

US EPA ARCHIVE DOCUMENT



August 31, 2004

Tomas A. Driscoll  
USEPA/OAQPS/EMAD/EFPAG  
109 TW Alexander Drive (D243-02)  
Research Triangle Park, NC 27709  
driscoll.tom@epa.gov

Subject: Comments on Stage II Vapor Recovery System Issue Paper

Dear Mr. Driscoll:

The Stage II vapor recovery efficiency used in the paper does not take into consideration that the required ORVR compatible Stage II systems are more efficient. At least 95% now vs 85% before ORVR.

The ORVR compatible balance Stage II system achieves an efficiency of almost 99% with no vent stack losses because the ORVR vehicles cause the system to operate at a negative pressure.

The ORVR compatible assist Stage II systems are also more efficient because they maintain a negative system pressure.

In addition improvements have been made in the nozzles to reduce spitback, spillage and nuisance shut offs when fueling ORVR equipped vehicles.

In figure 6 it would be more accurate to use a Stage II control efficiency of 95%. This moves the cross over, point B, out to 2020.

We have enclosed a CD of a presentation we gave to CAPCOA in July of this year containing test results that demonstrate why today's balance Stage II vapor recovery systems have such a high efficiency as a result of the introduction of ORVR vehicles.

Our StreamShaper CD, enclosed, shows what we have done to improve the fueling of ORVR vehicles.

Sincerely Yours,

A handwritten signature in black ink, appearing to read "Arthur C. Fink, Jr.", is written over a printed name and title.

Arthur C. Fink, Jr.  
VP Engineering

Enclosed:  
StreamShaper and Why a Balance System Works, CDs.

cc David Good



## Why a Balance Phase II Vapor Recovery System Works

July 2004

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

1



## Stations operate at a negative pressure!

- Why does a balance ORVR compatible / EVR phase II vapor recovery system work?
- Because the station operates at a **NEGATIVE** pressure...
- ...the UST acts like a giant vac-assist vapor pump

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

2



## A typical phase I station...

- A "typical" station has two 10,000 gallon tanks pumping 200,000 gallons per month at an average of 448 gallons per hour during the day.

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

3



## When fuel is dispensed an equal volume (of something) must replace the fuel

- Pumping 20 gallons of fuel into a single vehicle will lower the pressure in the system from 407 wc to 406.18 wc assuming an ullage of 10,000 gallons at an atmospheric pressure of 407 in wc
  - The formula is  $P_1V_1 = P_2V_2$
  - $407" \times 10,000 \text{ gallons} = 406.18" \times 10,020 \text{ gallons}$
- Pumping 200.5 gallons of fuel will drop the pressure 8" from 407" wc to 399" wc
  - $407" \times 10,000 \text{ gal} = 399" \times 10,200.5 \text{ gallons}$
- A pressure drop of -8"wc will cause the PV vent to open

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

4



## Only 43 cfh of air is needed to replace a 60 cfh ullage increase in the tank

- During the day the average pumping rate will be about 448 gallons per hour producing a 60 cfh increase of the ullage
- To satisfy this ullage increase, air will be drawn in through leaks in the system, as well as, the PV vent if the system reaches a  $-8''$  wc
- As each cubic foot of air is ingested it expands into 1.4 cubic feet of vapor
- **43 cfh of air becomes 60 cfh of vapor in the storage tank!**

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

5



## Assist phase II vapor recovery systems have a positive system pressure

- When the system is equipped with an assist phase II vapor recovery system air is FORCED into the system
- When fueling an ORVR vehicle, the air will be forced into the system at a rate equal to the increase in the ullage, an A/L of 1
- This air then expands by 40% when it mixes with the HC and pressure increases until the PV vent opens
- With 10,000 gallon ullage, pumping 185 gallons of fuel into ORVR vehicles causes 185 gallons of air to be **forced** into the system, which expands into 260 gallons of vapor, raising the system pressure by  $3''$  wc and opening the PV vent valve

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

6



## Balance phase II vapor recovery systems have a negative system pressure

- When a system is equipped with a balance Phase II vapor recovery system the change in the ullage is satisfied by the vapors returned from the vehicles through the nozzle, hose, dispenser and piping
- The system tends to operate at a slightly negative pressure because the volume of vapor available from the vehicle fuel tank is slightly less than the volume of fuel dispensed into the tank
  - With a V/L of only 0.95 pumping 448 gallons per hour will only return about 425 gallons per hour of vapor to the system resulting in a negative system pressure

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

7



## Balance system negative pressures were demonstrated in 1989

- Husky performed a 100 car CARB efficiency test in 1989 with our balance products
- A roots meter was installed on the vent stack to measure any fugitive emissions
- **There were no emissions, only a slight air intake**

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

8



## ORVR vehicles assist in increasing negative system pressures at balance sites

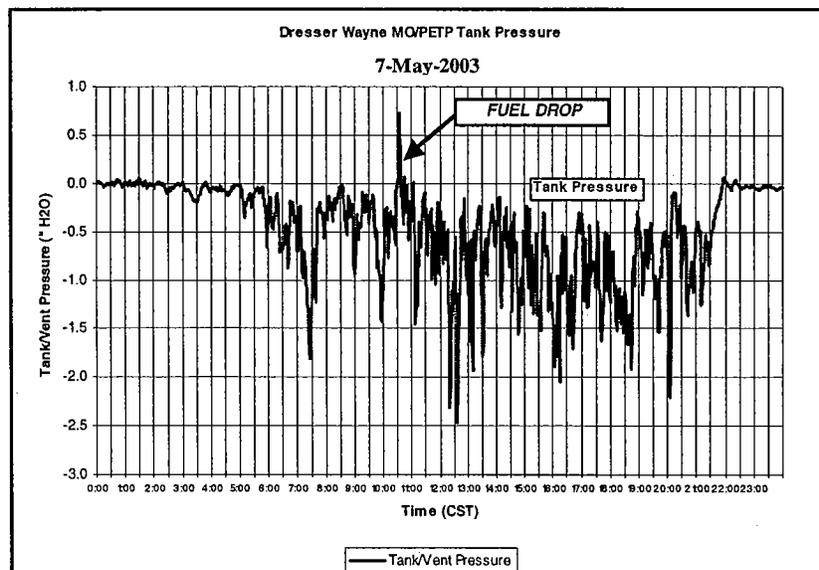
- When ORVR vehicles are also being fueled with the balance system the volume of vapor being returned to the UST is reduced dramatically, resulting in system pressures averaging -1" wc or greater
  - With only 10% ORVR vehicles being fueled the V/L is reduced from 0.95 to 0.85
  - With 30% ORVR vehicles the V/L is only 0.66
- So pumping 448 gallons per hour will only return 295 gallons per hour of vapor to the system producing a negative system pressure
- This gives very high vapor recovery efficiencies and prevents fugitive emissions
- Example: The 50 car test done at the Husky balance test site had an efficiency of **98.5%**

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

9



## Typical pressure profile



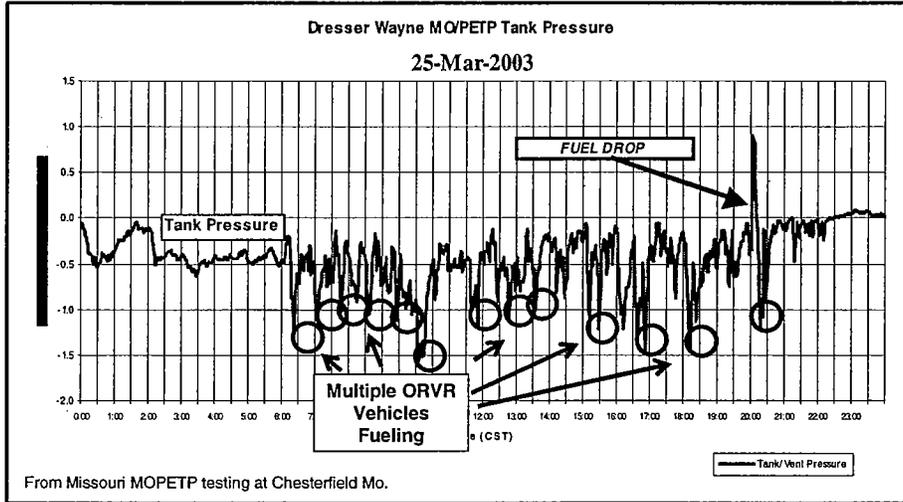
• Safety • Quality • Customer Loyalty • Team Building • Productivity •

10



## ORVR vehicles have a significant impact

The effects of the ORVR vehicles can readily be seen by the sudden reduction in the system pressure each time one is fueled.

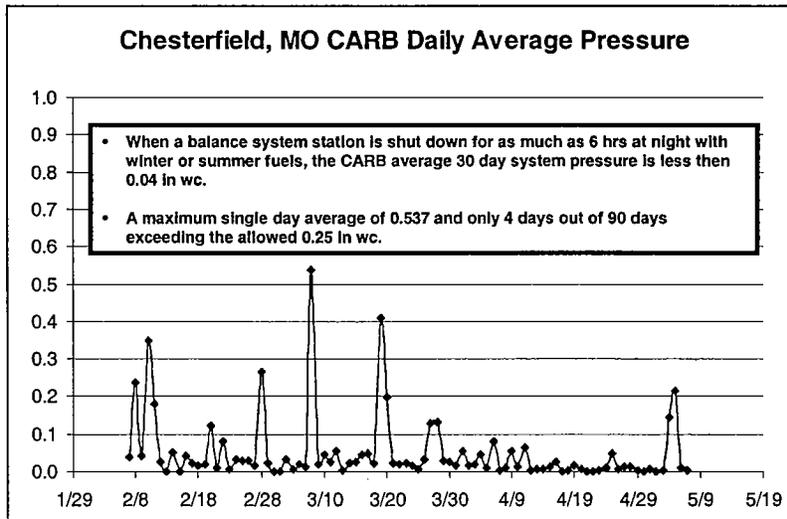


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

11



## Station shut downs have little effect...

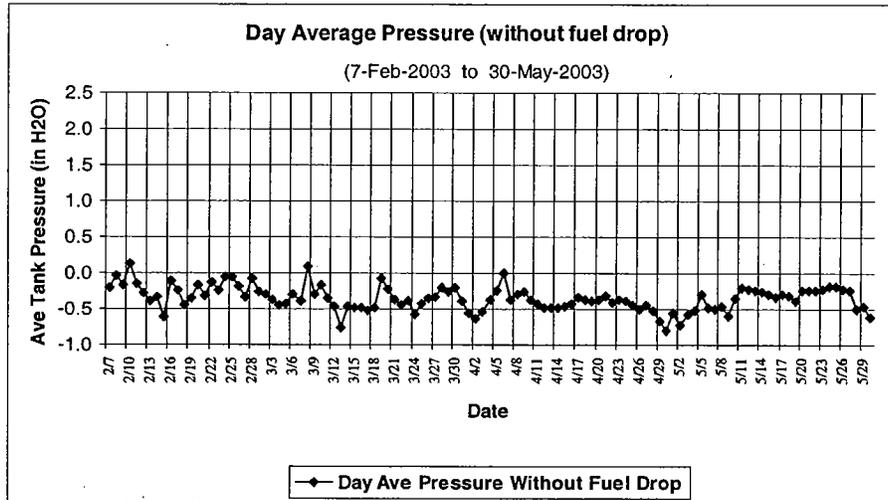


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

12



## Without fuel drops, system pressure is negative

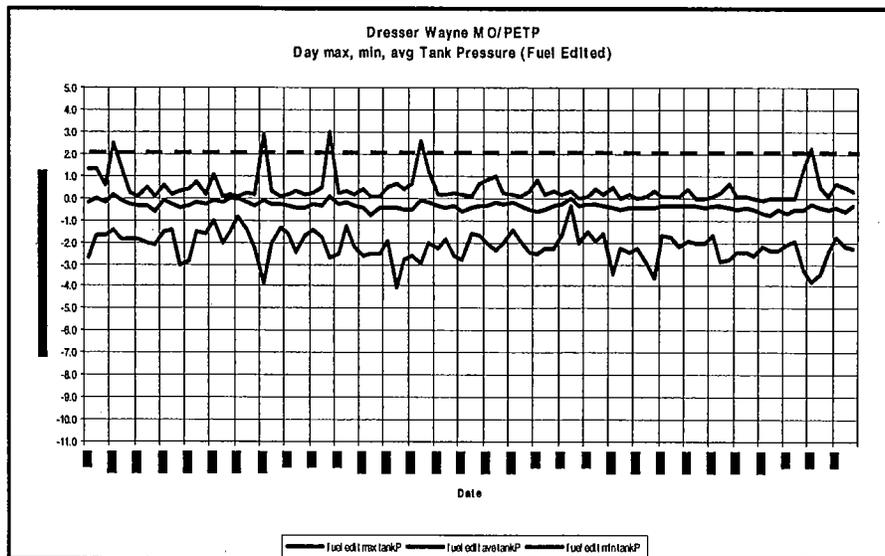


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

13



## 90-day pressure profile

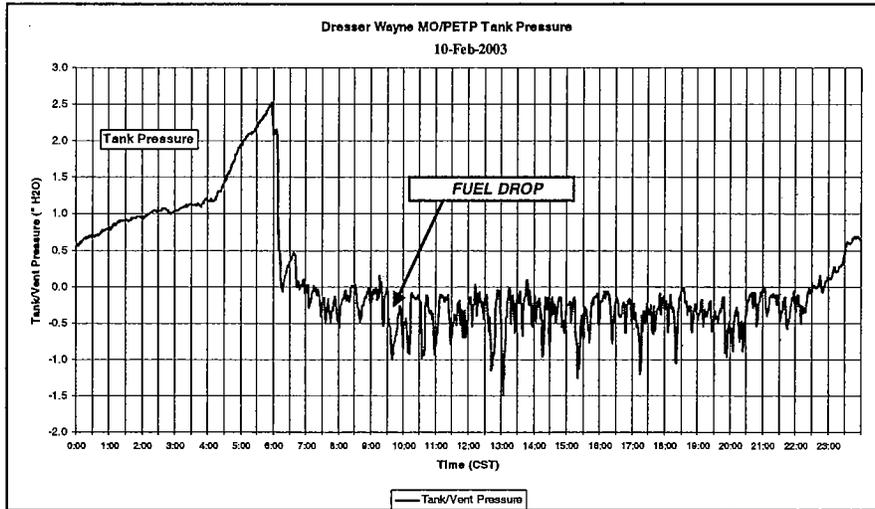


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

14



February 10, 2003

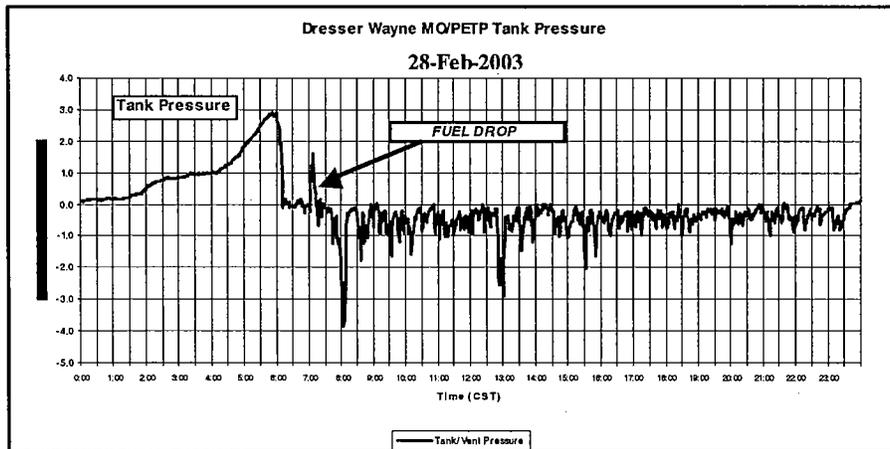


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

15



February 28, 2003

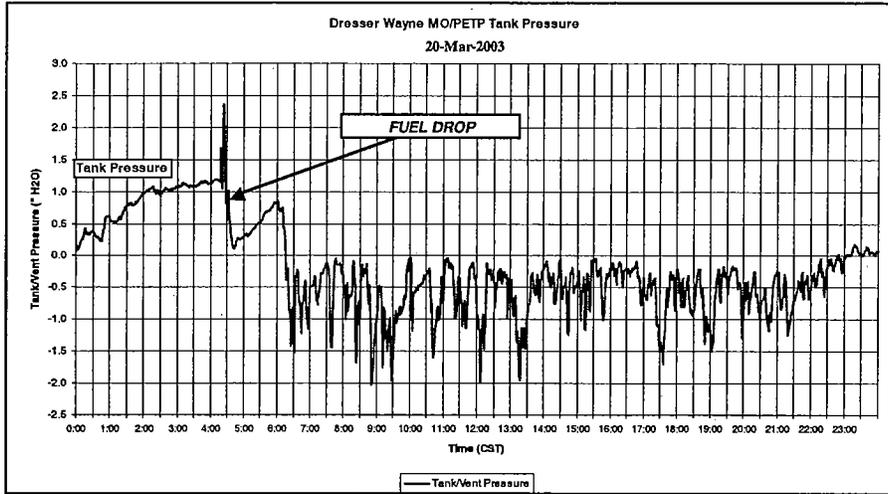


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

16



March 20, 2003

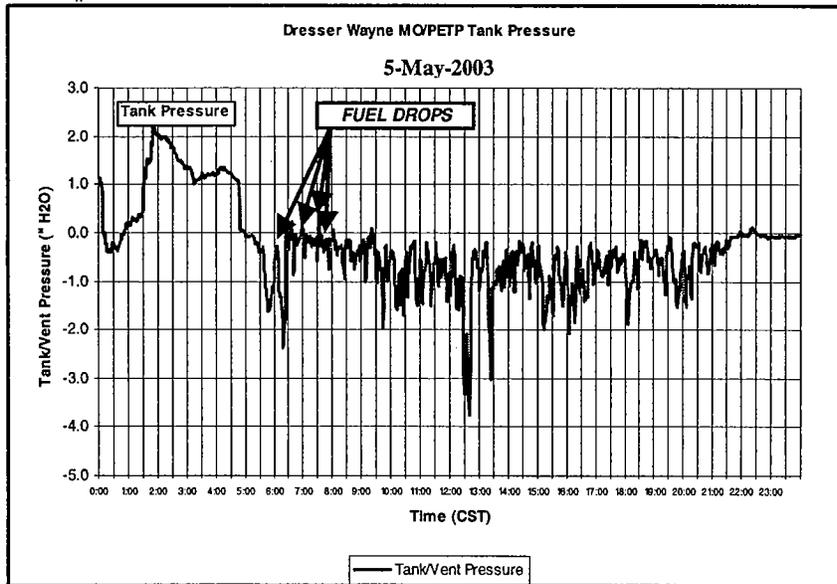


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

17



May 5, 2003

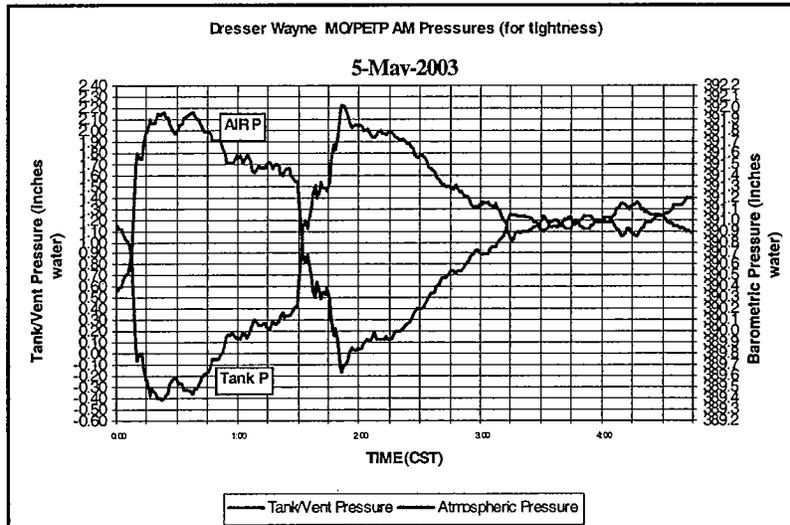


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

18



## May 5, AM Pressures

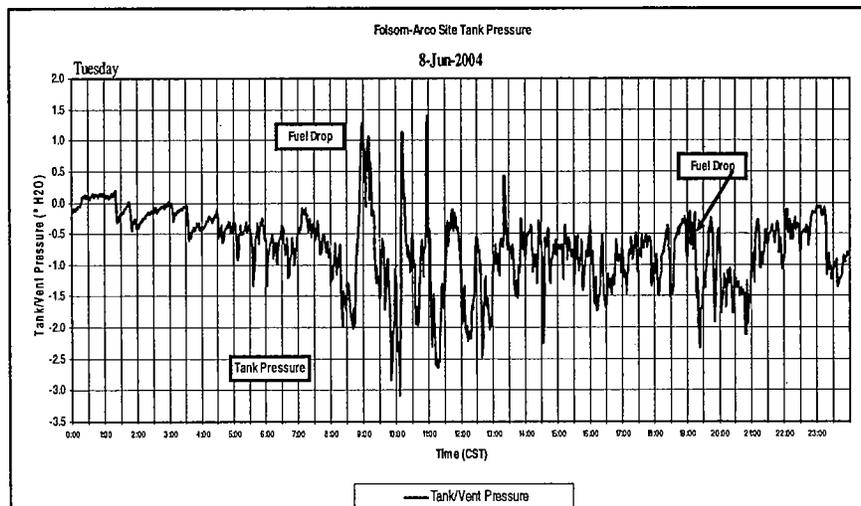


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

19



## Folsom, June 8, LX test day

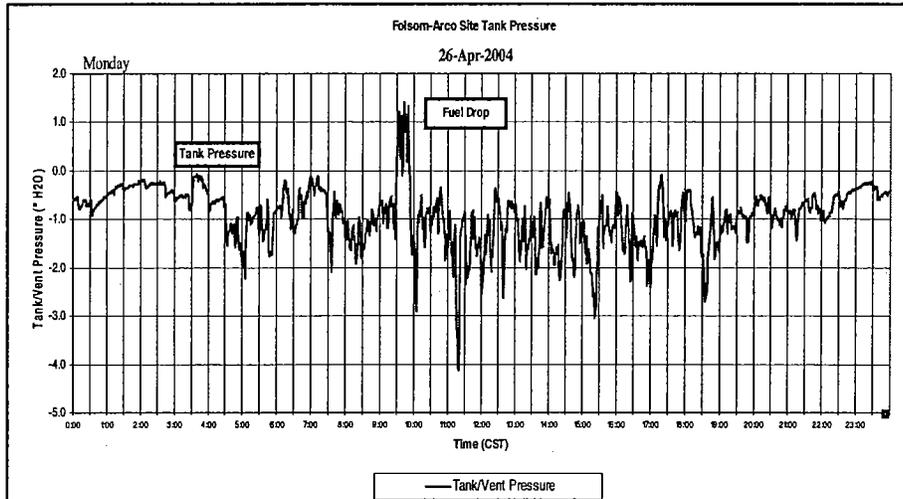


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

20



## Folsom system Pressure April 26

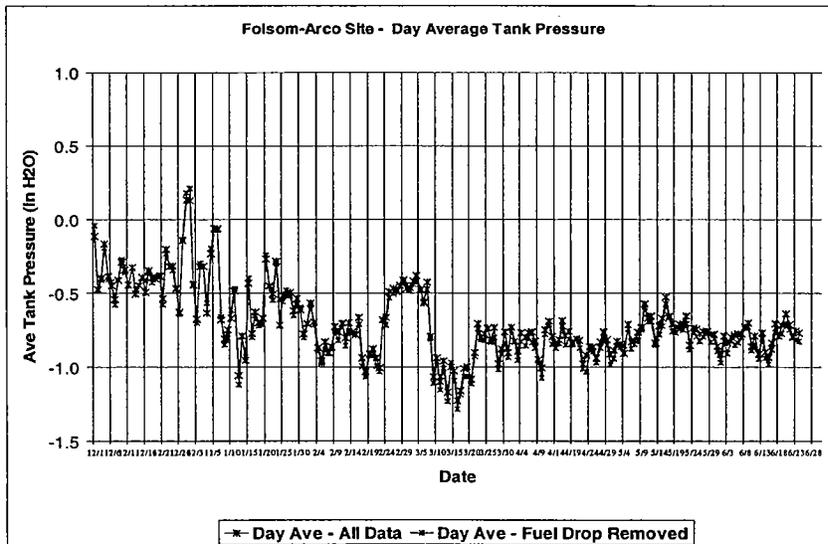


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

21



## Folsom day ave pressures 12/1/03 to 6/24/04

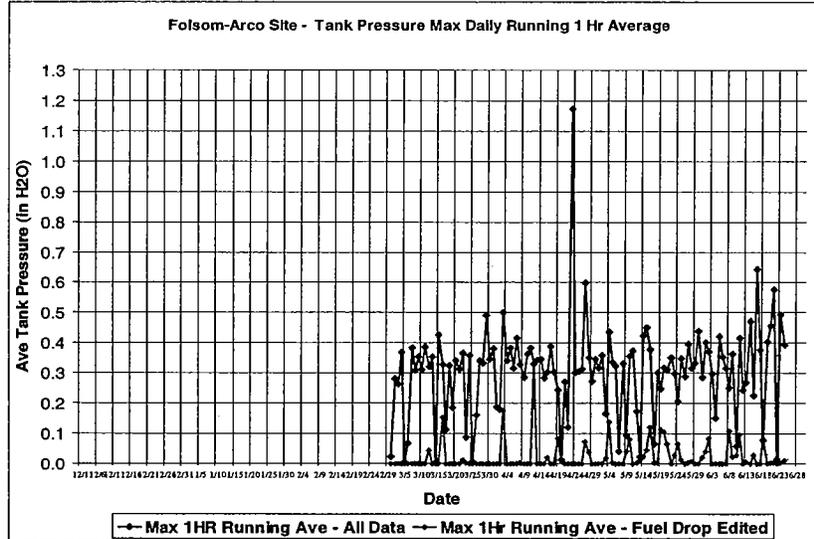


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

22



### Folsom 1 hr running ave Mar 1 to June 24

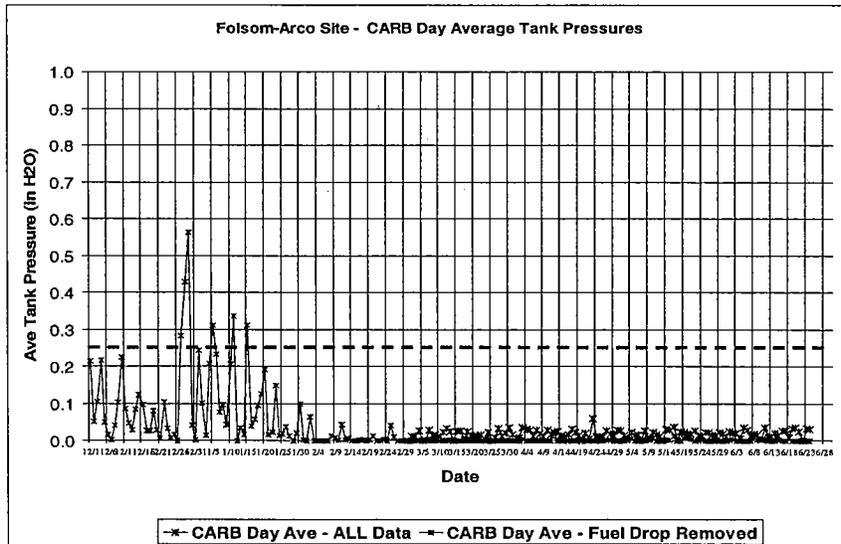


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

23



### Folsom CARB Day Ave Pressures 12/1/03 to 6/24/04

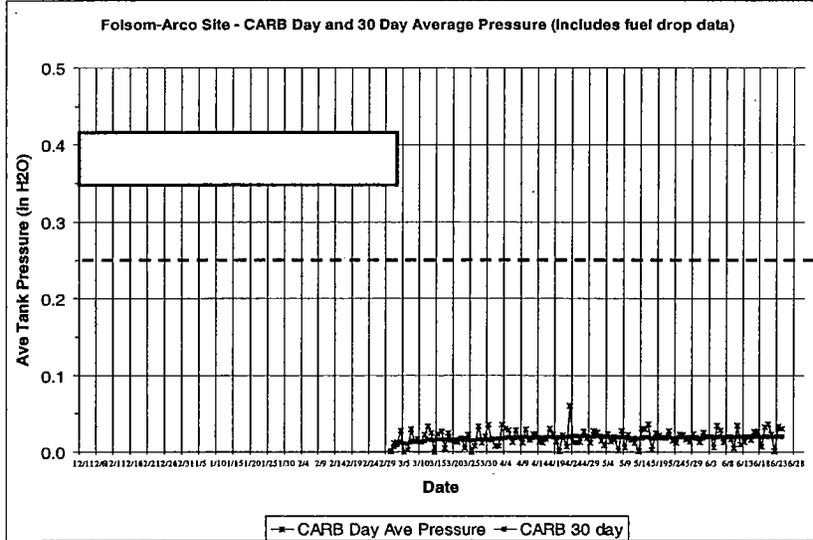


• Safety • Quality • Customer Loyalty • Team Building • Productivity •

24



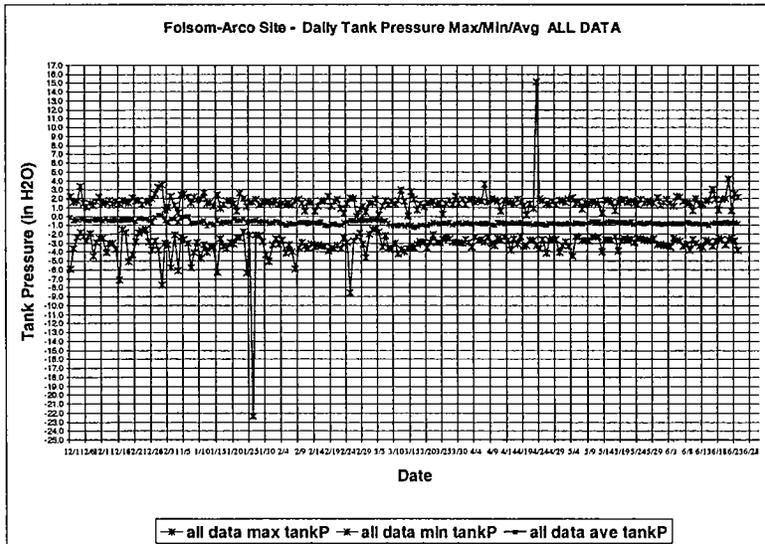
### Folsom CARB 30 day ave Pressure 3/1/03 to 6/24/04



• Safety • Quality • Customer Loyalty • Team Building • Productivity •



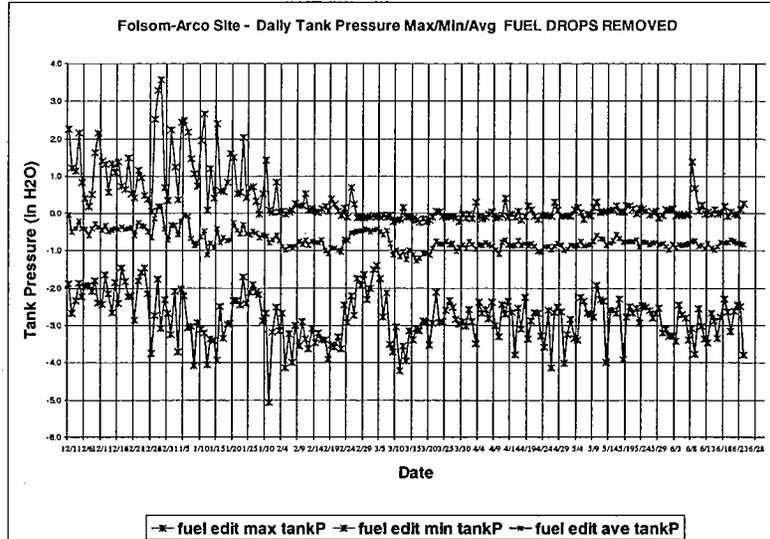
### Folsom Max/Min/Ave all Pressure data 12/1/03 to 6/24/04



• Safety • Quality • Customer Loyalty • Team Building • Productivity •



## Folsom Max/Min/Ave Pressure no fuel drops 12/1/03 to 6/24/04



• Safety • Quality • Customer Loyalty • Team Building • Productivity •

27



## Stations operate at a negative pressure!

- Why does a balance ORVR compatible / EVR phase II vapor recovery system work?
- Because the station operates at a **NEGATIVE** pressure...
- ...the UST acts like a giant vac-assist vapor pump

• Safety • Quality • Customer Loyalty • Team Building • Productivity •

28