GL00512

REPORT DD

REPORT OF SHORT FLOW TEST
31 Aug. 1987
David K. Mulliner, Consultant
9 p.

Appendix D

REPORT OF SHORT FLOW TEST

SUMMARY

STATE 2-14

Flow Test August 31, 1987

1. Opened Valve on the well	@ 0715
Flow to Pond T 276°F, P 49 psig	@ 0755
Closed well Valve T 430°F, P 300 psig	@ 1955
2. Brine Pond 8/30/87 @ water line	265.6' x 92'
30" above water line @ shelf	272.6' x 100'
3. Total Flow to the Pond, 12 hrs of flow	4,781,000 lbs
Average flow to Pond per hour	398,000 lbs/hr
4. Assume 30% steam flash from formation fluid	
Total Flow from the well steam plus brine	6,830,000 lbs
Average flow from well per hour	569,000 lbs/hr
5. Chemistry of well flow fluid sampled from	
high pressure brine line near well head	Cl, 134,000 mg/kg
	(calc)TDS, 231,000 Mg/kg
	pH 5.4

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STATE 2-14

SUBJECT: Well flow test on August 31, 1987

The valve to the well was opened at 7:15 AM. The well was allowed to heat up slowly by controlling the flow with the throttle valve. At 7:55 AM the well flow was diverted into the pond. The well head temperature was 276°F @ 49 psig pressure. Temperature and pressure continued to rise and the flow increased. With the control valve set at 50% open,the temperature rose to 376°Fand the pressure was 160 psig by 9:45 AM. At this time the flow had increased to 514,000 lbs/hr of brine into the pond. The control valve was operated to reduce and control flow. For the next five hours the temperature and pressure increased. To maintain a medium flow rate the control valve was closed slightly several times to reduce the ever increasing flow. The well stabilized at 4:00 PM. with a temperature of 445°F, pressure of 310 psig and a flow of 420,000 lbs/hr of brine to the pond. The control valve is now set at 35 % open.

Well flow chemistry sampling began at 5:00 PM. Brine samples were taken from the 2 phase high pressure flow line near the well head. The samples were collected using a modified LLL sample probe. Samples of the weir brine flow into the pond were also collected. The collected samples were taken to the Vulcan Plant's (Magma) laboratory. Titrations were run for Total Chlorides in the samples. The TDS of the samples were calculated using a factor derived from the chemistry of the brines at Magma, Union and State 2-14 previous flows.

Sample # 1

Cl	132,000 mg/kg
TDS (calc)	228,000 mg/kg
pH	5.3

Sample # 2

Cl	137,000 mg/kg
TDS (calc)	236,000 mg/kg
pH	5.4

Weir # 1

Cl	217,000 mg/kg
TDS (calc)	374,000 mg/kg
pH	4.8

Weir #2

Cl	217,000 mg/kg
TDS (calc)	374,000 mg/kg
pH	5.0

After the sampling was complete the control valve was reduced 3/4 of a turn to increase and stabilize the pressure at the well head. The temperature increased to 465°F with a pressure of 388 psig and brine flow to the pond of 492,000 lbs/ hr. This portion of the flow test was at the request of INEL, Idaho Falls - (Susan Stiger). This test was to stabilize the well at high pressure, to see if the high pressure would maintain with no drop off. The pressure did not drop off but continued to rise.

At 7:24 PM the well control valve was opened full for 32 minutes. Brine flow to the pond increased to 1,220,000 lbs/hr and was still increasing when the well was shut-in.

The total rise of brine level into the pond was 32 3/4 inches. This equates to a total flow of brine into the pond of 498,000 gallons during the 12 hours of well flow.

Using the Chloride analysis of the brine to the pond and the Chloride analysis from the well sample, the steam production from the well brine calculates out to be 38%.

$$\frac{\text{Cl (conc) in brine line from well}}{\text{Cl (conc) in fluid flow to pond}} = \text{conc. by boiling off steam}$$

$$\frac{134,000}{217,000} \times 100 = 62\%$$

100 - % conc by boiling off steam = % steam boiled off

100 - 62 = 38% Steam

∴ 1 lb well flow fluid = 62% conc. brine and 38% steam to the pond

ASSUME: Brine from atmospheric flash vessel temperature to be 215 °F

From the steam tables Enthalpy (h_f) of 215 °F H_2O = 183 BTU/lb
brine to the pond is 374,000 mg/kg TDS (calc).
which is equal to 37% salts and 63% water
% water in brine x h_f = h_f of brine
∴ (h_f of brine) 183 x 0.63 = 115 BTU/lb for brine to pond

Heat of vaporization (h_{fg}) = 968 BTU/lb steam (steam tables)
Formation fluid, TDS (calc) = 231,000 mg/kg
To produce 38% steam from formation fluid,
heat of vaporization (h_{fg}) x % steam = heat extracted from formation fluid /lb.

∴ 968 x 0.38 = 368 BTU/lb

Heat extracted from formation fluid + heat still in brine to pond = Brine Enthalpy in the formation fluid.

∴ h_f = 368 + 115 = 483 BTU/lb, formation fluid.

To convert Enthalpy of the formation fluid to Temperature in the well, it is necessary to convert the brine Enthalpy to pure water Enthalpy. This can be done by extracting the brine TDS (calc).

$\therefore$ h_f of pure water at formation temperature
$= 483 \div (1 - 0.23) = 627$ BTU/ lb

h_f of 627 BTU/lb equates to 607 °F (steam tables)

Enthalpy of Formation fluid = 483 BTU/lb

Temperature of Formation fluid = 607 °F

Appendix A

State 2-14

Brine pond August 31, 1987

Inches rise of Brine	Color on measuring Ruler	Time 24 hr Clock	Minutes per inch brine rise	Well Head Pressure @ P 1 psig	Well Head Temperature @ T 2 °F
1	W	0857	--	118	355
2	B	---	--	142	370
3	R	0949	--	148	376
4	W	1015	26	160	383
5	B	1042	27	173	393
6	R	1102	20	189	400
7	W	1123	21	190	402
8	B	1145	22	200	405
9	R	1209	24	210	410
10	W	1232	23	208	408
11	B	1253	21	221	415
12	R	1314	21	250	425
13	W	1333	19	270	433
14	B	1355	22	285	435
15	R	---		300	440
16	W		avg 18.3	---	---
17	B	1450		305	442
18	R	---		308	443
19	W		avg 16.6	---	---
20	B	1540		310	445
21	R	---		310	445
22	W		avg 22.3	310	445
23	B	1647		310	445
24	R	---		300	445
25	W			300	440
26	B		avg 25.4	---	---
27	R			---	---
28	W	1854		380	465
29	B	1912	18	388	462
30	R	1931	19	---	---
31	W	1939	8	---	---
32	B	1947	8	---	---
32 3/4	R	Closing Valve, shut-in well			

Total rise in brine pond 32 3/4 inches.

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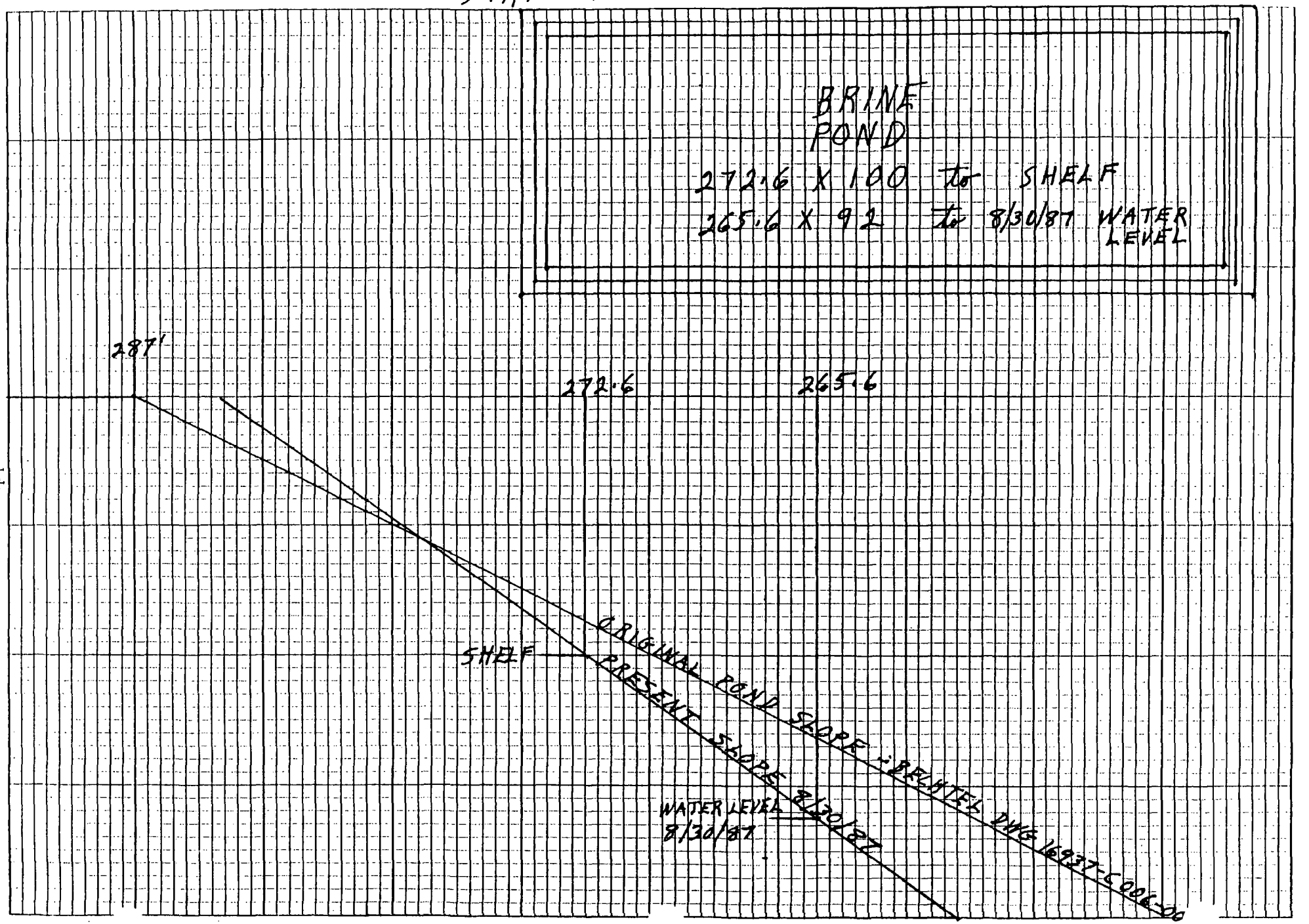
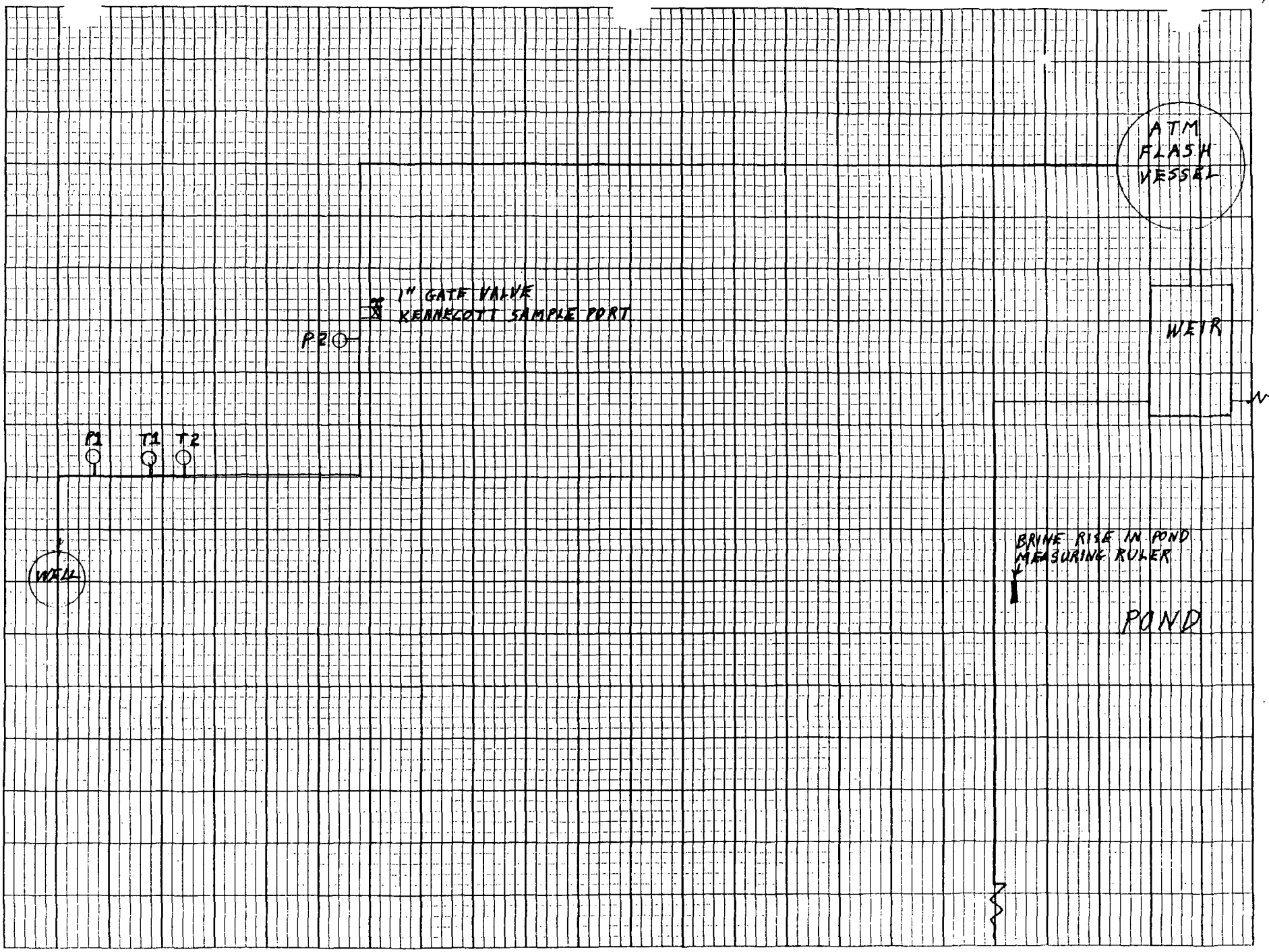

BRINE POND
272.6 X 100 to SHELF
265.6 X 92 to 8/30/87 WATER LEVEL
287'
272.6
265.6
SHELF
ORIGINAL POND SLOPE - REVISED DWG 1693-C-006-00
PRESENT SLOPE 8/30/87
WATER LEVEL 8/30/87


ATM FLASH VESSEL
1" GATE VALVE
KENNECOTT SAMPLE PORT
P2
WEIR
P1
T1
T2
WELL
BRINE RISE IN POND MEASURING RULER
POND