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**Title 40 CFR Part 191  
Compliance Certification  
Application  
for the  
Waste Isolation Pilot Plant**

**DEL Attachment 1**

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## **Typical Oil or Gas Drilling Sequence in the Delaware Basin**

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The typical sequence of activities for an oil or gas well drilled in the WIPP area in the future is as follows (WIPP IIAP and New Mexico Junior College 1995):

- Obtain required drilling and land use permits. Move in and rig up (set up a rotary drilling rig over selected drilling site). See Section DEL.5.1.8 for detail of preliminary activities before rig-up.
- Weld or bolt flow nipple on 20-inch (50.8-centimeter) conductor pipe that has been set in place by the auger contractor. (This is necessary in order to establish circulation of drilling fluids when drilling begins).
- Spud in (initiate drilling). Start drilling with spud mud, which is the mixing of drilling mud composed of fresh water, fresh water gel (a clay material) mixed at 15 to 20 pounds per barrel (6.8 to 9.1 kilograms per 1.59 decaliters) and lime at 1 to 2 pounds per barrel (0.453 to 0.907 kilograms per 1.59 decaliters). Add cotton seed hulls and cedar plugs for seepage if necessary.
- Begin drilling using a 17.5-inch (44.45-centimeter) steel tooth or carbide insert bit. Drill a surface hole 550 to 800 feet (168 to 244 meters) deep. The estimated time for drilling the surface hole is 12 to 20 hours (the surface depth varies with characteristics of the locale). The bottom hole assembly consists of a drill bit, shock-sub, 9-inch (22.86-centimeter) drill collar, reamer, and fifteen 8-inch (20.32-centimeter) drill collars.
- Reach total depth of the 17.5-inch (44.45-centimeter) hole, circulate, run a directional survey, and trip out of the hole (drill to the bottom of the first string, set the surface casing, verify that the hole is straight, and remove the drill stem from the borehole).
- Run a 13 3/8-inch (33.97-centimeter), 54 pound-per-foot casing (one foot of casing weighs 54 pounds [24.5 kilograms]) to the total depth. Run appropriate number of centralizers on casing joints (run selected casing into the borehole with centralizers to keep the casing centered in the borehole; this is to ensure that cement will be placed completely around the casing).
- Cement the casing in place using 500 to 700 sacks of cement. Circulate the cement to the surface (circulation of cement to surface indicates that all areas behind the casing have been cemented from the bottom casing joint to the top joint).
- Wait for the cement to set (12 to 24 hours). Cut off the 13 3/8-inch (33.97-centimeter) casing. Weld on a casing head of the same size. Nipple up the annular blowout prevention system (this means assemble the blowout preventer stack on the wellhead at the surface). The annular blowout preventer is a large valve that forms a seal in the

annular space between the pipe and the wellbore. This preparation is necessary in order to have the blowout preventer system in place when drilling commences or resumes.

- Change from a 17 1/2-inch (44.45-centimeter) drill bit to an 11-inch (27.94-centimeter) drill bit to begin to drill the second or intermediate string. Pick up the bottom hole assembly, consisting of an 11-inch (27.94-centimeter) carbide insert bit, stabilizer, and fifteen 8-inch (20.32-centimeter) drill collars. Trip back into the hole.
- Drill through the Salado Formation. The weight on the bit during drilling would range from 10,000 to 60,000 pounds (4,536 to 27,216 kilograms). The rotary speed on the drill bit is 70- to-75 revolutions per minute. The drilling fluid is now a saturated brine. The rate of drilling penetration is 35 to 70 feet (10.7 to 21.3 meters) per hour. Circulate the drilling cuttings into the reserve pits.
- Reach the total depth of the 11-inch (27.94-centimeter) hole at approximately 4,500 feet or at least 100 feet below the base of the salt (Castile Formation).
- Trip out of hole. Run a caliper log (measures inside diameter of the borehole) to provide data to calculate estimated cement volumes. Run (insert into the wellbore) a 8 5/8-inch (21.9-centimeter), 32 pounds (14.52 kilograms) to the foot, K-55 ST&C (standard threads and collars) casing to a depth of 4,500 feet (1,372 meters). Cement the casing with approximately 1,300 sacks cement. Circulate the cement to the surface.
- Set slips (wedged-shaped pieces of metal with teeth used to hold the pipe in place) on 8 5/8-inch (21.9-centimeter) casing. Install a new nipple (threaded tubular coupling) for 8 5/8-inch (21.9-centimeter), 11-inch (27.9-centimeter), 3,000 psi  $2.07 \times 10^7$  Pa casinghead (a flanged steel fitting connected to the first string of casing). Install a 3,000 psi  $2.07 \times 10^7$  Pa blowout preventer stack and manifold. Test the stack, manifold, and casing to 1,500 psi  $1.03 \times 10^7$  Pa with the rig pump. Wait 24 hours for the cement to set before resuming drilling.
- Pick up the bottom hole assembly, which consists of a 7 7/8-inch (20-centimeter) carbide insert bit, stabilizer, 6 1/2-inch (16.51-centimeter) drill collar, stabilizer, and twenty-nine 6 1/2-inch (16.51-centimeter) drill collars. Drill out the cement.
- Continue drilling into the formation. The weight on the bit is 30,000 to 70,000 pounds (13,608 to 31,751 kilograms.) The rotary drill speed is 50 to 70 revolutions-per-minute. The drilling fluid is now fresh water rather than brine water. Circulate drilling fluid to the reserve pit.
- Continue drilling to proposed depth of 8,000 feet (2,438 meters).
- Circulate bottoms up (bring all drilling cuttings to the pit). Trip out of hole (pull the drill stem out of the wellbore). Run open hole logs. (An open-hole log of the borehole in the

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production zone is run and evaluated by the geological engineer, the production casing will be run and cemented in place only if the engineer determines that oil or gas is present and recoverable).

- Install 5.5-inch (13.97-centimeter) production casing for the first 2,000 feet (609 meters) at 17 pounds (7.7 kilograms) per foot K-55 LT&C (long threads and collars). The remaining production casing of K-55 LT&C at 15 pounds (6.8 kilograms) to the foot will be run to tie in with the intermediate casing.
- Cement the production casing and circulate the cement to the surface.
- Nipple down the blow out preventer stack. Install tubing head (remove the blowout preventer and prepare the well for completion). Release the drilling rig from the location.