

ATTACHMENT G: CONSTRUCTION DETAILS WELL 357-7R

Elk Hills A1-A2 Storage Project

Facility Information

Facility name: Elk Hills A1-A2 Storage
357-7R

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Well location: Elk Hills Oil Field, Kern County, CA
35.32802963 / -119.5449982

Introduction

The testing activities at the 357-7R described in this attachment are restricted to the pre-injection phase. Testing and monitoring activities during the injection and post-injection phases are described in Attachment C, along with other non-well related pre-injection baseline activities such as geochemical monitoring.

Injection well 357-7R is an existing well approved for gas injection as part of a UIC approval for pressure maintenance. The well has cumulative injection of 3.5 billion cubic feet of gas. As part of the UIC approval, California Resources Corporation (CRC) has conducted annual MITs and SAPT tests every five years to ensure internal and external mechanical integrity.

Injection Well Construction Details

Casing Specifications

Name	Depth Interval (feet)	Outside Diameter (inches)	Inside Diameter (inches)	Weight (lb/ft)	Grade (API)	Design Coupling (Short or Long Threaded)	Thermal Conductivity @ 77°F (BTU/ft hr, °F)	Burst Strength (psi)	Collapse Strength (psi)
Conductor	20-60	20.000	19.5	52	H-40	Short	31	875	90
Surface	20-501	13.375	12.715	48	H-40	Short	31	1,727	740
Intermediate	20-3,517	9.625	8.835	40	N-80	Long	31	5,750	3,090
Long-string	20-8,990	7.000	6.184 6.276 6.366	29 26 23	N-80	Long	31	8,160 7,240 6,340	7,020 5,410 3,830

Tubing Specifications

Name	Depth Interval (feet)	Outside Diameter (inches)	Inside Diameter (inches)	Weight (lb/ft)	Grade (API)	Design Coupling (Short or Long Thread)	Burst strength (psi)	Collapse strength (psi)
Injection tubing	8,454	4.500	3.826	15.2	13CR-95	Long (premium)	12,450	12,760

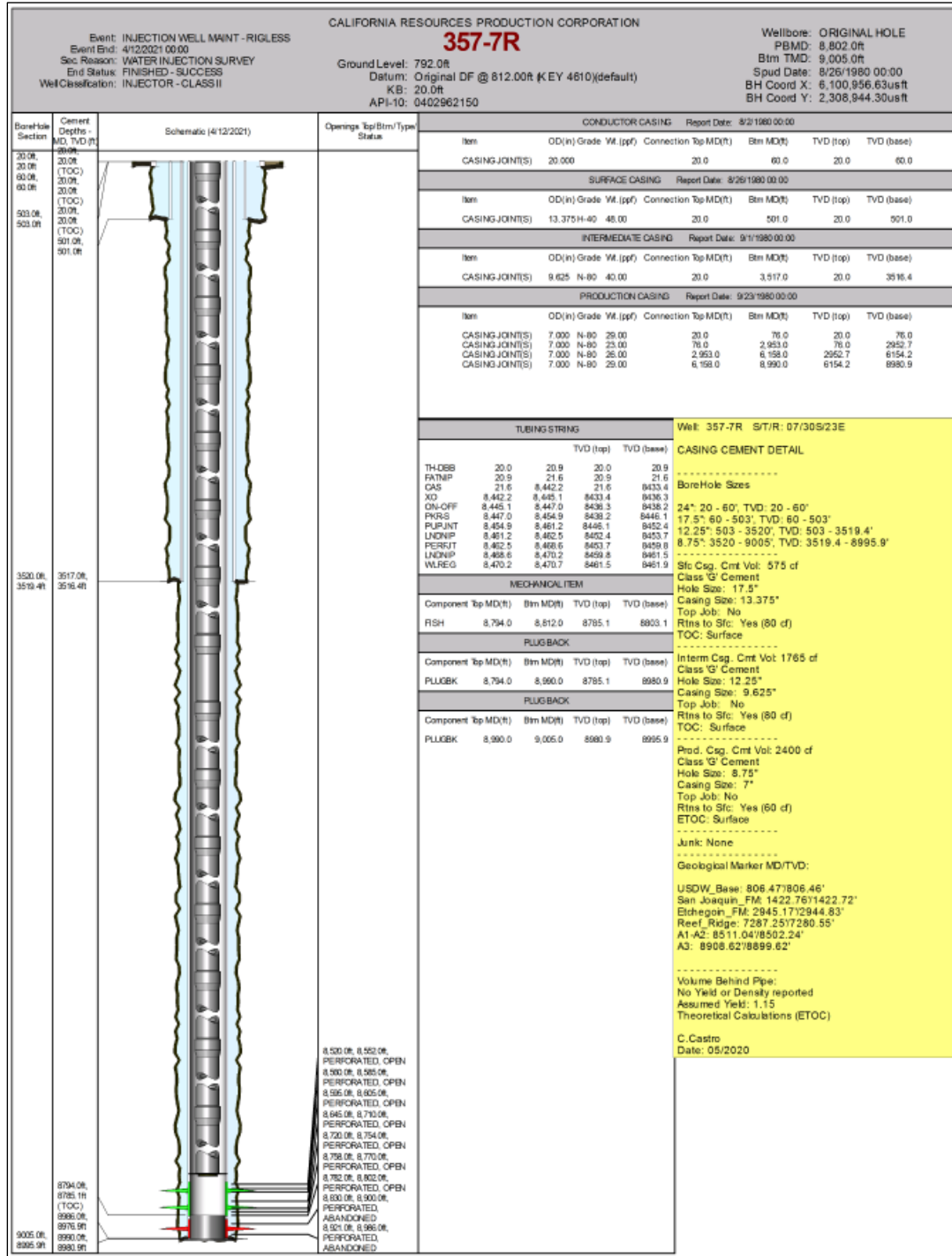
Packer Specifications

Packer Type and Material	Packer Setting Depth (feet bgs)	Length (inches)	Nominal Casing Weight (lbs/ft)	Packer Main Body Outer Diameter (inches)	Packer Inner Diameter (inches)
Baker-Hornet, Ni plated	8,447	95.4	23-29	6.000	2.920

Tensile Rating (lbs)	Burst Rating (psi)	Collapse Rating (psi)	Max. Casing Inner Diameter (inches)	Min. Casing Inner Diameter (inches)
10,000	8,000	8,000	6.466	6.184

Injection Well Construction Diagrams

Figure 1: Injection well 357-7R casing diagram.



Pre-Injection Testing Plan – Injection Well

The following tests and logs have been acquired during drilling, casing installation and after casing installation in accordance with the testing required under 40 CFR 146.87(a), (b), (c), and (d). The tests and procedures are described below and in the Proposed Injection Well Construction Information section of the permit application.

Deviation Checks

Deviation measurements were conducted approximately every 10 feet during construction of the well.

Tests and Logs

The following logs were acquired during the drilling and prior to the completion of the 357-7R well:

- Array Compensated True Resistivity Log
- Spontaneous Potential Logs
- Caliper Logs
- Compensated Spectral Natural Gamma Log
- Spectral Density Dual Spaced Neutron Log
- Mud Log

The following cased-hole logs were acquired after the drilling and completion of the 357-7R well:

- Cement Bond Log
- Mechanical Integrity Tests (Temperature Log and SAPT)

Demonstration of mechanical integrity

Below is a summary of the tests to be performed prior to injection:

Class VI Rule Citation	Rule Description	Test Description	Program Period
40 CFR 146.89(a)(1)	MIT - Internal	SAPT	Prior to operation
40 CFR 146.87(a)(4)	MIT - External	Temperature Log	Prior to operation
40 CFR 146.87(a)(4)	MIT - External	Radioactive Tracer	Prior to operation

CTV will notify the EPA at least 30 days prior to conducting the test and provide a detailed description of the testing procedure. Notification and the opportunity to witness these tests/logs shall be provided to EPA at least 48 hours in advance of a given test/log.

Pre-Injection Testing Plan – Deep Monitoring Wells 327-7R-RD1 and 342-7R-RD1

Deep monitoring wells proposed for the Elk Hills A1-A2 Storage project have already been drilled and completed.

Deviation Checks

Deviation measurements for 342-7R-RD1 and 327-7R-RD1 were recorded approximately every 35 and 156 feet respectively, during construction of the well.

Tests and Logs

The following logs were acquired during the drilling and prior to the completion of the 342-7R-RD1 and 327-7R-RD1 wells:

- Array Compensated True Resistivity Log
- Spontaneous Potential Logs
- Caliper Logs
- Compensated Spectral Natural Gamma Log
- Spectral Density Dual Spaced Neutron Log

Demonstration of mechanical integrity

CTV will run mechanical integrity logs and tests prior to injection operations.

Annulus Pressure Test Procedures for Injection Well 357-7R:

1. The tubing/casing annulus (annulus) will be completely filled with liquid. The volume of fluid required will be measured;
2. Temperature stabilization of the well and annulus liquid is necessary prior to conducting the test;
3. After stabilization, the annulus of the well will be pressurized to a surface pressure of no less than 500 PSI. Following pressurization, the annular system must be isolated from the source (annulus tank) by a closed valve; and
4. The annulus system must remain isolated for a period of no less than 60 minutes. During the period of isolation measurements of pressure will be made at ten-minute intervals;

Annulus Pressure Test Procedures for Monitoring Well 327-7R-RD1 & 342-7R-RD1:

1. The tubing/casing annulus (annulus) will be completely filled with liquid. The volume of fluid required will be measured;
2. Temperature stabilization of the well and annulus liquid is necessary prior to conducting the test;

3. After stabilization, the annulus of the well will be pressurized to a surface pressure of no less than 500 PSI. Following pressurization, the annular system must be isolated from the source(annulus tank) by a closed valve; and
4. The annulus system must remain isolated for a period of no less than 60 minutes During the period of isolation measurements of pressure will be made at ten-minute intervals;

Pressure Fall-Off Test Procedures:

The benefit of completing a pressure fall-off test is to assess injectivity, reservoir flow boundary distances and reservoir pressures. CTV does not currently plan to complete pressure fall off testing. The Monterey Formation A1-A2 reservoir is a depleted oil and gas reservoir with known reservoir continuity, boundaries, and flow properties from decades of water and gas injection. CTV may address scaling through time by acidizing the well to clean out the perforations.

CTV will consider pressure fall-off testing if injection rate decreases, with a simultaneous injection pressure increase outside the results from computational modeling.

Testing details

Pressure fall-off testing procedures are described below:

1. Injection rate will be held constant prior to shut-in. The injection rate will be high enough to produce a pressure buildup that will result in valid test data. The maximum operating pressure will not be exceeded.
2. Upon shutting-in the injector, surface and bottom-hole pressure and temperature measurements will be taken continuously. If there are offset injectors, rates will be held constant and recorded during the test.
3. The fall-off portion of the test will be conducted for a length of time sufficient that the pressure is no longer influenced by wellbore storage or skin.

Pressure sensors used for this test will be the wellhead gauges and a downhole gauge for the pressure falloff test. Each gauge will meet or exceed ASME B 40.1 Class 2A that provides 0.5% accuracy.