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MEMORANDUM

To: Ken MacLeod
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Date: 12 January 2006

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From: Jim Lovekin

Subject: Summary of Well Test Results - Draft

Chronology

MC-6 Drilling and Initial Completion

25 Sep 2004 Precision Drilling Rig 620 begins drilling below conductor.

14 Nov 2004 Total depth reached at 2,662.6 meters

16 Nov 2004 Circulated hole with fresh water after installing 9-5/8" liner to total depth. Last circulation at 21:10 hours.

18-19 Nov 2004 Static temperature/pressure surveys at 36 and 60 hours after circulation (T01 & T02). Highest temperatures on bottom, with no reversals. Inflections in thermal gradients suggest some permeability below about 1,950 meters.

19-20 Nov 2004 Air lift 20 hours through drill pipe staged in hole to 2,641 meters. Well unloaded in surges at successive depths and flowed weakly for 7 hours (just steam during last hour). Produced roughly two times the volume of fluid in the well at the start of air lifting. Pressure measurements of rising liquid column after pulling drill pipe indicate Productivity Index (PI) of about **1.5 gpm/psi**.

21 Nov 2004 Static temperature survey shows maximum temperature of **234°C** on bottom with inflection at 2,500 meters. Horner analysis of temperature extrapolates stabilized temperatures of 250°C+.

21 Nov 2004 Injection test at 200 and 400 gpm. Pressure sensor hung at 2,000 meters. Clock did not advance evenly, so pressure fall-off data was lost. However, Injectivity Index could be estimated at **1.1 gpm/psi** from rate change between 200 and 400 gpm. Pressure survey conducted while well was injecting at 200

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gpm showed pressures about 60 bar (870 psi) above static pressure gradient, implying a much lower Injectivity Index of **0.23 gpm/psi** for rate change between 0 and 200 gpm. Overall Injectivity Index was **0.38 gpm/psi** (1,058 psi increase from 0 to 400 gpm injection). Maximum wellhead pressure during 400 gpm injection was **198 psig,** declining to 169 psig two hours later, at end of test. Cumulative volume injected was approximately 680 m^3 (180,000 gallons).

22 Nov 2004 — Static temperature survey 2 hours after injection shows cooling all the way to bottom, with inflections (suggesting permeability) around 2,000 and 2,500 meters.

MC-7 Drilling and Initial Completion

30 Nov 2004 — Spud date for MC-7 with Precision Rig 620.

2 Feb 2005 — Reached total depth of 3,291 meters at 21:00 hours.

4 Feb 2005 — Last circulation at 20:30 hours. No liner installed.

5 Feb 2005 — Static temperature/pressure survey 10 hours after circulation. Highest temperature (198° C) on bottom, with no reversals. No air lift performed.

5-6 Feb 2005 — Injection test at four rates (200, 310, 400, and 510 gpm). Pressure sensor hung at 2,500 meters. Injectivity Index for rates over 200 gpm was **1.4 gpm/psi**. Pressure survey conducted while well was injecting at 200 gpm showed pressures about 70 bar (1,015 psi) above static pressure gradient, implying a much lower Injectivity Index of **0.20 gpm/psi** for rate change between 0 and 200 gpm. Overall Injectivity Index was **0.44 gpm/psi** (1,160 psi [80 bar] increase from 0 to 510 gpm). **Note that these Injectivity Index values are very close to those of MC-6**, and both wells exhibit high "threshold pressure" at lowest injection rate. Maximum wellhead pressure during 400 gpm injection was **340 psig**, declining to 305 psig in 1.5 hours, then dropping to about 250 psig. Maximum wellhead pressure at 510 gpm was 365 psig, declining to 340 psig after two hours, at end of test. Pressure fall-off data from Kuster tool available, but not quantitatively analyzed.

6 Feb 2005 — Static temperature survey in **MC-6** shows maximum temperature of **255°C** at 2,600 meters, a rise of 61°C at that depth in 76 days post-injection.

7 Feb 2005 — Static temperature survey in **MC-7** 36 hours after injection showed some cooling (suggesting permeability) as deep as 3,000 meters, with minor

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inflections at 900 and 1,500 meters. Maximum temperature was on bottom (**216°C**), reflecting 18°C of heat-up since survey 2 days earlier and suggesting that little or no injection water had reached the bottom of the well.

Static Surveys of MC-6 and MC-7 in March 2005

15 Mar 2005 Static temperature survey in **MC-7** shows maximum temperature of **243°C** at 2,900 meters, a rise of 27°C in 36 days post-injection. Also suggests slight temperature reversal below this depth (242°C on bottom).

16 Mar 2005 Static temperature survey in MC-6 shows **258°C** on bottom (2,632 meters), 114 days post-injection. Temperature at 2,600 meters was slightly cooler than previous survey (6 February 2005) (possibly bad data point), but in general, temperatures below 800 meters are 3 to 4°C hotter than previous survey.

MC-8 Drilling and Initial Completion / Attempted Air Caps on MC-6

8 Apr 2005 Spud date for MC-8 with Precision Rig 620.

10 May 2005 GeothermEx memo on Well Test Plan, including wellbore simulation of MC-6.

13-27 May 2005 Attempted to induce flow from **MC-6** with air caps of up to 550 psig. Static temperature surveys on 13 and 17 May. Latter showed **260°C** on bottom (2,632 meters). About 10 attempts to flow MC-6 by releasing air caps. Well would produce some fluid to weir, but never sustained flow.

15 May 2005 Static temperature survey in **MC-7** shows maximum temperature of **253°C** at 2,900 meters, a rise of 37°C in 96 days post-injection. Survey confirms temperature below 2,900 meters, to 249°C at bottom-most reading (3,140 meters).

25 May 2005 MC-8 encounters large crack at 2,345 meters. Total loss of circulation.

28-31 May 2005 Initial testing of MC-8, including static surveys on 28 and 30 May, air lift from 28 to 30 May, and injection test 30-31 May. Some injection into MC-7.

MC-6 Air Lifting Through 2-7/8" Tubing

~15 Jun 2005 Install 2-7/8" tubing in MC-6 to 1,700 meters.

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15-20 Jun 2005 Repeated air lifts through 2-7/8" tubing. By 20 June, well was cycling fluid to surface every 3-3.5 hours, with air compressors running one out of every four hours. Well does not sustain flow on its own after shutting off air.

MC-8 Step-Rate Injection Test

2-4 Jul 2005 Testing showed Injectivity Index in MC-8 of about **2 gpm/psi.**

4 Jul 2005 Temperature survey after injection showed cooling all the way to bottom of MC-8, implying some water had exited the bottom of the well, below big fracture at 2,345 meters.

MC-6 Extended Injection Test with Periodic Temperature Surveys of MC-8

7 Jul – 23 Aug 05 Gravity feed into MC-6 at 200 gpm. Downhole pressures at 800 meters in MC-6 decline gradually. At the time, it was hoped this indicated improving permeability. In hindsight, the declining pressures appear to have been due to cooling of liquid column below capillary chamber (denser fluid results in shorter liquid column to balance reservoir pressure, hence less height of water over chamber).

12 Jul 2005 Static temperature survey of MC-8.

27 Jul 2005 Static temperature survey of MC-8. Installed capillary tube in MC-6 at 800 meters.

19 Aug 2005 Static temperature survey of MC-8. First indication of temperature reversal in bottom of MC-8.

20-21 Aug 2005 Repeat temperature surveys in MC-8 confirm temperature reversal.

23 Aug 2005 Stop injection into MC-6 at 16:30 hours. Before shut-in (at 9:00 hours), capillary chamber depth in MC-6 adjusted from 800 meters to 600 meters. After shut-in (about 18:00 hours), capillary chamber lowered to 667 meters due to low pressures (19 psia) at 600 meters. Downhole pressures at 667 meters rise gradually over next two days as liquid column begins to heat back up.

Step-Rate Injection Test at MC-6 with Downhole Pressure Monitoring in Same Well

25-26 Aug 2005 Performed injection test at 200, 400, and 600 gpm. Confirms Injectivity Index of about **1.4 gpm/psi**, indicating no improvement in permeability from 6

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weeks of injection into MC-6. After injection stops, pressure at 667 meters in MC-6 fall off to about 40 psi below pressure at start of test, apparently due to thermal effect (cooling of liquid column by injection). This makes quantitative interpretation of the pressure fall-off difficult.

Interference Test: Injection into MC-6 with Downhole Pressure Monitoring in MC-8

4-9 Sep 2005	Start gravity feed into MC-6 at about 187 gpm at 8:32 hours. Pressure response evident at MC-8 (capillary chamber at 800 meters) within 1 hour. Pressures in MC-8 rise 10 psi over 5 days, not quite leveling off.
9-15 Sep 2005	Stop injection into MC-6 at about noon. Pressures in MC-8 decline over next 5 days by about 7 psi and then level out for last day of monitoring. Failure to return to pre-injection pressure is apparently due to gradual heating of liquid in upper part of MC-8 wellbore (?), making quantitative interpretation of pressure transient difficult.

Periodic Temperature Surveys of MC-6 and MC-8

20-21 Sep 2005	Static temperature survey of MC-8. Temperature at 2,377 meters is 185.3°C.
14 Oct 2005	Static temperature survey of MC-8. Temperature at 2,377 meters is 196.5°C.
19 Oct 2005	Static temperature survey of MC-6. Temperature reversal below 1,800 meters indicates cumulative effect of injection. Fluid invasion especially pronounced from 2,000 to 2,500 meters, suggesting most permeability in this zone. Minimum temperature below reversal is 178.2°C at 2,200 meters.
20 Nov 2005	Static temperature survey of MC-8. Temperature at 2,377 meters is 201.4°C.
21 Nov 2005	Static temperature survey of MC-6. Minimum temperature below reversal is 191.0°C at 2,300 meters.