UST Alternatives Study Grant: 2005 Energy Act Mandate

Agenda

I. Introduction/ Grant Overview	**R. Gagnon, RIDEM**
II. ERP Study Design & Results	**R. Enander, RIDEM**

RI UST ERP

- Legislative Mandate for Biennial Inspections
- Resource Constraints Allow Facility Inspections Once Every Six Years
- Management Decision to Use ERP to Meet Legislative Mandate
- The regulations shall require that all federally regulated underground storage tanks used for petroleum products and subject to registration in this state shall be inspected at least once in each thirty-six (36) month period. (Rule change in 2009 to be consistent with federal requirement.)

Advantages of ERP

- All Facilities/Tanks are Inspected
- Assistance/Training/P2
- Enforcement
  - Random Inspections
  - Targeted Inspections
- Performance Measures - EBPIs
  - Measure Individual Facility Improvement
  - Measure Sector Improvement

UST 2005 Energy Act Mandate

The Energy Policy Act of 2005

SEC. 1523 (b) STUDY OF ALTERNATIVE INSPECTION PROGRAMS Environmental Protection Agency, in coordination with a State, shall **gather information on compliance assurance programs that could serve as an alternative to the inspection programs** under section 9005(c) of the Solid Waste Disposal Act (42 U.S.C. 699ld(c)) and shall, within 4 years after the date of enactment of this Act, **submit a report to the Congress** containing the results of such study.

http://www.epa.gov/NCEI/stategrants/rhodeisland2006.htm

Rhode Island's State Innovation Grant Project - 2006

Underground Storage Tanks - Alternative Inspection Programs and the Energy Policy Act of 2005 **(*State Innovation Grant EI-97150001-0*)**

Workplan (PDF) (13 pp, 108K)

Fact Sheet (PDF) (2 pp, 56K)

Final Report (PDF) (41 pp, 397K) December 29, 2009

Progress Reports

Risk Analysis, An International Journal

Peer-reviewed, Society for Risk Analysis

"Reducing Drinking Water Supply Chemical Contamination Risks from Underground Storage Tanks"

2011-12

2006 SIG Research Objectives

- **To Assess:**
  - Whether ERP can be as effective or more effective than traditional enforcement model
    - Can fewer inspections achieve same/better results?
  - Comparative costs/benefits of each approach

Project Partners

- **Florida DEP**
- **URI**
  - Center for Pollution Prevention & Environmental Health
    - Research Prof. + 1 undergrad
  - Computer Science and Statistics
    - Prof. of Statistics + 2 grad:
      Ph.D. and M.S. students
- **RI DEM**
  - Offices of Waste Management, and Compliance & Inspection

http://www.epa.gov/NCEI/stategrants/rhodeisland2006.htm

Multidisciplinary 3-Yr Team Effort (Statistics, Sci. and Eng.)

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Standard ERP Model

- **Integrated, evidence-based approach to compliance:**
  - Independent agency field inspections
  - Compliance certification using standardized checklists
  - Regulatory/technical assistance
  - Statistically-based performance measurement

Of Interest to ERP Community:
Now Being Used in Hospital Settings
"Simple Checklist Makes Surgery Safer"
NY Times & N Engl J Med '09
• Self-administered checklist approach w/ written guidance and training reduced surgical death rates by nearly one-half. Recommended by WHO

Followed Three-Step Process

1. **2004 Baseline inspections**
   - OWM regulatory staff, "random" n=96 (14%)

2. **2005 Agency-led Intervention**
   - 6 Workshops/training 297 people
   - OCTA/UST Guidebook & Checklist mailing (N=608)
   - Industry self-audits/deficiency reporting/corrective actions
     * Model Underground Storage Tank Environmental Results Program Workbook (EPA 510-R-04-003) June 2004. http://www.epa.gov/OUST/pubs/erp.htm

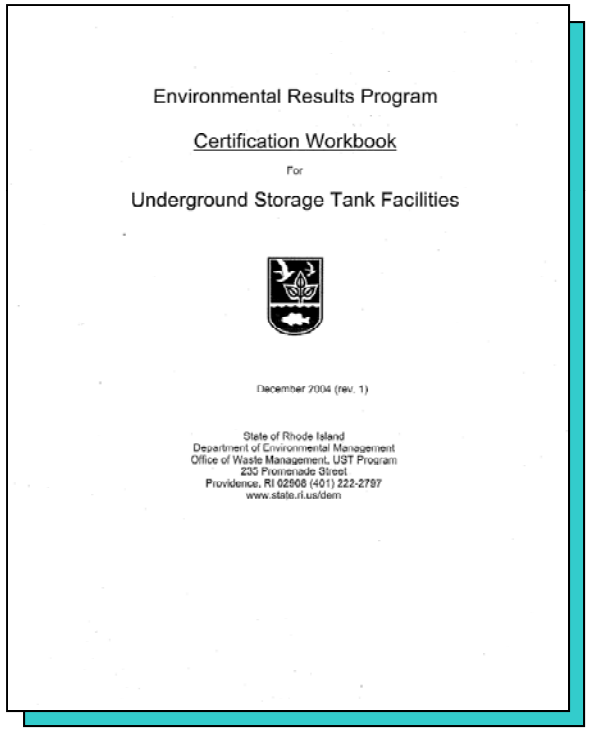
3. **2006 Post-intervention inspections**
   - OWM regulatory staff, "random" n=93

UST Certification Workbook

www.dem.ri.gov/programs/benviron/assist/usterp/index.htm

- 141 pg. Certification Workbook Explains regulations (in plain English)

- Used in conjunction w/ self-certification checklist and as a facility reference


Environmental Results Program

Certification Workbook

For

Underground Storage Tank Facilities

December 2004 (rev. 1)

State of Rhode Island
Department of Environmental Management
Office of Waste Management, UST Program
235 Promenade Street
Providence, RI 02908 (401) 222-2797
www.state.ri.us/dem

Sec. A Tank Profile
Sec. B Corrosion Protection
Sec. C Tank Leak Detection
Sec. D Piping Corrosion Protection
Sec. E Piping Leak Detection
Sec. F Spill Prevention
Sec. G Spill Containment
... Sec K Closed Tanks

Detailed, Step-by-Step Guidance

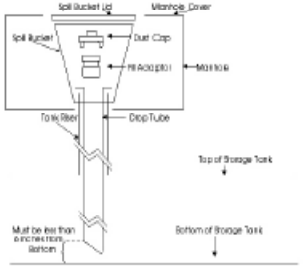
The illustration below shows a typical tank area of a gasoline dispensing facility, with a cargo tanker delivering gasoline product to, and recovering vapor, from two underground storage tanks.

Cargo tank delivering product to, and recovering vapor from, two underground storage tanks.

The illustration below shows both product delivery and vapor recovery sides of a tank, with some of the components labeled. In the dual, two point system, as shown in the illustration, the manhole above the underground storage tank contains two tank risers. One riser is for delivering product from the cargo tank to the underground tank. The other riser, which includes the vapor recovery adapter (drybreak), is for delivering displaced vapor from the underground tank back to the cargo tank.

Stage I Product Delivery

DIAGRAM OF PRODUCT DELIVERY PIPING INTO THE UNDERGROUND STORAGE TANK AT A GDF



The schematic to the left shows the product delivery piping.

Product is delivered to the UST from the cargo tank via a submerged pipe called a drop tube.

The drop tube is guided into the UST by the tank riser pipe.

The Vent Area

Storage tanks have vent pipes equipped with pressure/vacuum (P/V) relief valves. P/V valves are designed to open at specified positive and negative pressures, so that the tank is protected from physical damage or permanent deformation caused by routine increases in internal pressure or vacuum. They also provide a safeguard in the event any pipes become blocked or inoperable. Additionally, the P/V valve setting on the tank vent is such that it acts as a flow control device that preferentially allows displaced vapors to pass to the tanker compartment during a drop.

Tanks need to breathe because of volume fluctuations due to temperature changes, barometric pressure changes, and variations in the vapor/liquid ratio during refueling. When the internal pressure exceeds the valve design setting, the valve opens to vent the excess pressure to the atmosphere. When the vacuum exceeds the design setting, the valve opens to allow air to flow into the tank and relieve the excess vacuum condition.

The vent area contains one to three product vent lines, usually one vent for each underground storage tank. Each vent line must be capped with a pressure/vacuum relief (P/V) valve, as shown in the illustration below on the right, or manifolded with the other lines, as shown in the illustration on the left.

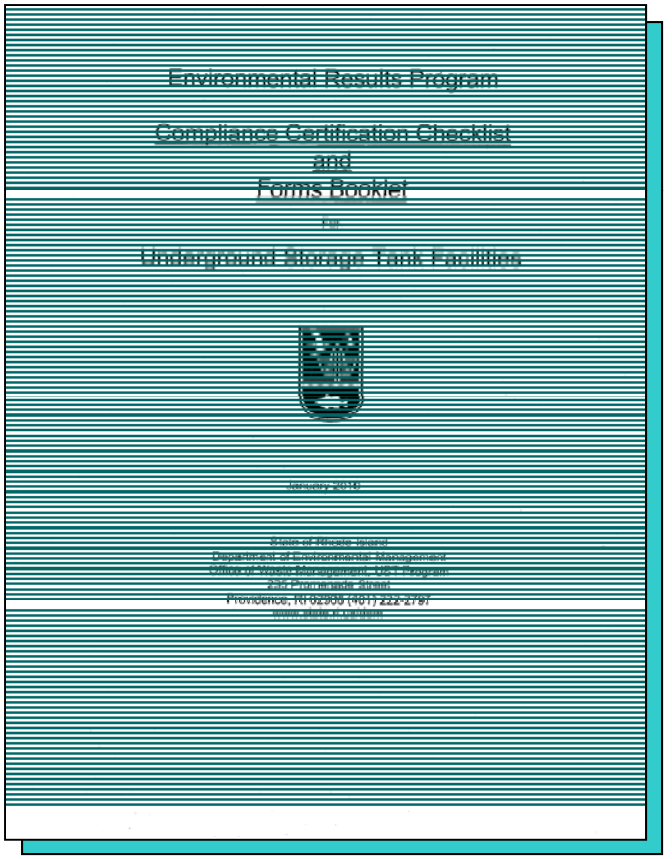
Thanks to California Air Resources Board, Stationary Source Division, Compliance Assistance Program Vapor Recovery Interactive CD, August 2002; CARB Interactive CD w/ Stage I & II

UST ERP Certification Checklist

- ✓ **The checklist contains a series of compliance questions, which generally require "yes" or "no" answers**
- ✓ **Certification Statement**
- ✓ **Return to Compliance Plan**

Joe's Overfill Protection Checklist For USTs With Overfill Alarms

Circle the UST number for each UST that has an overfill alarm. Fill out the questions below for each UST you circled.	UST # =	1	2	3	4	5
Questions		Yes (Y) or No (N)				
1. Does your overfill alarm activate at 90% of tank capacity or at least one minute before being overfilled?		1 Y / 1 N	2 Y / 2 N	3 Y / 3 N	4 Y / 4 N	5 Y / 5 N
If no, have a qualified person adjust your overfill device to the right height. Also, submit a Return to Compliance plan and submit it with your Certificate of Compliance.						
2. Can your overfill alarm be seen and/or heard from the delivery location so that it will alert the delivery person that the tank is almost full?		1 Y / 1 N	2 Y / 2 N	3 Y / 3 N	4 Y / 4 N	5 Y / 5 N
If no, have a qualified person fix your overfill alarm so that it can be heard and/or seen from the delivery location. Also, submit a Return to Compliance plan and submit it with your Certificate of Compliance.						



Checklist Website:

www.dem.ri.gov/programs/benviron/assist/usterp/index.htm

Certification Statement

Underground Storage Tank Environmental Results Program

Note: Complete all required Return to Compliance Plan forms before signing this statement!

I _____, as the UST owner(s) attest,

1) That I/we have personally examined and am/are familiar with the information contained in this submittal, including any and all documents accompanying this certification statement;

2) That, based on my/our inquiry of those individuals responsible for obtaining the information, the information contained in this submittal is, to the best of my/our knowledge, true, accurate and complete;

3) That I/we am/are fully authorized to make this attestation on behalf of this facility;

4) That _____ is/are the Operator(s) of this facility. I have discussed the division of duties with the operator(s). I understand that the Department of Environmental Management may pursue either the owner, operator or both for any violations of the Rules and Regulations For Underground Storage Facilities Used For Petroleum Products and Hazardous Materials, where owner/operator is mentioned.

5) I/we am/are aware that there are significant penalties for submitting false information.

Owner's Signature: _____ **Date:** _____

Printed Name: _____ **Title:** _____

1st Round: 146 NOI's sent to facilities who did not submit; 1,291 RTCs rec'd; > 30 formal enforcement actions

Return to Compliance Plan

Underground Storage Tank Environmental Results Program

- ✓ Complete a separate Return to Compliance Plan for **EACH** compliance question/answer that requires one. (Attach to your Certification Checklist and return with entire package.)
- ✓ Only submit a Return to Compliance Plan for violations that you were unable to correct BEFORE certifying.
- ✓ Completing this form does not relieve the facility of its affirmative responsibility to operate in compliance with applicable regulations. Failure to operate in full compliance with the applicable regulations may result in enforcement actions that include fines or penalties.

Facility Contact Information

_____
Facility Name

_____ _____ _____
Facility Street Address | City/Town | Zip Code

_____ _____
Contact Person | Phone Number

Return to Compliance Information

1. What is the Compliance Question number for which you are reporting noncompliance? ____
2. How many USTs at your facility does the non-compliance apply to? _____
3. Which USTs (please list the UST numbers consistent with the numbers you used in the certification checklist) are not in compliance? _____
4. What is the specific violation (reference the workbook section number in which the requirement is explained and a description of the requirement)?
   a) Workbook section number: _____
   b) Brief description of the requirement:

_____
_____
_____

5. What action will you take to return to compliance?

_____
_____
_____
_____

A Return to Compliance Plan Report, which contains documentation of all actions taken to return to compliance, must be submitted within 60 days of submittal of the Return to Compliance form.

6. Return to compliance date: _____ (month/day/year)

UST ERP Statistical Approach

- **2004 Baseline inspection data**
  - 96/608 (15%) random baseline audits
  - Sample size: MADEP/RIDEM *Environmental Health Practice: Statistically-Based Performance Measurement." Am. J. Pub. Health 97(5):1-6 (2007);* EPA's *ERP Sample Planner* www.epa.gov/erp/toolsandresources.htm
  - 118 RTC certification checklist questions (>45,000 data points/cross-checked by interns)
    - Sec. "A" Tank Profile to "I" Groundwater Monitoring

UST ERP Compliance Certification Checklist

N = 118 Potential RTC Plan Measures

SECTION C: TANK LEAK DETECTION

	Tank ID Number	Tank #	Tank #	Tank #	Tank #	Tank #	RTC Plan Needed?
C.1	*Do you have a leak detection method in place for each tank?* (complete all that apply below)	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.2	**Continuous Monitoring System**	☐	☐	☐	☐	☐	
C.3	Manufacturer						
C.4	Model #						
C.5	Installation Date						
C.6	Are the employees who run, monitor, or maintain the release detection system aware of correct operating procedures?	Y / N					
C.7	*Is your leak detection system currently operating properly?*	Y / N					☐
C.8	**Automatic Tank Gauge (ATG)** (Section 4.7.1) (required for single-walled tanks)	☐	☐	☐	☐	☐	
C.9	Date (month/year) installed						
C.10	*Do you use the ATG to conduct monthly 0.2 gallon/hour leak rate tests?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.11	*Did all of your 0.2 gallon/hour leak rate tests pass the most recent test?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.12	*Do you have records of the last 36 months of leak detection tests?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.13	*Do you have records of the last 36 months of ATG system checks?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.14	*Was the ATG system calibrated and inspected in the past year?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐

Performance Measurement Objective:

- To determine whether “improvement” over baseline conditions occurred in the post-intervention setting for each measurable compliance indicator

Study Hypotheses

Ho = no difference in the proportion of facilities in compliance at baseline and post-intervention

Ha = improvement in compliance post-intervention

Analytical Approach

N = 118 Potential RTC Plan Measures

118 Checklist questions organized into 3 categories:

1) Performance measurement indicators (n=41) (performance changes possible to measure)

SECTION C: TANK LEAK DETECTION

	Tank ID Number	Tank #	Tank #	Tank #	Tank #	Tank #	RTC Plan Needed?
C.1	*Do you have a leak detection method in place for each tank?* (complete all that apply below)	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.2	**Continuous Monitoring System**	☐	☐	☐	☐	☐	
C.3	Manufacturer						
C.4	Model #						
C.5	Installation Date						
C.6	Are the employees who run, monitor, or maintain the release detection system aware of correct operating procedures?	Y / N					
C.7	*Is your leak detection system currently operating properly?*	Y / N					☐
C.8	**Automatic Tank Gauge (ATG)** (Section 4.7.1) (required for single-walled tanks)	☐	☐	☐	☐	☐	
C.9	Date (month/year) installed						
C.10	*Do you use the ATG to conduct monthly 0.2 gallon/hour leak rate tests?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.11	*Did all of your 0.2 gallon/hour leak rate tests pass the most recent test?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.12	*Do you have records of the last 36 months of leak detection tests?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.13	*Do you have records of the last 36 months of ATG system checks?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐
C.14	*Was the ATG system calibrated and inspected in the past year?*	Y / N	Y / N	Y / N	Y / N	Y / N	☐

2) Performance trend indicators (n=19) (96-100% compliance at baseline; performance improvement measurement not possible)

3) Indicators not measurable (n=58); i.e., lack of data/not applicable to sampled facilities

UST Performance Trend Indicators

	Performance Trend Indicators	Baseline Sample Size n_1	Baseline Proportion p_1	Post Intervention Sample Size n_1	Post Intervention Proportion p_2	Percentage change[a]
1	F.24 Device set to shutoff at 90% full	24	0.96	50	1.00	4
2	C.1 Have leak detection in place for each tank	89	0.97	91	0.99	2
3	D.1 Corrosion protection for piping (each tank)	93	0.97	92	0.97	0
4	C.18 Continuously use interstial monitoring for leaks	63	0.97	68	0.94	-3
5	B.1 Corrosion protection for each tank	90	0.98	92	1.00	2
6	C.33 Measure water in tank once every 30 dys	94	0.98	82	0.96	-2
7	F.7 Tank equipped w/ submerged fill drop tube	96	0.98	93	0.97	-1
8	F.16 Boots sealed to prevent infiltration	80	0.99	78	1.00	1
9	F.18 Properly operating overfill protection	96	0.99	94	0.99	0
10	B.10 Cathodic protection system operate continuously	7	1.00	2	1.00	0
11	B.20 Cathodic protection operate continuosly	8	1.00	12	1.00	0
12	B.24 System pass most recent test	5	1.00	11	1.00	0
13	C.32 Measuring equip. nearest 1/8th" over tank height	94	1.00	82	0.99	-1
14	F.1 Tank fill equipped w/ spill containment	96	1.00	94	1.00	0
15	F.21/F.24 Device set for 95% full	19	1.00	50	1.00	0
16	F.22 Alarm audible/visible to delivery person	23	1.00	29	1.00	0
17	F.26 Set to restrict flow when tank 90% full	61	1.00	53	1.00	0
18	F.4 Spill bucket surrounded by impervious surface	94	1.00	30	1.00	0
19	F.5 Spill bucket capacity >=3 gal.	96	1.00	93	1.00	0

NOTES: n = number of facilities in sample; p_1 = no. of facilities in compliance at baseline/number of facilities in the sample; p_2 = no. of facilities in compliance postintervention/number of facilites in the sample; For all n cells, counted facility if one or more "Y's" or "N's" recorded. For all p cells, counted facility as in compliance only if one or more "Y's" recorded and no "N's".

[a]Calculated as $100(p_2 - p_1)$.

41 Measurable Indicators

- **Pre-/Post- Analysis:** evaluated all 41 indicators for performance improvement (statistical correction for multiple comparisons); did not preselect EBPIs

  - **<u>Rationale:</u>**
    - Evaluate entire field of performance—
      more complete understanding of what is happening across all performance categories
    - Maximize opportunity for finding significant changes

Table I. UST Facility Baseline (96 random inspections, '04) and Postintervention (93 random inspections, '07) Performance Comparisons

		Baseline		Post Intervention		Statistical Comparison	
	Measurable Indicators	Sample Size n_1	Proportion p_1	Sample Size n_1	Proportion p_2	Percentage[a] change (95%CI)[b]	*P*[c]
1	E.16 Tightness tests annually+	6	0.00	9	0.22	22	0.343
2	E.17 Passing results for each reqd. yr	6	0.00	9	0.33	33	0.185
3	B.21 Is system tested every 3 yrs + w/in 6 mos. of repair	7	0.14	12	0.50	36	0.144
4	I.4B/I.8P Records of GW monitoring well checks	55	0.18	42	0.60	42 (24,60)	<0.001**
5	C.28 W/ ATG, >20 yrs: tightness test passing results, 2 yrs.	17	0.41	15	0.73	32	0.07
6	B.25 Records of all repairs/test results	7	0.43	12	0.83	40	0.095
7	E.22 System calibrated and inspected last yr	9	0.44	11	0.91	47 (5,75)[d]	0.038*
8	F.3 Inspect spill buckets daily	94	0.52	93	0.40	-12	
9	E.4 Records of LLD tests for last 3 yrs.	81	0.58	69	0.68	10	0.135
10	F.11 Sumps free of water/debris/product	81	0.62	78	0.76	14 (0,28)	0.043*
11	E.21 Records of system checks/repairs	10	0.60	15	0.93	33	0.064
12	E.12 System calibrated/inspected last yr	65	0.66	60	0.80	14	0.062
13	C.20 Monitoring system been calibrated/inspected past yr.	55	0.67	62	0.79	12	0.110
14	E.20 Continuously use interstitial monitoring	12	0.67	17	0.94	27	0.078
15	I.5B/I.6P Well caps closed tightly and locked	92	0.67	85	0.95	28 (23,33)	<0.001**
16	F.2 Tank have operational spill containment device	96	0.68	93	0.69	1	0.497
17	C.14 ATG sys calibrated and inspected last yr	80	0.69	70	0.81	12	0.055
18	E.11 Records of system checks/repairs	67	0.73	61	0.75	2	0.464
19	I.2B/I.4P Wells equipped w/road box and lock cap	92	0.73	85	0.96	23 (13,33)	<0.001**
20	C.31 Records of inventory control	94	0.74	81	0.70	-4	
21	E.7 Conducted tightness test w/in past yr	17	0.76	10	0.90	14	0.371
22	C.13 Records of last 36 mos. ATG sys checks	78	0.77	70	0.74	-3	
23	C.19 Records of monthly sys checks for past 36 mos.	56	0.79	66	0.73	-6	
24	C.10 Use ATG to conduct leak rate tests	82	0.79	71	0.85	6	0.267
25	C.11 Recent ATG leak rate tests pass	63	0.79	61	0.62	-17	
26	F.13 Sensors upright and at correct height	73	0.79	76	0.96	17 (7,27)	0.002**
27	F.8 Containment sump present	96	0.80	93	0.81	1	0.602
28	C.12 Records of last 36 mos. leak test	67	0.81	60	0.95	14 (3,25)	0.013*
29	F.15 Sensors mounted properly	73	0.81	76	0.96	15 (5,25)	0.003**

Table I. *Continued*

		Baseline		Post Intervention		Statistical Comparison	
		Sample Size n_1	Proportion p_1	Sample Size n_1	Proportion p_2	Percentage change (95%CI)	*P*
30	C.30 Perform inventory control properly	91	0.81	81	0.77	-4	
31	F.12 Sumps have sensors	82	0.82	78	0.97	15 (6,24)	0.001**
32	F.19 Qualified UST contractor check device	87	0.84	90	0.98	14 (6,22)	0.001**
33	I.3B/I.5P Wells equipped w/ pipe not screened at top	91	0.85	85	0.95	10 (1,19)	0.017**
34	C.26 W/ ATG, <20 yrs: tightness test passing results	22	0.86	14	1.00	14	0.216
35	E.1 Leak detection method in place for each run	93	0.91	85	0.98	7	0.067
36	C.7 Leak detection system operating properly	93	0.92	90	0.94	2	0.406
37	F.14 Sensors functioning properly	72	0.93	76	0.95	2	0.466
38	F.6 Fill pipes/box covers labeled/marked	96	0.94	93	0.94	0	
39	E.10 Interstitial monitoring for leaks	71	0.94	61	0.97	3	0.415
40	F.17 Secondary piping test boot disconnected	75	0.95	75	0.95	0	
41	I.6B/I.7P Are any well caps submerged under water	91	0.95	85	1.00	5 (3,7)	0.035**

NOTES: CI = Confidence Interval; n = number of facilities in sample; p_1 = no. of facilities; B=Basline; P=Postintervention; p1 = no. of facilities in compliance at baseline/number of facilities in the sample; p_2 = no. of facilities in compliance postintervention/number of facilites in the sample;

For an indicator, a facility was counted if one or more tank "Y's" or "No's" were recorded. The facility was in compliance only if one or more "Y's" were recorded and no "N's".

[a]Calculated as $100(p_2 - p_1)$.

[b]95% CIs calculated for indicators showing statistical significance at α= .05; 95% CIs calculated as $(p_2–p_1) \pm 1.96 \times$ square root $[p_1(1.00 – p_1) / n_1 + p_2(1.00 – p_2) / n_2]$.

[c]P values were calculated with the Fisher exact test online, available at http://www.quantitativeskills.com/sisa/statistics/fisher.htm;

[d]Due to small sample size, computation of the confidence interval on the difference of proportions for E.22 followed Agresti A and Caffo B (2000), American Statistician, pages 280-288.

P values calculated only for performance indicators showing improvement (1-tailed test).

*Statistically significant at the .05 (95%) confidence level without an adjustment for multiple comparisons

**P value = Holm's-modified Bonferroni adjustment for multiple comparisons calculated on a category by category basis (i.e.,B,C,E,F, and I)

Summary of Table I Data: Baseline/Post-intervention Comparisons

- **Statistically significant improvements in performance were found subsequent to ERP implementation:**

  1) 95% confidence level, 12 of 41 compliance indicators showed statistically significant improvements—Fisher exact test
  2) 90% confidence level, 19 of 41 indicators showed significant improvement
  3) Holm's modified Bonferroni adjustment for multiple comparisons, 3 of the 12 indicators with p-values <.05 were no longer significant
  4) Among 19 trend/high performing indicators (i.e., indicators showing compliance levels between 96 and 100% at baseline), no significant decreases in compliance performance were observed post-intervention; that is, high levels of compliance performance were sustained throughout the first ERP cycle

Significant Operational Compliance Comparisons

	Baseline ('04)		Post Intervention ('07/'08)		Statistical Comparison	
	Sample Size n_1	Proportion p_1	Sample Size n_2	Proportion p_2 (95%CI)[a]	Percentage change[b] (95% CI)[c]	P[d]
Random Inspection Data						
% in SOC w/ Release Prevention	96	0.75	93	0.94 (.89,.99)	19 (9,29)	<.001*
% in SOC w/ Release Detection	96	0.53	93	0.75 (.67,.84)	22 (9,35)	.001*
% in SOC w/ Release Detection & Prevention	96	0.51	93	0.72 (.63,.81)	21 (8,35)	.002*

NOTES: n = number of facilities in sample; p = proportion = no. of facilities in compliance/number of facilities in the sample or assumed universe of facilities; CI = Confidence Interval

[a]Wald CI calculated using online program at: http://www.measuringusability.com/wald.htm

[b]Calculated as $100(p_2 - p_1)$

[c]95% CIs calculated for indicators showing statistical significance at $\alpha = .05$; 95% CIs calculated as $(p_2 - p_1) \pm 1.96 \times$ square root $[p_1(1.00 - p_1) / n_1 + p_2(1.00 - p_2) / n_2]$.

[d]p-values calculated with the Fisher exact test online, available at http://www.quantitativeskills.com/sisa/statistics/fisher.htm

*p≤.05, statistically significant at the 95% confidence level

- **Statistically significant improvements (p-values <.01) in compliance found for all three EPA OUST SOC categories**
- **Observed performance improvements post-intervention, using standardized SOC reporting metrics, ranged from 19 to 22%.**

Interstate Comparison: FL-RI

- SOC Data Used in Analysis
  1. RIDEM regulatory staff converted baseline (n=96) and post-intervention (n=93) data into SOC categorical measures
  2. Looked for statistically significant improvements
  3. Analyzed FL census data for significant improvements over same time period
  4. Significant Improvements: a) FL 2-3%; RI 19-22%, b) point estimates for "release prevention" similar (92, 94%), though higher for FL for "release detection/prevention"—though RI started at a lower baseline

*** 90+% of FL's entire UST universe is inspected each yr by 139 Dept. of Health/Environmental Protection and county government staff**

Florida-Rhode Island SOC Data

Table VI. UST Facility Significant Operational Compliance Comparisons

	Baseline ('04)		Post Intervention ('07/'08)		Statistical Comparison	
	Sample Size[a] n_1	Proportion p_1	Sample Size n_2	Proportion p_2 (95%CI)[b]	Percentage change[c] (95% CI)[d]	*P*[e]
Rhode Island						
% in SOC w/ Release Prevention	96	0.75	93	0.94 (.89,.99)	19 (9,29)	<.001*
% in SOC w/ Release Detection	96	0.53	93	0.75 (.67,.84)	22 (9,35)	.001*
% in SOC w/ Release Detection & Prevention	96	0.51	93	0.72 (.63,.81)	21 (8,35)	.002*
Florida						
% in SOC w/ Release Prevention	10,000	0.90	10,000	0.92	2	<.001*
% in SOC w/ Release Detection	10,000	0.87	10,000	0.89	2	<.001*
% in SOC w/ Release Detection & Prevention	10,000	0.85	10,000	0.88	3	<.001*

NOTES: n = number of facilities in sample; p = proportion = no. of facilities in compliance/number of facilities in the sample or assumed universe of facilities; CI = Confidence Interval

[a]The term "sample size" applies to RI data only as the data reflect a random sample taken from a population of ~600 UST facilities. n_1 and n_2 for Florida = the entire regulated universe (i.e., population) of registered facilities estimated to be 20,000 (based on personal communication with FLDEP) for calculation purposes. Since the FLDEP inspects >90% of all facilites each year, p_1, p_2 and "percentage change" data are assumed to reflect proportions and changes in the entire population.

[b]Wald CI calculated using online program at: http://www.measuringusability.com/wald.htm

[c]Calculated as $100(p_2 - p_1)$

[d]95% CIs calculated for indicators showing statistical significance at $\alpha = .05$; 95% CIs calculated as $(p_2 - p_1) \pm 1.96 \times$ square root $[p_1(1.00 - p_1) / n_1 + p_2(1.00 - p_2) / n_2]$.

[e]p-values calculated with the Fisher exact test online, available at http://www.quantitativeskills.com/sisa/statistics/fisher.htm

*p≤.05, statistically significant at the 95% confidence level

Cost-Benefit Analysis

- Costs associated with the traditional UST inspection program in RI vs. costs needed to support the alternate ERP approach
- Various ERP models were analyzed where both sample size (100 or 250 inspections) and frequency (every 1-3 years) were combined in five different scenarios
- Based on 2008 figures, approximately $172,000 was needed annually to fund the traditional program (250 inspections/yr)

Cost-Benefit Analysis Findings

- Due to fewer inspections required for ERP, costs associated with inspections would be reduced for each scenario
- Additional expenses to support ERP-related activities (workshops, data gathering, statistical analysis, oversight) are incurred, but the overall costs (reduced inspections and ERP activities) were still lower than that for the traditional program
- “Payback” or time to recover ERP start-up costs and realize savings was shown to vary from 0.65 to 1.22 years

Study Results

- **Taken together, RI field data showed:**
  - UST ERP successful at producing statistically significant improvements in industry-wide performance
  - Observed performance improvements in both categorical (SOC, 19-22%) and individual compliance inspection indicators (5-42%)

Risk-Based Approach

- **States w/ limited funding or resources to meet the Energy Act's 3-yr inspection requirement would benefit from:**
  - The cost efficiencies and statistical strengths of the ERP approach
  - An integrated risk-based approach where high risk facilities inspected more frequently and ERP model is applied to low risk facilities

* U.K. Environment Agency, *Delivering for the environment: a 21st Century approach to regulation*

Study Recommendation

- Based on the results of this study, we recommended that the U.S. Energy Policy Act of 2005 be amended to allow relief from Subtitle B Sec.1523 (C)(2)—on-site inspection of each underground storage tank once every 3 years

- States should be allowed flexibility to enforce their own inspection requirements if an alternative program provides effective compliance

Study Conclusion

- **The alternative model, utilizing an emphasis on technical assistance tools:**

  1. Produces measurable improvements in compliance performance,
  2. Can be a cost-effective adjunct to traditional facility-by-facility inspection and enforcement programs, and
  3. Has the potential to allow regulatory agencies to decrease their frequency of inspections among low risk facilities without sacrificing compliance performance or increasing public health risks

More Details

- **Underground Storage Tanks - Alternative Inspection Programs and the Energy Policy Act of 2005** (*State Innovation Grant EI-97150001-0*)
  http://www.epa.gov/NCEI/stategrants/rhodeisland2006.htm

- ***Risk Analysis, An International Journal***
  - Peer-reviewed, Society for Risk Analysis
  - "Reducing Drinking Water Supply Chemical Contamination Risks from Underground Storage Tanks" 2011-12