UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION III
1650 Arch Street
Philadelphia, Pennsylvania 19103-2029

STATEMENT OF BASIS

FOR

U. S. EPA's UNDERGROUND INJECTION CONTROL (UIC) PROGRAM
DRAFT CLASS II-D PERMIT NUMBER PAS2D026BELK

FOR

Seneca Resources Corporation
5800 Corporate Blvd., Suite 300
Pittsburgh, Pennsylvania 15237

FOR

A project consisting of one Class II-D injection well #38282 (API#37-047-32885) used for the disposal of produced fluids, associated with Seneca Resources Corporation oil and gas production operations. The injection well is located at:

SRC Kane Field
Highland Township
Elk County, Pennsylvania
Latitude 41° 36' 44.7", Longitude -78° 49' 20.2"

In May 2016, Seneca Resources Corporation (Seneca or Permittee) submitted a UIC permit application for the construction and operation of the above referenced injection well. EPA has reviewed this application, as well as subsequent submittals of additional information, and has found the application to be acceptable.

The draft permit specifies conditions for construction, operation, monitoring, reporting, and plugging and abandonment, in order to prevent the movement of fluids into an Underground Source of Drinking Water. General provisions for EPA UIC permit requirements are found at 40 CFR Parts 144 and 146. In addition, permit conditions specific to this project are as follows:

Area of Review: This is an area surrounding the project or a well which the applicant must, first research, and then develop a program for corrective action to address any wells which penetrate the injection zone and which may provide conduits for fluid migration. Seneca proposed a fixed radius Area of Review of a one-quarter mile. This is a larger radius than what would have applied using a zone of endangering influence calculation. Seneca has provided documentation on the well population within the Area of Review. After extensive research of local, county and state well records, as well as a field survey, no ground water wells were found. The closest

public water supply source is from a spring located approximately 1.0 mile north of the proposed injection well. The nearest ground water well is approximately 0.5 miles to the northeast of the proposed injection well. There are two active Seneca gas production wells #04384 (API #37-047-00515) located about 1,000 feet to the northeast and well #04406 (API #37-047-00516) located about 1,000 feet to the northwest of the proposed injection well. Both wells penetrate the injection zone and have cemented surface casing to below the lowermost Underground Source of Drinking Water. These wells will be configured for use as fluid level monitoring wells which will measure the pressure buildup during the operation of the injection well. A long-string casing will be placed in each well to isolate the injection formation for this purpose. If either of these wells are ever taken out of production, Seneca is required to notify EPA for specific guidance on corrective action to be taken. If any other well which penetrates the injection zone is identified at a future date, corrective action will be performed on that well in the form of plugging and abandonment.

Underground Sources of Drinking Water (USDWs): USDWs are defined by the UIC regulations as aquifers or portions thereof which contain waters that have 10,000 parts per million or less of Total Dissolved Solids and which are being or could be used as a source of drinking water. The Permittee has identified the lowermost USDW's depth to be approximately 400 feet below surface elevation which lies within the Mississippian Devonian Formation. The surface casing in the proposed injection well has been cemented from 553 feet to the surface. This exceeds the regulatory criteria of 40 CFR §146.22 which requires surface casing to be placed to at least 50 feet below the lowermost USDW and cemented back to the surface.

Injection and Confining Zones: Injection of fluids for disposal is limited by the permit to the Upper Devonian Elk 3 Sand in the interval between 2327 feet and 2372 feet. This injection zone is separated from the lowermost USDW by an array of confining formations, totaling almost 2000 feet. The confining zone immediately above the injection zone is comprised of at least 270 continuous feet of shale within the Devonian Elk Shale Formation. This was determined from a review of the completion report of Well #38282 included in the permit application.

Geologic and Seismic Review: The SDWA regulations for Class II wells do not require consideration of seismicity, unlike the SDWA regulations for Class I wells used for the injection of hazardous waste. See regulations for Class I hazardous waste injection wells at 40 C.F.R. §§ 146.62(b)(1) and 146.68(f). Nevertheless, EPA evaluated factors relevant to seismic activity such as the existence of any known faults and/or fractures and any history of, or potential for, seismic events in the area of the Injection Well as discussed below and addressed more fully in *"Region 3 framework for evaluating seismic potential associated with UIC Class II permits, September, 2013."* EPA also established a maximum injection pressure in the draft permit designed to limit the potential for seismic events.

The permit provides that the Permittee shall inject through the Injection Well only into a formation which is free of known open faults or fractures within the Area of Review as required

in 40 C.F.R. § 146.22. The Permittee submitted geologic information that indicates the absence of faults in the confining and injection zone. Although this does not conclusively demonstrate the absence of any faults in the area of the well, the probability of injection induced seismicity is low because permit conditions require the operator to operate the well at a pressure low enough so any existing fractures will not be perpetuated.

Earthquake activity in Pennsylvania has been associated with the Precambrian, crystalline, igneous/metamorphic bedrock, sometimes referred to as "basement rock", which is located below sedimentary bedrock. Earthquakes in Pennsylvania are commonly related to either faulting in the basement rock, or to faulting at a shallower depth caused by tectonic stresses that originated from the basement rock. The available geophysical and seismic information researched by the Permittee, as well as through EPA's review of published information of seismicity in Pennsylvania (refer to information referenced below), shows no evidence of faults that reach the land's surface from basement rock.

The United States Geologic Survey (USGS) and the Pennsylvania Bureau of Topographic and Geologic Survey have not recorded any seismic activity that originated in Elk County, Pennsylvania. See "Earthquake Epicenters in Pennsylvania", Pennsylvania Department of Conservation and Natural Resources website; and "Earthquakes Hazards Program, Pennsylvania Seismicity Map 1973 to Present", United States Geological Survey website.

In addition, the National Academy of Sciences or National Research Council's report, "Induced Seismicity Potential in Energy Technologies", National Academy Press, 2013, indicates that oil and gas production in a reservoir can assist in preventing future impacts from seismicity due to injection because of the reduction in reservoir pore pressure during the years of gas production. The Permittee identified in the Permit Application significant gas production in the vicinity of the proposed Injection Well. As a result of this production, the reservoir pressure within the injection formation declined from over 400 pounds per square inch (psi) when production began in about 1900 to 26.6 psi in June 2013.

EPA developed the maximum injection pressure for the Injection Well using data submitted by the Permittee in the permit application. The Permittee provided to EPA fracture stimulation data obtained when the well was completed for gas production that included an instantaneous shut-in pressure (ISIP). The ISIP is the minimum pressure necessary to begin to reopen any fractures created during the fracture stimulation process and is significantly lower than the pressure required to fracture the rock. EPA limited in the draft permit the surface injection pressure and the bottom-hole injection pressure to a level lower than both the ISIP and the fracture pressure to prevent the initiation of new or the propagation of existing fractures.

Finally, a number of factors help to prevent injection wells from failing in a seismic event and contributing to the contamination of a USDW. Deep injection wells (Class I and Class II injection wells) are constructed to withstand significant amounts of pressure. The Seneca

Injection Well is constructed with multiple steel strings of casing that are cemented in place. Furthermore, the draft permit requires Seneca to mechanically test the Injection Well to ensure integrity before operations begin and to continuously monitor the Injection Well during operations to detect any potential mechanical integrity concerns. The Injection Well will also be designed to automatically shut in and cease operation if a seismic event occurs that would affect the operation and/or mechanical integrity of the well. For the reasons above, the risk of seismic activity in Elk County as a result of the Seneca Injection Well operation would be very low.

Injection fluid: The permit limits this well to the disposal of produced fluids associated solely with Seneca's oil and gas production activities, with an expected maximum volume of 45,000 barrels per month.

Maximum Injection Pressure: The maximum allowable surface injection pressure for the permitted operation will be 1416 pounds per square inch (psi) and the maximum bottom-hole pressure will be 2587 psi. These maximum pressures were developed using a specific gravity for the injection fluid of 1.16 and an injection well depth of 2327 feet. Injection pressure and annular pressure will be continuously monitored. These pressure limitations will meet the regulatory criteria of 40 CFR § 146.23(a) and have been calculated using the top of the Elk 3 Sand Formation at the facility location and the anticipated specific gravity of the injection fluid, and the geologic information appropriate to the injection zone at this locality. The maximum injection pressure has been calculated to prevent the fracturing of the Elk 3 Sand Formation during operation.

Monitoring and Reporting Requirements: The Permittee will be responsible for monitoring injection pressure, annular pressure, flow rate and cumulative volume on a continuous basis and reporting this data to EPA on an annual basis. The Permittee is also required to conduct a mechanical integrity test (MIT) once every five years. This test will provide EPA with an evaluation of the integrity of the casing, tubing and packer in the well as well as documentation as to the absence of fluid movement into or between USDWs, thus helping to assure that USDWs are protected. As indicated above, the Permittee proposes to use two nearby gas wells (#04384 and #04406) to monitor fluid level and pressure buildup within the Area of Review.

Plugging and Abandonment: The facility has submitted a plugging and abandonment plan that will result in an environmentally protective well closure at the time of cessation of operations. The Permittee has also made a demonstration of financial responsibility that indicates adequate resources will be maintained for well closure and should preclude the possibility of abandonment without proper closure.

Expiration Date: A final permit, when issued, will be in effect for ten years from the date of permit issuance. Annual review of the Permittee's operation will be conducted. This proposed draft permit contains essentially the same conditions as the final permit will unless information is

supplied to EPA which would warrant alternative conditions or actions on this permit application.

Additional Information: Questions, comments and requests for additional information may be directed to:

Roger Reinhart
Ground Water & Enforcement Branch (3WP22)
U.S. Environmental Protection Agency
1650 Arch Street
Philadelphia, PA 19103
reinhart.roger@epa.gov
215-814-5462

A public hearing has been scheduled for July 24, 2017, at 7:00 PM, at the Highland Township Fire Hall located on Pennsylvania Avenue in James City, Pennsylvania. The Administrative Record for this action will remain open for public comment until July 24, 2017.