core holes to the USEPA on a revised copy of Form 7520-19 (*Plugging and Abandonment Plan*) approximately 60 days prior to the planned abandonment. The form will include descriptions of the proposed abandonment materials and methods of emplacement. Copies of Forms 55-38 and 7520-19 will be submitted to ADEQ concurrently with submittal to ADWR and USEPA.

Once ADWR has approved the abandonment method and materials identified on ADWR Form 55-38, ADWR will issue authorization to the driller to commence with the proposed abandonment. Authorization from ADWR will be in the form of a “well abandonment card” issued to the licensed driller. No well or core hole will be abandoned on the FCP site unless the driller has received a well abandonment card, issued by the Director of the ADWR, authorizing the abandonment of the specific well or core hole.

E.3 WELL, CORE HOLE, AND SHAFT ABANDONMENT PROCEDURES

The standard abandonment procedure will be to completely fill the well, core hole, or shaft with an appropriate sealing material, with some variation depending on the type, condition, and total depth of the well or core hole. Within the AOR, the sealing material will be Type V cement, or approved equivalent as defined in the UIC Permit. The condition and depth of each well, core hole, or shaft varies significantly. Abandonment will be considered complete when all applicable sealing steps set forth below have been completed or have been determined to be unnecessary.

E.3.1 Well or Core Hole Preparation

The following tasks will be performed to prepare each well or core hole for effective sealing.

- a. Locate and Inspect Well, Core Hole or Shaft: The well or core hole will be located using available survey coordinates. The condition and location of the well or core hole will be recorded. If the well or core hole is not visible from the surface, the area will be excavated to locate the collar of the core hole or expose the surface casing of the well. A video log will be run in each of the shafts to verify the condition of the shaft.
- b. Move in Workover Rig: A workover rig capable of performing the required abandonment operations at the required depths will be moved in and set up over the well, core hole, or shaft.
- c. Equipment Removal: All pumps, tubing, wiring, and ancillary equipment within each well will be removed prior to abandonment of the well. No equipment exists within the core holes or shaft.
- d. Perforations: If records demonstrate that a well annulus is inadequately sealed and its casing is not removed, the casing will be perforated to allow installation of cement grout in the annulus. If necessary and the casing extends that distance, perforations will extend from at least 20 feet below the bedrock-LBFU contact to at least 20 feet above the contact; from at least 20 feet below the base of the MFGU to at least 20 feet above the top of the MFGU; and from 25 feet bgs to 5 feet bgs. Formation tops will be identified based on core hole logs, or information obtained from the site geologic model. Where the contact depth cannot be determined, the entire length of the casing will be perforated, and the entire length of the annulus will be cemented.

- e. Cleaning: Wells and core holes will be cleaned out, if necessary, to a depth of at least 100 feet below the bedrock-LBFU contact to enable proper placement of cement seals. This will be accomplished by installing a work string of tubing and circulating fluids, or drilling, or performing other remedial work as required to clean the well or core hole to the required depth. Video inspection of the shafts has shown that they are open to the required sealing depth. Following removal of ISCR-related equipment, a video log will be run in each shaft to verify that no new obstructions have been introduced into the shafts. If obstructions are observed, they will be removed using well bore fishing procedures.
- f. Equalization of Wellbore Fluids: After cleaning the well or core hole, wellbore fluids (bentonite mud) may be circulated and treated as necessary to achieve equilibrium and stabilize the hole.

E.3.2 Equipment and Materials

The following material and equipment will be used in sealing wells and core holes according to the procedure described below if required to make proper seals.

- a. Cement Grout: All cement grout will consist of Type V cement, or equivalent approved in accordance with the UIC Permit.
- b. Mechanical Plugs: A mechanical bridge plug will be set at the base of the interval to be cemented off if it is not at the bottom of the well or core hole. Alternately, the well or core hole may be filled with suitable formation stabilizer (i.e., mixture of sand and pea gravel) to support the cement seal during placement. This will prevent migration cement below the interval to be cemented and sealed. Each shaft will be filled with formation stabilizer to the required sealing depth.
- c. Cement Plugs: Cement plugs will consist of Type V cement grout or equivalent approved in accordance with the UIC Permit.
- d. Cement Retainer: If cement grout is to be installed in the annulus behind perforated casing, a cement retainer will be set above the top perforation prior to pumping cement grout into the perforated interval that has been isolated by the cement retainer.
- e. Work String: A work string of small diameter pipe or tubing (tremie pipe) will be used for the placement of cement grout and plugs.

E.3.3 General Procedure for Sealing Wells, Core Holes, and Shafts

The following procedure will be used to seal each well or core hole:

- a. If the surface casing is loose at ground surface, an attempt will be made to remove it. If removal of the casing is not feasible, it will be left in the hole and perforated as needed to allow an annular seal to be placed to a depth of 25 feet bgs. In areas of agricultural use, the surface casing will be cut at least 5 feet bgs and removed.
- b. A tremie pipe will be used to place Type V cement in the open well, core hole, or shaft from the bottom of the hole to the top of the hole. Cement retainers, as described above, will be used to force cement grout into the annulus behind perforated intervals, as necessary.

- c. If the hole has been obstructed, as much cement as possible will be placed from 100 feet below the LBFU-bedrock contact to the top of the hole.
- d. The volume of Type V cement will be recorded and will not be less than the estimated volume of material required to fill each interval.

E.3.4 Procedures for Special Circumstances

The following procedures will be completed for special circumstances, as indicated.

- a. Seal of Perched Aquifer: If cascading water is encountered during preparation for abandonment, the well casing in the target area will be cleaned or perforated, isolated with cement plugs, and Type V cement will be used to seal the annulus around the perched layer. Cement seals will be emplaced in four steps as follows:
 - 1. In the area of the observed cascading water, existing casing perforations in the well will be cleaned to the point that they are open and will readily allow neat cement to pass, or new perforations will be cut that will allow neat cement to pass.
 - 2. The well casing will be filled with Type V cement to a point at least 20 feet below the cascading zone and will be allowed to cure for a minimum of 12 hours.
 - 3. A packer will be emplaced above the cascading zone.
 - 4. Type V neat cement will be injected under pressure into the cascading zone until a volume of cement has been pumped that is equal to or greater than the combined volume of the well bore and the annular space within the isolated zone.
- b. Injection Wells: Injection wells plugged and abandoned in accordance with the procedures specified above will be deemed to have been plugged and abandoned in accordance with the provisions of 40 CFR 146.10. Therefore, Florence Copper will comply with the procedures specified above to ensure that any deviation from the above procedures will not violate the provisions of 40 CFR 146.10.

E.3.5 Documentation and Reporting

Following completion of plugging and abandonment, reports will be prepared and filed with the respective agencies, as described below.

E.3.5.1 Reporting Responsibilities

The licensed driller or supervised designee will maintain a log of all abandonment activities. The log will be of sufficient detail that the driller will be able to complete all ADWR requirements and all abandonment reports required by USEPA. The driller will sign all ADWR abandonment forms. The authorized Florence Copper representative will sign all narrative abandonment reports submitted to ADWR and all abandonment reports to USEPA.

E.3.5.2 Reports to ADWR

The licensed driller will complete and sign a *Well Abandonment Completion Report* (ADWR Form 55-58) and submit it to ADWR within 30 days following abandonment of any well (including Class III wells) or

core hole. Form 55-58 will update the information provided on ADWR Form 55-38 (*Notice of Intent to Abandon a Well*) including updated information on the treatment, materials, and methods used for abandoning the well or core hole. Florence Copper will complete and sign a *Well Owner's Notification of Abandonment* (ADWR Form 55-36) and submit it to ADWR within 30 days following abandonment.

E.3.5.3 Reports to USEPA

Within 60 days after plugging and abandoning a well or core hole or at the time of the next quarterly report due to the USEPA (whichever is less), Florence Copper will submit a report to the Regional Administrator of USEPA. If the quarterly report is due less than 15 days before plugging and abandonment is completed, then the report will be submitted within 60 days. The report will be certified as accurate by the licensed driller who performed the plugging and abandonment procedures.

The report will consist of either:

- A statement that the well or core hole was plugged and abandoned in accordance with the plan previously submitted to the Regional Administrator; or
- An updated version of the plan on Form 7520-19, specifying differences if the actual plugging or abandonment differed from the plan previously submitted.

The report will also include a summary of non-Class III wells and core holes abandoned and will include copies of all forms (Forms 55-38, 55-58, and 55-36) submitted to ADWR.

Completed copies of Form 7520-19 and schematic diagrams of wells, core holes, and shafts within the AOR are provided as Exhibit E-1 to this Attachment.

E.3.5.4 Reports to ADEQ

Florence Copper will include in its quarterly APP monitoring report to ADEQ a summary noting the identification number of each well or core hole for which abandonment was completed during the reporting period, the date that the abandonment was completed, and the location of the well or core hole.

Florence Copper will also submit to ADEQ a copy of the plugging and abandonment report developed for submittal to USEPA.

E.3.5.5 Maintenance of Records

Copies of all completed and required abandonment report forms, plans, and narratives required by ADWR or USEPA will be maintained at the FCP site for inspection until closure is completed. After commencement of post-closure, the records will be stored by Florence Copper, subject to review by USEPA and ADEQ, until post-closure is completed.

E.4 PLUGGING AND ABANDONMENT FORMS

The planned ISCR well field area has been divided into resource blocks to aid in well field planning. Each resource block measures 500 feet by 500 feet and covers area of approximately 5.7 acres. Because resource characterization extended beyond the edge of the ISCR well field, the resource blocks also continue beyond the edge of the well field. The ISCR well field area boundary shown on Figures A-1 and A-2 (Attachment A of this Application) reflects the cutoff selected for copper recovery based on ore body characteristics. A total of 50 resource blocks fall either fully or partly inside the ISCR well field area. The proposed ISCR wells located within the ISCR well field are listed by resource block on Tables E-1 through E-50, provided in Exhibit E-1.

Each of the planned ISCR wells will be constructed based on site-specific geologic information developed during drilling and logging of the individual bore hole that the well will be constructed in. Specific information developed includes lithologic logging, caliper, gamma-ray, temperature, directional survey, and electrical logs. This information will be used to adjust the location of well seals, injection intervals, and eventually plugs based on this geologic information. By contrast, the well diagrams and plugging and abandonment forms (USEPA Form 7520-19) included in Exhibit E-1 reflect preliminary well designs based on core hole data, with interpolation in areas between core holes. The core hole information was also used to develop the resource blocks shown on Attachment A, Figures A-1 and A-2 of this Application. Based on the information presently available, the planned ISCR wells to be constructed in each resource block will be of a similar depth and will feature a similar seal interval and injection zone interval. Consequently, one plugging and abandonment form was prepared for each resource block. Each plugging and abandonment form includes one well diagram for injection and recovery wells, and another for perimeter and observation wells for blocks that include both types of wells. Coordinates for each well location are provided in tabular format (Tables E-1 through E-50) with each plugging and abandonment form (Exhibit E-1). Tables E-1 through E-50 include well information for a total of 1,757 injection and recovery wells, 87 perimeter wells, and 44 observation wells.

Corrective action will be taken to prevent the migration of injected fluids between or into USDWs within or adjacent to the AOR. Corrective action includes plugging and abandonment of all wells and core holes within the AOR, with the exception of Class III wells, prior to placing an injection well into operation within 500 feet of the well or core hole. The wells and core holes will be plugged and abandoned in accordance with this Plugging and Abandonment Plan. All non-Class III wells currently existing within the AOR, and which will be plugged and abandoned prior to injection within 500 feet, are listed in Table A-7. Plugging and abandonment forms (USEPA Form 7520-19) for each of the wells listed in Table A-7 are included in Exhibit E-2. Plugging and abandonment forms (USEPA Form 7520-19) for the two Conoco shafts are included in Exhibit E-2. All open core holes currently existing within the AOR and which will be plugged and abandoned prior to injection within 500 feet are listed in Table A-8. Plugging and abandonment forms (USEPA Form 7520-19) for each of the core holes listed in Table A-8 are included in Exhibit E-3. Plugging and abandonment forms (USEPA Form 7520-19) for the BHP Class III wells listed in Table A-6 are included in Exhibit E-4.

E.5 PLUGGING AND ABANDONMENT COST ESTIMATE

A cost estimate for plugging and abandonment is included with the estimated closure and post-closure costs provided in Attachment F of this Application.