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Attachment B: Construction Details

SYD Denova 1

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[40 CFR 146.82(a)]

Revision	Date	Notes	Written By	Approved By
A	6/14/2023	Issued for Approval		R. Keeling
B	10/25/2023	In Progress	R. Mendez	R. Mendez
C	11/22/2023	Issued for Approval	R. Keeling	

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Contents

Figures

Tables

Appendices

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1. Facility Information

[redacted]

2. Introduction

[redacted].
Upon approval of this Class VI permit application, [redacted] The well construction was successfully executed using a casing design, including a conductor, surface, intermediate, and a dedicated injection casing string. Each casing string was designed for both drilling and injection loads expected, and was cemented to the surface to ensure structural integrity and zonal isolation.

Well design was conducted in-house by the [redacted] reservoir engineering and geological teams, and was verified by a third-party independent engineering firm. The design process was informed by the comprehensive subsurface data collected from the Denova 1 stratigraphic well, as discussed in the **Permit Application Narrative, Section 4**, and the static and dynamic modeling of the subsurface as discussed in **Attachment A: Area of Review and Corrective Action Plan, Section 2**.

Key industry standard design factors were employed in the well design, ensuring robustness and safety, and are as follows:

- [redacted]

Further, additional engineering design assumptions were incorporated to provide specific requirements of carbon dioxide (CO_2) injection in a [redacted] and other operational parameters:

- [redacted]
- Compliance with U.S. Environmental Protection Agency (EPA) Underground Injection Control (UIC) Class VI requirements.
- [redacted]
- [redacted]
- [redacted]
- Modeling of varied CO_2 injection rates.
- Calculation of maximum allowable injection pressure (MAIP).

- MAIP calculated for surface and bottomhole pressures (discussed further in Section 4 of this document).

For the designed completion and injection phases, premium connections were utilized for the injection casing, tubing and tubing hanger, and packer. Cementing was a critical aspect of well integrity:

- Each casing section was cemented to the surface, verified through cement bond log (CBL) and volumetric analyses. Injection string cement will be verified upon well completion.

[redacted]

3. Injection Well Construction Details

The [redacted]

Table B-1. Open Hole Diameters and Intervals

[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]

- *Surface Section:* [redacted]
- *Intermediate Section:* [redacted]
- *Injection Section:* [redacted]

3.1 Casing and Cementing

3.1.a Casing Design

The casing design for the [redacted] injection well was meticulously developed, employing advanced casing design software to accurately model the various drilling and injection loads anticipated during operations. This design process was critical to ensure adherence to the stringent requirements of 40 CFR 146.82(a)(12), focusing on well integrity and the protection of USDWs. Table B-2 summarizes the casing strings used in the drilling of Denova 1.

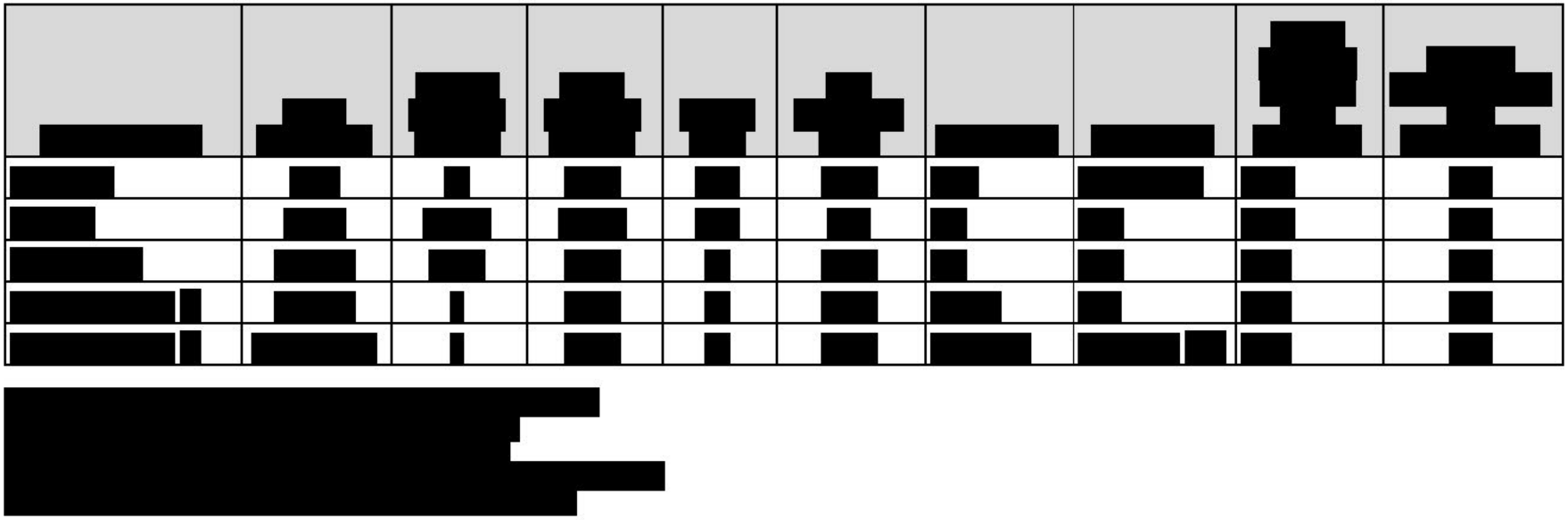
Each casing point was set within competent geological formations. This strategic placement is essential for ensuring the isolation of both shallow and deep USDWs, a key compliance aspect under 40 CFR 146.82(a)(12). The surface and intermediate casing creates effective barriers against potential fluid migration into these sensitive zones.

The downhole conditions, [redacted] were integral to the casing design process. These conditions provided essential inputs for evaluating the mechanical stresses and environmental challenges that the casing strings will encounter, ensuring that the design can withstand these extremes while maintaining structural integrity.

To validate the mechanical integrity of each cemented casing string, post-casing run pressure tests were conducted, followed by comprehensive evaluations using CBL. These tests are crucial to demonstrate the robustness of the casing design and the effectiveness of the cementing process, as per the requirements of 40 CFR 146.82(a)(12), which emphasizes the maintenance of well integrity throughout the well's operational life.

Additionally, specific attention was given to the 7-inch injection string, designed to handle the maximum CO_2 injection volumes. The 7-inch string design process involved modeling both drilling and injection loads, ensuring that it could withstand the unique challenges posed by CO_2 injection operations. In line with the regulatory focus on material suitability and fluid migration prevention, [redacted] was selected for cementing across the planned injection zone. The use of [redacted] in this section underscored the commitment to ensuring long-term well integrity and adherence to the stringent environmental protection standards set forth by EPA under 40 CFR 146.82(a)(12).

Table B-2. Casing Specifications



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3.1.b Cement Design

The cement design for the proposed [redacted] injection well was planned and successfully executed. This design was crucial in fulfilling the requirements of 40 CFR 146.82(a)(12), which mandates stringent measures for well integrity and environmental protection, particularly in the context of Class VI wells used for CO_2 injection and sequestration.

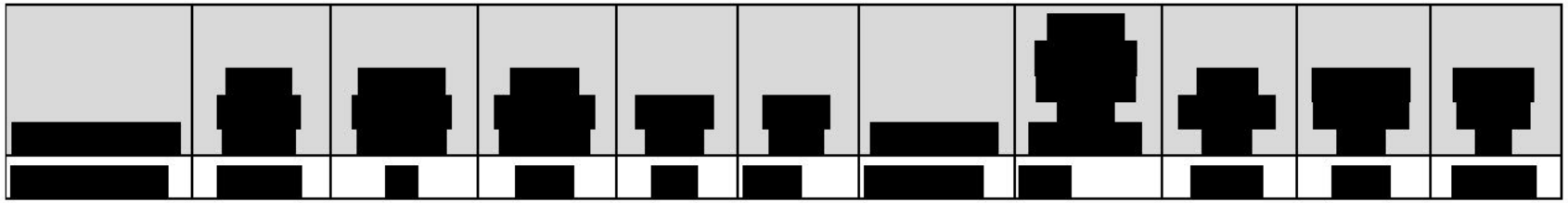
[redacted]

3.2 Tubing and Packer

Proposed tubing and packer specifications are listed in Tables B-3 and B-4. The downhole configuration of the tubing and packer elements is shown in Figure B-2.

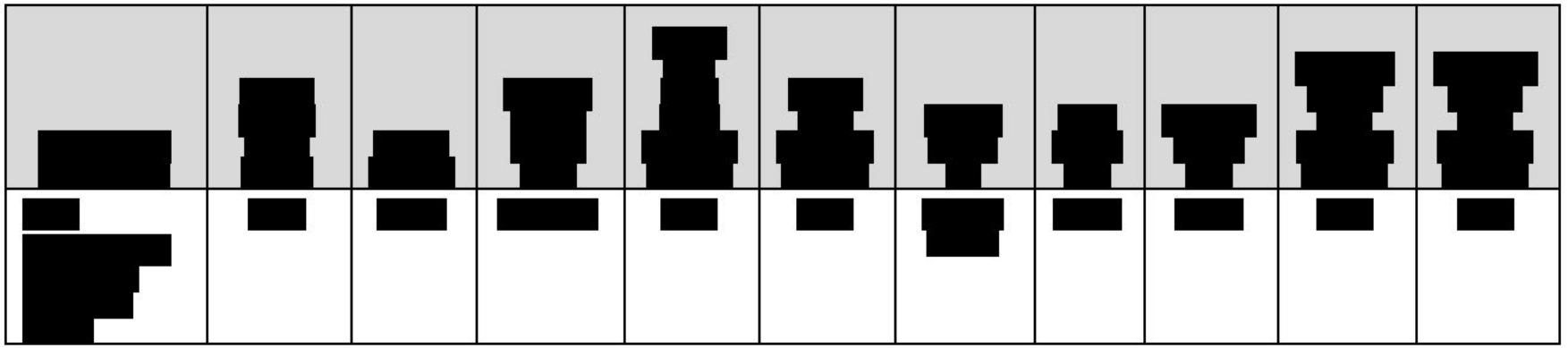
[redacted]

Table B-2. Tubing Specifications



Notes: [redacted] tubing specifications listed in Appendix B-7.

Table B-3. Packer Specifications



Notes: Packer specifications listed in Appendix B-8.

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3.3 Completion Procedure

The proposed completion interval in [redacted] is detailed below and is shown in Figure B-2. Note that these procedures are subject to change based on field conditions and the availability of materials. A detailed procedure will be provided to the EPA prior to the completion of Denova 1.

[redacted]

4. Continuous Monitoring and Automatic Shutoff Devices

[redacted]

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[redacted]

Any deviations from normal operating specifications, indicating a potential issue within the well (such as loss of mechanical integrity or tubing blockage) or caused by a change in injection flowrate, will be investigated further. Anomalous pressure measurements trigger the need for an investigation into the cause of the change [40 CFR 146.89 (b)].

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Figures

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