# CLASS VI PRE-OPERATION NARRATIVE 40 CFR 146.82(c)

**INSERT PROJECT NAME**

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| **INSTRUCTIONS**  To reduce the potential for redundancy and to organize pre-operational information in a manner that facilitates efficient review by the permitting authority, EPA recommends that Class VI owners or operators submit both:   1. A narrative describing updated site characterization information, synthesizing the results of pre-operational logging and testing, and other general project information (compiled into a single file and submitted using the Project Information Tracking module of the GSDT). 2. Specific, detailed information required by certain Class VI Rule provisions (submitted using other GSDT modules, which are tailored to the applicable Class VI Rule requirements).   This template provides a suggested outline for the narrative component of the pre-operational submissions. Permittees are not required to use this template. This document does not substitute for promulgated provisions or regulations, nor is it a regulation itself, and it does not impose legally-binding requirements on the U.S. Environmental Protection Agency (EPA), states, or the regulated community.  Note that references to EPA’s Class VI Rule in the code of federal regulations (CFR) are provided in this template. States with Class VI primacy have requirements that are at least as stringent as EPA’s. If your Class VI well is in a primacy state, consult your permitting authority about any additional requirements for what must be included in this narrative.  In this template, instructions or suggestions appear in ***blue text***. These are provided to assist with site- and project-specific narrative development. These are recommendations and are not required elements of the federal Class VI Rule.  Please delete the ***blue text*** and replace the yellow highlighted text before submitting your document. Similarly, please adjust the example text and tables throughout as necessary (e.g., by adding or removing rows or columns). Appropriate maps, figures, references, etc. should also be included to support the text. If desired, appendices, attachments, or other supplemental information associated with the narrative that do not fit into one of the specific GSDT modules can be uploaded directly to the Project Information Tracking module using the module field designated for “any other information requested by the UIC Program Director.”  For more information, see EPA’s Class VI guidance documents at <https://www.epa.gov/uic/class-vi-guidance-documents>.  This narrative file does not need to repeat any information submitted with the GSDT, but it should clearly reference these other submissions to ensure that all Class VI requirements are met. EPA recommends that you review the GSDT modules and/or user guides for each topic area below before developing your narrative, to avoid duplicating efforts or information.  After completing the narrative, upload it to the Project Information Tracking GSDT module, on the Updated Information tab. EPA recommends converting to PDF prior to uploading. |

**Project Background Information**

*[In this section, please update proposed project information as necessary to reflect information collected during pre-operational testing and logging. Specifically, please indicate if changes are made to the project timeframe, proposed injection mass/volume, CO2 source, or CO2 composition.*

*Key project and facility details can be updated directly in the Project Information Tracking module of the GSDT.]*

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| **GSDT Submission - Project Background and Contact Information** |
| ***GSDT Module:*** Project Information Tracking  ***Tab(s):***General Information tab; Facility Information and Owner/Operator Information tab  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Required project and facility details ***[40 CFR 146.82(a)(1)]***  NO UPDATES NECESSARY |

**Final AoR Model and Delineation [40 CFR 146.82(c)(1)]**

*[Please provide a short description of the information and files submitted to the GSDT related to the final AoR model and delineation that incorporates the results of pre-operational testing and logging, with references to the rule requirements those submissions satisfy. If there is additional information that could not be submitted using the forms in the GSDT, it can be included here.*

*Recommended considerations include:*

* *How does the final AoR delineation based on site-specific well data compare to the original modeling effort?*
* *How were pre-operational testing and logging results incorporated into the final AoR model? What, if any, data from the original permit application were used in the updated AoR model?*
* *What might be the cause(s) of differences between the model results?*
* *Do the results of the final AoR modeling effort indicate that changes to operational procedures (e.g., injection rate, injection pressure) are necessary?*
* *Does the updated AoR include any additional wells/artificial penetrations not included in the tabulation of wells submitted to meet the requirements at 40 CFR 146.82(a)(4)?]*

*[Associated figures may include:*

* *Map showing the maximum vertical and lateral extent of the plume and/or pressure front.*
* *Map showing the delineated AoR with the location of the proposed injection well and any monitoring wells.*

*Upload files related to the final AoR modeling and delineation effort and provide detailed modeling/well tabulation information using the AoR and Corrective Action module.]*

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| **AoR and Corrective Action GSDT Submissions** |
| ***GSDT Module:*** AoR and Corrective Action  ***Tab(s):***All applicable tabs  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Final computational modeling details ***[40 CFR 146.82(c)(1) and 146.84(c)]***  Tabulation of all wells within final AoR that penetrate confining zone ***[40 CFR 146.82(a)(4)]*** |

**Site Characterization Updates [40 CFR 146.82(c)(2)]**

*[In this section, please provide a narrative description of any relevant updates to information on the geologic structure and hydrogeologic properties of the proposed storage site, based on the results of site-specific pre-operational testing and logging. This description should be supplemented by site-specific figures and graphics based on pre-operational testing results. Please frame this discussion to match the sections in the 146.82(a) narrative submitted with the original permit application.*

*These sections are provided below for reference, along with the corresponding rule citations.]*

*[Recommended considerations include:*

* *How well do site-specific pre-operational testing and logging results compare to the data used in the original permit application? What are the differences between the original and updated site characterization?*
* *What specific testing and logging results led to updates in the site characterization?*
* *How well do pre-operational testing and logging results compare to literature and regional geologic and hydrogeologic data? What are the possible reasons for the differences?*
* *How do the data collected as part of pre-operational testing and logging inform a comprehensive understanding of site-specific conditions? Are any additional testing and monitoring methods required to gain a greater understanding?]*

*[Associated figures may include:*

* *Site-specific stratigraphic columns.*
* *Figures showing the location and extent of identified faults or major fractures.]*

***Regional Geology, Hydrogeology, and Local Structural Geology [40 CFR 146.82(a)(3)(vi)]***

*[See recommendations above.]*

***Maps and Cross Sections of the AoR [40 CFR 146.82(a)(2), 146.82(a)(3)(i)]***

***[Note: Updated maps and cross sections showing the final AoR are required per the Class VI Rule.***

*See recommendations above.]*

***Faults and Fractures [40 CFR 146.82(a)(3)(ii)]***

*[See recommendations above.]*

***Injection and Confining Zone Details [40 CFR 146.82(a)(3)(iii)]***

*[See recommendations above.]*

***Geomechanical and Petrophysical Information [40 CFR 146.82(a)(3)(iv)]***

*[See recommendations above.]*

***Seismic History [40 CFR 146.82(a)(3)(v)]***

*[See recommendations above.]*

***Hydrologic and Hydrogeologic Information [40 CFR 146.82(a)(3)(vi), 146.82(a)(5)]***

*[See recommendations above.]*

***Geochemistry [40 CFR 146.82(a)(6)]***

*[See recommendations above.]*

***Other Information (Including Surface Air and/or Soil Gas Data, if Applicable)***

*[See recommendations above.]*

***Site Suitability [40 CFR 146.83]***

*[See recommendations above.]*

**Compatibility of the CO2 Stream [40 CFR 146.82(c)(3)]**

*[In this section, please provide a narrative description of the compatibility of the CO2 stream with injection zone fluids, minerals in the injection and confining zones, and well construction materials. This should be based on the results of the pre-operational testing program.*

***Note: For additional guidance on evaluating the compatibility of the CO2 stream with subsurface fluids, solids, and well materials, please see Section 3.3. of EPA’s UIC Program Class VI Site Characterization Guidance.]***

*[Recommended considerations include:*

* *What pre-operational testing and logging results were used to determine the compatibility of the CO2 stream with formation fluids, solids, and well materials? Are there any limitations in the data or major uncertainties that remain after pre-operational testing?*
* *Were any geochemical models or laboratory experiments used to determine compatibility? What models, if any, were used, and what were the results? If laboratory experiments were conducted, from what depths and formations were relevant core samples collected? Note: EPA strongly recommends using geochemical models to assess the potential impacts of CO2 injection on subsurface materials.*
* *If models or laboratory experiments were not used, what literature and site-specific information are used to evaluate the interactions between the CO2 stream and subsurface materials? What literature-derived reaction rates were investigated? How was site-specific information incorporated into this assessment? Note: The permit applicant may provide a detailed discussion of geochemical characteristics as the evaluation of CO2 stream compatibility in limited circumstances, and with the agreement of the UIC Program Director.*
* *Will subsurface interactions between injectate, fluids, and/or solids lead to mineral precipitation or dissolution? Is this expected to affect permeability, porosity, or injectivity?*
* *If permeability, porosity, or injectivity are expected to be affected, how was this information incorporated into the final AoR model and delineation?*
* *Will the introduction of CO2 lead to geochemical changes that might cause the mobilization of trace elements (e.g., lead or arsenic) from formation minerals?*
* *Is there evidence that the interactions between the injectate and well cement cause deterioration of the cement and a loss of mechanical integrity?*
* *Based on the results of formation testing, are any changes to the composition of the proposed CO2 stream or the Testing and Monitoring Plan necessary?]*

**Pre-Operational Logging and Testing [40 CFR 146.82(c)(4),(7) and 146.87]**

*[In this section, please provide a narrative summary of the results of the formation testing program required by 40 CFR 146.82(a)(8). The summary should synthesize the results, demonstrate a comprehensive understanding of site-specific geology and hydrology, and reference Class VI rule requirements at 40 CFR 146.87 as applicable. Actual pre-operational testing and logging data should be submitted directly to the GSDT’s Pre-Operational Testing module. Please provide a description of the files uploaded to the GSDT to meet the requirements of 40 CFR 146.87.*

***Note: The sections below follow the structure of the UIC Program Class VI Site Characterization Guidance. Please see that document for more detailed information on methods for analyzing and reporting the results of pre-operational testing.]***

*[Recommended considerations include:*

* *How do the pre-operational testing and logging results demonstrate that the injection and confining zones are suitable for receiving and containing injected fluids?*
* *How well do the results of pre-operational testing compare to the information submitted with the initial permit application?*
* *If the proposed well is being transitioned from a different class of injection well, what testing, monitoring, and logging data were collected previously?]*

***Well Logging [40 CFR 146.87(a)(2) and (3)]***

*[Recommended considerations include:*

* *What well logs were run? Why were these logs selected? When were the logs run?*
* *Are the data collected from well logs consistent with available site characterization data in the permit application? Do the data support other assessments of stratigraphy and formation properties?*
* *Were logs run in multiple wells to evaluate lateral continuity?*
* *If the data collected form well logs differs significantly from other sources of data, what implications are there for operational procedures, AoR delineation, and the project plan?]*

*[Associated figures may include:*

* *Wireline log results for critical intervals (injection and confining zones).*
* *Correlation plots if multiple wells were logged.]*

***Core Analyses [40 CFR 146.87(b)]***

*[Recommended considerations include:*

* *Were the core collected from the injection well or a stratigraphic well? If they were collected from a stratigraphic well, what data supports the assumption that the cores will represent the injection well?*
* *What type(s) of cores were collected? What depths were the cores collected from? How many cores were collected from the confining and injection zones?*
* *How does the collected core catalog sufficiently support stratigraphic correlation, interpretation of depositional environments, and wireline log calibration?*
* *What laboratory analyses were conducted on the cores?*
* *Were any major anomalies identified in the cores?]*

*[Associated figures may include:*

* *Photomicrographs of thin sections in the injection and confining zones.*
* *If cores were collected from a stratigraphic well, correlation plots to the injection well.]*

***Characterization of Injection Formation Fluid Properties [40 CFR 146.87(b) and (c)]***

*[Recommended considerations include:*

* *At what depths were formation fluids sampled? How many samples were collected?*
* *When during well construction and drilling was fluid collected?*
* *What types of sampling equipment was used? What field procedures were followed?*
* *Are the collected fluids representative of the injection formation?*
* *How will fluid analysis support a determination of the compatibility of the injectate with the formation fluids?*
* *Was there any anomalous data?]*

***Fracture Pressure of the Injection and Confining Zones [40 CFR 146.87(d)(1)]***

*[Recommended considerations include:*

* *What method(s) was used to determine or calculate fracture pressure? Was a step-rate test conducted?*
* *What test conditions were obtained? Was a constant injection rate used? Where were pressure gauges located? If gauges were located at the surface, what correction factors were used?*
* *Are the results of fracture pressure calculations consistent with expected fracture pressures identified in the initial permit application?*
* *How does the calculated fracture pressure compare with data from core tests or other wells in the region?*
* *Are any changes to the proposed maximum injection pressure necessary given the results of the pre-operational fracture pressure determination?]*

***Hydrogeologic Testing [40 CFR 146.87(e)(1)-(3)]***

*[Recommended considerations include:*

* *How do the results of hydrogeologic testing verify porosity, permeability, and connectivity data collected from well and core logs?*
* *Is there any evidence of a local reduction in permeability due to the well construction process (skin factor)? If so, is this expected to impact injection operations?*
* *Do the results of hydrogeologic testing suggest that a stimulation program is necessary to increase injectivity?]*

*[Associated figures may include:*

* *Semi-log plots of fall-off and injectivity/pump test results.]*

*Pressure Fall-Off Tests*

*[Recommended considerations include:*

* *What injection and shut-in periods were used for the fall-off test? Why were these periods selected?*
* *Was flow rate constant through the injection period? Was the test conducted over a sufficient period of time?*
* *Are fall-off test data used to verify computational model results?*
* *What data or information demonstrate the validity of the fall-off test results?*
* *Were any non-linearities identified in the fall-off test results? If so, what may be the cause? What other pre-operational testing data can help explain the non-linearities?*
* *How consistent are the results of the fall-off test with other site-specific data?]*

*Injectivity and Pump Tests*

*[Recommended considerations include:*

* *What type of test was conducted (injectivity or pump)? Why was this test selected for this particular site?*
* *What calibration procedures were used?*
* *What information demonstrates that the test results are valid? What data was used to verify the results?]*

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| **Pre-Operational Logging and Testing GSDT Submissions** |
| ***GSDT Module:*** Pre-Operational Testing  ***Tab(s):***All tabs  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Logging and testing results ***[40 CFR 146.82(c)(7) and 146.87]*** |

**Final Injection Well Construction Procedures [40 CFR 146.82(c)(5)]**

*[Please provide a brief description of the final injection well construction procedures to meet the requirement at 40 CFR 146.82(c)(5), with specific details to demonstrate an understanding of site-specific conditions based on the results of pre-operational testing and logging. Also include or attach any other information necessary to demonstrate/establish compliance with the requirements at 40 CFR 146.86.*

***Note: Schematics or other graphics showing the surface and subsurface well construction details will have been submitted to meet the requirements at 40 CFR 146.82(a)(11). If no changes to the well construction are required, please provide a brief description that justifies the continued applicability of the original schematics and graphics. Otherwise, please submit updated schematics.]***

*Casing and Cementing*

*[Please provide a brief narrative description of changes, if any, made to the casing and cement prior to and during pre-operational testing, and update the corresponding table from the 40 CFR 146.82(a) narrative.]*

**Table 1.** **Casing details.**

| **Casing String** | **Casing Depth** **Range and Units** | **Borehole Diameter and Units** | **Wall Thickness** **and Units** | **External Diameter and Units** | **Casing Material** (e.g., weight/‌grade/‌connection) | **String Weight and Units** |
| --- | --- | --- | --- | --- | --- | --- |
| Conductor |  |  |  |  |  |  |
| Surface |  |  |  |  |  |  |
| Long String |  |  |  |  |  |  |
| *Insert other casing types as applicable* |  |  |  |  |  |  |

*Tubing and Packer*

*[Please provide any updates related to the tubing and packer materials in the corresponding table from the 40 CFR 146.82(a) narrative.]*

**Table 2. Tubing and packer details.**

| **Material** | **Setting Depth Range and Units** | **Tensile Strength and Units** | **Burst Strength and Units** | **Collapse Strength and Units** | **Material** (e.g., weight/‌grade/‌connection) |
| --- | --- | --- | --- | --- | --- |
| Tubing |  |  |  |  |  |
| *Insert additional materials as applicable* |  |  |  |  |  |

**Corrective Action Status [40 CFR 146.82(c)(6)]**

*[Please describe the status of corrective action for wells within the final AoR, to meet the requirements of 40 CFR 146.82(c)(6). This description must indicate the number, type, and location of all plugs used to perform corrective action. Relevant documentation such as well plugging records should be uploaded directly to the GSDT.]*

*[Recommended considerations include:*

* *Was any corrective action required on wells within the AoR? Was any remedial cementing conducted?*
* *If a phased corrective action plan is used, what is the current stage of that process?]*

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| **Corrective Action GSDT Submissions** |
| ***GSDT Module:*** AoR and Corrective Action module  ***Tab(s):***Corrective Action tab  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Corrective action documentation ***[40 CFR 146.82(c)(6)]***  NO UPDATES NECESSARY |

**Demonstration of Mechanical Integrity [40 CFR 146.82(c)(8) and 146.89]**

*[Please provide a brief description of the results of mechanical integrity testing on the proposed injection well to meet the requirements of 40 CFR 146.82(c)(8). This description should support a demonstration of mechanical integrity to meet the requirements at 40 CFR 146.89.*

*Recommended considerations include:*

* *What approved methods were used to demonstrate mechanical integrity?*
* *What are the results of the mechanical integrity test? Is there evidence of leaks or fluid movement in the wellbore?*
* *Do the results of pre-operational mechanical integrity testing indicate that changes need to be made to the mechanical integrity evaluations as specified in the testing and monitoring plan?]*

**Plan Updates [40 CFR 146.82(c)(9)]**

*[Please provide a short description of any plan updates that are necessary as a result of pre-operational testing results. If no updates are required, please provide a brief narrative demonstrating that changes are not necessary. If there is additional information that could not be submitted using the forms in the GSDT it can be included here.*

***Note: Any updated plan must be resubmitted to the GSDT as described below. Be sure to include a revision number for any updated plan when submitting it to the GSDT.]***

***AoR and Corrective Action***

*[Upload your updated AoR and Corrective Action Plan using the AoR and Corrective Action module.]*

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| **AoR and Corrective Action GSDT Submissions** |
| ***GSDT Module:*** AoR and Corrective Action  ***Tab(s):***All applicable tabs  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Updated AoR and Corrective Action Plan ***[40 CFR 146.82(c)(9) and 146.84(b)]***  NO UPDATES NECESSARY |

***Testing and Monitoring***

*[Upload your updated Testing and Monitoring Plan using the Project Plan Submissions module.]*

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| **Testing and Monitoring GSDT Submissions** |
| ***GSDT Module:*** Project Plan Submissions  ***Tab(s):***Testing and Monitoring tab  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Updated Testing and Monitoring Plan ***[40 CFR 146.82(c)(9) and 146.90]***  NO UPDATES NECESSARY |

***Injection Well Plugging***

*[Upload your updated Injection Well Plugging Plan using the Project Plan Submission module.]*

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| **Injection Well Plugging GSDT Submissions** |
| ***GSDT Module:*** Project Plan Submissions  ***Tab(s):***Injection Well Plugging tab  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Updated Injection Well Plugging Plan ***[40 CFR 146.82(c)(9) and 146.90]***  NO UPDATES NECESSARY |

***Post-Injection Site Care (PISC) and Site Closure***

*[If an alternative PISC timeframe is proposed, please provide a brief description of the pre-operational testing results that support the proposed alternative timeframe, or provide updates to the existing alternative timeframe demonstration as needed.*

*Upload your updated PISC and Site Closure Plan to the Project Plan Submissions module. If applicable, upload your alternative PISC timeframe demonstration to the Alternative PISC Timeframe Demonstration module.]*

| **PISC and Site Closure GSDT Submissions** |
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| ***GSDT Module:*** Project Plan Submissions  ***Tab(s):***PISC and Site Closure tab  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Updated PISC and Site Closure Plan ***[40 CFR 146.82(c)(9) and 146.90]***  NO UPDATES NECESSARY |
| ***GSDT Module:*** Alternative PISC Timeframe Demonstration  ***Tab(s):***All tabs (only if an alternative PISC timeframe is requested)  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Updated alternative PISC timeframe demonstration ***[40 CFR 146.82(c)(9) and 146.90]***  NO UPDATES NECESSARY |

***Emergency and Remedial Response***

*[Upload your updated Emergency and Remedial Response Plan to the Project Plan Submissions module.]*

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| **Emergency and Remedial Response GSDT Submissions** |
| ***GSDT Module:*** Project Plan Submissions  ***Tab(s):*** Emergency and Remedial Response tab  Please use the checkbox(es) to verify the following information was submitted to the GSDT:  Updated Emergency and Remedial Response Plan ***[40 CFR 146.82(c)(9) and 146.90]***  NO UPDATES NECESSARY |

**Well Operation [40 CFR 146.88]**

*[Please describe updates to the well operational procedures and/or proposed carbon dioxide stream, if applicable, that are necessary based on the results of pre-operational testing. If no updates are required, it will be assumed that the operational information provided in the 40 CFR 146.82(a) narrative still applies. Changes to well operational procedures or the carbon dioxide stream should be reflected in the final AoR model and delineation described earlier in this narrative.*

*If updates are necessary, please update tables (such as the one below), and/or figures that were submitted to fulfill the operating data requirements for the permit application, listed at 40 CFR 146.82(a)(7) and (10). Also include or attach any other information necessary to demonstrate/establish compliance with the requirements at 40 CFR 146.88.]*

**Table 3. Proposed operational procedures.**

| **Parameters/Conditions** | **Original Permit Value** | **Updated Value** | **Unit** |
| --- | --- | --- | --- |
| Maximum Injection Pressure |  |  |  |
| Surface |  |  |  |
| Downhole |  |  |  |
| Average Injection Pressure |  |  |  |
| Surface |  |  |  |
| Downhole |  |  |  |
| Maximum Injection Rate |  |  |  |
| Average Injection Rate |  |  |  |
| Maximum Injection Volume and/or Mass |  |  |  |
| Average Injection Volume and/or Mass |  |  |  |
| Annulus Pressure |  |  |  |
| Annulus Pressure/Tubing Differential |  |  |  |

## **Optional Additional Project Information [40 CFR 144.4]**

*[The following is a list of Federal laws that may apply prior to the issuance of UIC permits. When any of these laws are applicable, EPA must ensure that they are followed. The optional additional information requested below will assist EPA in its analyses to satisfy these laws. If this information was provided in the initial permit application narrative and has changed based on the results of pre-operational testing (e.g., based on a change in the delineated AoR), please update as appropriate.*

* *The Wild and Scenic Rivers Act, 16 U.S.C. 1273 et seq. Identify any national wild and scenic river that may be impacted by the activities associated with the proposed project.*
* *The National Historic Preservation Act of 1966, 16 U.S.C. 470 et seq. Identify properties listed or eligible for listing in the National Register of Historic Places that may be affected by the activities associated with the proposed project. If previous historic and cultural resource survey(s) have been conducted, provide the results of the survey(s).*
* *The Endangered Species Act, 16 U.S.C. 1531 et seq. Identify any endangered or threatened species that may be affected by the activities associated with the proposed project. If a previous endangered or threatened species survey has been conducted, provide the results of the survey.*
* *The Coastal Zone Management Act, 16 U.S.C. 1451 et seq. Identify any coastal zones that may be affected by the activities associated with the proposed project.]*

**Other Information**

*[Provide any other information requested by the UIC Program Director, or any information that is not specifically requested/required but may be useful to support your submission, in this section to fulfill the requirement at 40 CFR 146.82(c)(10). You can also provide information in a separate file or files using the designated field on the Updated Information tab of the Project Information Tracking module.]*