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McDonald, Jeffrey

From: Gilmore, Tyler J [Tyler.Gilmore@pnnl.gov]
nt: Wednesday, January 22, 2014 4:12 PM
: Greenhagen, Andrew; Bayer, MaryRose; Akhavan, Maryam; McDonald, Jeffrey; Saieh, Patrick; McDonald, Jeffrey
Cc: Vermeul, V R (Vince); Bonneville, Alain; Williams, Mark D; Appriou, Delphine
Subject: Re: Discussion on maximum allowable injection pressure calculations and critical pressure front methodology

Used wrong symbol in last paragraph < vs >. Meant to read "less than 6L over 100 years". Also this is a very conservative estimate and likely it is much less as we can explain tomorrow.

From: <Gilmore>, Tyler Gilmore <tyler.gilmore@pnnl.gov>
Date: Wednesday, January 22, 2014 1:53 PM
To: "Greenhagen.Andrew@epa.gov" <Greenhagen.Andrew@epa.gov>, "Bayer, MaryRose" <Bayer.MaryRose@epa.gov>, "Akhavan, Maryam" <Akhavan.Maryam@epa.gov>, Jeff McDonald <mcdonald.jeffrey@epa.gov>, "Saieh, Patrick" <saieh.patrick@epa.gov>, Jeffrey McDonald <Mcdonald.Jeffrey@epamail.epa.gov>
Cc: Vincent Vermeul <vince.vermeul@pnnl.gov>, Alain HR Bonneville <alain.bonneville@pnnl.gov>, "Williams, Mark D" <mark.d.williams@pnnl.gov>, "Appriou, Delphine" <Delphine.Appriou@pnnl.gov>
Subject: Re: Discussion on maximum allowable injection pressure calculations and critical pressure front methodology

To facilitate our discussion tomorrow I've attached below some background on how we assessed the critical pressure front.
Tyler

In our UIC permit application we identified the AoR as the maximum extent of the separate-phase CO_2 plume. We could not use pressure to define the AoR because the natural hydrostatic pressure within the Mt Simon is greater than the hydrostatic pressure in the lower most USDW, the St Peter FM before injection. This situation would make an AoR that is based on the pressure front essentially infinite. To the site's benefit, however, is that the nearest well, which penetrates the confining layer or caprock, is 26-Km from the storage site.

To evaluate this situation, we conducted a study is to assess whether an Area-of-Review (AoR) determination based on the maximum extent of the predicted $scCO_2$ plume is also protective of the lowermost Underground Source of Drinking Water (USDW) from the induced reservoir pressure front at the FutureGen 2.0 site using a scenario of focused brine leakage along plugged and abandoned or poorly constructed wells. We found that an AoR based on the maximum extent of the predicted $scCO_2$ plume is protective.

A recent study published by Lawrence Berkeley National Laboratory (LBNL) researchers detailed an approach assessing well leakage scenarios that includes an analytical model for multi-layered systems. A common limitation of simple well leakage assessments is that they neglect the impact of permeable units below the

USDW. The presence of these permeable units can act as thief zones and reduce the flux of brine to the upper layers.

There are 3 major permeable units at the site between the primary caprock and the lowermost USDW. The closest well that penetrates the caprock outside the predicted $scCO_2$ plume extent (~2-km) is located 26-km away. Brine flux into the permeable layers and USDW was estimated using the LBNL analytical model for wells at two locations (2-km, which is our stratigraphic well and 26-km). Layer thicknesses at the site were used along with conservative estimates for their hydraulic properties. The effective permeability range for the zone around a plugged and abandoned or poorly constructed well is not well constrained; however researchers have categorized them by leakage potential. The highest permeabilities published for High and Extremely High leakage potential categories were used.

Results of these cases showed very small volumes of brine leakage (>6L over 100 years) into the lowermost USDW at the two well locations. Most of the focused leakage from the reservoir discharges into the first permeable unit above the caprock. This analysis indicates that the AoR defined by the maximum predicted extent of the $scCO_2$ plume would also be protective of the USDWs from the induced pressure front under these scenarios.

From: Greenhagen.Andrew@epa.gov
When: 8:30 AM - 9:30 AM January 23, 2014
Subject: Discussion on maximum allowable injection pressure calculations and critical pressure front methodology
Location: R5Metcalfe-ConfRm-R1614/R5-Metcalfe---16th-Floor

When: Thursday, January 23, 2014 10:30 AM-11:30 AM (UTC-06:00) Central Time (US & Canada).
Where: R5Metcalfe-ConfRm-R1614/R5-Metcalfe---16th-Floor

Note: The GMT offset above does not reflect daylight saving time adjustments.

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