



WINDFALL

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Mr. S. Stephen Platt
USEPA Region III
1650 Arch Street
Philadelphia, PA 19103-2029

**Re: Underground Injection Control (UIC) Permit Application PAS2D020BCLE
Response to Notice of Deficiency**

Dear Mr. Platt,

Please find attached our response to the Notice of Deficiency for the above referenced permit application.

Attachment A: Area of Review

Permeability calculations provided within the original application were based on an injectivity test conducted on the Green Glenn #1 well located in Clearfield County. Upon further review a conversion error was found in the calculation and we have re-calculated the permeability to be 6.1 millidarcies. See calculation and data attached.

No porosity logs are available in our immediate area on the Chert/Oriskany formation; however attached are two open hole logs sections on the Chert/Oriskany in Somerset and Potter County of wells with similar IP data. These logs indicate a porosity of 8-12%. Therefore we have assumed an average of 10% porosity for our calculations.

Current reservoir pressure is assumed to be 90 psi; that is the current pipeline operating pressure. The two direct offset wells located on the block can no longer produce against line pressure. Well permit number 37-033-20327 is no longer in production and permit 37-033-20333 is being produced with a pump jack.

Attachment B: Maps of wells in area of review

Note that the original application provided a list of landowners within a 1320' radius of the wellbore we have extended that radius to 1320' beyond the area of review. Please find attached that list of landowners along with a map showing their location.

Attachment E: Name and Depth of USDW's

The state completion report for well permit number 37-033-20597 is located 455 ft. SW from the proposed Zelman well at an elevation of 1672. The drillers log noted FW (freshwater) at 750'. Please find this report attached. As concluded by the Hydrology report completed by RMS Inc; the Lowermost USDW to be encountered at the Zelman location is 797' BLS.

Attachment G: Geologic Data

The following is a list of gas storage fields that utilize the Oriskany as its storage reservoir in Pennsylvania. The efficient operation of these fields proves the Oriskany formation as an effective storage pool. The Chert/Oriskany formation is bounded above and below by the Onondago Limestone and the Helderberg Limestone respectively. The faults act as the areal limiting boundary. The existence of these boundaries can be verified by injection/withdrawal volumes into and out of these pools.

Rager Mountain Storage	Cambria County	PA
Greenlick Storage	Clinton/Potter County	PA
Tamarack Storage	Clinton County	PA
Leidy Storage	Cameron/ Clinton/ Potter County	PA
Sabinsville Storage	Tioga/Potter County	PA
Harrison Valley Storage	Potter County	PA
Tiogo Storage	Tioga County	PA
Ellisburg Storage	Potter County	PA

Additionally, a large number of "dry hole" wells drilled into the Chert/ Oriskany formation in Pennsylvania have either been plugged backed and kicked across a fault or offset wells drilled across these fault boundaries into the productive portion of the reservoir. These offset or kicked wells further provide evidence that faults act as the reservoir boundary.

To address the issue of injection causing earthquakes, our understanding of the theory is that the injection fluids wet the fault boundary causing slippage. Again, we find through the operation of gas storage fields; wells that are "low on structure" have fluid being injected into and withdrawn from the reservoir annually without any evidence of seismic activity. These storage operations in the Oriskany reservoir have been operating for over 50 years; therefore, our position is that the issue is not a concern.

Attachment K: Injection Procedures

Please find attached the fluid analysis of the proposed injection fluids with the TOC contained.

Attachment "I" (page 1)
Formation Testing Program
Green Glenn #1 Injection Well

An Injectivity Test was conducted on the Green Glenn # 1 Well from 10/13/2009 to 10/22/2009.

The following data was obtained: (See "Attachment I: Appendix -1 Injection Test Data")

Total volume injected	4311 bbls
Fluid Density (Marcellus produced fluids)	8.7 to 9.1 ppg
Average Injection Rate	1040 bbls per day
Average Injection Surface Pressure	1225 psig
Draw Down Time	1 minute
Draw Down Pressure	0 psi

Permeability: Utilizing Darcy Flow Equation = 6.1 md (see calculations below)

$$Q = \frac{7.082 \text{ KH} (P_e - P_w)}{\ln (R_e/R_w)}$$

Where: Q = flow rate (bbls/day)
 K = formation permeability (darcy's)
 H = formation thickness (ft)
 P_e = static external boundary pressure (psia)
 P_w = wellbore pressure during injection (psia)
 R_e = external radius (ft)
 R_w = wellbore radius (ft)

Well Data: Depth to Injection zone	= 7200 G.L.
Average Test injection rate (Q)	= 1040 bbls/day
Reservoir Surface pressure	= 15 psig
Average Wellbore Injection Pressure	= 1225 psig
Wellbore Radius (R _w)	= 0.1979 ft
Average Specific Gravity of test fluid	= 1.07
External Radius (R _e)	= 50.5 ft
Specific Gravity of reservoir gas	= .60
Injection Volume	= 4311 bbls
Gross Thickness	= 78 ft
Net Formation Thickness (H)	= 30 ft
Porosity	= 0.10

**Attachment "I" (page 2)
Formation Testing Program
Green Glenn #1 Injection Well**

Due to the extremely high natural flows encountered in the Chert/Oriskany formations in our project area, standard completion procedures were to top set the Production casing in the Onondago Limestone and then drill –in to the Chert/Oriskany reservoir. When high volumes were encountered the drill piped was tripped and the formation was produced open hole. Therefore most wells were not drilled completely through the Oriskany. Since the field was developed in the late 1950's and early 1960's; log data is not available. Well records closest to the proposed injection well reported the following thickness data:

Permit Number	Distance/Direction	Chert	Oriskany
37-033-20236	1600' Northeast	46	17' in sand
37-033-20047	1850' Southwest	66'	18' in sand

Records research of wells drilled through the Oriskany in Huston Township, Clearfield County provided the following thickness data:

Permit Number	Chert	Oriskany
37-033-20245	63'	31' (located 3450' northeast of the proposed injection well)
37-033-20299	38'	31'
37-033-20183	45'	34'
37-033-20182	47'	29'
37-033-20179	46'	30'

(See Attachment I – Appendix 2; Well Records)

The Chert thickness at the Green Glenn # 1 well is 48' and we will assume an oriskany thickness of 30' for an overall Chert/Oriskany Reservoir of 78'. However for net thickness we will use 30' with a porosity of 10%. This porosity in the Oriskany has been well documented from wells with similar IP data. (See Attachment I – Appendix 3; Oriskany Well Log)

Wellbore Pressure Calculation(Pw):

$$P_w = P_{\text{surface}} + P_{\text{Hydrostatic}}$$

$$P_w = 1225 + ((1.07)(.433)(7200))$$

$$P_w = 4560 \text{ psig}$$

$$P_w = 4560 \text{ psig} + 14.7$$

$$P_w = 4575 \text{ psia}$$

External Boundary Pressure Calculation(Pe):

$$P_e = \text{Surface Pressure} + \text{delta P (gas gradient)}$$

$$\text{Delta P} = ((0.25 (P_w/100))(\text{Depth}/100))$$

$$\text{Delta P} = ((.25)(29.7/100)(7200/100))$$

$$\text{Delta P} = 5.3 \text{ psi}$$

$$P_e = 15 \text{ psig} + 14.7 + 5.3$$

$$P_e = 35 \text{ psia}$$

Date	Time	Rate	Vol.	Press.	Density	Remarks	pl	pf	time
		bbls/day	bbls	psi	ppg		psi	psi	minutes
	10/13/2009	8:00:00 AM	0	0	0	9.10 Gravity fed well to load hole for pump test			
	10/14/2009	6:45:00 AM	850	180	0	9.10 Start Injection Test			
		7:45:00 AM	840	215	0	9.10 Increase rate			
		8:45:00 AM	1200	260	0	9.10			
		9:15:00 AM	1175	284	300	9.10 Caught Pressure at 104 bbls on pump			
		10:00:00 AM	620	286	300	9.10 Start Pump		300	40
		10:30:00 AM	0	292	1500	9.10 Shut down; monitor pressure decline			
		11:00:00 AM	425	292	0	9.10 Start Pump		1500	25
		11:30:00 AM	0	300	1500	9.10 Shut down; monitor pressure decline			
		12:00:00 PM	425	300	0	9.10 Start Pump		1500	20
		12:30:00 PM	0	309	1500	9.10 Shut down; monitor pressure decline			
		1:30:00 PM	425	309	0	9.10 Start Pump		1500	10
		1:30:00 PM	0	318	1400	9.10 Shut down; monitor pressure decline			
		2:00:00 PM	425	318	0	9.10 Start Pump		1400	7
		2:30:00 PM	0	326	1380	9.10 Shut down; monitor pressure decline			
		3:00:00 PM	425	326	0	9.10 Start Pump		1380	5
		3:30:00 PM	425	335	1300	9.10 Well taking fluid at 1300 psi			
		4:00:00 PM	850	344	1300	9.10 Increase rate			
		5:00:00 PM	850	379	1320	9.10			
		5:15:00 PM	0	390	1320	9.10 Shut down for night		1320	3
	10/15/2009	6:00:00 AM		390	0	9.10 Open well; well on vacuum			
		6:00:00 AM	950	390	0	9.10 Start pump			
		7:00:00 AM	1030	430	0	9.10			
		8:00:00 AM	990	471	0	9.10			
		9:00:00 AM	800	504	0	8.90 Change suction tank			
		10:00:00 AM	800	537	0	8.90			
		11:00:00 AM	800	570	300	8.90			

Green Glenn #1 DEP ID #37-033-20228

Dannic Energy Injection Test