STRATA ENERGY INC
A WHOLLY-OWNED SUBSIDIARY OF PENINSULA ENERGY LIMITED

August 29, 2018

Attention: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Re: Strata Energy, Inc., Ross In-Situ Recovery Project
Source Materials License SUA-1601, Docket No. 040-09091
Request for Additional Information, LC 9.5, 2018 Annual Revised Financial Assurance Estimate

To Whom it May Concern:

Strata Energy, Inc. (Strata) is in receipt of the referenced Request for Additional Information (RAI) for the 2018 annual financial assurance update. Attached please find Strata's responses to the RAI. If you have any questions, please contact me at 307-467-5995 or by email at rpond@stratawyo.com.

Sincerely,
STRATA ENERGY INC.

Royal Pond
Manager of Health, Safety, and Environment/Radiation Safety Officer

cc: B.J. Kristiansen, WDEQ

NMSS01

NMSS

**RAI 1**

Description of the Deficiency

The pore volume calculations in the 2018 surety update (Strata, 2017a) use a flare factor of 1.44 "[b]ased on groundwater modeling of expected operational conditions and horizontal flare factors applied at other [in situ recovery] ISR facilities (e.g., Lost Creek, Nichols Ranch, and Christensen Ranch)". However, in the reclamation plan approved for the licensing of the Ross ISR Project, numeric modeling results for licensing the Ross ISR Project, and the most recent surety updates (e.g., Strata, 2015, 2016a), Strata stated that a flare factor of 1.58 is applicable to the Ross ISR Project. The licensee did not provide justification for revising the flare factor other than it is "applied at other ISR facilities."

Basis for Request

Requirements in Title 10 of the Code of Federal Regulations Part 40, Appendix A, Criterion 9, specify that the amount of surety liability include adjustments to recognize any increases or decreases resulting from inflation, changes in engineering plans, activities performed, and any other conditions affecting costs.

Guidance in NUREG-1569 (NRC, 2003), Appendix C, Section (II)(B) indicates that a surety is to include the aquifer volume to be restored. The aquifer volume is estimated using a flare factor. Therefore, changing the flare factor will affect ground water restoration costs.

License Condition 9.5 (NRC, 2018) states, in part, "Along with each proposed revision or annual update of the financial assurance estimate, the licensee shall submit supporting documentation, showing a breakdown of the costs and the basis for the cost estimates with adjustments for inflation, maintenance of a minimum 15 percent contingency, changes in engineering plans, activities performed, and any other conditions affecting the estimated costs for site closure."

Request for Additional Information

Please provide a detailed basis for the adjustment in flare factor. Alternatively, please revise the surety calculations to use the previously approved flare factor of 1.58 for the Ross ISR Project.

**Response:**

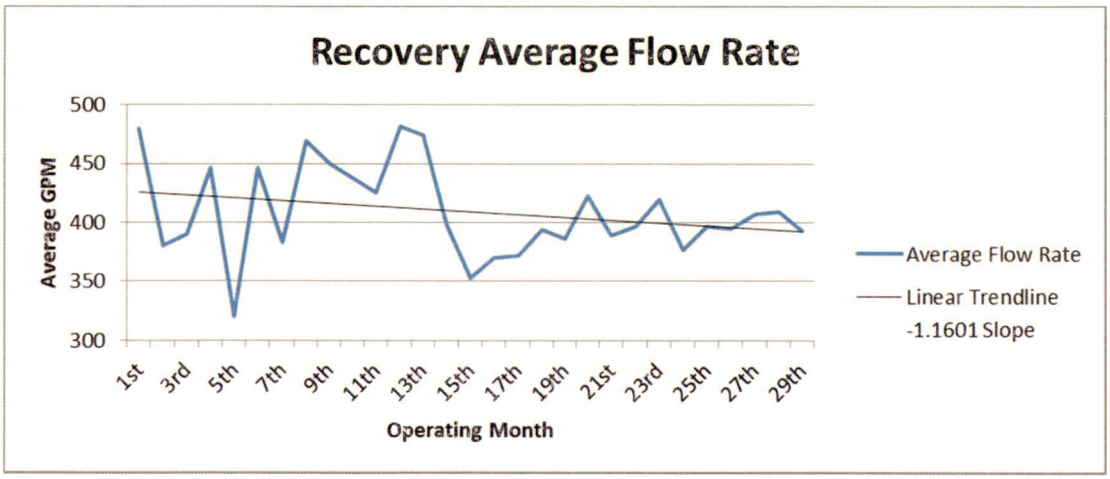
In preparing the 2018 surety update, Strata evaluated the impact of site-specific injection and recovery flow rates, well placement and wellfield geometry in Mine Units 1 and 2. The results of this evaluation support the lower flare factor of 1.44. These aspects were identified in the numeric modeling provided with the license application as the most sensitive inputs[1]. As required in Appendix A, Criterion 9, Strata

[1] Ross TR Addendum 2.7-H at pg. 109: *During the flare modeling exercise the flare was found to be most sensitive to injection and recovery well flowrates, well placement, and wellfield shape. During the simulation, changes to well flow rates were found to significantly affect the flare. Well placement can also significantly affect not only the*

considered these design and operational aspects for the two specific mine units covered by the surety rather than a representative mine unit that was postulated during the licensing process, which resulted in changes to the flare factor and, ultimately, in restoration costs.

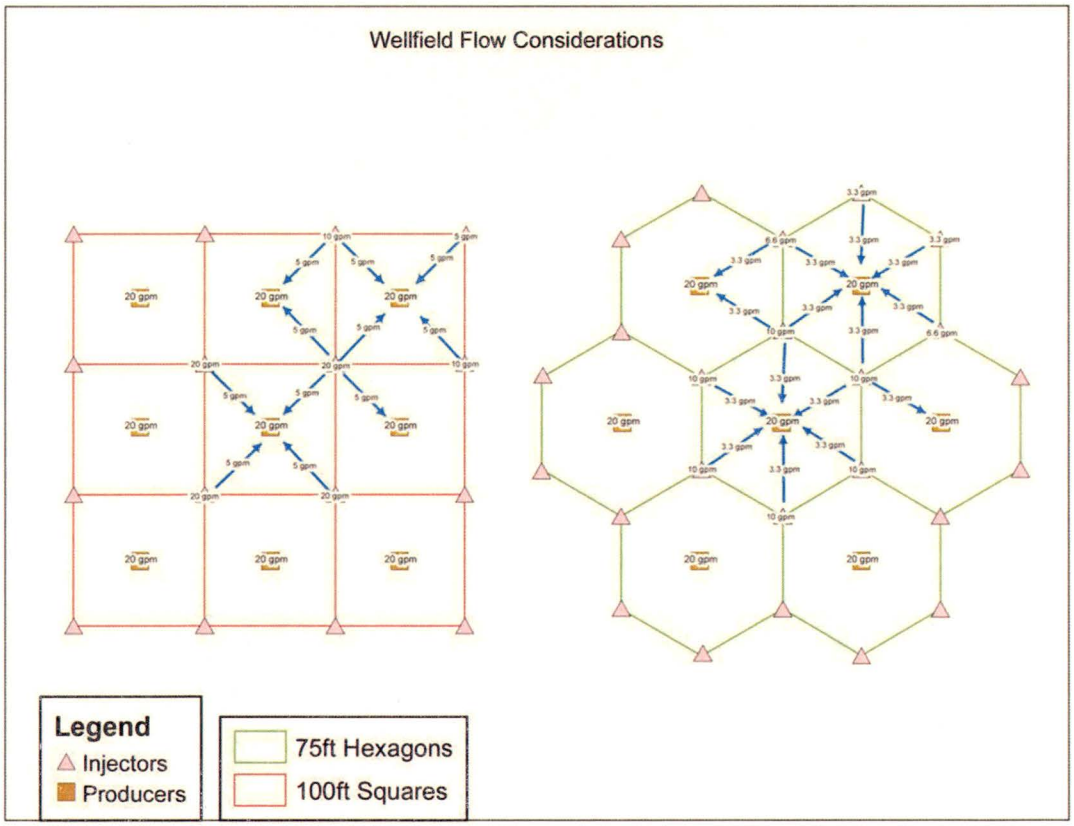
Based on the results of the analysis of Mine Units 1 and 2, the following points indicated that a reduction in the modeled flare factor was necessary:

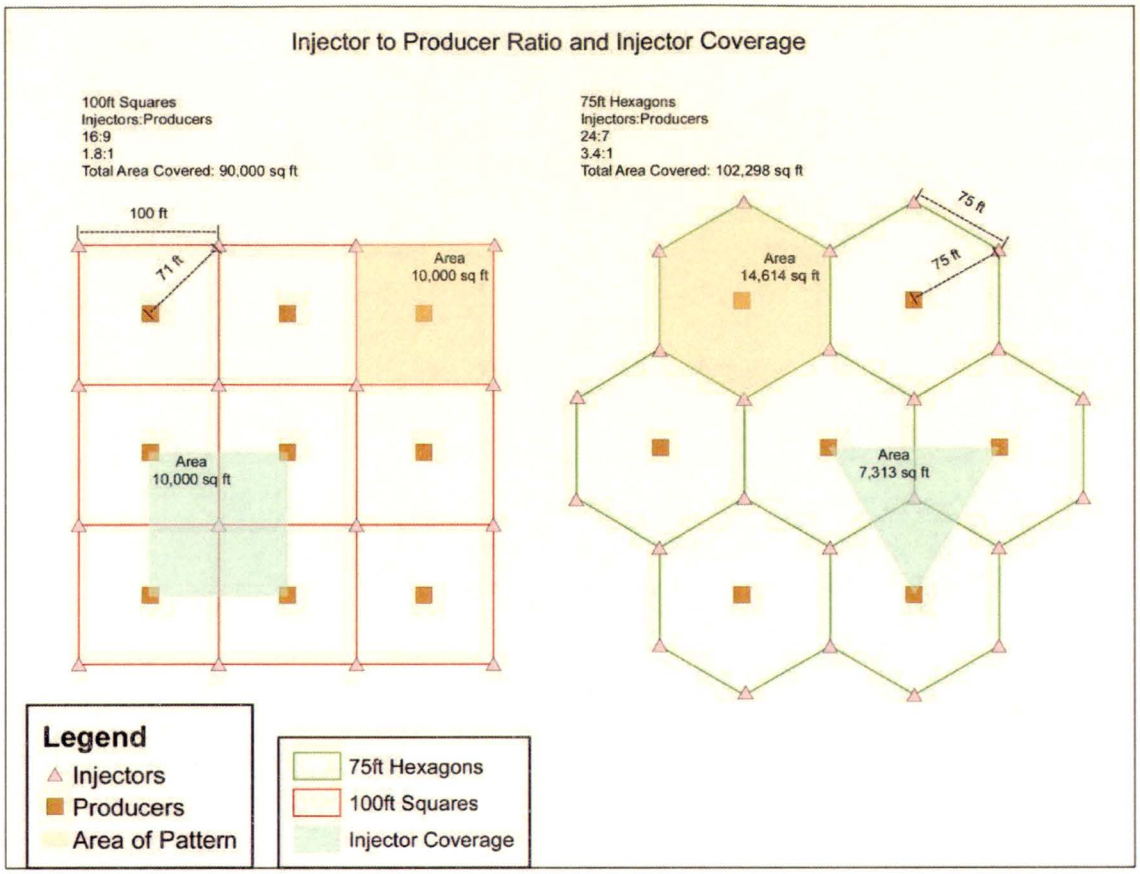
- The modeled injection and recovery flow rates were held constant during the simulations used to support licensing. These modeled flow rates were recovery flows of 11 to 19.7 GPM, injection flows of 0.4 to 27 GPM, and an average flow rate of 16.2 GPM. However, empirical field conditions indicate significant variability and declining flow performance in both well types over time during operations, which effectively decreases the amount of horizontal and vertical flare. The following figure presents the recovery flow history for a typical MU1 headerhouse over time and shows the variability and gradual decline in the rate.




*flare but the efficiency of the ISR operations. In general a more regular well pattern results in a more efficient wellfield, assuming the formation has relatively homogeneous hydraulic properties. As shown on Figure 4.12-2, wellfield shape also affects the flare. The large blocky portion of the wellfield has less relative flare than the relatively narrow portion of wellfield on the west.*

- The groundwater model prepared for the license application used 5-spot patterns (i.e., a central recovery well surrounded by four injection wells). This design is less efficient than the 7-spot well patterns that Strata has installed and operated in MU1 and MU2 (the specific mine units covered by the surety estimate). 7-spot patterns allow lower injection rates on a per well basis to access the same amount of mineralization as 5-spot patterns. This more effectively sweeps the mineralized zone inside the pattern area versus the barren material surrounding the ore body, which is the area defined as "flare". The following figures compare the injector to producer ratio and flow rates for typical 5-spot and 7-spot patterns.






- As described in the MU1 and MU2 wellfield data packages previously reviewed by NRC, low permeability zones were identified during the hydrologic testing conducted within MU1 and MU2. These low permeability zones further limit groundwater flow and flare.
- Strata has maintained an inward hydraulic gradient in MU1 and MU2 since the initiation of operations. This inward hydraulic gradient has resulting in no excursions and has effectively limited horizontal flare. Water level data for perimeter monitor (PM) wells that confirm this inward gradient are reviewed during NRC routine inspections of the Ross project and submitted to NRC in the required quarterly reports.

**RAI 2**

Description of the Deficiency

The 2018 surety estimate (Strata, 2017a) does not include a line item with detailed information or an explanation of estimated costs for remediation of radioactive contamination in onsite subsurface material. Since operations were initiated, Strata has experienced several reportable unplanned releases, based on Wyoming criteria for reportable spills (for example, see Strata, 2016b, 2016c, 2016d, 2017b, 2017c; for purposes of this RAI, an unplanned release is referred to as a "spill"). At this time, Strata has not reported whether or not soils affected by a spill require remediation. The regulations permit Strata to defer cleanup of the soils until decommissioning, provided adequate financial surety is set aside for the cost of the cleanup (see 76 FR 35532).

Basis for Request

Criterion 9(b)(2) of 10 CFR Part 40, Appendix A, states that each cost estimate must contain "[a]n estimate of the amount of radioactive contamination in onsite subsurface material."

Request for Additional Information

The surety estimate should provide costs for cleanup of the subsurface radioactive contamination. For the historical spills, please provide, at a minimum, the area of impacted soils, the soil sampling results, estimated background soil levels for that spill area, the depth of the impacted soils, and, unit and totals costs for any cleanup. If a historical spill does not warrant remediation, then please list the cost for that unplanned release as "$0.0".

**Response:**

In response to this RAI, Strata states that none of the releases experienced to date at the Ross project have resulted in an exceedance of the soil cleanup criteria from 10 CFR Part 40. Complete spill records are maintained on site in the decommissioning file as required in 10 CFR §40.36(f)(1). These records include a description of each release, the source and volume of released material, the location and area affected by the release, the cause and any identified corrective action(s), and an analysis of whether the release is reportable and/or exceeds the applicable soil cleanup criteria. These records are reviewed by the NRC during each routine inspection of licensed activities.

The determination of whether a release is reportable and/or exceeds soil cleanup criteria is accomplished through the use of a Spill Notification Determination Analysis, which is a release impact calculator contained in an Excel workbook. As part of the immediate response to a release, the responsible Strata employee collects and enters the necessary data into the calculator. This data includes the volume and source of the release, the affected area (in square feet), and the concentration of licensed material in the released solution. Based on these inputs, the calculator compares the entered

data with multiple reporting criteria from 10 CFR Parts 20 and 40 as well as Wyoming Department of Environmental Quality-Land Quality Division criteria in Non-coal Rules and Regulations Chapters 4 and 11.

One of the criteria that a release is compared against is whether it results in the exceedance of a soil cleanup standard from 10 CFR Part 40 due to the deposition of radioactive material. The calculator uses the volume of the release to determine the total quantity of licensed material contained in the released solutions. This determination is based on the source of the spill (e.g., production or injection solutions) and the most recent radio-analytical results for that solution. The calculator conservatively assumes that the licensed material is deposited in the first 15 cm layer across the total area affected by the release. The calculator then uses the site-specific average soil density to determine the specific activity of the natural uranium and radium-226 deposited in the soil, with results given in picocuries per gram. This result is then compared against the uranium and radium-226 cleanup standards.

Based on the releases of licensed material experienced at the Ross project since operations began in 2015, the average *increase* in the soil radium-226 concentration above background has been 0.0141 pCi/g. The maximum *increase* in soil radium-226 due to any release has been 0.168 pCi/g. This is far below the radium-226 surface cleanup standard from 10 CFR Part 40 of 5 pCi/g.

The majority of spills at Ross (as with all ISR facilities) involve injection solution that contains only trace concentrations of natural uranium. In addition, the site-specific approved natural uranium cleanup standard for Ross is 479 pCi/g (see approved application, Technical Report Section 6.4.1.2). Therefore the impacts from the release of natural uranium are also well below the cleanup standard.

This RAI requests specific data from all historic releases at the Ross Project since operations began in 2015. That data is included Table 1 below. A few items in Table 1 require explanations:

- Background soil Radium: The value of 1.8 pCi/g is based on the data provided in the approved application in Table 2.9-11. The application does not determine a final site background soil radium-226 concentration and states this will be determined in the final Decommissioning Plan. The value of 1.8 pCi/g is the highest result for samples taken in the 0 to 15 cm interval during preoperational monitoring as discussed in Section 2.9.2.6 of the Technical Report, disregarding four samples that involved naturally-elevated concentrations of radium-226. Use if the highest radium-226 concentration results in a conservative analysis of whether the cleanup criteria are exceeded.
- For the purposes of the spill impact calculator it is assumed that all licensed material is deposited in the top 15 cm of soil. This is assumed since 1) the majority of spills involve injection solution with minimal natural uranium; 2) radium-226 is present as a particle and will adhere to surface soils; and 3) the soil criteria is specified for successive 15 cm thick layers.

As can be seen from the data in Table 1, the releases at the Ross project have had minimal adverse effects on soil radium content. The release with the maximum affect occurred in April 2017 and resulted

in an increase in the radium-226 soil concentration of 0.168 pCi/g, which is well below the cleanup standard of 5 pCi/g above background. As shown in the table, no cleanup is necessary under the decommissioning standards for any historical release at the Ross project to date and therefore no allowance in the bond is required.

| Ross Project Required Bond for Spill Soil Impacts | | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | Location | Total Area | Total Depth | Bkgd Soil Radium | Spill Radium Impact | Total Soil Radium | Required Bond Amount |
| | | (Ft2) | (cm) | (pCi/gm) | (pCi/gm) | (pCi/gm) | (USD) |
| 3-Mar-16 | CPP Sumps | | 15 | 1.8 | | 1.8000 | $ - |
| 3-Mar-16 | Retention Pond | | 15 | 1.8 | | 1.8000 | $ - |
| 29-Apr-16 | CPP | 30 | 15 | 1.8 | 3.06E-02 | 1.8306 | $ - |
| 28-May-16 | OZ-209 | 30 | 15 | 1.8 | | 1.8000 | $ - |
| 1-Jun-16 | CPP | 900 | 15 | 1.8 | 3.06E-02 | 1.8306 | $ - |
| 19-Jul-16 | CPP | 2368 | 15 | 1.8 | 4.20E-03 | 1.8042 | $ - |
| 21-Jul-16 | MU-1 | 36 | 15 | 1.8 | 1.83E-02 | 1.8183 | $ - |
| 6-Oct-16 | OZ-290/HH-4 | 200 | 15 | 1.8 | 2.53E-02 | 1.8253 | $ - |
| 11-Oct-16 | OZ-150 | 8100 | 15 | 1.8 | 2.82E-03 | 1.8028 | $ - |
| 16-Dec-16 | CPP | 267 | 15 | 1.8 | | 1.8000 | $ - |
| 18-Feb-17 | Cell 2 Pond | 300 | 15 | 1.8 | 1.20E-02 | 1.8120 | $ - |
| 3-Mar-17 | OZ-95 | 876 | 15 | 1.8 | 1.02E-03 | 1.8010 | $ - |
| 10-Mar-17 | OZ-099 | 1978 | 15 | 1.8 | 3.63E-03 | 1.8036 | $ - |
| 16-Mar-17 | OZ-060 | 1417 | 15 | 1.8 | 4.05E-04 | 1.8004 | $ - |
| 16-Mar-17 | OZ-103 | 610 | 15 | 1.8 | 4.41E-03 | 1.8044 | $ - |
| 13-Apr-17 | CPP | 32 | 15 | 1.8 | 1.68E-01 | 1.9680 | $ - |
| 25-May-17 | OZ-191 | 3170 | 15 | 1.8 | 3.03E-03 | 1.8030 | $ - |
| 14-Jun-17 | OZ-241 | 124 | 15 | 1.8 | 8.77E-03 | 1.8088 | $ - |
| 23-Jun-17 | OZ-118 | 100 | 15 | 1.8 | 6.69E-03 | 1.8067 | $ - |
| 19-Jul-17 | OZ-286 | 358 | 15 | 1.8 | 1.56E-03 | 1.8016 | $ - |
| 27-Jul-17 | HH-8 | 20845 | 15 | 1.8 | 8.96E-03 | 1.8090 | $ - |
| 31-Jul-17 | OZ-215 | 151 | 15 | 1.8 | 2.47E-03 | 1.8025 | $ - |
| 8-Aug-17 | OZ-126/HH-6 | 1509 | 15 | 1.8 | 5.34E-02 | 1.8534 | $ - |
| 13-Sep-17 | Main Well Road | 5276 | 15 | 1.8 | 1.93E-04 | 1.8002 | $ - |
| 9-Oct-17 | OZ-306 | 8 | 15 | 1.8 | 1.41E-02 | 1.8141 | $ - |
| 10-Nov-17 | HH-2 | 679 | 15 | 1.8 | 6.16E-04 | 1.8006 | $ - |
| 28-Dec-17 | OZ-197 | 2454 | 15 | 1.8 | 3.27E-03 | 1.8033 | $ - |
| 23-Jan-18 | HH-3 Basement | 682 | 15 | 1.8 | 1.33E-03 | 1.8013 | $ - |
| 4-Apr-18 | Road to HH-3 | 14737 | 15 | 1.8 | 3.05E-05 | 1.8000 | $ - |
| 10-Apr-18 | OZ-479 | 464 | 15 | 1.8 | 7.26E-04 | 1.8007 | $ - |
| 20-Apr-18 | OZ-479 | 409 | 15 | 1.8 | 2.75E-03 | 1.8028 | $ - |
| 30-Apr-18 | OZ-286 | 106 | 15 | 1.8 | 1.06E-03 | 1.8011 | $ - |
| 3-May-18 | OZ-312 | 265 | 15 | 1.8 | 1.15E-03 | 1.8012 | $ - |
| 9-May-18 | OZ-413 | 13 | 15 | 1.8 | 3.33E-02 | 1.8333 | $ - |
| 14-May-18 | OZ0413 | 12 | 15 | 1.8 | 5.41E-03 | 1.8054 | $ - |
| 17-May-18 | HH-9 | 1360 | 15 | 1.8 | 2.14E-03 | 1.8021 | $ - |
| | | Average increase Ra-226 (pCi/gm) | | | 0.0141 | | |
| | | Maximum increase Ra-226 (pCi/gm) | | | 0.168 | | |

**RAI 3:**

Description of Deficiency

As currently presented, the 2018 surety estimate (Strata, 2017a) does not include sufficient information for the NRC staff to verify that the well abandonment unit costs are derived from an independent source not financially affiliated with Strata.

Basis for the Request

The requirements in 10 CFR 40, Appendix A, Criterion 9, specify that cost estimates are to be based on the cost of an independent contractor to perform decontamination, decommissioning, and reclamation activities. In addition, the guidance in Appendix C of NUREG-1569 (NRC, 2003) states that "a third party is an independent contractor or operator who is not financially affiliated with the licensee."

The licensee states that the unit costs for well abandonment "are based on actual contract, material, and labor rates from the Ross Project." The actual unit cost for well abandonment states $1.56 per foot. However, in the previous surety update (Strata, 2016a), Strata's "Well Abandonment Unit Cost" was stated as $2.50 per foot, based on standardized rates found in Wyoming's Department of Environmental Quality's Guideline 12, Appendix L.

Request for Additional Information

Please provide support for the actual costs that demonstrates these costs were derived from an independent source not financially affiliated with Strata or revise the well abandonment surety calculations to reflect costs of an independent contractor for the Ross Project.

**Response:**

The 2018 financial assurance update used well abandonment rates developed for the Ross project based on the actual costs for an independent contractor to perform this work. WDEQ Guideline 12 allows mine operators to use the standardized rates or to propose site-specific rates[2]. The standardized rates included in the most recent revision of Guideline 12 were developed as a joint project of the Wyoming Mining Association (WMA) and the WDEQ Land Quality Division (LQD). As part of this continuing effort between WMA and WDEQ, efforts are underway to update the appropriate standardized rate for well abandonment at in situ uranium recovery facilities. While these efforts are not final, it has been clear to Strata since 2015 that the standardized rate of $2.50 per foot contained in the current Guideline 12 was more than what would be necessary for an independent contractor to abandon cased wells at the Ross project. Therefore, Strata developed the site specific rate included in the 2018 financial assurance

[2] Wyoming Department of Environmental Quality-Land Quality Division, Guideline 12, Bond Calculations, Introduction, page iv.

update, which was ultimately approved by the LQD in the 2018 bond update. Following is a discussion of how that rate was derived.

Abandonment of a cased well involves plugging the casing with an approved media and completion of a surface cap. Requirements for media, methods, surface completion, etc. are contained in WDEQ-LQD Rules and Regulations Chapter 11, In Situ Mining. The cost elements involved in abandoning a cased well include materials, labor, and equipment as shown in the following table (taken directly from the 2018 update, UC WELL ABAND tab):

**WELL ABANDONMENT**

| **Materials** | **500 ft. Well/4.5 Inch Casing (4.36 inch ID)** | **500 ft. Well/5 Inch Casing (4.91 inch ID)** | **Comments** |
|---|---|---|---|
| Bentonite Sacks Required per Well (including excess) | 25 | 28 | Based on actual quantities used during well and drill hole plugging |
| Bentonite Sack Cost | $9.42 | $9.42 | Actual contract cost |
| Bentonite Cost per Well | $235.50 | $263.76 | Calculated |
| Cement hole plug (1 sack cement) | $13.50 | $13.50 | Actual contract cost |
| Bentonite chips (5 bags @ $5.52 each) to top off | $27.50 | $27.50 | Actual contract cost |
| | | | |
| **Total Materials Cost Per Well** | $276.50 | $304.76 | |
| | | | |
| **Labor** | | | |
| Labor hours required per well | 2.5 | 2.5 | Based on operational data of labor hours required |
| Labor costs per hour (Operator/Laborer rate from restoration) | $26.45 | $26.45 | Actual costs |
| **Total labor per well (Supervision in GWREST)** | $66.13 | $66.13 | Calculated |
| **Equipment Rental** | | | |
| Backhoe cost per well | $85.00 | $85.00 | Drilling contract fee schedule |
| Hose reel cost per well | $150.00 | $150.00 | Drilling contract fee schedule |
| Cementer cost per hole | $200.00 | $200.00 | Drilling contract fee schedule |
| **Total Equipment and Labor Cost Per Well** | $501.13 | $501.13 | |
| | | | |
| **Total Cost to Plug & Abandon 500 ft. Wells** | **$777.63** | **$805.89** | |
| **Total Cost per foot to Plug & Abandon 4 1/2 in. OD Wells** | **$1.56** | **$1.61** | |

Following is a discussion of the sources of the costs used in the current estimate:

Materials:

The materials necessary to plug a cased well are based on the required sealants in WDEQ Rules (discussed above), the calculated volume of the cased well (based on depth and casing size), and the current contract costs from materials vendors. These materials costs are catalog prices available to any potential purchaser.

Labor:

Labor is based on the time required to plug a well (2.5 hours), which is based on operational experience at Ross and at other ISR facilities. The labor costs are based on using a cementer rather than a drill rig. The hourly rate is based on the current actual operator/laborer cost, which is specified in the groundwater restoration estimate (i.e., $55,000 per year or $26.45 per hour). Supervision is already included in the overall groundwater restoration estimate. Note that the equipment rate for backhoe includes the cost of the backhoe operator.

Equipment:

The estimate is based on the use of a backhoe, a hose reel unit, and a cementer. The hourly rate for each of these types of equipment is from the most recent drilling contracts that Strata has with independent drilling companies. These are rates that these contractors would quote to any potential client. As noted, the backhoe rate includes the cost of an operator, which is typical for estimates using this type of equipment. The other equipment assumes operation by an operator/laborer, included in the Labor estimate.