UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 6
1201 ELM STREET, SUITE 500
DALLAS, TEXAS 75270

January 26, 2023

FACT SHEET

EPA is proposing to approve a reissuance of an exemption to the land disposal restrictions for the following injection well facility:

Applicant:	Dow Chemical Company Texas Operations 5470 North Twin City Highway Suite A, P.O. Box 1646 Nederland, Texas 77627
Facility Location:	Dow Beaumont Aniline 5470 North Twin City Highway Suite A, P.O. Box 1646 Nederland, Texas 77627
Wells:	WDW-188 WDW-391
Issuing Office:	U.S. Environmental Protection Agency Region 6 (6WQ-SG) Renaissance Tower 1201 Elm St. Dallas, TX 75270-2733

Summary of Decision Basis

The reissuance document submitted by Dow Chemical Company Texas Operations, Dow Beaumont Aniline requested the following revisions to the existing previously approved 2001 reissuance: provide an extension of the operational life of the facility to December 31, 2040; include the addition of a new well, WDW-391; add more waste codes; decrease injectate volume limits from 700 gpm to 650 gpm for all wells injecting into the Frio interval; and revise the injectate specific gravity range based on a three-whole calendar month volume-weighted average specific gravity range of 0.986 to 1.075 gm/cc with a reference temperature of 70°F. The following explains the derivation of the proposed decision, categorized according to the criteria outlined in 40 CFR Part 148. [53 Fed. Reg., 28118, (7/26/88)]

Summary of Decision Modeling Demonstration Results

Site geology and other associated details have changed little since the 2001 reissuance, and the 2001 fact sheet summarizing area geologic detail is attached. The site is operated by Dow Chemical Company Texas Operations. Revised reissuance condition requests coupled with an additional 19 years of injection rate history, monitoring data, and annual testing resulted in

updated pressure buildup and long-term plume models being run for each of the injection intervals.

The maximum requested injection rate for each injection interval was used from January 1, 2019, through December 31, 2040, to project the maximum pressure buildup. The pressure buildup demonstration for the Frio Sand Injection Interval over-predicted well pressures compared to historical static and flowing pressure measurements obtained from falloff tests conducted in WDW-188 and WDW-391.

Site-specific data acquired during the drilling of WDW-188 and WDW-391, annual well tests, mechanical integrity tests, and offset well information and relevant literature were reviewed to determine appropriate values to be used in the no migration demonstration. Proper estimation techniques and testing protocols were used per 40 CFR §148.21(a)(2). A range was assigned to some parameters to maximize their impact on the demonstration. For example, higher permeabilities were assigned to maximize the lateral waste plume movement. In comparison, lower permeabilities were assigned to maximize the predicted pressure buildup from injection operations in both injection intervals.

A conservative 10,000-year plume migration model was constructed using worst-case reservoir characteristics for each injection interval. Both the low and high-density plume models utilized the thinner net thickness, conservative permeabilities based on historical pressure transient test results, and historical and projected maximum injection volumes. Additionally, a limiting concentration reduction factor was set to 1×10^{-12} for the constituents of concern, encompassing the requested EPA hazardous waste numbers included in this reissuance and lower formation fluid viscosity to predict an upper bound on the plume movement. The Low Specific Gravity Plume model utilized the requested low-end of the density range for the waste stream and did not include a background gradient to maximize up-dip plume movement. The High Specific Gravity Plume model used a conservative 0.5 feet/year as the maximum expected background gradient in the Frio Sand formation to maximize the downdip movement of the waste plume. These deviations are to estimate a worst-case prediction and to overestimate the actual plume movement.

Modeled boundary conditions that may result in potential barriers to fluid flow within or near the 2.5-mile radius Area of Review include Fault A located south of the Dow Beaumont Aniline plant intersecting with WDW-188. They are treated as sealed boundaries. Potential flow restrictions due to stratigraphy have also been considered in the modeling.

Potential additional no-flow boundaries are structural/stratigraphic discontinuities associated with the two nearby domal features, Spindletop Dome and Port Neches Dome. The effects of barriers to fluid flow, obtained from geological surveys of the site, are accounted for in the model using the method of image wells. The model represented these features as vertical planar boundaries of infinite extent. Their location and orientation are supplied to the model by providing the lateral coordinates of any two points along the flow barrier, then the model calculates the appropriate locations of all image wells.

A vertical diffusion demonstration was included in this petition for a reissuance request that calculated the maximum vertical movement into intact strata and a mud-filled wellbore. The models (10,000 years and diffusion) demonstrated that the injected waste stream for each interval would not migrate vertically upward out of the injection zone or laterally within the injection zone to the point of discharge or interface with a USDW.

Dow Chemical Company Texas Operations, Dow Beaumont Aniline's Flow and Containment models conservatively modeled waste fluid injections into the subsurface under certain modified conditions, these modifications make the modeled parameters less ideal than the measured values. Modeling through the end of 2040, using maximum projected injection rates, results in the maximum horizontal extent of the waste in the Frio Sand. The waste injected is contained within the Area of Review. No vertical permeation of fluids out of the Frio formation. The observed maximum vertical permeation into the aquiclude above the Frio Sand is less than 17.5 feet.

By end of 2040, the maximum pressure buildup along the Area of Review boundary does not exceed 605 psi within the Frio at a maximum cumulative injection rate of 650 gpm continuously into WDW-188 and WDW-391. The 10,000-year model predicts the dissipation of the Cone of Influence within 30 years of the well closing due to decreased pressure buildup. As pressure decreases within the formation, vertical permeation will slow, not exceeding a vertical permeation of 245 feet in the aquiclude layer above the Frio Sand. The total vertical extent of the most mobile constituent within the waste will not diffuse more than 227 feet of the 653 feet of shale overlying the Frio Sand. The 10,000-year low-density waste plume will migrate westward and be contained within the area between Spindletop Dome and sealing Faults A and J within 300 years. Once the waste plume gets to the pinchout at the dome, updip movement will be stopped and the waste plume will spread out laterally. The maximum down dip movement of the High Density waste will be minimal based on regional background flow effects and dispersion.

Through the results of the modeling demonstrations in the reissuance document and associated supporting information, including recent mechanical integrity testing, Dow Chemical Company Texas Operations has successfully demonstrated site no migration. Demonstration of modeling pressure buildup effects, long-term horizontal plume movement distances, and vertical movement modeling results are summarized below for the two current active injectors: WDW-188 and WDW-391:

Operational Life
End of Operational Life: December 31, 2040

Modeled Well Location	Injection Interval	Maximum Incremental Pressure Buildup (psi)
WDW-188	Frio Sand	603 psi
WDW-391	Frio Sand	603 psi

Long-Term Plume Movement
Maximum Up Dip Movement: 360 feet within the Frio Sand Injection Interval
Maximum Down Dip Movement: minimal within the Frio Injection Interval Sands

Maximum Vertical Movement

Maximum permeation at year-end 2040:	17.2 ft
Maximum residual permeation:	5.8 ft

Results from the most recent mechanical integrity tests for WDW-188 and WDW-391 is summarized below:

Well Number	Annulus Pressure Test	Radioactive Tracer Survey
WDW-188	05/08/2018	05/10/2018
WDW-391	09/07/2022	09/07/2022

Proposed Petition Reissuance Approval Conditions

This proposed approval of a petition for reissuance of an exemption to allow the injection of restricted hazardous wastes is subject to the following conditions, which are necessary to assure that the standard in 40 CFR § 148.20(a) is met. Noncompliance with any of these conditions is grounds for termination of the exemption per 40 CFR § 148.24(a)(1). This proposed exemption applies to the Dow Chemical Company Texas Operations injection wells: WDW-188 and WDW-391.

1. Injection of restricted waste shall be limited to the following injection zone:

Well	Depth of Injection Zone
WDW-188	3,689' – 7,669'[1]
WDW-391	3,689' – 7,669'[1]

([1]Injection Zone depths are referenced below mean sea level to Injection Well No. 3 (WDW-188) geophysical e-log.)

The injection intervals shall be defined by the following correlative log depths:

Well	Injection Interval	Depth of Injection Interval
WDW-188	Frio Sand	7,319’ - 7,534’
WDW-391	Frio Sand	7,330’ - 7,534’

2. For WDW-188 and WDW-391, the combined cumulative monthly volume injected into each of the injection intervals shall not exceed that calculated as follows:

   Frio Sand: (650, gpm)(1440 minutes/day)(number of days in that month)

3. The facility shall cease injection into WDW-188 and WDW-391 by December 31, 2040.

4. The characteristics of the injected waste stream for WDW-188 and WDW-391 shall, at all times, conform to those discussed in Section 6 of the 2020 Petition Reissuance document. The specific gravity of the waste stream injected into each interval shall

remain within the running volume-weighted average specific gravity range of 0.986 to 1.075 gm/cc with a reference temperature of 70°F.

The running three-whole calendar month average shall be calculated by multiplying each day's specific gravity/density value by that day's injected volume, totaling those values for the previous whole three-month period, and dividing by that three whole-month injected volume. For the above calculation, each day's specific gravity/density value shall be obtained by at least one representative grab sample for each active injection interval.

5. The approval for injection is limited to the following hazardous waste codes:

D Codes	D003, D004, D005, D007, D008, D009, D018, D036, D038
K Codes	K011, K013, K014, K083, K103, K104
P Codes	P063, P069, P101
U Codes	U002, U012, U031, U109, U118, U140, U154, U162, U169, U191

6. The facility must petition for approval to inject additional hazardous wastes not included in Condition No. 5. The facility must also petition for approval to increase the concentration of any waste, necessitating the recalculation of the limiting concentration reduction factor and the extent of the waste plume. Petition reissuances and modifications should be made according to 40 CFR §148.20 (e) or (f).

7. Dow Chemical Company Texas Operations shall annually submit to EPA the results of a bottom hole pressure survey for WDW-188 and WDW-391. These surveys shall be performed after shutting in each well for a period sufficient to allow the pressure in the injection interval to reach equilibrium, per 40 CFR § 146.68(e)(1). The annual report should include a comparison of reservoir parameters determined from the falloff test with parameters used in the approved no migration petition. The information should consist of a comparison of the current year's test results for the static and flowing bottomhole pressures with the values demonstrated in the approved petition reissuance and a comparison of the test results for transmissibility [Kh/μ (mD-ft/cP)] with the transmissibilities used in the approved petition reissuance demonstration for the pressure buildup and 10,000-year plume modeling.

8. Dow Chemical Company Texas Operations shall also annually submit to the EPA a radioactive tracer survey, annulus pressure test, and waste sample analysis for WDW-188 and WDW-391.

9. Dow Chemical Company Texas Operations shall notify the EPA if WDW-188 or WDW-391 loses mechanical integrity prior to any well work or Dow Chemical Company Texas Operations plans to plug WDW-188 or WDW-391. If any well work or plugging is being planned, Dow Chemical Company Texas Operations shall also submit the procedures to EPA for review before commencing any work.

10. Upon the expiration, cancellation, reissuance, or modification of the Texas Commission on Environmental Quality's Underground Injection Control permit WDW-188 and

WDW-391, this exemption is subject to review. A new demonstration may be required if information shows that the basis of granting the exemption is no longer valid under 40 CFR §148.23 and § 148.24.

In addition to the above conditions, this proposed approval of a petition for reissuance of an exemption is contingent on the validity of the information submitted in the Dow Chemical Company Texas Operations' petition reissuance request for an exemption to the land disposal restrictions. Any final reissuance decision is subject to termination when any of the conditions occur, listed in 40 CFR § 148.24, including noncompliance, misrepresentation of relevant facts, or a determination that new information shows that the basis for approval is no longer valid.