

**East Cheyenne Gas Storage, LLC
Well List - Bradenhead Tests**

API No.	Well Name	FERC ID	Status	T/R/S	Bradenhead Test Date	Initial Bradenhead Pressure	Notes
<u>Injection / Withdrawal Wells</u>							
05-075-09405	ECGS #6-17 WPD001-1	WP-D001-1	Active	11N 52W SWNE 6	2/23/2016	390	1)
05-075-09401	ECGS #6-15 WPD002-1	WP-D002-1	Active	11N 52W SWNW 6	2/27/2016	57	2)
05-075-09409	ECGS #6-19 WPD003-1	WP-D003-1	Active	11N 52W SESE 6	2/23/2016	2	3)
05-075-09389	ECGS #6-12	WP-D004-1	Active	11N 52W NESW 6	2/27/2016	NA / 287	4)
05-075-09426	ECGS #6-21 WPD004-2	WP-D004-2	Active	11N 52W NESW 6	2/24/2016	158	5)
05-075-09410	ECGS #31-7 WPD005-1	WP-D005-1	Active	12N 52W SESW 31	2/23/2016	45	6)
05-075-09427	ECGS #31-10 WPD005-2	WP-D005-2	Active	12N 52W SESW 31	2/23/2016	724	7)
05-075-07182	Gillham 6	WP-D006	Active	11N 52W NWNW 6	2/27/2016	NA	13)
05-075-07180	Gillham 2	WP-D007	Active	11N 52W NENW 6	2/27/2016	NA	13) and 14)
05-075-09411	ECGS #6-13 WPD007-2	WP-D007-2	Active	11N 52W Lot 3 6	2/23/2016	790	8)
05-075-09403	ECGS #6-14 WPD008-1	WP-D008-1	Active	11N 52W NWNE 6	2/27/2016	2	9)
05-075-07169	Gillham 1	WP-D009-1	Active	11N 52W SENW 6	2/27/2016	NA	13) and 14)
05-075-09402	ECGS #6-16 WPD009-2	WP-D009-2	Active	11N 52W SENW 6	2/27/2016	0	10)
05-075-07156	Gillham 3	WP-D010	Active	11N 52W NESW 6	2/27/2016	NA	13)
05-075-07146	Dorothy Strange 1	WP-D011-1	Active	11N 52W NWSE 6	2/27/2016	NA	13)
05-075-09406	ECGS #6-18 WPD011-2	WP-D011-2	Active	11N 52W NWSE 6	2/23/2016	390	11)
<u>Storage Observation Wells</u>							
05-075-07166	Gillham 4	WP-M002	Active	11N 52W SWNW 6	2/27/2014	NA	13)
05-075-08737	Lentfer-Michaels #1	WP-M003	Active	12N 52W NENW 31	2/27/2016	NA	13)
05-075-09400	ECGS #31-9 WPM004	WP-M004	Active	12N 52W SENE 31	2/27/2016	Vac	10)
05-075-07155	Gillham 5	WP-M006	Active	11N 52W NWSW 6	2/27/2016	NA	13)
05-075-07158	D Strange 1	WP-M007	Active	11N 52W SWSE 6	2/27/2016	NA	13)
05-075-08799	Schwake 1	WP-M008	Active	12N 52W SESE 31	2/27/2016	NA	13)
05-075-09408	ECGS #5-2 WPD003-2	WP-M009	Active	11N 52W SESE 6	2/27/2016	0	10)
<u>Produced Water Disposal Wells</u>							
05-075-07167	Schwake A-1	WP-W001	Active	11N 52W SWNE 6	3/3/2016	NA	13)
05-075-09407	ECGS #6-20J WPD003	WP-W003	Active	11N 52W SESE 6	2/24/2016	60	12)

Note 1) Initial bradenhead pressure was 390 psig. Bradenhead blew down to 0 psig within the first 5 minutes of the test. Did not see any change in production casing pressure as a result of blowing down bradenhead.

Note 2) Initial bradenhead pressure was 57 psig. Bradenhead blew down to 0 psig quickly. Production casing pressure dropped from 1168 to 1110 psig. However, ECGS does not feel the drop in pressure was due to blowing down the bradenhead as ECGS was injecting into this well with storage gas at the time of the test and feel the drop in production casing pressure was due to cooling from the injection of storage gas.

Note 3) Initial bradenhead pressure was 2 psig. Bradenhead blew down to 0 psig almost immediately. Did not see any change in production casing pressure as a result of blowing down bradenhead.

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- Note 4) Initial bradenhead pressure was 0 psig. Initial intermediate (well has 5-1/2" liner cemented inside of 7" casing to surface) was 287 psig. Performed intermediate test on 3/3/2016 and did not see any change in the production casing pressure as a result of blowing down the intermediate pressure.
- Note 5) Initial bradenhead pressure was 158 psig. Bradenhead continued light blow throughout test. Pressure at end of test was 0 psig. Saw no change in production casing pressure. Please note this well produces from the D-2 in the annular space between the production casing and tubing, and from the D-3 through the tubing. There is a sliding sleeve installed.
- Note 6) Initial bradenhead pressure was 45 psig. Bradenhead blew down to 0 psig almost immediately. Did not see any appreciable change in production casing pressure as a result of blowing down bradenhead.
- Note 7) Initial bradenhead pressure was 724 psig. Bradenhead pressure was down to 0 in 20 minutes. Saw no change in production casing pressure. Please note this well produces from the D-2 in the annular space between the production casing and tubing, and from the D-3 through the tubing. There is a sliding sleeve installed.
- Note 8) Initial bradenhead pressure was 790 psig. Bradenhead blew down to 0 psig within 30 minutes. Did not see any change in production casing pressure as a result of blowing down bradenhead.
- Note 9) Initial bradenhead pressure was 2 psig. Bradenhead blew down to 0 psig almost immediately. Did not see any change in production casing pressure as a result of blowing down bradenhead.
- Note 10) Initial bradenhead pressure was 0 psig.
- Note 11) The initial bradenhead pressure was found to be 754 psig. ECGS decided to perform a pressure test on the tubing and tubing/casing annulus. On 2/12/16 ECGS mobilized and rigged up equipment to test tubing and tubing/casing annulus. Pressures at commencement of pressure testing were: Shut in tubing Pressure (SITP) 850 psig; Shut in Tubing/Casing Annulus Pressure (SICP) 1300 psig; Shut in Bradenhead Pressure (SIBP) 400 psig. A plug was set in the profile nipple in production packer (set at 5042'), tubing was blown down to 100 psig and SICP and SIBP was monitored. SICP and SIBP did not change. The tubing/annulus pressure was bled down while monitoring SITP and SIBP. SITP and SIBP did not change. The tubing was then filled with water and the pressure was increased up to 1500 psig in 250 psig increments and shut in. The tubing pressure held essential solid for 15 minutes (saw 5 psig gain due to thermal expansion). Bled pressure off of tubing. Bled pressure off of tubing/casing annulus. Bled bradenhead pressure down to 100 psig. Filled tubing/casing annulus with water and increased pressure to 1500 psig and shut in. Pressure increased 6 psig over 30 minutes. Increase due to thermal expansion. SIBP increased from 40 to 100 psig during test. ECGS suspects some of the increase was due to casing stretch during test. At the end of the test the pressure on the tubing was bled down to 0 psig and on the tubing/casing annulus pressure was bled down to 530 psig. The next morning and the tubing/casing annulus pressure had increased from 530 to 770 psig and the tubing pressure had increased from 0 to 170 psig. Overnight the bradenhead pressure had increased to 180 psig. ECGS feel confident that the increase in pressure on the tubing and tubing/casing annulus was due to thermal expansion as the water was reaching thermal equilibrium with the formation. Conclusions were the casing was not leaking.
- On 2/23/15 ECGS performed the bradenhead test on this well. The starting pressure on the bradenhead was 390 psig. The pressure blew down to 0 and no flow within the first 25 minutes of the test. During the test the tubing and tubing/casing annulus were still full of water. Both the tubing and tubing/casing annulus pressures dropped from 200 and 216 to 190 and 153 psig respectively during the bradenhead test. Given the results of the aforementioned tubing and tubing/casing annulus pressure tests, ECGS feel the possible cause of the change in these pressures was due to cooling as the pressure in the bradenhead annulus was reduced.
- Note 12) Initial bradenhead pressure was 390 psig. Bradenhead blew down to 0 psig within the first 5 minutes of the test. Did not see any change in production casing pressure as a result of blowing down bradenhead.
- Note 13) Annular space between surface casing and production casing is cemented to surface.
- Note 14) No tubing or packer is run in well. Well is being produced through 5-1/2" casing.