APPENDIX D

PRE-OPERATIONAL TESTING PROGRAM
40 CFR 146.82(A)(8); 146.87

West Bay Storage Facility

1 FACILITY INFORMATION

Facility Name: West Bay Storage Facility

Facility Contact: [redacted]
501 Westlake Park Blvd., Houston, Texas 77079
[redacted]

Well Location: Galveston County, TX

[redacted]

2 INTRODUCTION

The Pre-Operational Testing Program describes the activities that BP Carbon Solutions LLC (BP) will perform in accordance with 40 Code of Federal Regulations (CFR) 146.82(a)(8) and 146.87 for the West Bay Storage Facility (Site). The testing activities at the Site described in this section are restricted to the pre-injection phase. The Testing and Monitoring Plan (**Appendix E**), as referenced herein, contains additional detail regarding testing and monitoring activities during the pre-injection phase. Testing and monitoring activities during the injection and post-injection phases are described in the Testing and Monitoring Plan (**Appendix E**) as well.

The pre-operational formation testing program will be implemented at each injection well to verify the chemical and physical characteristics of the injection zone and confining zone, in compliance with 40 CFR 146.87. The data gathered in the pre-operational testing phase will be used to guide the testing at each injection well and in-zone monitoring well during the injection and post-injection phases.

The pre-operational data will also be used to determine and verify the depth, thickness, mineralogy, lithology, porosity, permeability, and geochemical information of the injection zone, confining zone, and other related geologic formations, and the salinity of any formation fluids. The formation characteristics will be used to establish a baseline against which all future measurements may be compared.

The results of the testing activities will be documented and analyzed in a "Pre-Operational Testing Narrative" report prepared by a knowledgeable log analyst and submitted to the Underground Injection Control (UIC) Program Director after the well drilling and testing activities have been completed and before the start of carbon dioxide (CO_2) injection operations.

After completing the pre-operational characterization and testing, the testing boreholes will be completed as injection wells. Mechanical integrity tests will verify well construction and integrity.

3 PRE-INJECTION TESTING PLAN – INJECTION WELLS

The following tests and logs will be conducted during drilling, casing installation, and after casing installation of the injection wells in accordance with the testing required under 40 CFR 146.87(a), (b), (c), and (d).

3.1 Deviation Checks [40 CFR 146.87(a)(1)]

Deviation measurements will be conducted on every stand of drill pipe (approximately 90 feet (ft)) during construction of the injection well. Additionally, surveys will be completed for wellbore deviation if a pilot hole is to be used prior to reaming to a larger diameter and at final well total depth (TD). These surveys will include depth, inclination, and azimuth.

3.2 Tests and Logs During Drilling [40 CFR 146.87(a)]

During drilling of the surface casing hole section, gamma ray (GR), resistivity, and density log data will be collected to TD to allow for formation evaluation and base of underground source of drinking water (USDW) determination and assessment. Additionally, measurement while drilling (MWD), mud logs, and cuttings data will be collected during drilling.

During drilling of the long-string hole sections across the confining and injection zones, BP will acquire GR, resistivity, density, neutron, sonic, and fracture finding logs. Additionally, MWD, mud logs, and cuttings data will be collected during drilling of these sections.

Table 1 below summarizes the types of drilling data acquisition planned for each hole section in the injection wells.

3.2.1 Tests and Logs Before, During, and After Casing Installation [40 CFR 146.87(a)(2)-(3)]

Resistivity, spontaneous potential, and caliper logs will be completed before the surface casing is installed and upon installation. Cement bond logs, variable density logs, and temperature logs will be completed for the injection well after the intermediate surface casing has been cemented in place. Before the long-string casing is installed and upon installation, resistivity, spontaneous potential, porosity, caliper, gamma ray, and fracture finder logs will be completed. Cement bond logs, variable density logs, and temperature logs will be completed for the injection well after the long-string casing has been cemented in place. The logs will be collected and analyzed as baseline information to compare with the injection and post-injection phase monitoring outlined in the Quality Assurance and Surveillance Plan (QASP) (**Appendix E**).

Additionally, any necessary baseline mechanical integrity testing will be performed to demonstrate internal and external mechanical integrity of the casing and cement of the injection well. These logs will provide a baseline measurement for the Site that future injection measurements will be measured against. Further details on specific tests and logs can be found in the Testing and Monitoring Plan (**Appendix E**).

3.3 Demonstration of Mechanical Integrity [40 CFR 146.87(a)(4)]

Table 2 below is a summary of the Mechanical Integrity Testing (MIT) and pressure fall-off tests to be performed prior to injection as required under 40 CFR 146.87(a)(4). The MIT will be performed during and at the end of well construction to demonstrate internal and external mechanical integrity of the well. Full testing procedures can be found in the Testing and Monitoring Plan (**Appendix E**).

Table 2. Pre-Operational Testing Schedule

Class VI Rule Citation	Rule Description	Test Description	Program Period
40 CFR 146.89(c)(2) and **146.87(a)(4)**	MIT – External	Temperature Log Using Wireline	Prior to operation
40 CFR 146.89(c)(2) and **146.87(a)(4)**	MIT – External	Noise Log	Prior to operation
40 CFR 146.89(c)(2) and **146.87(a)(4**	MIT – External	Oxygen Activation	Prior to operation
40 CFR 146.87(e)(1)	Reservoir	Pressure Fall-Off Test Procedure	Prior to operation
40 CFR 146.87(a)(4)	MIT – Internal	Annulus Pressure Test	Prior to operation
40 CFR 146.87(a)(4)	MIT – External	Casing Inspection Log	Prior to operation
40 CFR 146.87(e)(2) and **(3)**	Reservoir	Injectivity or Pump Test	Prior to operation

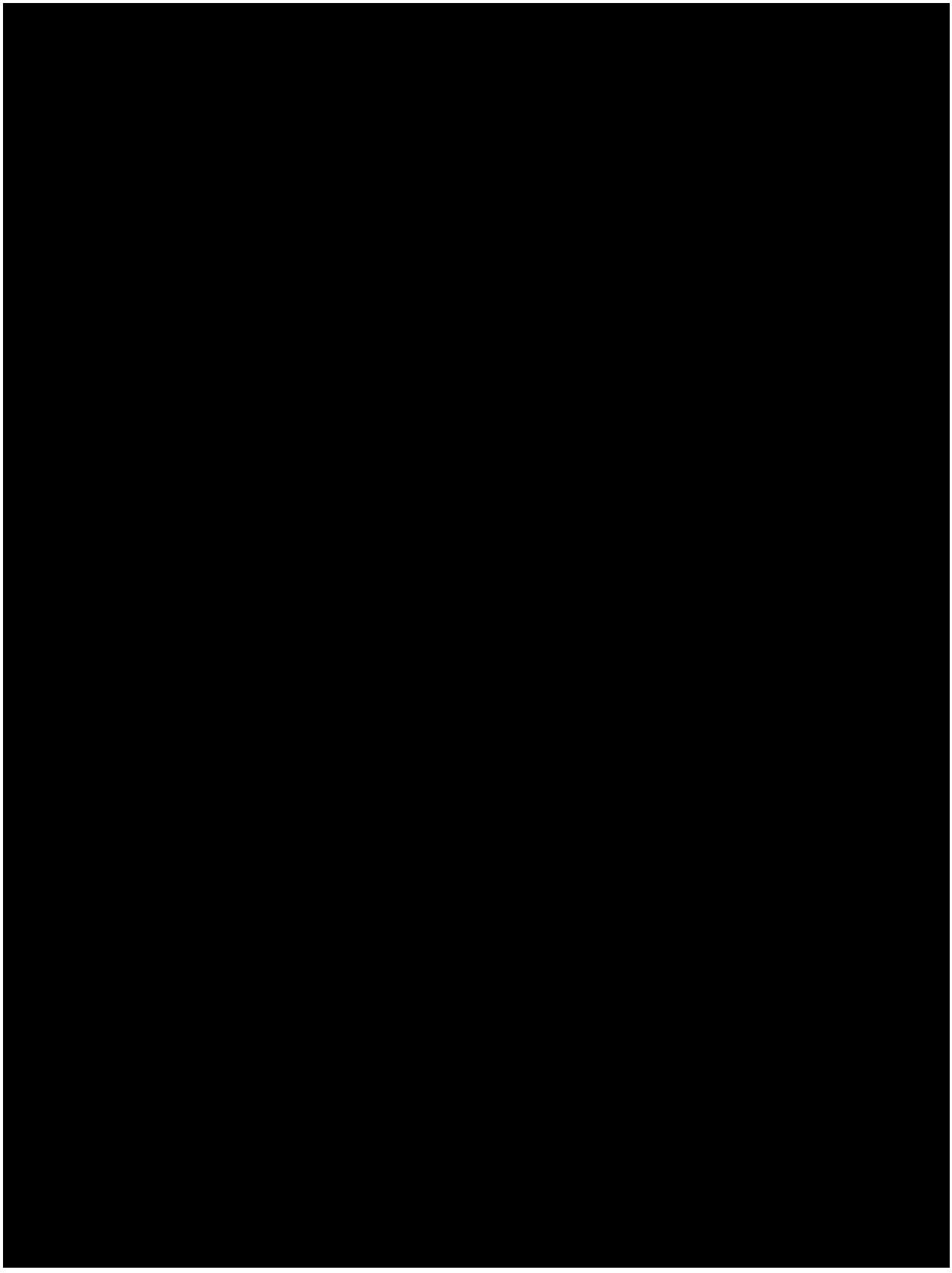
BP will notify the UIC Program Director at least 30 days prior to conducting the first logging and testing and will provide a schedule and detailed description of the testing and logging procedures, in accordance with 40 CFR 146.87(f). BP will submit any changes to the schedule 30 days prior to the next scheduled test. Notice and the opportunity to witness these tests/logs will be provided to the UIC Program Director at least 48 hours in advance of a given test/log.

3.4 Core from the Injection and Confining Zones [40 CFR 146.87(b)]

Extensive whole-core and rotary sidewall core plugs were acquired across the injection and confining zones in the appraisal well Nonagon #1. Over 800 ft of whole core were acquired across the confining zone and injection zone. Additionally, over 100 rotary and percussion sidewall cores were acquired in a mixture of lithologies over a 3,200 ft interval ranging from the top of the confining zone to below the injection zone, which supplements and duplicates the whole core samples. The data obtained from these cores will be necessary to inform and assure our ability to safely inject and store CO_2 into the prospective formations within the Area of Review (AoR) and will be incorporated into the AoR model for future updates to the overall

AoR plan. [redacted] However, if BP becomes aware of any significant differences between the geology at the appraisal well and any of the injection wells, BP will evaluate acquiring additional core data. The AoR and planned locations of the injection and monitoring wells are shown on **Figure 1**.

As required by 40 CFR 146.87(b), BP will submit to the UIC Program Director a detailed report prepared by a log analyst that includes well log analyses, core analyses, and formation fluid sample information.



3.5 Annulus Pressure Test Procedures for Injection Wells

Following each injection well's completion, which includes the installation of tubing, packer, and annular fluid, the internal mechanical integrity of each well will be tested by conducting an annular pressure test (Standard Annulus Pressure Test (SAPT)). The SAPT is a short-term test where the fluid in the annular space between the tubing and casing is pressurized, the well is shut-in, and the pressure of the annular fluid is monitored for leak-off.

3.6 Pressure Fall-Off Test for Hydrogeologic Characteristics of the Injection Zone [40 CFR 146.87(e)]

Baseline pressure fall-off tests and injectivity tests will be conducted as described in the Testing and Monitoring Plan (**Appendix E**). Each test will be conducted after well completion but prior to operation of the well. The objective of this testing is to establish the baseline near-wellbore performance to be able to periodically monitor for changes that would impact injectivity or cause injection pressures to increase. [redacted]

4 PRE-INJECTION TESTING PLAN – DEEP (IN-ZONE) MONITORING WELL

At the time of the submission, pre-injection testing for the deep (in-zone) monitoring well is not a requirement. However, if requested by the UIC Program Director, BP will provide a specific plan for the deep (in-zone) monitoring well.

5 RESERVOIR PRESSURE, FRACTURE PRESSURE, AND FORMATION FLUID MEASUREMENTS [40 CFR 146.87(C) AND (D)]

The reservoir pressure, fluid temperature, pH, conductivity, and static fluid levels of the injection zone will be measured and recorded during the construction of the injection wells. The formation fluid samples collected from the injection zone will be completed using a bottom-hole sampler or swabbing the well. The samples will be collected, transported, and analyzed in accordance with the parameters outlined in the QASP (**Appendix E**). The samples will be analyzed for salinity, pH, and conductivity.

Additional parameters will be utilized to identify specific physical and chemical characteristics of the fluids and injection zone. Logs and core data collected in the original appraisal well, Nonagon #1, form the initial basis of fracture pressure and other physical/chemical characteristics of the confining and injection zones for the Site. Logs collected in each injection well (**Table 1**) will be used to update the as-drilled conditions of the confining and injection zones as needed.

The reports prepared for each injection well in accordance with 40 CFR 146.87(a) will provide a summary of observations from the logs, core data, and various measurements, including measurements or estimates of fracture pressure and other physical/chemical characteristics of the confining and injection zones and fluids.