Vapor Leaks: Pressure's Building

Presented by

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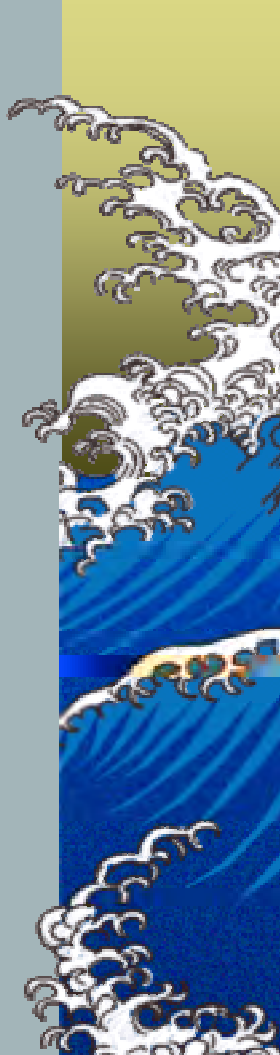
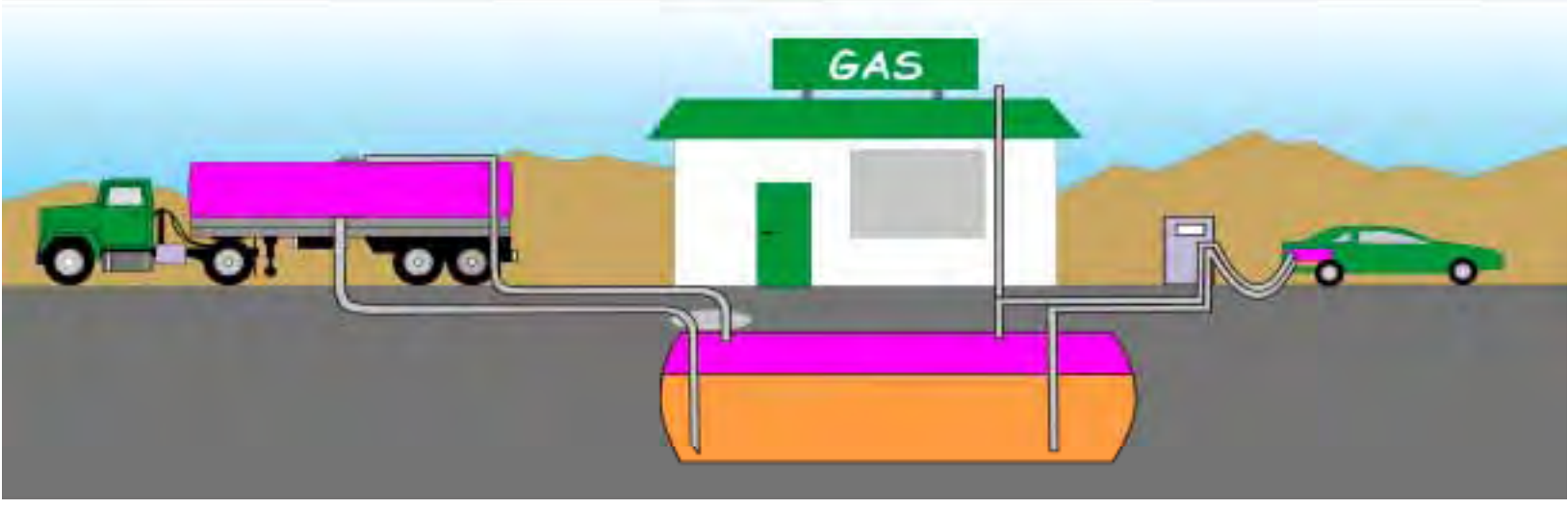
What Causes Vapor Leaks?

- UST Pressurization
  - Delivery Pressure Spikes
  - Stage II System Design and Operation
    - Vapor Growth
    - A/L Ratio > 1
    - ORVR System Incompatibility
- Leaky Components



Stage I vs Stage II Vapor Recovery

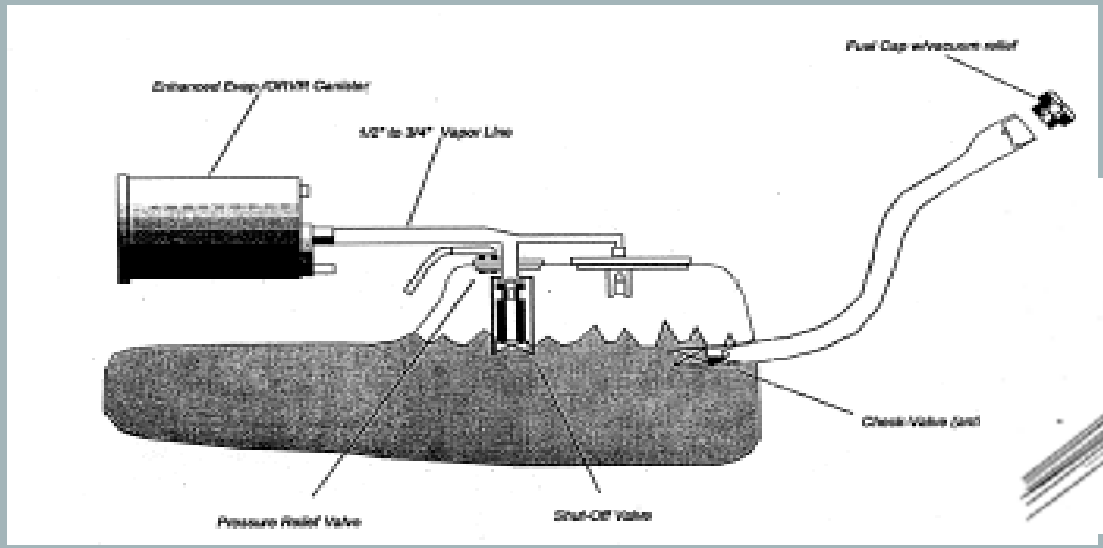
Stage I - Recovering Vapors While Filling UST

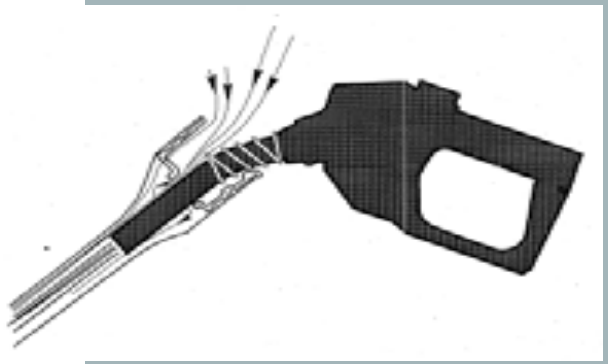


Stage II - Recovering Vapors While Filling Vehicle

Courtesy Gilbarco/Veeder Root

ORVR Vehicle Tank

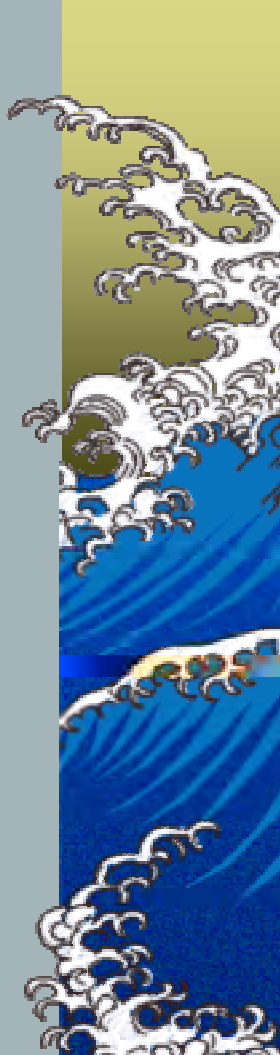




Vapors are routed to ORVR canister. Fill pipe diameter narrows after unleaded restrictor plate. This creates a liquid seal that forces vapors into ORVR canister. It also causes an inward flow of air into the fill pipe. There is no vapor for a vacuum assist system to recover. Vacuum assist systems return air to UST.

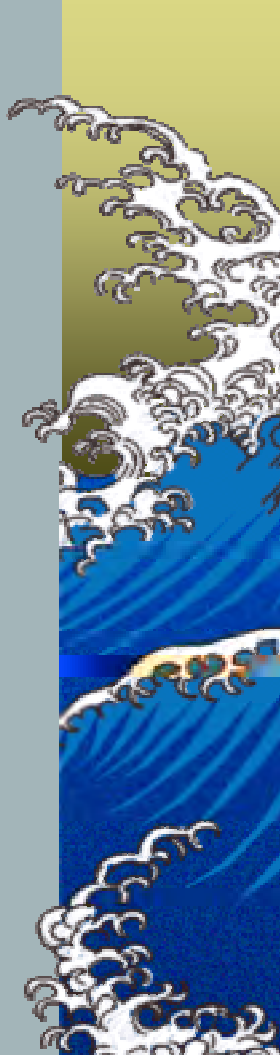
Leaky Components

- Atmospheric Leaks
  - Pressure Vents, Dispenser Leaks, Nozzles
- Subsurface Leaks
  - Dry Breaks, ATG Covers, Fill Caps, threaded connections…..
- Fixing Atmospheric Leaks Promotes Subsurface Leaks



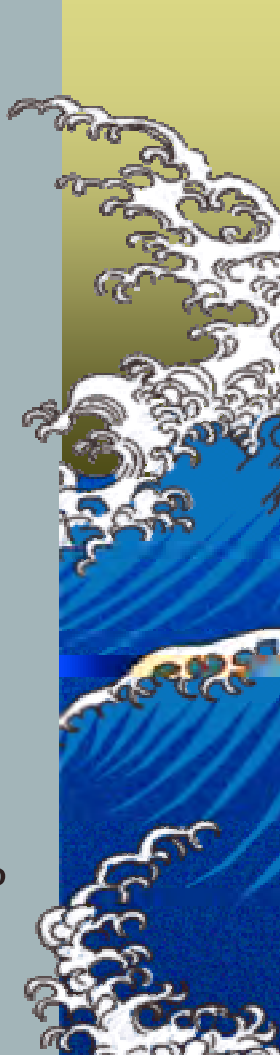
Why are Vapor Leaks Important?

- Numerous Vulnerable Systems Present
  - Stage I Systems – Most of Existing Tanks
  - Stage II Systems – 45,000 USTs
- Leaks are Common
  - NH Pressure Decay vs. MtBE Concentration Study
    - Suggests 75% of Stage II stations with leaks
    - Leaks, when present, average 30ppm MtBE near UST



Why are Vapor Leaks Important?

- Volatile Constituent Problem
  - Volatile components concentrate in vapor phase, represents high % of mass in leak
    - MtBE low biodegradability yields MtBE dominant sites (Lahvis API modeling, NH DES site review)
      - Reimbursement Fund Spending
      - Receptor Threats
    - Benzene, Ethanol high biodegradability yields DO sink?



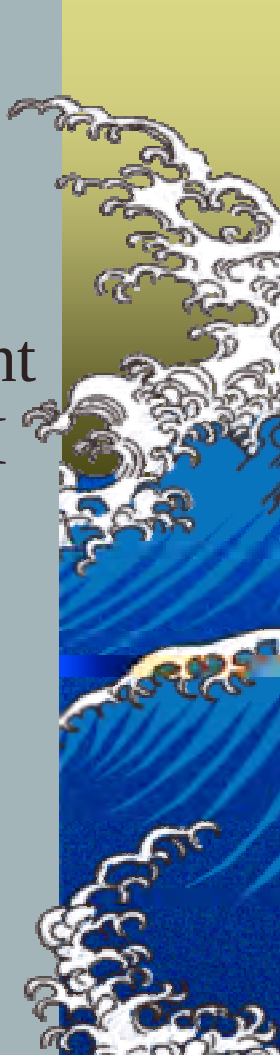
Vapor Composition Factor

Constituent	*Vp (mm Hg)*	*RFG Gas Composition*	*Liquid/Gas Composition**
MtBE	*251*	*10 to 15%*	*3.7 / 9.3%*
Benzene	*86*	*0 to 4.9%*	*2.2 / 5.2%*
Toluene	*28*	*1 to 20%*	*18.2 / 7.8%*
Ethylbenzene	*10*	*.2 to 4%*	*4 / 0.6%*
Xylenes	*6.6-8.7*	*1 to 18%*	*15.4 / 2.1%*
Butanes, pentanes, hexanes & enes	*1824 to 151*	*15%*	*15 / 46.3%*

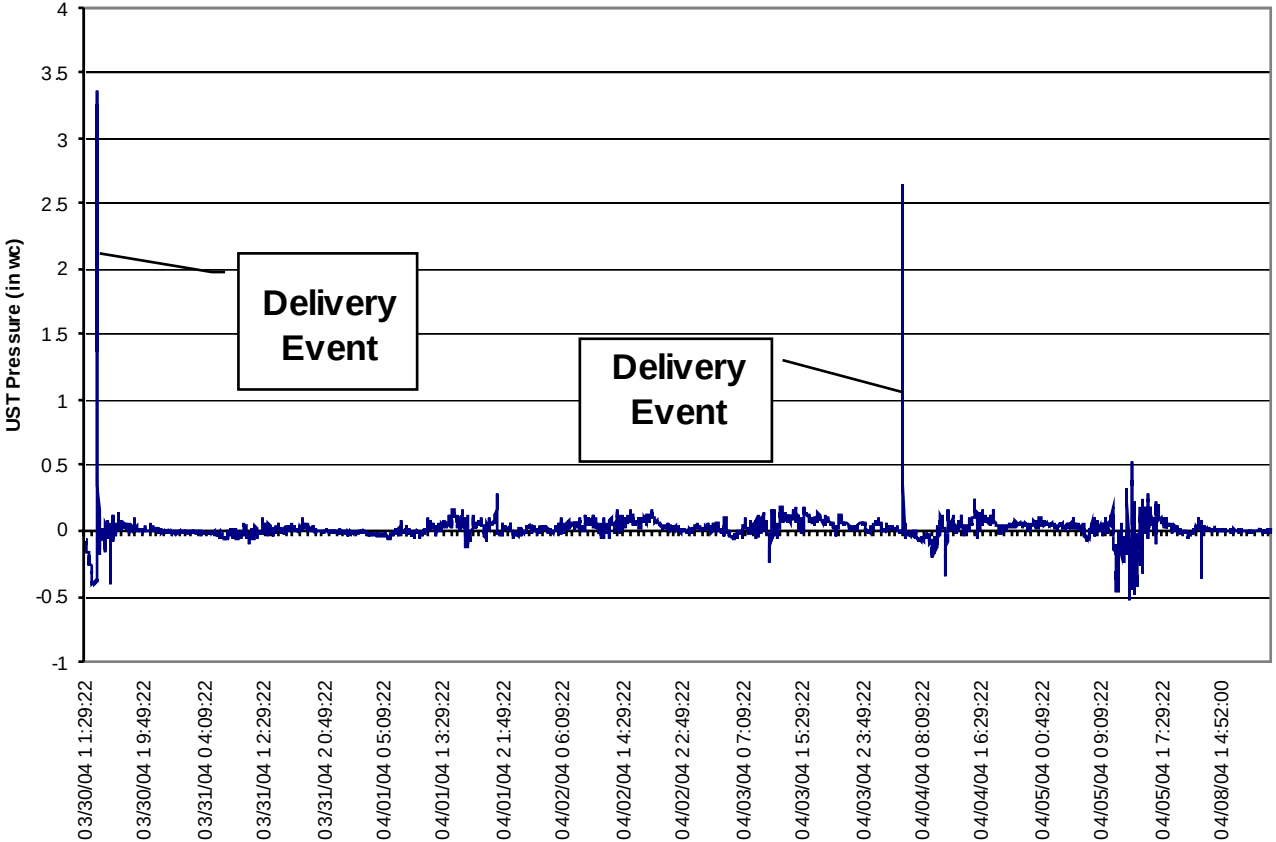
* Example composition from Lauri Saarinen People and Work Research Report 51. Note: Ethanol has a vapor pressure of 53 mm.

NH Studies

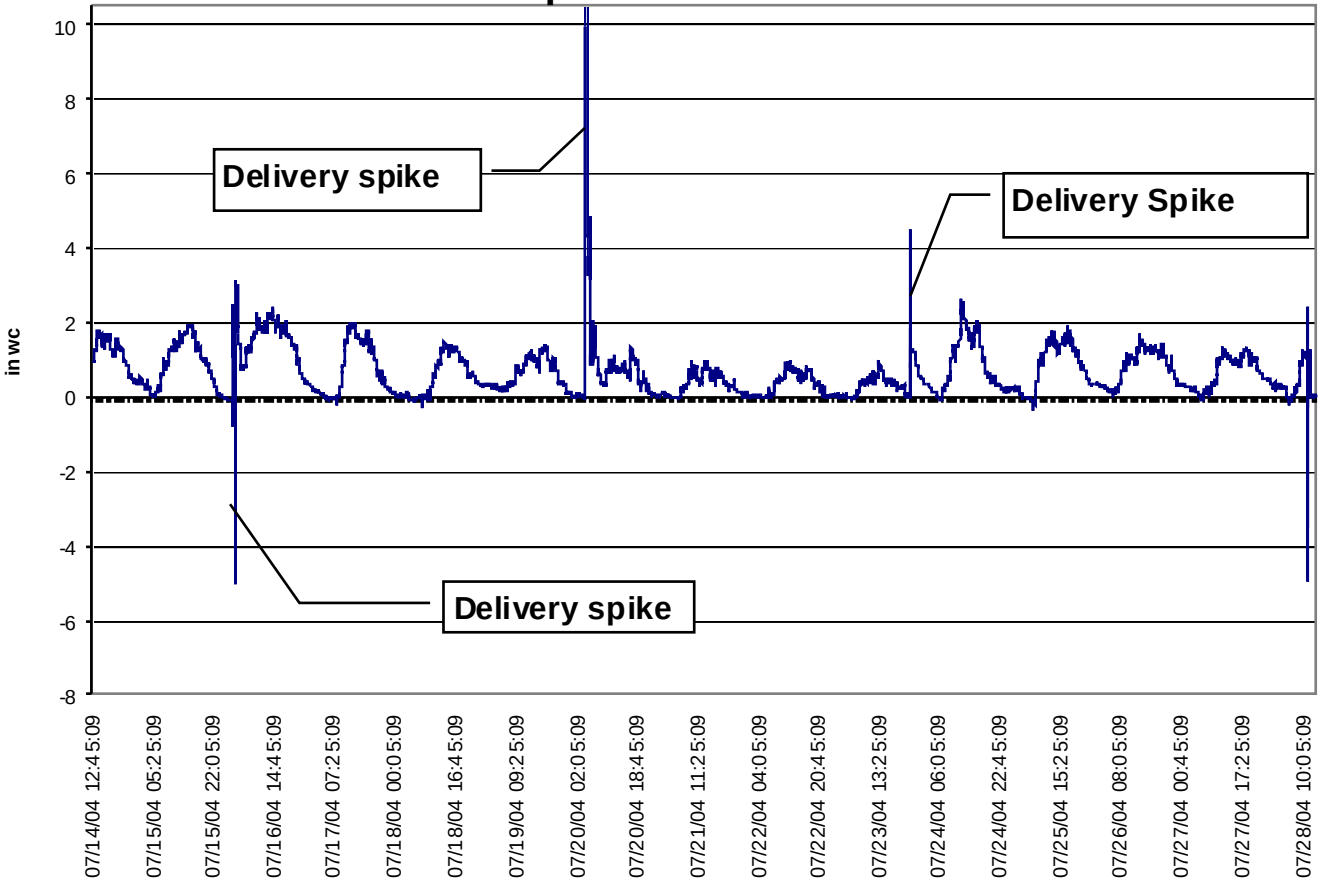
- NH Site Data Review (MtBE only or dominant sites at approximately 30% of the NH Stage II System Equipped Sites)
- UST System Pressures Profiling
- Stage I System Vapor Leaks
- Stage II System Pressure Reduction



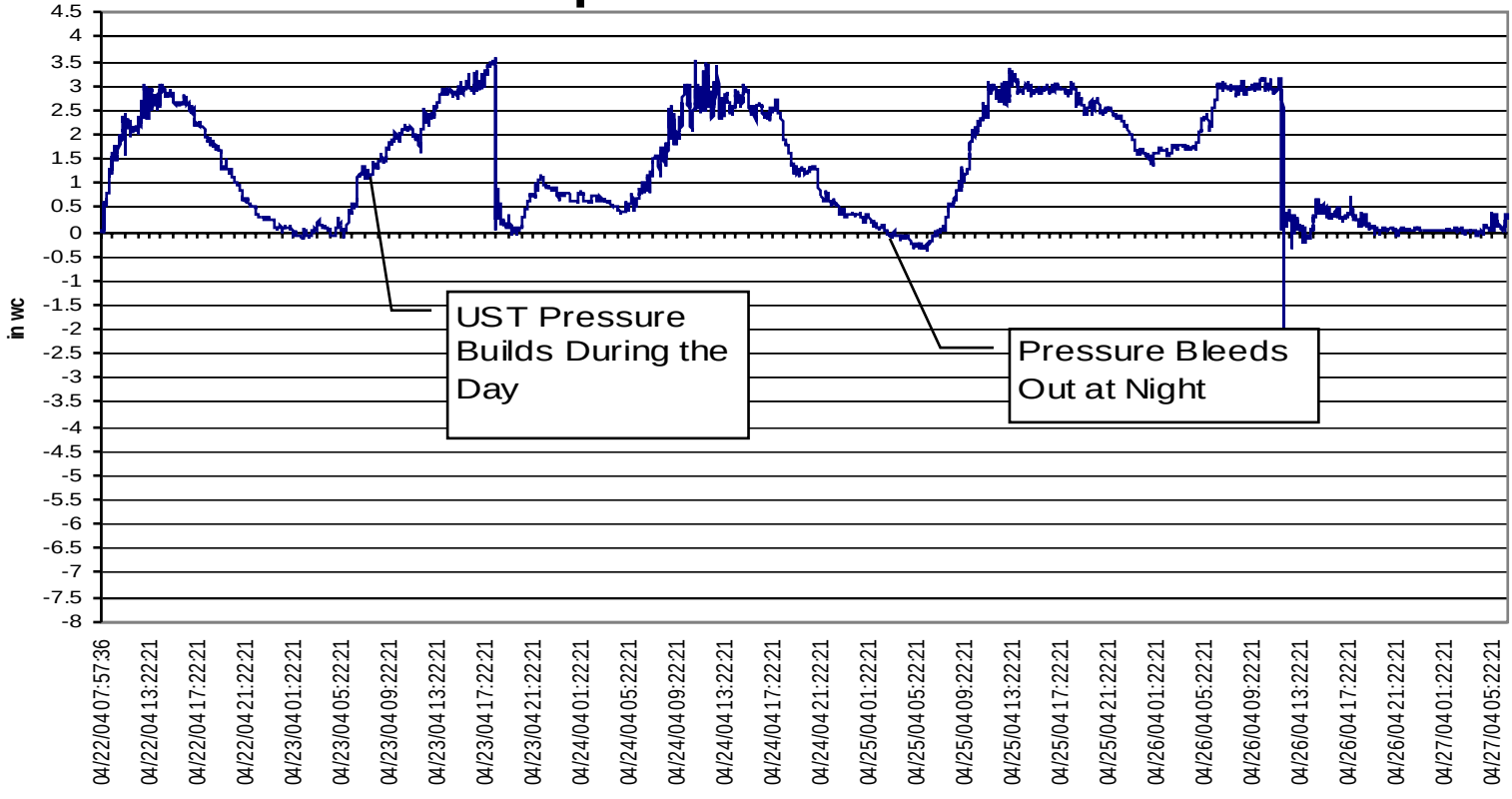
Stage II - Balance System Pressure Profile



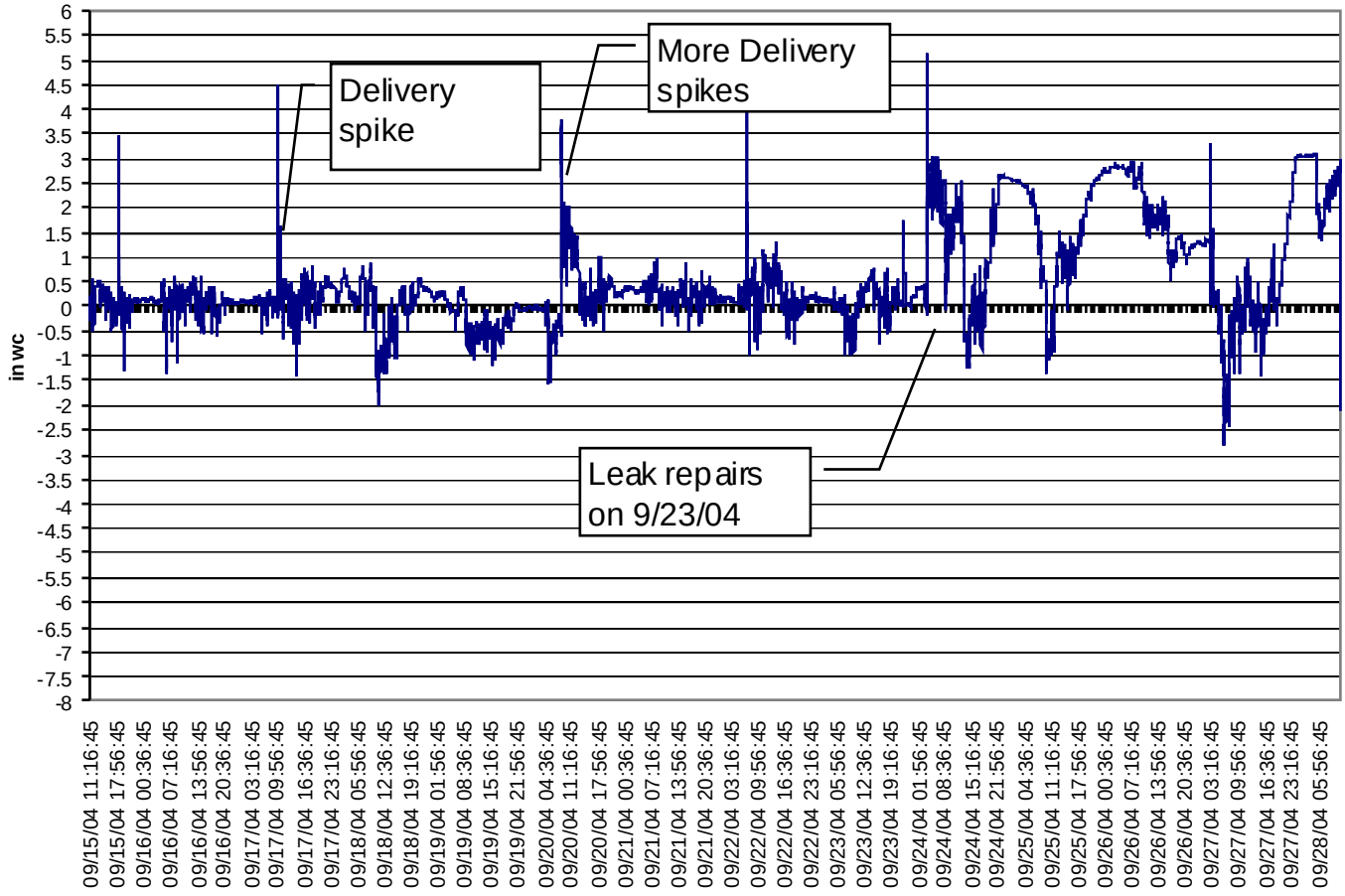
Plaistow Citgo, New Hampshire
UST pressure in inwc



O'Briens, a tighter vacuum assist system
UST pressure in inwc



Healy ORVR Nozzle



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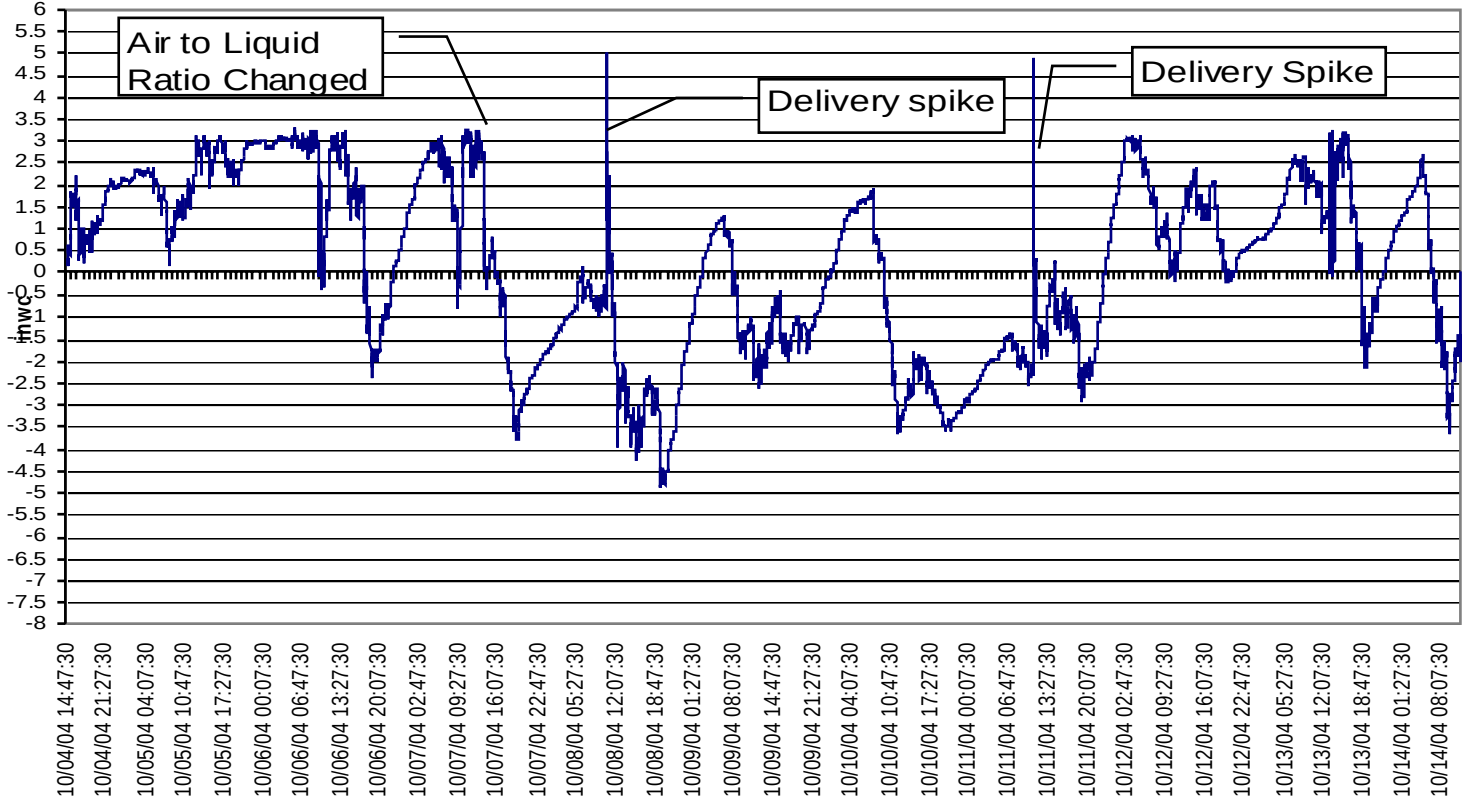
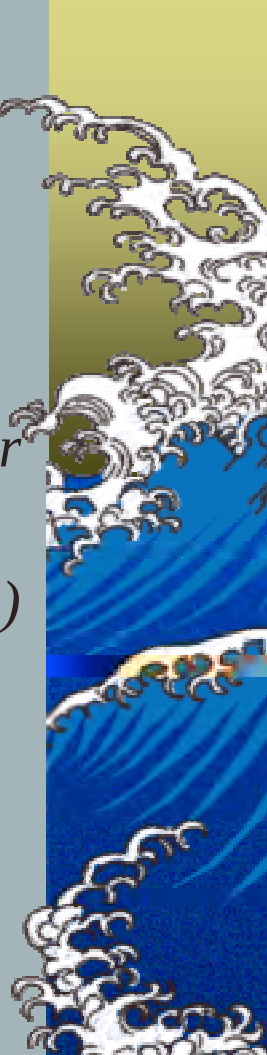


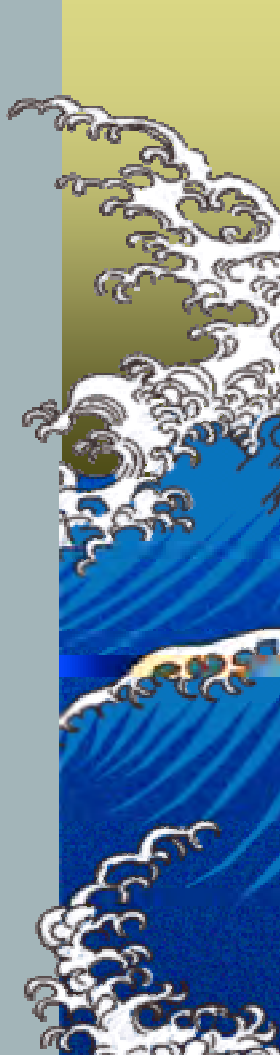
Stage I Leak Study

- *Fremont Village Market*
  - *Shallow, thin overburden aquifer (2 to 5 feet water table, 15 feet to bedrock)*
  - *BTEX contamination in one well (original release)*
  - *New MtBE problem impacting surrounding dug wells (2 wells with treatment systems 6 wells total impacted)*
  - *MtBE at approximately 1 ppm in groundwater*



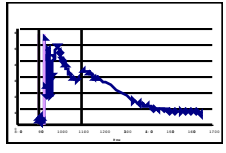
Addressing the Stage I leak

- *SVE system installed in tank gravel pack*
- *Vapor release during fuel deliveries observed in vapors collected by SVE*
- *Vapor releases identified and repaired during subsequent inspection*
- *Revisit to observe changes in vapor collection during deliveries pending*



SVE System Shed

Fremont – SVE TVOC vs. Time

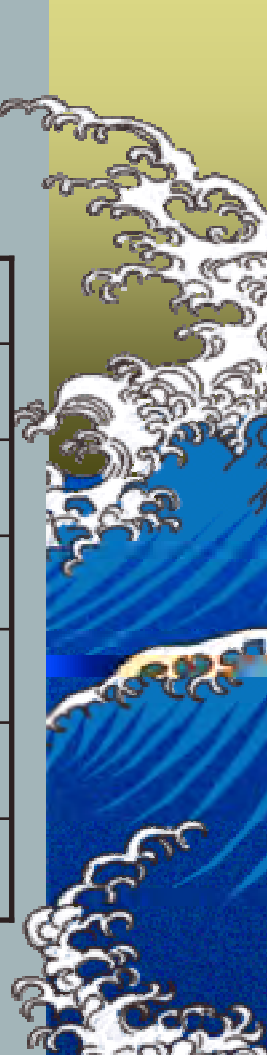


Start and End of Fuel Delivery

Return to Background

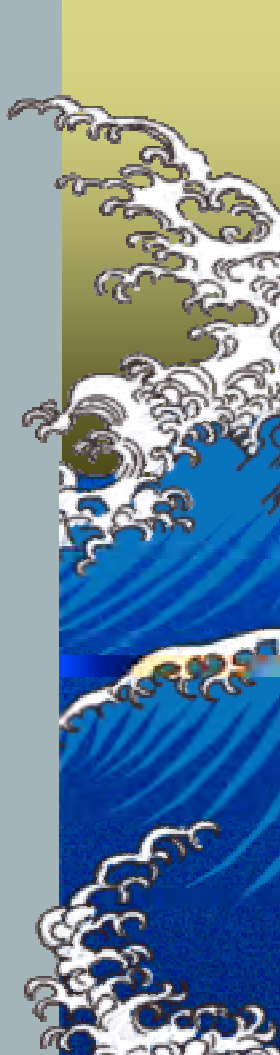
SVE Influent Grab Sample for Fremont Site

Contaminant	*Results PPBv*
MtBE	*118,000*
Benzene	*5,330*
Toluene	*14,000*
Hexane	*4,910*
Heptane	*2,850*
Xylenes and all others	*2,070*



Solution: SVE + Inspection & Repair

- *Delivery Inspection by former UST Inspector, now remedial program PM*
- *Leaks found at dry break and several ATGs*
  - *Dry break may have been bypassed*
  - *Last delivery of route, 2AM deliveries*
- *SVE operation bracketing delivery (timer set for Thursday thru Sunday)*
  - *MtBE at 41ppb versus up to 1,760 ppb prior to intervention*



Fremont Site Dry Break

Dry Break

Scored by
Screwdriver?

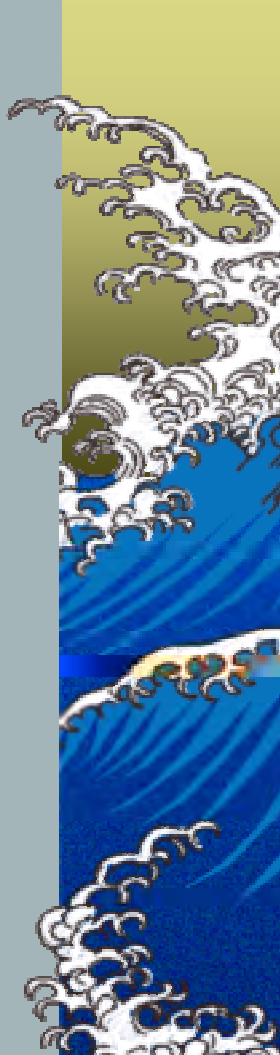
Fremont Site ATG Cover

Leaking Threaded Connection

Note: Gravel pack around sump

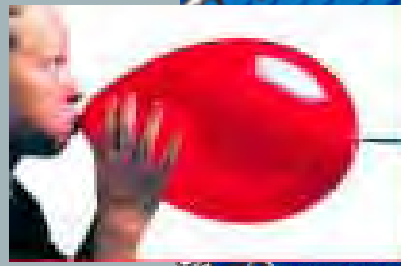
Stage II Leak Study

- *Waterhouse Country Store*
  - *MtBE concentrations in groundwater detected above 400,000 ppb*
  - *Limited BTEX in groundwater*
  - *MtBE only contaminant above soil standards*
  - *5 private wells with MtBE treatment systems*
  - *Double wall tank and piping, in compliance*
  - *Vacuum assist vapor recovery system/vapor release concern*



Addressing the Stage II Leak

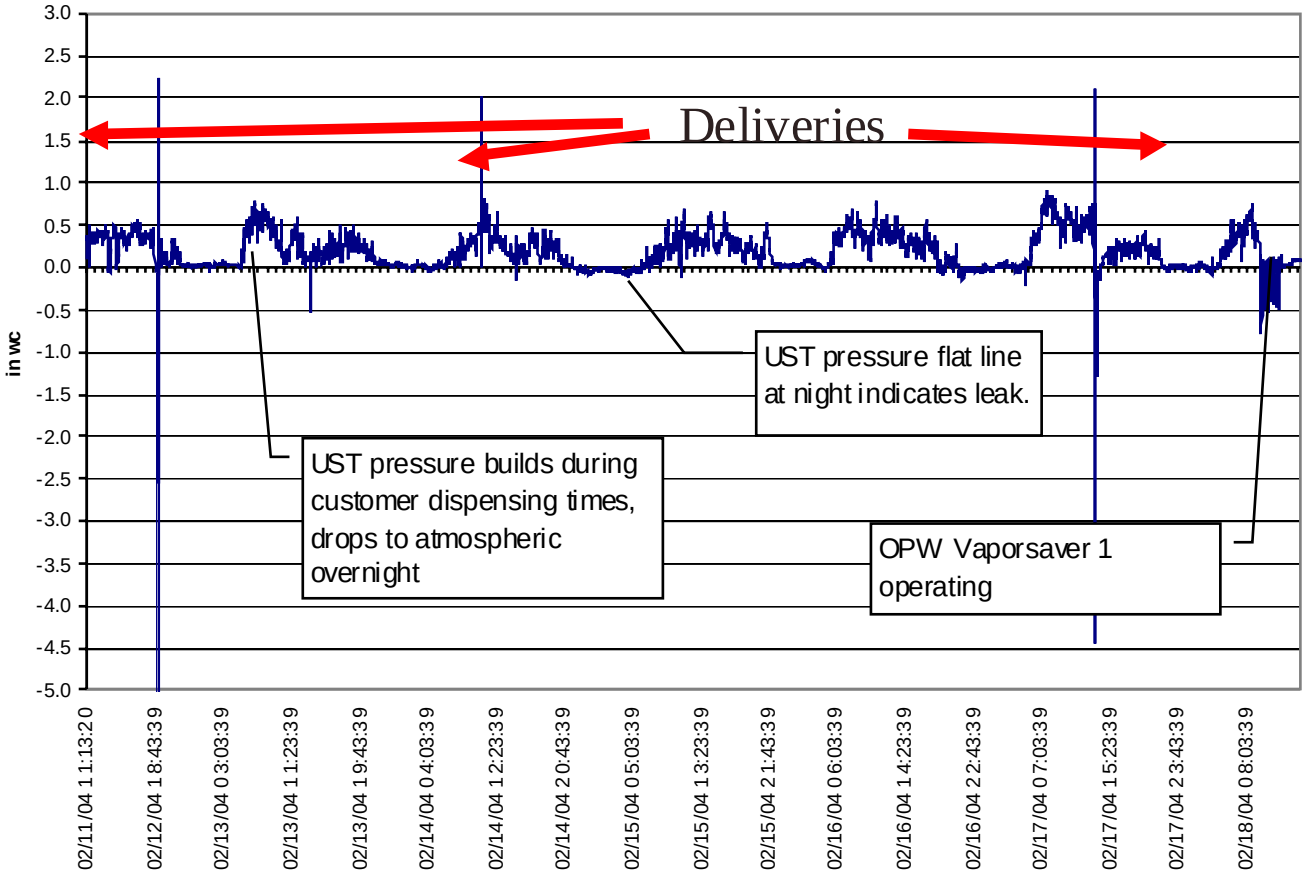
- Profile UST System Operating Pressures and Document Release(s)
  - *Tank pressure monitoring w/ data logger*
  - *Praxair Enhanced TracerTight testing*
- Reduce Pressures with Vaporsaver
- Monitor Long-term Changes in MtBE Concentrations in Groundwater



Tank Pressure Monitoring

Datalogger Setup

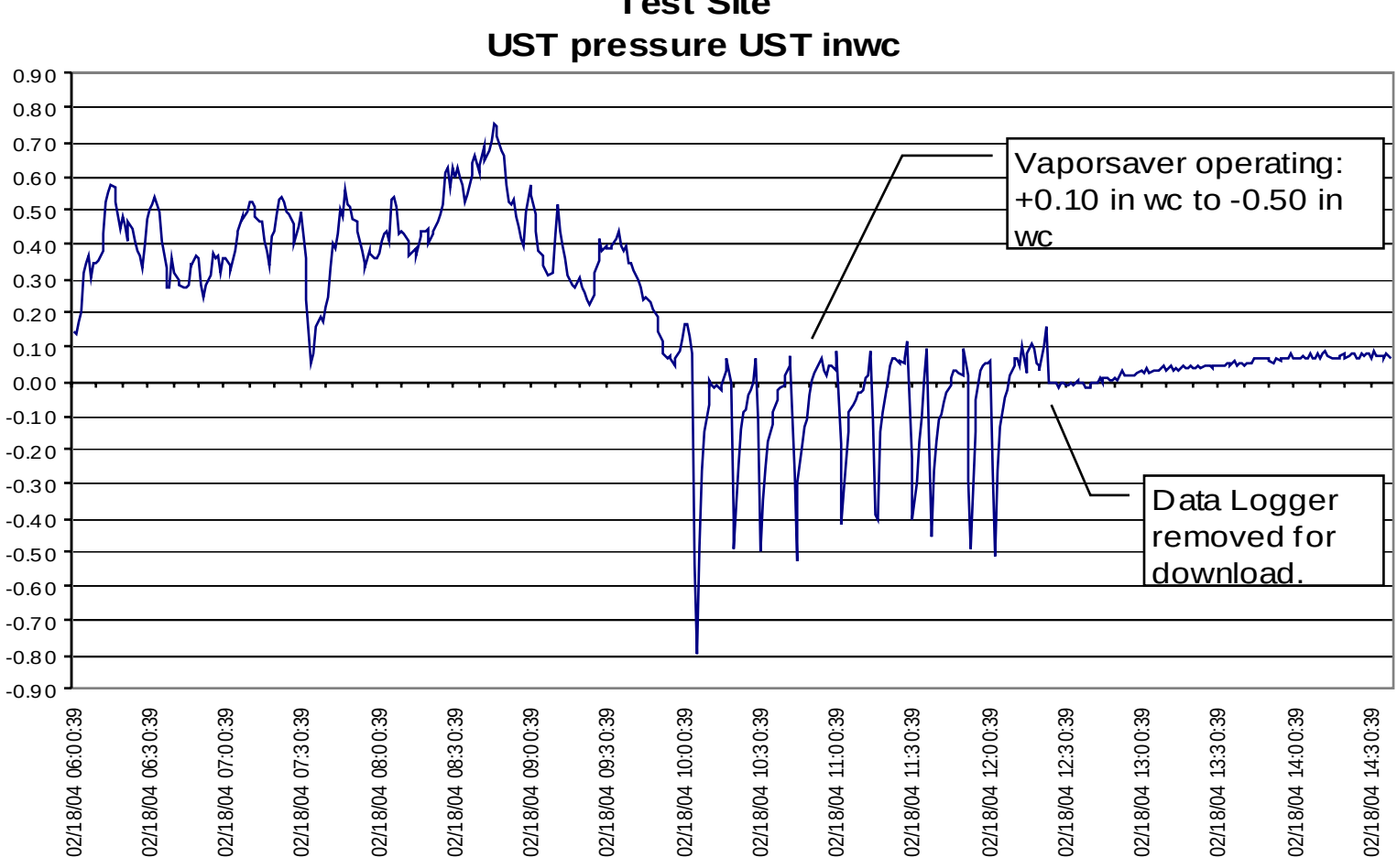
Vent tap for pressure monitoring


Waterhouse in Windham
UST pressure UST inwc
in wc
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-2.0
-2.5
-3.0
-3.5
-4.0
-4.5
-5.0
Deliveries
UST pressure flat line at night indicates leak.
UST pressure builds during customer dispensing times, drops to atmospheric overnight
OPW Vaporsaver 1 operating
02/11/04 11:13:20
02/12/04 18:43:39
02/13/04 03:03:39
02/13/04 11:23:39
02/13/04 19:43:39
02/14/04 04:03:39
02/14/04 12:23:39
02/14/04 20:43:39
02/15/04 05:03:39
02/15/04 13:23:39
02/15/04 21:43:39
02/16/04 06:03:39
02/16/04 14:23:39
02/16/04 22:43:39
02/17/04 07:03:39
02/17/04 15:23:39
02/17/04 23:43:39
02/18/04 08:03:39

Vaporsaver Installation

Vaporsaver and temporary base

Custom fitting for vent withdrawal and return


Test Site
UST pressure UST inwc
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
-0.50
-0.60
-0.70
-0.80
-0.90
Vaporsaver operating: +0.10 in wc to -0.50 in wc
Data Logger removed for download.
02/18/04 06:00:39
02/18/04 06:30:39
02/18/04 07:00:39
02/18/04 07:30:39
02/18/04 08:00:39
02/18/04 08:30:39
02/18/04 09:00:39
02/18/04 09:30:39
02/18/04 10:00:39
02/18/04 10:30:39
02/18/04 11:00:39
02/18/04 11:30:39
02/18/04 12:00:39
02/18/04 12:30:39
02/18/04 13:00:39
02/18/04 13:30:39
02/18/04 14:00:39
02/18/04 14:30:39

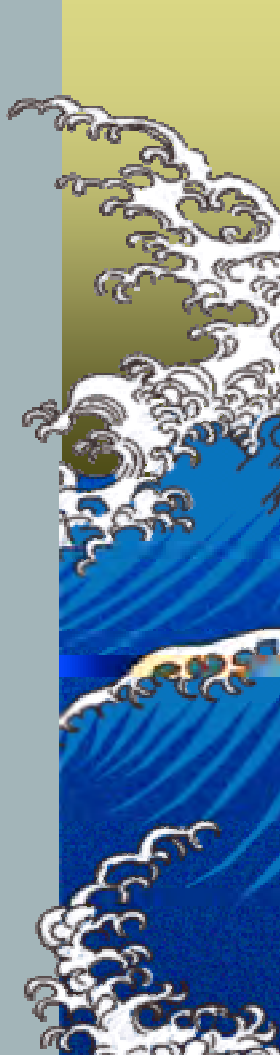
Groundwater Data for Research Site (JB-16/MW)

Date	*MW-JB13 (ppb MtBE)*	*Well JB14 (ppb MtBE)*	*Well JB16 (ppb MtBE)*
Average Initial MtBE Conc. (8 rds)	*17,000*	*168,000*	*225,000*
Post Pressure MtBE Reduction (5rds)	*10,000*	*59,000*	*79,000*
% Reduction	*31%*	*65%*	*65%*

Note: Vaporsaver unit operation from February '04 to November '05 (30% downtime). MW-JB16D also shows 65% reduction.

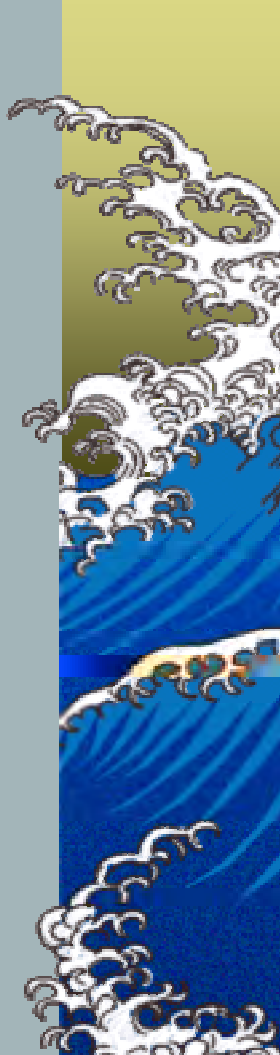
Unit Operational Problems

- *Retrofit Problem*
  - *Only the Second Retrofit Unit*
  - *Compressor Problem (recirculation?)*
- *Voltage*
- *Belt Alignment*
- *Loose Fan*
- *OPW Working on Problems*
- *100% Reliability Needed*



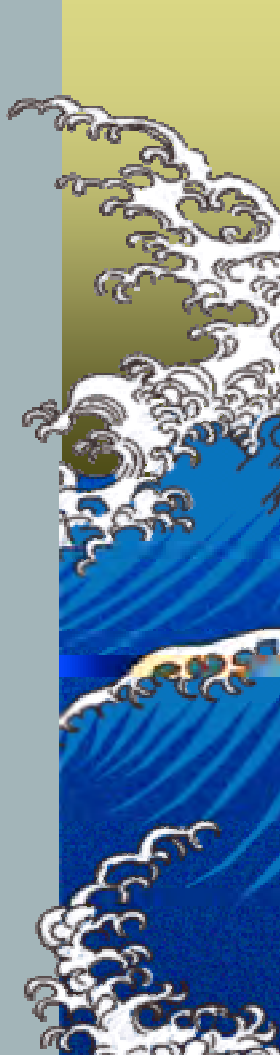
Lessons Learned

- *UST Pressurization needs to be minimized*
- *Gasoline Composition Important*
  - *MtBE and other ether problem*
  - *Compounds w/ similar physical properties issue*
- *Coordination w/ Vapor Recovery Program Essential*
  - *Subsurface/atmospheric release tradeoff*
  - *Stepped up inspection and repair*
  - *Revision to rules, testing, hardware necessary*



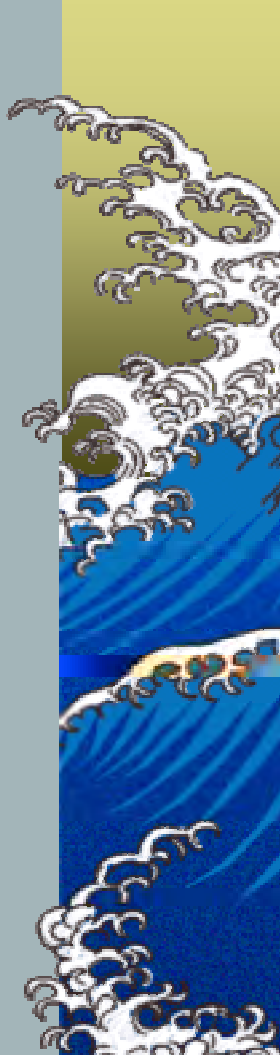
Solutions/Follow up Studies

- *UST Merged w/ Vapor Recovery Program*
  - *More, better coordinated inspections*
  - *Vapor Recovery Program rule changes*
    - *Monthly inspections, annual maintenance*
    - *Leak detection inspections during deliveries*
- *Independent Oil Company Pilot*
  - *Inspection/Maintenance implementation*
  - *ORVR compatible nozzles*
  - *Pressure Reduction*



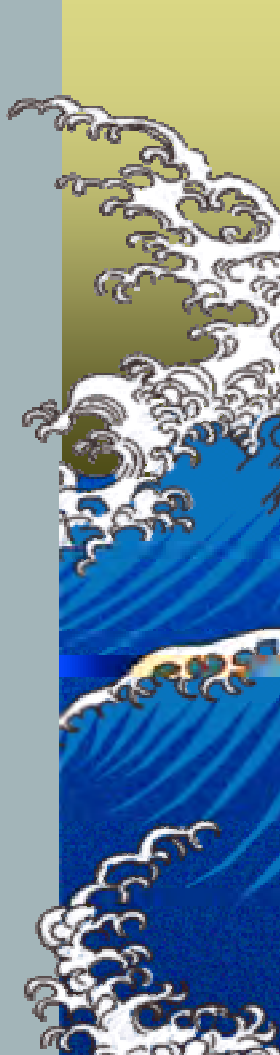
Oil Company Pilot Pilot

- *Intensive Inspection/Repair Program*
  - *36 enhanced inspections during deliveries*
  - *Tracer Testing Inspect/Repair*
  - *Stage II Pressure Decay Testing*
- *Gilbarco/Veeder Root ORVR Nozzle*
- *Healy ORVR Nozzle plus Bladder Tank*
- *Vapor System Technology/OPW Vaporsaver*
- *Cheap generic SVE system*



UST Enhanced Inspection Program at Cumbys

- *By former UST Inspector, now in remedial section*
- *13 Enhanced Inspections, 8 Regular Inspections*
  - *Enhanced Inspections during gas deliveries, pressures monitored, fittings soaped, repairs made while onsite*
- *Findings (77 leaks or 4/gas station)*
  - *<u>Vapor Leaks:</u> 15 Dry Breaks, 14 Fill Caps, 14 ATG covers, 6 vent covers, 4 spill bucket drains, 6 dispenser vapor leaks*
  - *<u>Liquid Leaks:</u> 6 spill buckets, 4 product in sumps and 7 liquid releases from fittings under dispensers*
- *Score: Enhanced Inspections 67 Regular Insp. 10*



Dry Break Leaks - Epping

Dry Break Leaks - Keene

Dry Break
Vapor Release

Dry Break Leaks - Plaistow

New, just out of box, dry break leak

Leaky ATG - Greenland

Sheen on water

Product Leaks – Newington/Milford

Gravel pack around sump

Sensor set above product

Oil Company Pilot Timeline

- *Secure Funding (spring of 2005)*
  - *SEP Negotiations*
  - *GREE Fund Money*
  - *EPA Funding Application*
- *Complete Delivery Inspections (end of 04)*
- *Baseline groundwater contamination (diffusion bags) spring 2005*
- *Installation of hardware (summer 2005)*
  - *Instrument Gas Station (pressures, soil temps. Etc)*

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