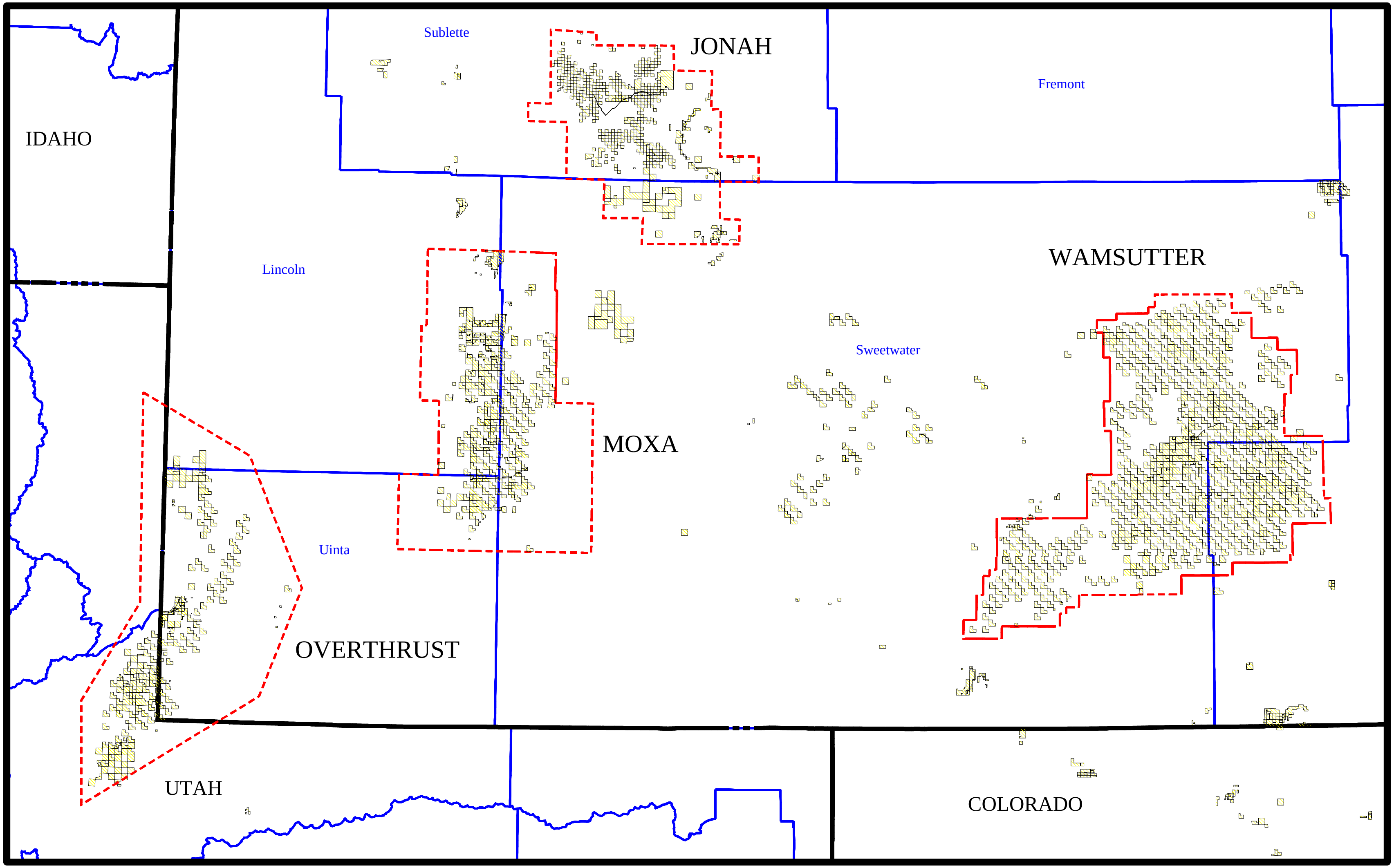
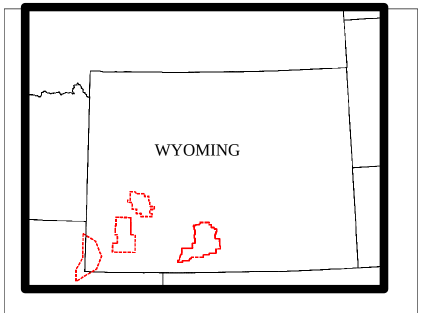
BP Moxa Operating Center

Success With the Solar Methanol and glycol pumps

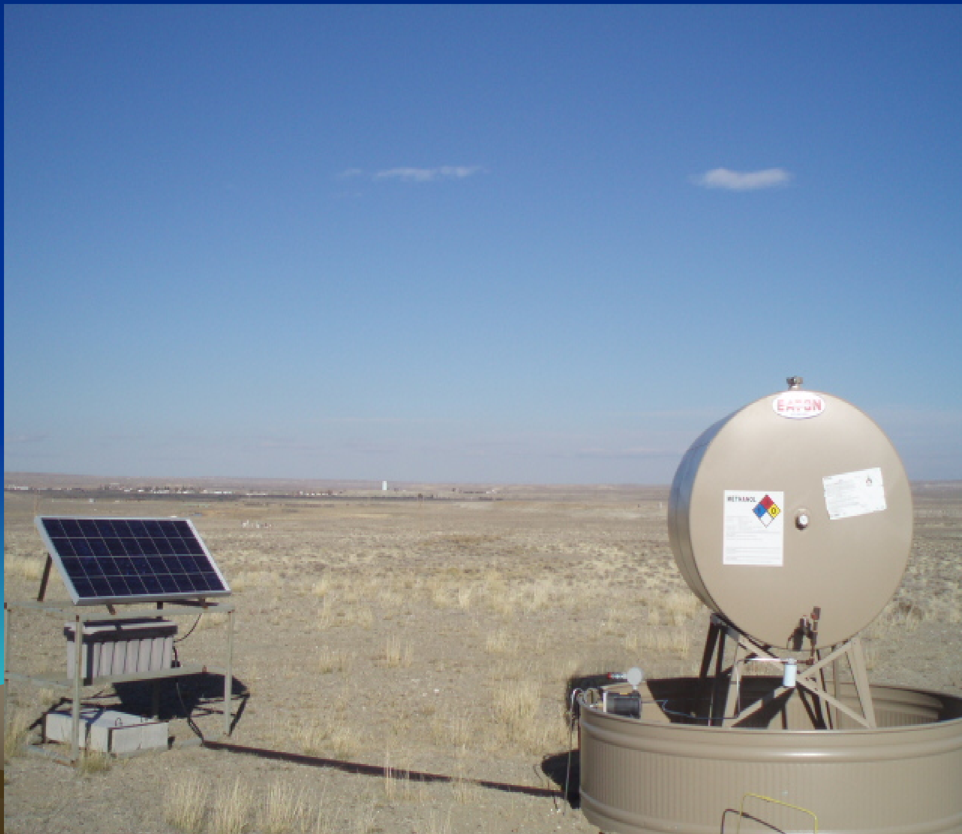




Moxa Geographic Location

Granger, Wyoming

Solar Methanol pump



Moxa’s severe winter

Challenge:

- Eliminate hydrates in the production string while producing.
- Pump down time contributes to the build up of hydrates.
- Hydrates cause production downtime and unsafe operations
- Some times hydrates are mistaken as liquid loading, causing operators to use incorrect operating procedures, which can cause a hazardous situation
- **Reduce Green House Gas emissions**
- Minimize methanol spills
- Lower Methanol consumption

The Hazards of Hydrates!!!

Pre-solar

- In the past we used two different styles of pumps: Western and Texteam
- These pumps would use an average of 6-8 gallons of methanol a day
- Working off a gas supply from the separator, **they would also vent to the atmosphere.**


75'
Fuel line distance from
separator to pumps


Western methanol pump

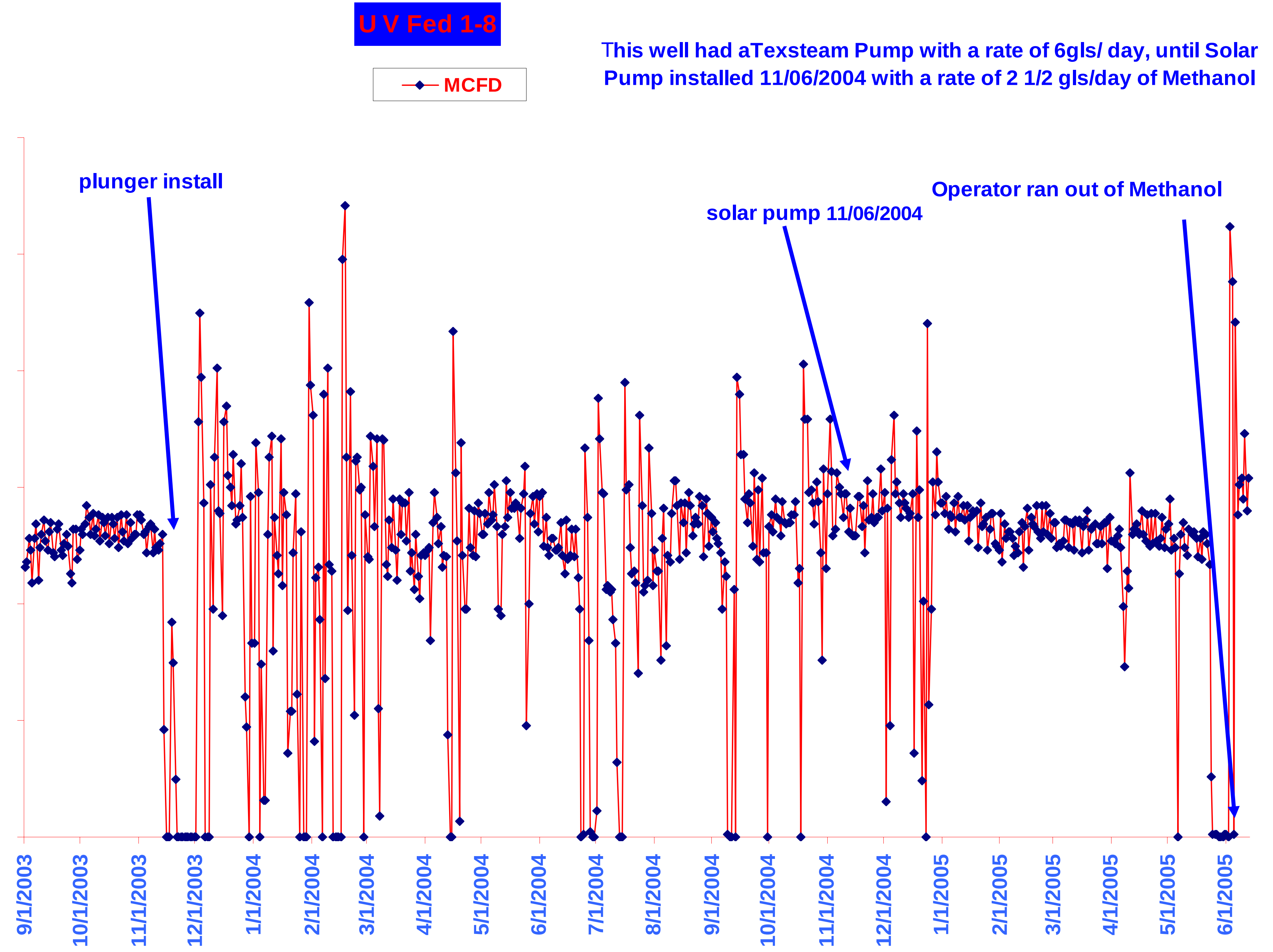

Texteam methanol pump

Solar Pump Advantages

- More reliable than diaphragm pumps.
- Reduce methanol usage to an average of 2.5 gallons per day
- Sell vs. vent gas

Solar Pump Advantages Cont.

- Fuel Gas savings.
- Less refilling of the methanol tank will reduce the chance of a spill incident.
- A more reliable pump means less down-time on production.


U V Fed 1-8
MCFD
This well had aTexsteam Pump with a rate of 6gls/ day, until Solar Pump installed 11/06/2004 with a rate of 2 1/2 gls/day of Methanol
plunger install
solar pump 11/06/2004
Operator ran out of Methanol
9/1/2003
10/1/2003
11/1/2003
12/1/2003
1/1/2004
2/1/2004
3/1/2004
4/1/2004
5/1/2004
6/1/2004
7/1/2004
8/1/2004
9/1/2004
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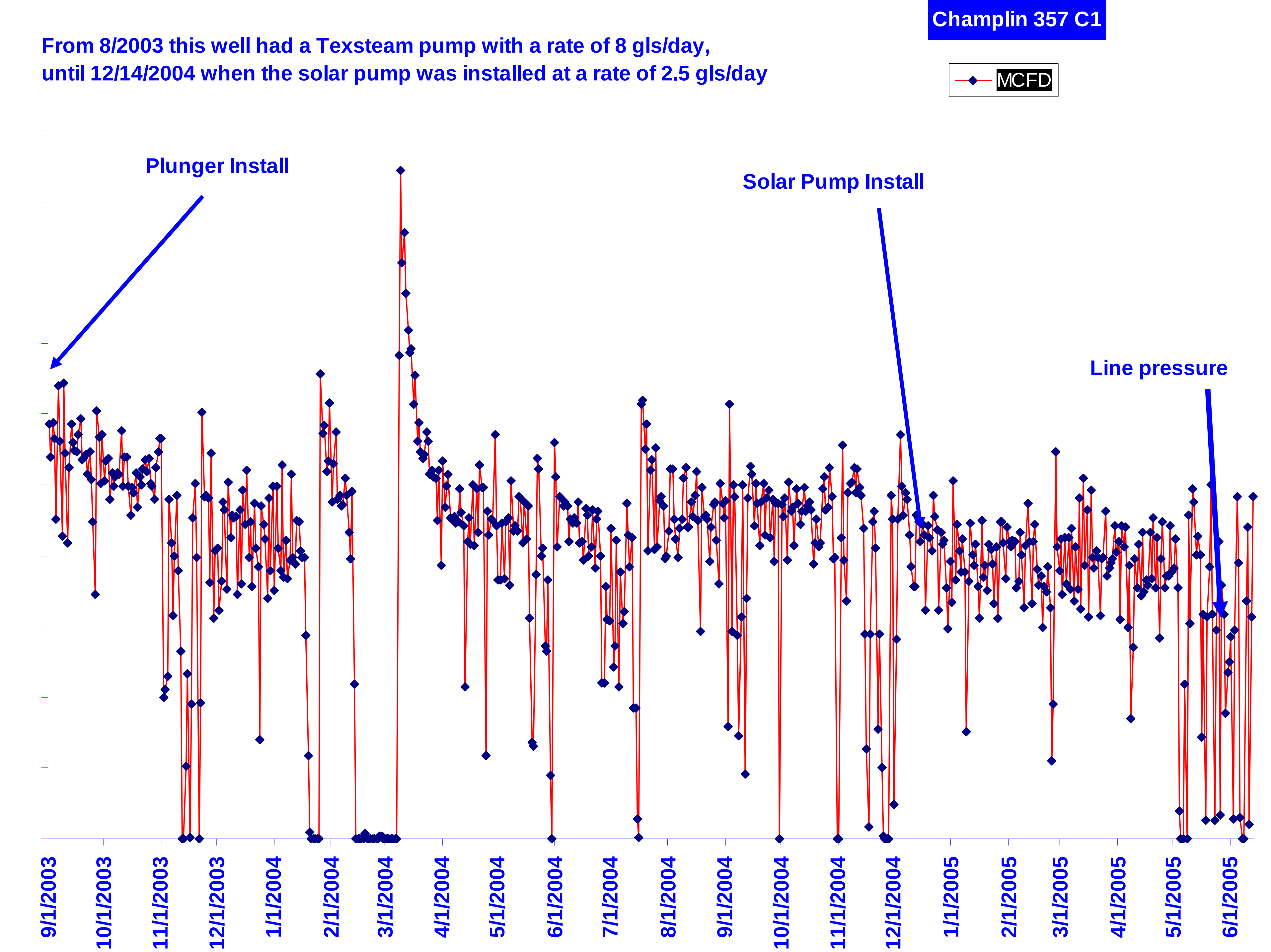


Champlin 357 C1
From 8/2003 this well had a Texsteam pump with a rate of 8 gls/day,
until 12/14/2004 when the solar pump was installed at a rate of 2.5 gls/day
MCFD
Plunger Install
Solar Pump Install
Line pressure
9/1/2003
10/1/2003
11/1/2003
12/1/2003
1/1/2004
2/1/2004
3/1/2004
4/1/2004
5/1/2004
6/1/2004
7/1/2004
8/1/2004
9/1/2004
10/1/2004
11/1/2004
12/1/2004
1/1/2005
2/1/2005
3/1/2005
4/1/2005
5/1/2005
6/1/2005

Economics

- 160 solar pumps cost $500,000.
- Methanol savings pay out is 1.3 years
- Texsteam & Western rate of 6-8 gal/day
- $1.5 gal x 160 pumps x 7 gal/day= $613,200 / year
- Solar pump rate of 2.5 gal/day
- $1.5 gal X 160 pumps x 2.5 gal/day= $219,000 / year
- Methanol savings of $395,000 / year
- 4 wells down at 300 mcfd for 6 months = $1.3 M

- ***Solar pumps pay out in less than 3 months in winter conditions.***

End Results

- The use of solar pumps keep production loss and hydrates to a minimum.
- Fine tune methanol usage.
- Less methanol usage 8 gal/day to an avg. of 2.5 gal/day.
- Elimination of fuel lines and freezing problems during winter times. (6-8 months of the year)
- **No Emissions**
- Less maintenance
- All this it will help us to have a safer and better environment operations

Solar Glycol Pump

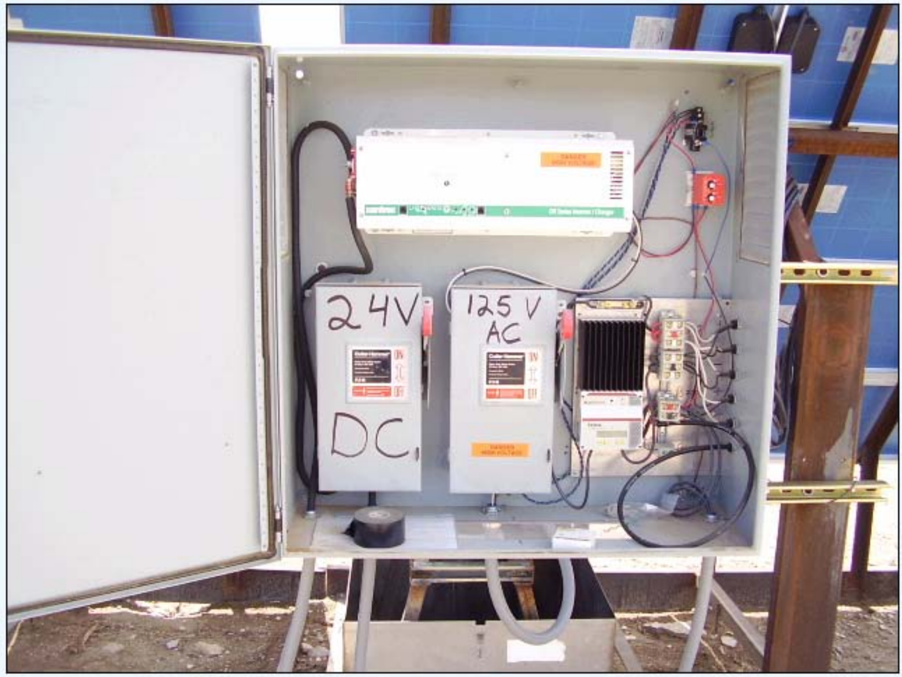
Solar Gycol Pump Tests

- Currently use heated GW for heat trace at well facilities.
- Fuel gas consumption is 4-13 mcf/d for each diaphragm pump (based on pump curves). Some wellsites have two pumps.
- Target FG savings about 1.2 mmscf/d -- 80% of the 430+ wells @ 8 months/yr run time.

First test

- System composed of solar panel, batteries, 24V to 120 Vac inverter, ½ hp motor and gear pump. Pumping about 3-4 gpm.
- Efficiency is poor taking over 1.2 electrical hp to generate .042 hhp– 3.5% total efficiency.
- Three shut-downs due to low voltage from Dec. 06 through July 07,
- Kept the well from freezing except for a few days during -41F weather in Jan (4gpm)
- Illustrated the need for more efficient pump/motor

First System



Test two

- •Using 24 V 1/5 hp brushless DC motor:
  - •Eliminates cost of inverter and energy conversion loss
  - •No high voltage safety concerns
  - •Higher efficiency motor
- •On line Feb ’07, but several shut down’s, reason unknown
- •Test run: 0.39 hp to generate .054 hhp, 14% total efficiency, 400% improvement

Second System

Final (?) version

- Using 24 V 1/2 hp brushless DC motor, close coupled gear pump:
  - 680 W solar generator
  - 800 A-hr battery
  - 5.5 gpm, 25 psig discharge, 5.5 amps
- 4 month run time, no problems
- Electrical to hydraulic power conversion efficiency >35%, up from 3.4% on the first system.
- Currently concentrating efforts to improve heat transfer,