UIC CLASS VI GEOLOGIC STORAGE OF CO_2 PERMIT APPLICATION

Midland CCS Hub

South Midland Facility

Upton County, Texas

Section 11: Financial Assurance Demonstration Plan (FADP)

[40 CFR §146.82 (a), §146.85]

Prepared for:

EPA Region 6

Underground Injection Control Section

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11.0 FINANCIAL ASSURANCE DEMONSTRATION PLAN (FADP) [CFR 146.82(a)(14) and 146.85]

Milestone is providing financial responsibility (Financial Assurance or FA) pursuant to 40 CFR 146.85 and [redacted] to cover the costs of: corrective action, emergency and remedial response, injection well plugging, post-injection site care, routine monitoring/reporting activities, and site closure. In compliance with 40 CFR 146.85(a)(4), these instruments will provide that they may not be cancelled or terminated except due to failure to make payment and, in such event, the cancellation or termination may not be final until 120 days after receipt of cancellation or termination notice mailed to Milestone and the permitting authority. All cost estimates were generated by an independent third party, Petrotek, of Littleton, Colorado.

11.1 Approach to Meeting Financial Assurance Requirements

Milestone will secure a surety bond to meet FA requirements for any corrective action, injection well plugging, post-injection site care, site closure, or uninsurable parts emergency and remedial response activities. [redacted]

11.2 Corrective Action Plan

The detailed AoR and Correction Action Plan are located in **Section 2** of this permit application. Milestone has determined that there [redacted] in the proposed AoR for which corrective action is required prior to, or during, the course of this project operation or post-closure period. However, in the event wells within the AoR are determined to require correction action, Milestone will demonstrate its financial responsibility for such actions by including the projected costs [redacted] to be provided as set forth in **Section 11.1.1**. The AoR will be re-evaluated every five (5) years to determine if any new penetrations have occurred and whether such penetrations require corrective action.

Even though there [redacted] within the AoR that penetrate the Injection Interval or Top Seal and require corrective action, there are ongoing monitoring activities that require cost estimation. Milestone has assigned a cost to monitoring future permits and possibly plugging and testing heretofore undiscovered wells. Therefore, Corrective Action costs contemplate the low probability future event that a deficient well is permitted by the RRC to drill into the AoR or a historical well is discovered to penetrate the Top Seal or Injection Interval in the future.

11.3 Injection Well-Plugging Program

Plug and abandonment (P&A) of the Midland CCS #2 Well is included within the project operating cost and is covered within this Financial Assurance Demonstration Plan and [redacted]
The specifics of the plugging program can be found in **Section 8 – Injection Well Plugging** of the permit application. Costs were estimated using work scopes provided by third-party industry experts and comparable third-party costs for performance of services and procurement of associated material and equipment. The estimate covers the aggregated P&A cost of one (1) injection well, including rig mobilization, rig and equipment rentals, cementing, logging, haulage, and P&A reporting. To ensure a conservative estimate, no cost deductions were made to salvage the value of materials. [redacted]

11.4 Post-injection Site Care (PISC)

PISC and facility closure estimates include site monitoring and periodic reassessment of the AoR, facilities maintenance and power costs, overhead and support costs. Details of the activities and actions contained in the PISC can be found in permit **Section 9 – Post Injection Site Care**. [redacted] Costs for PISC were developed using historical data, SME estimates, and Vendor estimates for specific materials and equipment. The estimates cover mobilization, detector arrays' installation, surveying, field-sampling, lab analyses, data processing, land agreements, and data interpretation-reporting. [redacted]

11.5 Facility Closure

[redacted]

11.6 Emergency & Remedial Plan

The Emergency and Remedial Response Plan (ERRP) and associated detailed assessment can be found in **Section 10 – Emergency and Remedial Response Plan** of this permit application.

Milestone conservatively estimated costs associated with emergency and remedial response related to each of the emergency events described in **Section 10** (ERRP) of this application, including well integrity failure or loss of mechanical integrity, injection well monitoring equipment failure, a spill, CO_2 or subsurface fluid migration out of the injection zone, damage due to a natural disaster, and damage due to induced seismicity. Most of these emergencies fall under site shut down, well control or other emergency remedial implementations, mechanical integrity event. The activities related to these ERRP events, as provided by Milestone, are presented in **Section 10 - Table 10-1** to **Table 10-7**. Estimated costs associated with ERRP events are shown in **Table 11-6**.

The cost estimates for well integrity failure or loss of mechanical integrity, CO_2 or subsurface fluid migration out of the injection zone, damage due to a natural disaster, and damage due to induced seismicity are conservatively based on a Monte Carlo analysis of the costs associated with a hypothetical worst-case scenario wherein a significant volume of briny water or CO_2 escapes to the surface. The scenario contemplates a reactive response approach – for example – mobilization of response personnel and equipment upon discovery of such an event. This approach is considered appropriate because of the remoteness of the residual risk. Specific post-occurrence action is not determinable until occurrence; thus, actual response to such an event would be based on its severity level. Costs associated with this scenario are intended to account for the outer-limit estimate to satisfy event response. The cost estimate is based on the optimal operating conditions (10 years' operation) requiring outer-limit response and remediation costs.

The cost estimates also account for a scenario in which CO_2 or subsurface fluids migrate and potentially endanger an underground source of drinking water (USDW). The risk of endangerment to USDWs is considered remote and unlikely given the large number of impermeable layers between the injection zone and USDW. However, as part of the reactive response scenario contemplated in the ERRP cost estimate, Milestone assessed the specific response actions and cost data to represent the likely impact of such an event on sources of drinking water.

Milestone will utilize its Spill Control and Prevention Plan in combination with the response strategy to minimize this portion of environmental repair. This subsurface migration and USDW endangerment have primary costs related to groundwater delineation and an extended period (10 years) of quarterly monitoring and reporting after emergency remedial actions are taken. [redacted]

11.7 Methodology – Monte Carlo Simulation

As a way of addressing and managing cost-estimation input-data uncertainties, FA analysis employed Monte Carlo simulation for stochastic modeling. From the EPA we note: "*It is the policy of the U.S. Environmental Protection Agency that such probabilistic analysis techniques as Monte Carlo analysis, given adequate supporting data and credible assumptions, can be viable statistical tools for analyzing variability and uncertainty in risk assessments*." (Fred Hansen, EPA, 1997, p. 1.)

The specific simulator used was RiskAMP™, a full-featured Monte Carlo simulation engine add-in for Microsoft Excel written by, and sourced-through, Structured Data LLC. The RiskAMP add-in includes more than 40 random distribution functions allowing for good, practical, contextual application specific to intuited or estimated project and/or FA activities operational constraints.

Basic to FA, is knowing the cost of effectively meeting the compliance mandates listed and described in Project Financial Assurance section above. The purpose and scope of this FA assessment (Fred Hansen, EPA, 1997, p. 2) is a composite and accurate estimate of the costs of that compliance. Such estimation is challenged on three fronts: data uncertainties, sourcing, and assumptions.

11.7.1 Uncertainties

For FA estimation, the first uncertainty is the lack - that comes with a relatively new industry - of corresponding historical cost data. The geologic sequestration of CO_2 via the method of deep subsurface injection remains a relatively new undertaking. This applies most directly to data sets worthy of parametrization in the service of cost estimation. Data useful for infrastructure and operational costs evaluation continues to be scarce, and thereby subject to application only through indirect comparison and analogy – in particular, through the use of data reflecting oil and gas (O&G) fields' subsurface infrastructure development and operations costs. Such O&G industry costs reflect global markets, are affected politically, and have a distinct history of price/cost volatility. Accordingly, the indirect nature of volatile cost-data comparisons brings compound uncertainties; and inevitably, estimates' extended ranges.

The second uncertainty is the evolving cost of applied technologies, materials, and their associated operational changes to be employed for compliant management of CO_2 geologic sequestration. As the subsurface carbon sequestration industry grows and matures, changes to regulatory design and operational standards are probable, and are equally likely to materially impact the cost of doing business – even post-injection.

The third is the uncertainty with shifting EPA, TRRC, or TCEQ standards regarding FA, FA costs estimation, associated risks assessment, and practical assessment of risk-underwriting scale and scope.

11.7.2 Data Sources

This FA analysis aligned with EPA's UIC Program Class VI Financial Responsibility Guidance (EPA, 2011) as the basis to define the activities required to be included in the cost estimate. Supported by that guidance, Milestone Carbon's FA-relevant Permit Application sections (EPA phases) were reviewed for operational and technical approach, for CO_2 injection model output, and post-injection FA activities' durations and periodicities.

Additionally, for FA required activities, both estimated costs and their stochastic treatments were guided by a variety of Agencies', National Laboratories', Universities', and Industries' data and expertise. Sources included:

- Historic price data from other Petrotek managed UIC projects and FA analyses;
- Cost quotations from third-party service providers;
- Academic investigation and assessment of distribution functions application;
- PNL's Assessment of the Geomechanical Risks Associated with CO2 Injection at the FutureGen 2.0 Site (PNL, 2019);
- EPA's Geologic CO_2 Sequestration Technology and Cost Analysis (EPA, 2008);
- DOE's Final Risk Assessment Report for the FutureGen Project Environmental Impact Statement (NETL, 2007);
- NETL's Overview of Potential Failure Modes and Effects Associated with CO2 Injection and Storage Operations in Saline Formations (DOE/NETL, 2020); and
- Petrotek professional engineering, project management, and estimation expertise.

11.7.3 Data Assumptions

Almost by definition, estimation of FA cost looks far into future technologies and operational cost relationships. Realities of carbon sequestration industry price escalation and general macroeconomic inflation are important factors. However, aligned with EPA Class VI Permit Application submission requirements (EPA, 2011, p7) for initial FA analysis, “current dollars” (December 2024) are employed.

11.7.4 Monte Carlo Simulation

Monte Carlo simulation has been used for estimating FA costs in the current evaluation. While this overview does not aim to be a comprehensive guide on the technique, a brief explanation of Monte Carlo simulation will help contextualize its application for this Milestone Carbon FA evaluation, which focuses on future events.

Monte Carlo simulation is a computational method that uses random sampling to model and analyze uncertain systems or processes. In cost forecasting, this technique involves running numerous iterations with varying input values and assumptions to generate a range of possible cost estimates. By examining different combinations of input variables, such as FA cost drivers, (e.g. probability of events, ranges of costs), Monte Carlo simulation captures the inherent uncertainty in forecasting.

The core idea behind Monte Carlo simulation is that any uncertain variable, such as the cost of an unanticipated event, can be represented by a probability distribution. This distribution describes the range of possible values and their likelihood. For example, a probabilistic cost estimate of an FA operational activity might be appropriately modeled using a parameterized distribution reflecting Gaussian (normal), Weibull, beta-PERT, Gamma, etc. distributions. According to the particular activity modeled, each distribution would be chosen and parameterized specific to the nature of the activity’s estimated scale, scope, periodicity, duration, and probability. By assigning crafted probability distributions to specifically uncertain variables in the FA cost analysis, we create a mathematical model of the total FA cost estimate.

The process involves using a random number generator to sample values from each distribution and calculate a total event cost. Repeating this process many times produces a large set of simulated event costs, which form a frequency distribution. This distribution reveals the most likely FA total cost, percentiles of cost, as well as the minimum and maximum possible costs. It also shows the probability of achieving a specific cost target or staying within a certain range. This information helps assess the likelihood or probability of the FA cost based on the model.

Monte Carlo simulation is particularly useful for addressing and quantifying uncertainties in complex, future, and non-linear systems. In the context of FA, it combines multiple cost and probability estimates - first individually and then aggregated through Monte Carlo analysis - to provide a range of possible FA costs and associated probabilities. Compared to other forecasting methods, such as deterministic or single-point estimates, Monte Carlo simulation offers several advantages. It:

- Captures the complexity and interdependence of multiple variables and factors that affect FA cost, such as resource availability, quality issues, and external risks;
- Provides a realistic and comprehensive view of the uncertainty and variability of FA cost, and quantifies the level of confidence and accuracy of the estimate;
- Identifies the key drivers and contributors of FA cost and highlights potential areas of high risk and/or opportunity;
- Supports decision making and risk management by providing quantitative treatments and metrics. These include FA total and FA phases’ costs range, mean, median, mode, standard

deviation, confidence intervals, percentile distributions, cumulative distributions, probability density distributions, and expected values; and

- Facilitates communication and presentation of the results by using graphical and numerical tools, (e.g., Probabilities and Costs) graphics and tables.

As noted, the RiskAMP Monte Carlo simulation engine was employed for all FA costs estimation simulation work. [redacted] Each Monte Carlo simulation when run delivered a set of statistical metrics used to evaluate, compare, and contrast costs across the scale and range of Class VI operational activities addressed through FA estimation and assessment.

[redacted]

11.8 Cost Estimates

Tables in this section provide a detailed estimate, in 2024 (December) dollars, of the cost of performing corrective actions on wells in the AoR, plugging the injection well, post-injection site care, facility closure, and emergency and remedial response. **Table 11-1** is a summary of the cost estimates underlying the FADP document, identifying proposed financial instrument(s) that will provide the appropriate assurance to regulatory agencies of Milestone's intent and ability to fulfill its responsibilities. Petrotek Corporation of Littleton, Colorado, an independent third party, provided the estimates herein.

Cost estimates assume that these costs would be incurred if a third party were contracted to perform these activities. For that reason, the estimate includes costs such as project management and oversight, general and administrative costs, and overhead during the post-injection period, (e.g., the use of post-injection seismic surveys). Cost estimates are based on the Monte Carlo analysis previously described. These values are subject to change. Additionally, these values are driven by market forces such as changes in energy prices, inflation, contractor availability, materials costs etc. If the cost estimates change, Milestone will adjust the value of the financial instruments, and any adjustment will be submitted for approval as required under 40 CFR §146.85(a)(5).

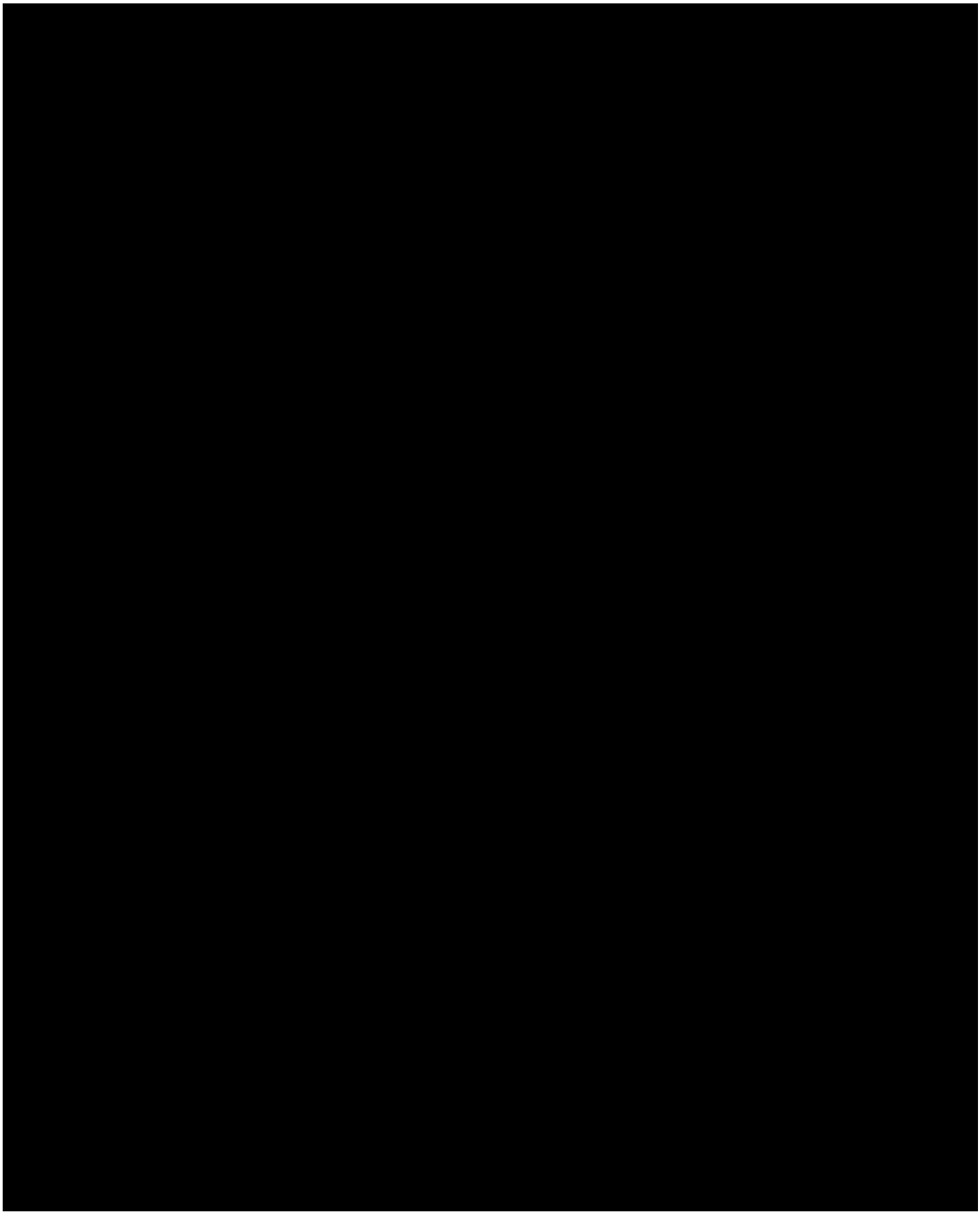
The total estimated costs of each of these activities, as provided by Milestone, are presented in **Table 11-1**. Detailed estimates for major EPA Class VI phases are found in **Table 11-2** to **Table 11-7**.

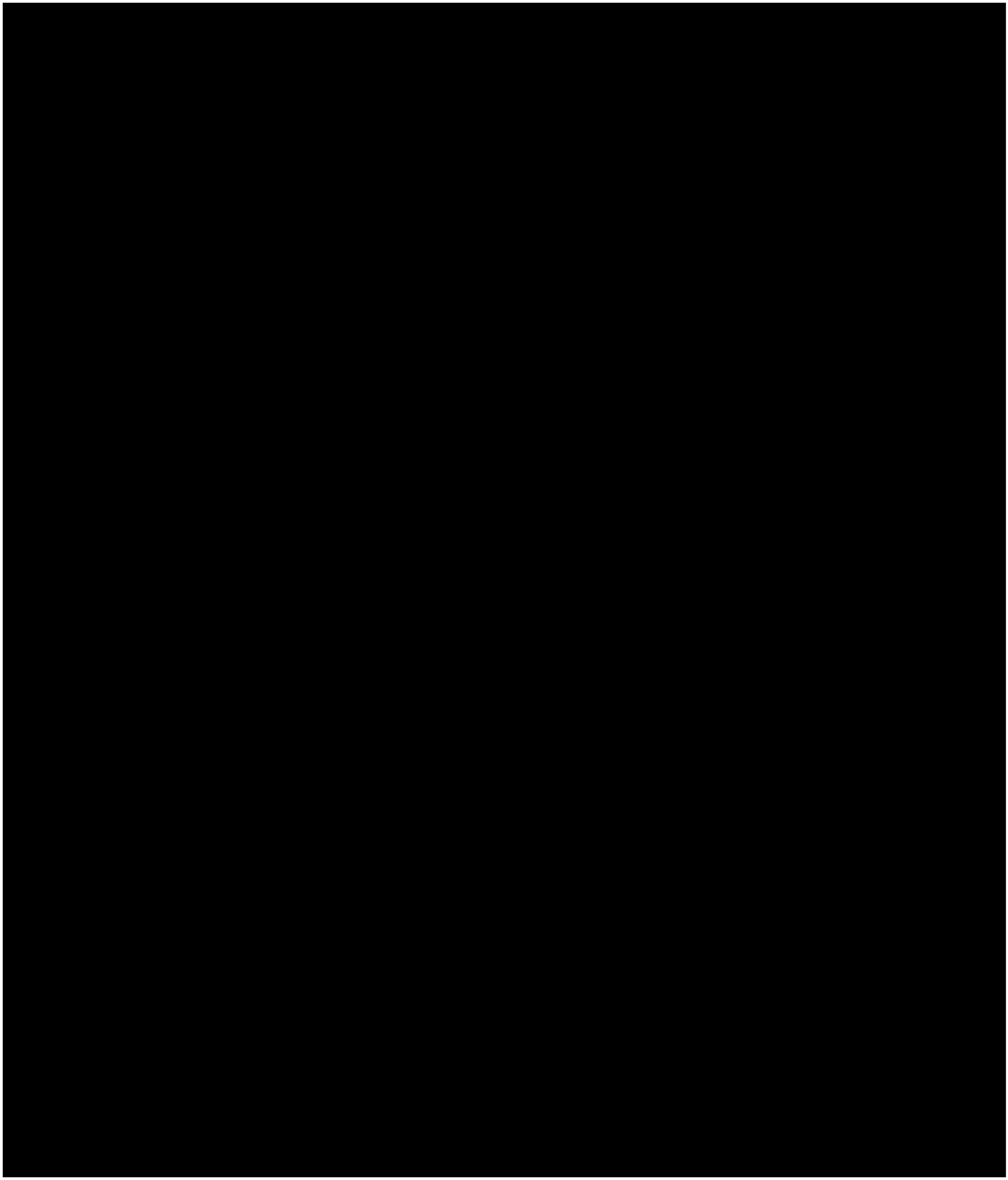
As noted above, even though [redacted] within the AoR, there is a non-zero chance that in the future Milestone could be required to perform corrective action. Therefore, a cost is provided for this low probability event.

[redacted]

[redacted]

[redacted]





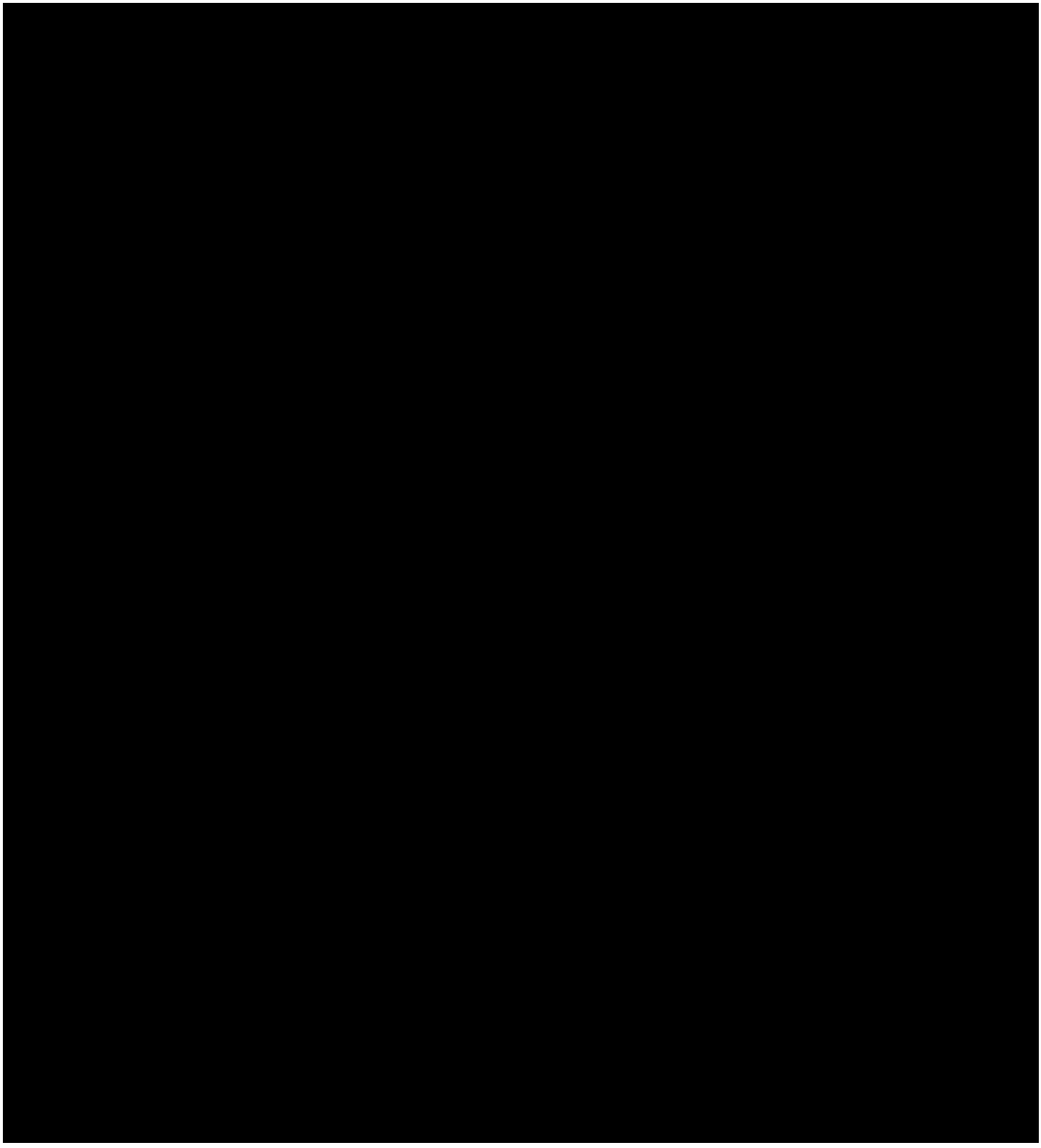
[redacted]

[redacted]

[redacted]

11.8.3 Charts of Monte Carlo Output Distributions

Associated charts for each major category and the final project output displayed in **Figures 11-1** through **11-6** which contain the output distributions for each FA Phase. Several of the distributions contain long tails indicating worst-case scenario(s) were contemplated but they are low probability event(s).



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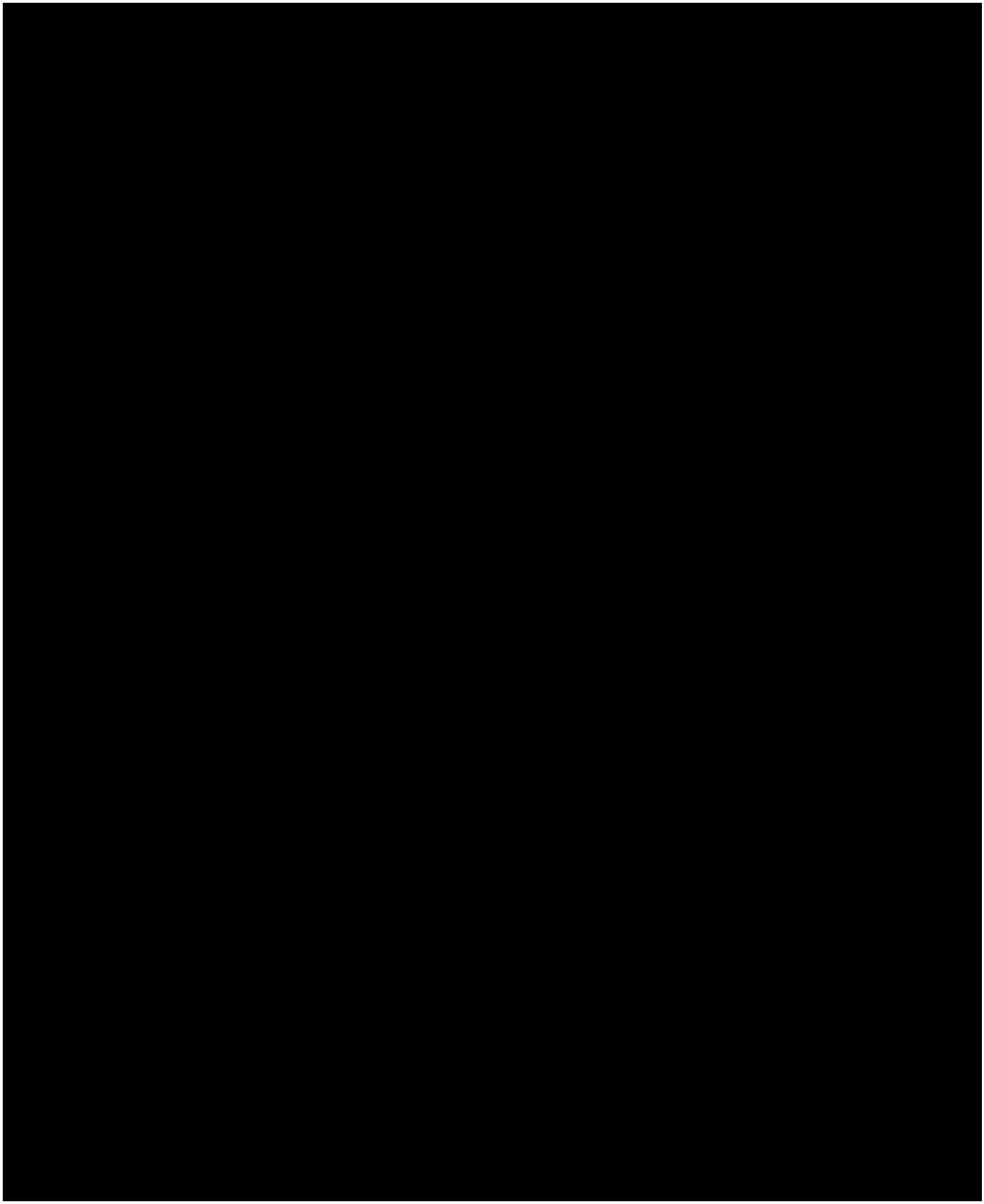

11.9 Update Schedule

Milestone will provide updates on an annual basis to the EPA UIC Director if there are any changes to the Financial Assurance portion of the permit. Milestone will adjust the Financial Assurance within 60 days after changes approved by the Director. Milestone will maintain financial instruments during the review period. If permit sections or cost estimates change regarding area of review and corrective action plan, injection well plugging plan, post-injection site care and or site closure plans, the associated FA section and costs will be updated. Changes with written estimates will be submitted to the UIC Director within 60 days.

If there are no changes, Milestone will submit a letter stating that no changes are needed at this time, except for inflation adjustments.

11.9.1 Inflation Adjustments

Milestone will automatically adjust the FA instruments for inflation based on CPI tables for the preceding calendar year. This adjustment will be included in the annual update.

11.10 Duration

Milestone will maintain adequate FA instruments and renew instruments for the entire duration of the geologic sequestration project until the EPA UIC Director receives and approves a completed post-injection site care and site closure plan and approves the site closure plan.

Milestone may request release of FA obligations if it has completed a phase of the geologic sequestration project for which the financial instrument was required and has fulfilled all its financial obligations as determined by the UIC Director.

11.11 Third Party Instruments

When using a third-party instrument to demonstrate financial responsibility, Milestone will provide a proof that the third-party providers either have passed financial strength requirements based on credit ratings; or has met a minimum rating, minimum capitalization, and ability to pass the bond rating when applicable.

11.12 Increases or Decreases

The EPA UIC Director must approve any decrease or increase to the initial cost estimate. During the active life of the geologic sequestration project, Milestone will revise the cost estimate no later than 60 days after the Director has approved the request to modify the area of review and corrective action plan, the injection well plugging plan, the post-injection site care and site closure plan, and the emergency and response plan, if the change in the plan increases the cost. If the change to the plans decreases the cost, any withdrawal of funds must be approved by the Director. Any decrease to the value of the financial assurance instrument must first be approved by the Director. The revised cost estimate will be adjusted for inflation (**Section 11.9.1**).

Whenever the current cost estimate increases to an amount greater than the face amount of a financial instrument currently in use, Milestone, within 60 days after the increase, will either cause the face amount to be increased to an amount at least equal to the current cost estimate and submit evidence of such increase to the Director, or obtain other financial responsibility instruments to cover the increase. Whenever the current cost estimate decreases, the face amount of the financial assurance instrument may be reduced to the amount of the current cost estimate only after the owner or operator has received written approval from the Director.

11.13 Adverse Financial Conditions

Milestone will notify the EPA UIC Director by certified mail of adverse financial conditions such as bankruptcy that may affect the ability to carry out injection well plugging and post-injection site care and site closure.

Milestone will also notify the EPA UIC Director of any third-party financial instrument providers that are going through bankruptcy by certified mail. Milestone will notify the Director by certified mail of the commencement of a voluntary or involuntary proceeding under Title 11 (Bankruptcy), U.S. Code, naming Milestone as debtor, within 10 days after commencement of the proceeding.

11.14 Summary

[redacted]

[redacted]

Milestone will comply with all state and federal regulations for financial responsibility regarding the geologic sequestration project.