Life Cycle Cost (LCC) Study of Gasoline Storage and Dispensing Systems at AAFES Express Stores

CORRECTED FINAL REPORT

July 12, 2017

FOR

ARMY AIR FORCE EXCHANGE SERVICE (AAFES)

PREPARED BY:

ROBERT AND COMPANY

ENGINEERS-ARCHITECTS-PLANNERS

229 PEACHTREE STREET, NE

INTERNATIONAL TOWER, SUITE 2000

ATLANTA, GEORGIA 30303

TABLE OF CONTENTS

LIST OF APPENDICES

1. PROJECT STATEMENT OF WORK
2. KICKOFF MEETING MINUTES
3. DETAILED CONSTRUCTION COST ESTIMATES
4. LIFE CYCLE COST DATA
5. EQUIPMENT AND COMPONENT CUTSHEETS
6. A/E QUALIFICATIONS

LIFE CYCLE COST (LCC) STUDY OF AAFES GASOLINE STORAGE AND DISPENSING SYSTEMS

1.0 INTRODUCTION

1.1 EXECUTIVE SUMMARY

Under AAFES Purchase Order 7300239661, Robert and Company has been tasked with developing life cycle cost analyses and comparisons between three typical configurations of AAFES gasoline storage and dispensing systems. This report will include general descriptions of each system, assumptions made for the analyses, specific system components and sizing for the various scenarios, and life cycle costs and recommendations. The purpose of this effort is to better understand and provide comparisons of the initial installation costs and longer-term life cycle costs of various fuel system configurations for AAFES Express Store facilities.

Three different fuel system configurations will be evaluated. All scenarios include storage tanks for regular and premium gasoline, pumps, fuel dispensers and pressurized issue piping on a typical service station site development. The first configuration includes direct-bury underground storage tanks. The second scenario includes aboveground storage tanks. Finally, the third scenario includes storage tanks which are installed in a below-grade concrete vault structure.

The first step of this effort is to determine the initial installation / construction costs for each configuration. Section 2.0 of this report describes the specific features and components of each type system. Certain features which are common to all three systems, such as dispensers and canopies, are intentionally excluded from these analyses. Costs are estimated for only the fueling-related features and installation, assumed to be part of a larger overall service station development project. The detailed initial installation costs for each configuration are presented in Appendix 3.

In addition to these installation costs for a typical site location, Section 3.0 presents site-specific adjustment factors which apply to certain environmentally-sensitive locations or areas which are subject to unusual environmental conditions. These adjustment factors will be estimated for their impacts to the first-time installation costs as well as the recurring maintenance, operation and inspection costs throughout the life of the system. These factors should be considered by project planners and programmers, depending on the various site conditions and local regulations encountered for a particular AAFES location. Section 3.0 also presents some of the “intangible”, non-monetary factors and considerations of the various system configurations.

Once the typical baseline installation costs have been developed, each system will be evaluated for its particular recurring costs over the 30-year system life evaluation period. These recurring costs include overall system operation, electricity usage, equipment maintenance, compliance and integrity inspections, component repair / replacement, recoating, etc. The focus of this section will be on those recurring costs which are different / unique among the three configurations. Section 4.0 of this report describes the specific recurring costs and other life-cycle considerations of each type system, and presents results of the analyses. The detailed life cycle cost input data and results for each configuration are presented in Appendix 4.

Appendix 5 includes typical equipment and component cutsheets and information for the three different system configurations. Appendix 6 includes the qualifications and resumes of the various Design Team members.

1.2 RESULTS OF LIFE CYCLE COST ANALYSIS

Per the chart below, the direct-bury underground storage tank configuration has the lowest installation (construction) cost and also the lowest recurring costs over the 30 year lifespan analysis period. For most site locations, this is the recommended configuration. Adjustment factors for unique / unusual site conditions are described and estimated in Section 3.0.

Tank Configuration	Initial Cost Installed	Total Recurring Costs for 30 Year Design Life	Recurring Cost NPV for 30 Year Design Life
Direct Bury Underground Tanks	$747,077	$2,557,630	$1,489,896
Aboveground Tanks	$1,316,029	$3,637,597	$2,116,141
Below-Grade Vaulted Tanks	$1,785,393	$5,420,364	$3,151,527

1.3 GENERAL DESCRIPTIONS OF EACH SYSTEM

The direct-bury, underground storage tank configuration includes two underground storage tanks, tank-mounted submersible issue pumps, and flexible plastic type underground fuel lines to eight dispenser positions. The storage tanks are the double wall fiberglass type with interstitial monitoring and access manways to grade. One tank is 15,000 gallon and the other tank is a 20,000 gallon split compartment configuration. Per typical service station layouts, these tanks are located below the drive areas of the main service station area, and delivery trucks provide fuel via gravity drop.

The aboveground storage tank configuration includes three 12,000 gallon capacity storage tanks, fuel receipt pumping system, carbon steel receipt piping, submersible issue pumps, transition sump, and flexible plastic type underground fuel lines to eight dispenser positions. The tanks are the fire-rated double wall steel (UL 2085 “Fireguard”) type, installed on a curbed pad area which is separate from the main service station area. This configuration requires additional security fencing and protection of the aboveground tank area.

The vaulted storage tank configuration includes three 12,000 gallon capacity storage tanks, submersible issue pumps, and flexible plastic type underground fuel lines to eight dispenser positions. The tanks are single wall steel (UL 142) type which are installed in a below-grade concrete vault structure. The vault includes ventilation, vapor detection and other confined-space entry features and is located adjacent to the main service station area.

Section 2.0 of this report describes the specific features and components of each type system.

2.0 DETAILED SYSTEM FEATURES

2.1 GENERAL

All three system configurations include storage tanks for regular and premium gasoline (Class I Flammable Liquid), tank-mounted submersible issue pumps, flexible underground issue piping, and dispensers for vehicle servicing. All three systems include pressurized type fuel issue to dispensers (suction-type systems were not evaluated). All tanks and sumps utilize the Veeder Root type monitoring system. All tanks include the typical vapor recovery, overfill prevention, venting, access, and gauging / alarm features. Specific features and functions of each system are presented below.

2.2 APPLICABLE CODES AND REGULATIONS

During the preparation of this report, all applicable Federal, State and Military codes, standards and regulations were considered for system construction, operation and maintenance. The various system features, components and functional requirements meet these standards for similar applications and installations. Additional, site-specific considerations (seismic, groundwater, environmental, etc.) and their estimated short- and long-term impacts are discussed in Section 3.0. For development of the system descriptions, installation cost estimates, and life cycle costs, the most important technical references involved include:

- NFPA 30 Flammable and Combustible Liquids Code
- NFPA 30A Code for Motor Fuel Dispensing Facilities and Repair Garages
- UFC 3-460-01 Design: Petroleum Fuels Facilities
- UFC 3-460-03 Operation and Maintenance of Petroleum Systems
- UFC 3-570-01 Cathodic Protection
- UFGS Section 33 56 10, Factory-Fabricated Fuel Storage Tanks
- UFGS Section 33 58 00 Leak Detection for Fueling Systems
- AFI 23-201 Fuels Management
- API RP 1615 Installation of Underground Petroleum Storage Systems
- API RP 1626 Storing and Handling Ethanol and Gasoline-Ethanol Blends at Distribution Terminals and Filling Stations
- API RP 1632 Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems
- STI Handbook of Storage Tank Systems
- T.O. 42B-1-1 Quality Control of Fuels and Lubricants
- T.O. 37A-1-101 Fuel, Water, and Lubricant Dispensing Equipment
- T.O. 37-1-1: General Operation and Inspection of Installed Fuel Storage and Dispensing Systems
- Latest editions of applicable Recommended Practices of API and PEI, including, API 1007, PEI RP100, PEI RP200, PEI RP300, PEI RP900, PEI RP1200
- 40 CFR 112, 40 CFR 280
- 40 CFR 63CCCCCC

- DoD STD 123-335-03: Military Service Station and Factory Fabricated Tank Engineering Standard

2.3 DIRECT-BURY UNDERGROUND TANK SYSTEM

2.3.1 System Functions

- Fuel receipt into below-grade tanks via simple gravity-drop method from tanker trucks. Connections made to spill bucket receipt points mounted directly atop tank fill nozzles.
- Tanks are double wall fiberglass type with interstitial monitoring and access manways to grade. One tank is 15,000 gallon and the other tank is a 20,000 gallon split compartment configuration.
- Fuel issue to dispensers via submersible issue pumps located in access manways.
- Fuel delivery to dispensers via double wall flexible type issue piping.

2.3.2 System Features

- Entire system is considered an "Underground" system, so associated underground piping and sumps are subject to additional testing and inspections.
- Typical compact layout with storage tanks directly below the main service station area.
- Fiberglass tank-top sumps require leak detection probes and additional devices for compliance testing.
- Double wall tanks include interstitial leak detection.
- No additional security fencing or protection required.
- Fiberglass tank shell material requires no cathodic protection and is not subject to corrosion.
- Force Protection: This compact, underground system is not subject to any ATFP-related concerns.
- With numerous leak prevention and leak detection features, the chance of an undetected spill from a UST system is thought to be negligible.

2.4 ABOVEGROUND TANK SYSTEM

2.4.1 System Functions

- Fuel receipt into aboveground tanks from tanker truck using fixed offload pump system. A single offload system can be used for all three tanks. (For purposes of this report, all aboveground tank systems are assumed to require this fixed offload equipment, instead of using a less-common on-board tanker truck pumping system. All equipment, installation, electrical usage, manpower and maintenance costs of this fixed system are included in the estimates and life cycle costs for this option.)
- Three 12,000 gallon storage tanks are used, and the tanks are the fire-rated double wall steel (UL 2085 "Fireguard") type.

- Tanks are considered STI "Category 1" type – ASTs with spill control, and with CDRM.
- Fuel issue to dispensers via submersible issue pumps located atop each tank.
- Fuel delivery to dispensers via carbon steel aboveground piping up to a transition sump, then underground double wall flexible type issue piping is provided.

2.4.2 System Features

- Aboveground tank systems require additional clearances and separation distances between facilities. Per NFPA and UFC requirements, the pumped offload facility must be at least 25' from aboveground tanks, buildings, roads overhead power lines, pad-mounted transformers, and property lines. For this reason, the required acreage for this configuration is greater than for the underground tank configuration. Also see section 3.2, Item 2 for some intangible / safety considerations of this aboveground tank configuration.
- Offload pump system typically includes offload hose, basket strainer, 300 GPM self priming centrifugal or positive displacement pump, air elimination, metering, isolation valves and controls.
- For spill containment of this pumped offload system, the tanker truck servicing area includes concrete surfacing, rollover curbs, catch basins / trenches and drain piping to a remote containment basin.
- Additional security fencing around tanks is typically required. In addition, bollards and other protective measures are needed around the offload area.
- Steel storage tanks and aboveground issue and receipt piping require protective exterior coatings for corrosion prevention. The tanks and piping require periodic recoating over the life span of the system.
- Force Protection: This aboveground system requires additional security fencing around the storage tanks and bollard protection for vehicle traffic near the offload position. Even with these security / protection features, this system is readily visible and may be subject to ATFP-related concerns.

2.5 VAULTED TANK SYSTEM

2.5.1 System Functions

- Fuel receipt into below-grade vaulted tanks via simple gravity-drop method from tanker trucks. Connections made to spill bucket receipt points which are installed adjacent to the main vault or in the vault cover.
- Three 12,000 gallon storage tanks are used, and the tanks are single wall steel (UL 142) type (Note: if double wall UL 142 tanks are desired, this would increase the total system installation cost by approximately 5%).
- Tanks are considered STI "Category 1" type – ASTs with spill control, and with CDRM.
- Fuel issue to dispensers via submersible issue pumps located atop each tank.
- Fuel delivery to dispensers via double wall flexible type issue piping.

2.5.2 System Features

- Vaulted tanks require additional clearances for vault excavation / placement, as these structures are located outside the service station area. For this reason, the required acreage for this configuration is greater than for the underground tank configuration.
- Vaults are considered confined space entry structures, and must be provided with a continually-operating ventilation system with a Mine Safety Administration vapor monitoring system. In addition, a dry-pipe fire suppression system is provided for foam injection via separate fire vehicle.
- Steel storage tanks require protective exterior coatings for corrosion prevention. The tanks require periodic recoating over the life span of the system.
- Force Protection: This underground system is not subject to any ATFP-related concerns. The vaulted tanks are inherently protected in their below-grade reinforced enclosure.

2.6 INTERCONNECTING PIPING

2.6.1 Piping Materials

- UST system includes all non-ferrous, underground double wall flexible plastic type issue piping.
- AST system includes carbon steel piping from offload system to each tank, and from each tank's issue pump to the transition sump. Thereafter, underground double wall flexible piping is used.
- Vaulted system includes mostly non-ferrous double wall flexible plastic type piping for issue and receipt. Some sections of piping within the vault structure may be carbon steel material.

2.6.2 Piping Lengths

- UST system compact site only includes relatively short underground piping runs between the issue pumps and the nearby dispensers.
- AST system includes separate aboveground receipt piping runs to each tank, plus aboveground piping to the transition sump and longer underground piping runs to the dispensers.
- The vaulted system has relatively short receipt piping lengths to each tank, but the underground issue piping lengths are relatively long to reach the more-remote dispenser area location.

3.0 SITE LOCATION ADJUSTMENT FACTORS AND OTHER CONSIDERATIONS

3.1 SITE LOCATION ADJUSTMENT FACTORS

In addition to the baseline construction costs for each system (site work, equipment, installation, labor, testing, etc.), additional site-specific requirements and conditions can affect the overall facility implementation costs and the recurring costs over the life of the system. These site-specific factors are described below, along with expected impacts to each of the three system configurations being considered.

3.1.1 Environmentally Sensitive Locations

The 2015 update to the Federal EPA UST regulations has helped establish more-common baseline requirements for all locations throughout the US. There are still some state- and region-specific additional environmental requirements which must be satisfied, though. Most states have UST programs which are approved by the Federal EPA, which streamlines and simplifies statutes and regulations. These regulations are frequently updated and should always be evaluated prior to beginning work for a particular location.

- UST System: Additional system features required (provisions for continuous hydrostatic monitoring of underground piping, manometer testing devices, etc.); additional periodic requirements for tank / piping tightness testing. (Estimated Cost Impact: $25,000 initial cost)
- AST System: Minimal impact.
- Vaulted System: Minimal impact.

3.1.2 Wind Impacts (Tornado / Hurricane)

Areas with the potential for extreme wind conditions require additional tank and component anchoring. Dispenser area canopies (not included in these analyses) are also impacted.

- UST System: Minimal impact.
- AST System: Additional anchoring required at tank foundations. (Estimated Cost Impact: additional 30% foundation cost = $40,000)
- Vaulted System: Minimal impact.

3.1.3 Seismic Activity (Earthquake)

Areas with the potential for extreme seismic conditions require additional tank and component anchoring. Dispenser area canopies (not included in these analyses) are also impacted.

- UST System: Minimal impact.
- AST System: Additional anchoring required at tank foundations.
- Vaulted System: Additional anchoring required at tank foundations; additional reinforcing required for vault structure; vault inspections required after seismic event to ensure continued integrity / containment capabilities. (Estimated Cost Impact: additional 30% foundation cost = $90,000)

3.1.4 Groundwater

High groundwater conditions require additional foundation work for underground structures and can have impacts during construction.

- UST System: Ensure tank hold-down slabs and anchors are adequate; de-watering required during excavation activities. (Estimated Cost Impact: additional 15% foundation cost = $12,000)
- AST System: Minimal impact.
- Vaulted System: Additional concrete material / footings may be required for the vault structure to resist buoyancy forces; de-watering required during excavation activities. (Estimated Cost Impact: additional 20% foundation cost = $60,000)

3.1.5 Corrosive Environments

Coastal areas have frequent problems with corrosion of tanks and carbon steel components due to the higher-salt environment.

- UST System: Minimal impact.
- AST System: Consider highest-quality coating system for storage tanks and carbon steel pipes and components (3-coat system with zinc-rich epoxy primer, epoxy intermediate, polyurethane topcoat). All field coating (and periodic recoating) operations require extensive surface preparation and testing prior to coating application. (Estimated Cost Impact: $25,000)
- Vaulted System: As the vaults are continuously ventilated, consider highest-quality coating system for storage tanks and carbon steel pipes and components (3-coat system with zinc-rich epoxy primer, epoxy intermediate, polyurethane topcoat). All field coating (and periodic recoating) operations require extensive surface preparation and testing prior to coating application. (Estimated Cost Impact: $25,000)

3.2 OTHER CONSIDERATIONS

In addition to initial costs and life-cycle costs of the various scenarios, the following “intangible” factors should be considered when selecting a particular system for a specific operating location:

1. Property Size: Although the actual costs of land acquisition and approval are excluded from these analyses, the size of the available site is a critical consideration. These estimates assumed that the most-compact UST configuration would only require a 1 acre site. To accommodate the additional safety clearances, equipment, and vehicle movements for the AST and vaulted configurations, a 2 acre site was assumed.
2. Site Circulation: In addition to the larger overall site requirements for aboveground tank systems, there are potential safety concerns with tanker truck and customer vehicle movements during offload operations. It is often difficult for tanker trucks to safely access the offload pump areas, especially during busy sales hours and for areas with limited parking availability.

3. Site Aesthetics: Depending on the location and traffic density around the proposed site, some owners are opposed to having exposed, highly visible storage tanks immediately adjacent to the facility. In this case, the UST or vaulted configuration may be preferred.
4. Security / Force Protection: For locations which are subject to ATFP-related concerns, the UST and vaulted configurations provide a more-durable, resilient type installation.
5. Environmental Risk: For environmentally-sensitive locations or jurisdictions, many owners prefer not to have underground storage tanks because they are not readily visible and are not easy to inspect and repair. Underground piping environmental risks are the same for all three configurations considered in this study.

4.0 LIFE CYCLE COST ANALYSIS

4.1 INTRODUCTION

This section of the report contains the life cycle cost (LCC) of the three different configurations being evaluated. For each configuration, the anticipated long-term requirements for operation, maintenance / repair and inspection / compliance are provided. The intent of this guidance is to provide project programmers with the approximate life-cycle costs for the different fueling system configurations.

4.2 BASIS OF COSTS

This LCC is based on the three typical AAFES service station configurations which are detailed in previous sections. The overall life cycle cost includes these components:

- Initial Construction Costs: Equipment and component costs, labor costs for qualified installers, site preparation costs, typical testing and startup costs, etc. Costs are estimated for only the fueling-related features and installation, assumed to be part of a larger overall service station development project.
- Operational Costs: Electrical costs, manpower costs, fuel receipt system costs, etc.
- Maintenance Costs: General inspection and testing costs, overfill / spill cleanup; general repair and preventative maintenance, surface recoating, etc.
- Regulatory / Inspection Costs: Recurring fees for permitting, compliance inspection costs, spill response plan updates, etc.

The periodic LCC costs for each configuration are estimated for a typical installation location. Site specific adjustment factors for unusual conditions for the initial system installation costs as well as the periodic LCC costs are presented in Section 3.0.

Certain maintenance and operational costs are common to all three configurations and are not included in these analyses. These costs include: Dispenser maintenance; Electrical costs for dispenser pump operation; Manpower for dispenser pump operation; Site lighting; General site maintenance (landscaping, etc.). The periodic LCC costs focus primarily on those costs which are unique or different from the other configurations, to better illustrate and facilitate comparisons between each option.

4.3 SYSTEM FEATURES AND LCC FACTORS

Installation requirements and general features are listed here for information only. These costs have already been included in the cost estimates for initial construction for each configuration.

4.3.1 Direct Bury Underground Tank System

Installation Requirements / General Features:

1. Excavation of soil / de-watering of the pit during tank installation

2. Leak detection system testing for tank interstitial space, tank sumps and UG piping
3. All-underground dispenser issue piping
4. No fuel receipt equipment, receipt spill containment, or tank interior/exterior coatings are required
5. Requires state-certified contractors for tank installation

Long-Term Operational, Maintenance / Repair, and Regulatory / Inspection Requirements:

1. Maintenance of Leak Detection System Devices
2. Walk-through Inspection (general inspections of spill prevention, leak detection, sump systems every 30 days)
3. Overfill Prevention Inspections (operational checks every 3 years)
4. Sump / Spill Bucket Inspections (integrity testing every 3 years)
5. Release Detection Equipment Testing (annually)
6. Storage Tank Vapor Balance Testing (per 40 CFR 63CCCCCC guidelines, every 3 years)
7. Replacement of Specialized Leak Detection System Components (at year 15)

4.3.2 Aboveground Tank System

Installation Requirements / General Features:

1. At-grade housekeeping pad below tanks
2. Aboveground and underground dispenser issue piping
3. Tank interior and exterior coatings
4. Remotely-located equipment for pumped fuel receipt / piping up to tanks.
5. Spill containment system for receipt tanker trucks
6. Tank-top access platforms / walkways
7. Leak detection system for tank interstitial space and UG piping

Long-Term Operational, Maintenance / Repair, and Regulatory / Inspection Requirements:

1. Offload System Electrical Costs
2. Offload System Manpower Costs
3. Offload System Maintenance / Repair Costs
4. Tank interior and exterior recoating required every 10 years
5. Carbon steel pipe recoating required every 10 years
6. Walk-through Inspections (general inspection per STI SP001 guidelines, every 30 days)
7. STI SP001 Annual Inspection

8. Formal STI SP001 Inspection (every 20 years) (Note: UFC recommends 10 year inspection intervals)
9. Storage Tank Vapor Balance Testing (per 40 CFR 63CCCCCC guidelines, every 3 years)
10. Replacement of Specialized Leak Detection System Components (at year 15)

4.3.3 Vaulted Tank System

Installation Requirements / General Features:

1. Excavation of soil/de-watering during concrete vault installation
2. Leak detection system for UG piping
3. Mostly underground dispenser issue piping (some short CS sections inside vault)
4. Tank interior and exterior coatings
5. No fuel receipt equipment or receipt spill containment required
6. Vault ventilation / vapor detection system (confined space entry conditions)

Long-Term Operational, Maintenance / Repair, and Regulatory / Inspection Requirements:

1. Ventilation / Vapor Monitoring System Electrical Costs
2. Ventilation / Vapor Monitoring System Maintenance / Repair Costs
3. Tank interior and exterior recoating required every 10 years, under confined space restrictions
4. Confined Space Training, Equipment and Calibrations (Annual)
5. Walk-through Inspections (general inspection per STI SP001 guidelines, every 30 days)
6. STI SP001 Annual Inspection
7. Formal STI SP001 Inspection (every 20 years) (Note: UFC recommends 10 year inspection intervals)
8. Storage Tank Vapor Balance Testing (per 40 CFR 63CCCCCC guidelines, every 3 years)
9. Replacement of Vault Ventilation / Monitoring System Components (at year 15)

4.3.4 Summary of LCC Inputs

General service station system maintenance costs have been included as LCC program inputs for each scenario. Costs which are specific to each system are presented below:

Tank Configuration and Recurring Cost / Inspection	Frequency	Cost
Direct Bury Underground Tanks		
1. Maintenance of Leak Detection System Devices	Annual	$5,000
2. Walk-through Inspection (general inspections of spill prevention, leak detection, sump systems)	Monthly	$0 (Included in typical system O&M)
3. Overfill Prevention Inspections (operational checks)	Every 3 Years	$1,500
4. Sump / Spill Bucket Inspections (integrity testing)	Every 3 Years	$5,000
5. Release Detection Equipment Testing	Annual	$5,000
6. Storage Tank Vapor Balance Testing (per 40 CFR 63CCCCCC guidelines)	Every 3 Years	$3,000
7. Replacement of Specialized Leak Detection System Components	At Year 15	$30,000
Aboveground Tanks		
1. Offload System Electrical Costs	Annual	9,000 kWh @ $0.12/kW = $1,080 annually
2. Offload System Manpower Costs	Annual	200 hours @ $100/hr = $20,000 annually
3. Offload System Maintenance / Repair Costs	Annual	$10,000
4. Tank interior and exterior recoating	Every 10 Years	$50,000
5. Carbon steel pipe recoating	Every 10 Years	$10,000
6. Walk-through Inspections (general inspection per STI SP001 guidelines)	Monthly	$0 (Included in typical system O&M)
7. STI SP001 Annual Inspection	Annual	$3,000
8. Formal STI SP001 Inspection	Every 20 Years	$20,000
9. Storage Tank Vapor Balance Testing (per 40 CFR 63CCCCCC guidelines)	Every 3 Years	$3,000
10. Replacement of Specialized Leak Detection System Components	At Year 15	$30,000
Below-Grade Vaulted Tanks		
1. Ventilation / Vapor Monitoring System Electrical Costs	Annual	12,000 kWh @ $0.12/kW = $1,440 annually

Tank Configuration and Recurring Cost / Inspection	Frequency	Cost
2. Ventilation / Vapor Monitoring System Maintenance / Repair Costs	Annual	$45,000
3. Confined Space Training, Equipment and Calibrations	Annual	$20,000
4. Tank interior and exterior recoating required every 10 years, under confined space restrictions	Every 10 Years	$75,000
5. Walk-through Inspections (general inspection per STI SP001 guidelines, every 30 days)	Monthly	$0 (Included in typical system operation)
6. STI SP001 Annual Inspection	Annual	$10,000
7. Formal STI SP001 Inspection (every 20 years)	Every 20 Years	$45,000
8. Storage Tank Vapor Balance Testing (per 40 CFR 63CCCCCC guidelines, every 3 years)	Every 3 Years	$4,000
9. Replacement of Vault Ventilation / Monitoring System Components	At year 15	$35,000

4.4 LCC EVALUATION

The LCC analysis was compiled using Building Life-Cycle Cost software BLCC 5.3-11. It is Department of Energy software used to calculate the present value of various project options. It is available from the DOE at this webpage:

http://www.energy.gov/eere/femp/building-life-cycle-cost-programs.

The program compiles the data, evaluates all the inputs for all the options or scenarios and calculates the NPV based on the tabulation of the initial capital costs, periodical costs, and recurring M&O costs. This software was selected because of its straightforward and versatile reporting function.

Three (3) alternatives were evaluated based on the descriptions provided above. Inspection, maintenance and repair costs were input and evaluated based on the type of systems being reviewed.

To evaluate the LCC, routine O&M costs were assigned based on complexity of the system. These values were assigned as annually occurring costs as routine maintenance. Some scenarios have more than one continually occurring O&M cost.

Periodical costs include tank re-coating, leak detection system upgrades, and tank system testing and repairs. These costs were applied as applicable to the storage tank systems being considered.

4.4.1 Assignment of Costs

The ROM costs were prepared in Excel format with values taken from RS Means, Vendor discussions and historical data. The ROM estimates were then input into the BLCC5 program as alternate scenarios. The ROM costs were used as the initial capital costs. For annual O&M costs we used historical data from other projects of this type. Periodic maintenance values were calculated for the systems that require replacement. These values were estimated at various intervals based on partial or complete replacement of systems as technology changed or equipment degraded over time.

4.4.2 LCC Summary

Construction costs and periodic costs are compiled for each alternative. The order of magnitude costs for each alternative are set to be incurred after the first year of evaluation. The result is a lower present value (PV) for the initial capital cost (ECC) than is shown in the cost estimate sheets provide in Appendix B.

Recurring costs are compiled in two ways, annually and periodically. Annual costs are normal and customary maintenance / operational costs and are incurred regularly. These costs are compiled annually over the 30 year evaluation period with a 2% inflation value assigned over the term of the evaluation. Periodic costs are assigned at various intervals for each alternative. The same 2% inflation has been assigned to all periodic costs. General service station energy consumption costs are included as annual costs, along with any specific additional energy costs which are unique to each scenario.

4.4.3 LCC Results

Tank Configuration	Advantages	Disadvantages	Initial Cost Installed	Total Recurring Costs for 30 Year Design Life
Direct Bury Underground Tanks	1. Allow fuel receipt via gravity 2. Cheaper than other configurations 3. Allows installation on compact site locations. 4. Provides force protection	1. Requires additional component testing and leak detection monitoring	$747,077	$2,557,630
Aboveground Tanks	1. Requires a simple housekeeping pad below tank for tank sizes up to 12,000 gallons (Class I liquids) instead of complete secondary containment	1. Requires pumped fuel receipt 2. Requires interior coating 3. Requires protective exterior coatings 4. Requires tank-top access platform 5. Requires larger site 6. Higher fire and safety risks than for other configurations 7. ATFP considerations add to the overall system cost	$1,316,029	$3,637,597
Below-Grade Vaulted Tanks	1. Provides force protection 2. Allows gravity fill 3. Allows fuel dispensing units to be mounted directly onto the tank for space-savings.	1. Vaults susceptible to movement, cracks and leaks 2. Expensive to construct 3. Confined space entry rules apply 4. Requires interior coating 5. Requires protective exterior coatings 6. Requires vault ventilation and vapor detection system 7. Requires larger site	$1,785,393	$5,420,364

4.4.4 LCC Discussion

Per the chart above, the direct-bury underground storage tank configuration has the lowest installation (construction) cost and also the lowest recurring costs over the 30 year lifespan analysis period. For most site locations, this is the recommended configuration. The chart also includes advantages, disadvantages and other factors which should be considered. Paragraph 3.2 summarizes many of these "intangible" factors which don't necessarily impact the system costs but are still important to consider. Also, adjustment factors for unique / unusual site conditions are described and estimated in Section 3.0.

There have been numerous recent improvements in the materials, features, and installation and testing requirements for direct bury underground tank systems. Early UST systems included single wall steel tanks with inadequate coatings and cathodic protection, direct-buried mechanical joints, and poor construction and inspection techniques. Now, there are numerous improvements to UST systems, including double wall fiberglass tanks and piping with built-in inspection / testing features, access sumps below dispensers and at tank manways with continuous monitoring probes, advanced tank gauging and leak detection technologies, and more stringent construction, installation, permitting and operational testing requirements of the system. With all of these features, the chance of an undetected spill from a UST system is thought to be negligible. Along with more-rigorous monthly, annual and triennial system testing and inspection requirements during the operational life of the facility, underground storage tank systems are more reliable than ever.

Appendix 1 – PROJECT STATEMENT OF WORK

Army Air Force Exchange Service (AAFES)

Gasoline Storage and Dispensing Systems at Xpress Stores

Life Cycle Cost (LCC) Study

AAFES operates approximately 500 motor fuel stations located on Army and Air Force Installations around the world. These stations are usually co-located with an Xpress store. The Xpress stores are similar to a commercial convenience store. Initial construction is funded with non-appropriated funds, with follow-on maintenance and repair costs (except the dispensers) paid by the individual installation using appropriated funds.

The scope of this study includes all piping, tanks, tank appurtenances, receipt hardware, and fuel handling equipment up to and excluding the dispensers/meters. This includes everything from product receipt up to the above ground dispensers.

Reference: *Department of Air Force, Air Force Civil Engineering Center, Preliminary Final Report with LCC Evaluation and Decision Matrix, Contract FA8903-08-D-8794, Task Order No. 4C02 dated March 2015.*

Statement of Work

Life Cycle Cost Investigation of direct bury Underground Storage Tanks (USTs)/Above Ground Storage Tanks (ASTs)/ Above Ground Storage Tanks in Below Grade Fuel Vaults. The goal is to present planners with metrics that will allow them to select the best motor fuel storage system in terms of Life Cycle Cost consistent with applicable criteria when adjusted for certain site specific impacts.

Period of Performance: 90 Days

General Requirement: Accomplish an expanded cost analysis based on the Referenced Study to compare the total life cycle costs of three types of retail fuel tank/distribution systems: (1.) standard direct bury USTs, (2.) ASTs, and (3.) below grade vaulted tanks. The comparison should include initial capital cost to construct and all cost to operate and maintain each system during the systems' expected life. Life expectancy is defined at 30 years. Provide a detailed description of the materials and equipment used in the analysis. Each contributing cost item should be broken out and described for each type system. AE will make a recommendation on the lowest cost option and will summarize best practice currently used for commercial service stations.

Applicable Documents:
AE study shall comply with all applicable Federal, State, and Local Statutes, Instruction, Manuals, Handbooks, regulations, Guidance, Policy Letters, and rules (including all changes and amendments as of the date of this task order), and Presidential Executive

Orders, Air Force/Army/Military Criteria; National Association of Corrosion Engineers (NACE); American Petroleum Institute (API); National Fire Protection Association (NFPA); Petroleum Equipment Institute (PEI); Steel Structures and Painting Counsel (SSPC); National Electrical Code (NEC);Federal and State Environmental Regulations, including all changes and amendments in effect on the date of the issuance of this task order. The following is a partial list of the most important technical references that the AE shall consider:

- NFPA 30 Flammable and Combustible Liquids Code
- NFPA 30A Code for Motor Fuel Dispensing Facilities and Repair Garages
- UFC 3-460-01 Design: Petroleum Fuels Facilities
- UFC 3-460-03 Operation and Maintenance of Petroleum Systems
- UFC 3-570-01 Cathodic Protection
- UFGS Division 33 – Utilities
  - Section 33 56 10, Factory-Fabricated Fuel Storage Tanks
  - Section 33 58 00 Leak Detection for Fueling Systems
- AFI 23-201 Fuels Management
- API RP 1615 Installation of Underground Petroleum Storage Systems
- API RP 1626 Storing and Handling Ethanol and Gasoline-Ethanol Blends at Distribution Terminals and Filling Stations
- API RP 1632 Cathodic Protection of Underground Petroleum Storage Tanks and Piping Systems
- STI Handbook of Storage Tank Systems
- T.O. 42B-1-1 Quality Control of Fuels and Lubricants
- T.O. 37A-1-101 Fuel, Water, and Lubricant Dispensing Equipment
- T.O. 37-1-1: General Operation and Inspection of Installed Fuel Storage and Dispensing Systems.
- Latest editions of applicable Recommended Practices of API and PEI, including, API 1007, PEI RP100, PEI RP200, PEI RP300, PEI RP900, PEI RP1200
- 40 CFR 112, 40 CFR 280
- 40 CFR 63CCCCCC

Background: The Exchange constructs new Express (Retail) Fuel Dispensing Facilities on Army and Air Force Installations to support the military mission and authorized patrons. They construct these facilities with Non-Appropriated Funds and then turn ownership over to the Services for maintenance; however, the Exchange operates the facilities. These facilities primarily use Underground Storage Tanks (USTs) since these facilities most resemble commercial convenience stores. However, at some locations throughout the country the individual Base/Post requests ASTs or ASTs in below grade vaults. Some of the reasoning given behind the requests has been related to less stringent regulation requirements for ASTs, site location restraints (due to potential soil or water conditions), reduced operation and maintenance costs, or a variety of other reasons. In the past, the Exchange has compiled data on life cycle costs (in-house) for the three fuel systems, but in an effort to provide an independent study, would like to obtain an

Investigative Cost Analysis of the three fuel systems described over a thirty year period. The baseline should reflect the initial construction cost of each system for comparison for a complete retail system up to but not including dispensers. The AE will use the referenced Report as a starting point to update and expand with a breakout of those line items that contribute to the LCC of all three tank systems in various locations. **The emphasis of this study is to clearly show detail on ALL maintenance costs including but not limited to recurring environmental compliance; safety and fire inspections; or maintenance actions unique to each of the three tank systems. This is to clearly show the sustainment burden placed upon the local host service for each tank system. Also include descriptions of impacts that may not have a direct recurring cost such as added real estate required for ASTs.**

Site Location: The study will be based on three generic fuel systems. In addition to breakouts for each cost line item, the AE will develop adjustment factors for locations in more environmentally sensitive jurisdictions such as Florida, California, and New York. Adjustment factors will also be applied for locations prone to natural events such as hurricanes, tornados, and earthquakes as well as other impacts such as corrosion impacts in coastal locations. The AE will identify other locations where local criteria could impact life cycle cost either up or down.

Assumptions:
The typical retail petroleum system includes tanks with remote dispensers.

Dirct Bury Double Wall USTs:

1. Assume one 15,000 gallon regular tank, one 20,000 gallon split compartment tank for regular and premium, fiberglass, double-wall USTs, double-walled rigid fiberglass lines, with interstitial monitoring, and piping to eight fuel dispensers.
2. Environmental Compliance
3. What are the impacts of the latest Federal EPA requirements

AST's:

1. Assume three 12,000 gallon double-wall steel tanks with at least one adequately sized off-loading pump to transfer fuel from tanker trucks to the tanks. Include a containment system around the tanks and above ground lines within the containment with a transition sump to below ground piping to eight fuel dispensers.
2. Include all costs for ATFP and damage protection.
3. Consider all additional costs for fuel off-loading fees
4. AE will state the maximum allowable size for AST systems
5. The AST should include the cost of an engineered concrete dike to contain a potential spill, transfer pumps for off-loading and a 10'-12' high chain link fence with plastic slats and appropriate bonding/grounding.

6. Natural disasters such as hurricanes, tornados, and earthquakes in locations where applicable
7. Consideration towards corrosion resultant from salt air in costal locations.

Below Grade Vaulted:

1. Assume three 12000 gallon single-wall steel ASTs in concrete fuel vaults and eight fuel dispensers.
2. Costs associated with inspection access including confined space entry
3. A requirement for the below grade fuel vaults is an engineered vault ventilation system with a Mine Safety Administration vapor monitoring system as well as a fire suppression system (2" steel piping) leading to each vault where foam can be injected. Assume a continuously running ventilation system. Assume repair and inspection work on items in vault is permit-required confined space entry. See NFPA 30A, 4.3.3 and example drawings for additional details.
4. Natural disasters such as hurricanes, flooding, and earthquakes in locations where applicable. Additional concrete anchoring for the fuel vaults outer perimeter is required in high groundwater locations and should be included.

General Assumptions: Site construction of all three types of systems should generally meet the applicable standards and practices in Applicable Documents above and any apparent deviations from these standards should be noted.

For initial cost estimation purposes, all three fuel systems should <u>exclude</u> the cost of the fuel dispensers and the canopy over the dispensers.

All of the systems will include the cost of electrical and a TLS 450 Plus Veeder Root Console with sensors in every sump where fuel could accumulate. The Exchange standard UST system is double-walled fiberglass tanks with double-walled fiberglass lines. The tank vaults should contain liquid and vapor sensors that operate as required by NFPA 30A, paragraph 4.3.3.7.

Tanks in all systems must meet requirements of 40 CFR 63CCCCCC for throughput of over 100,000 gallons, including drop tubes, vapor balance fills, pressure vent caps, and appropriate testing at start up and every 3 years.

As the Initial baseline costs will be established for the cost of the construction of each system, the cost for Operation/Maintenance/Regulatory Compliance must be provided for each distinct fuel system and listed separately as Military vs The Exchange cost over a period of thirty years.

Assume that the local fire code does not prohibit the use of ASTs for retail fuel.

Architect-Engineer (AE) Qualifications:

AE shall demonstrate experience with design, construction and maintenance of all three retail fuel systems (USTs, ASTs, and vaulted ASTs). Experience with design engineering and cost estimation of these systems is mandatory. The AE shall show at least three projects (preferably one of each system type) within the last five years on US military bases. The project engineer shall have at least ten years of experience in the design of fuel handling and storage systems and shall show demonstrated knowledge of commercial and military service station design.

Deliverables:

AE Qualifications. One draft and one final report in electronic format, which will include:

Report will provide sources of data used, such as “Manufacturer Product Brochure,” “industry knowledge,” “published contract data,” etc.

Use Excel spreadsheet or other suitable chart to display and compare cost data on each system.

Report shall be in the following format, unless mutually agreed between contracting officer and contractor.

Title Page

Table of Contents

Executive Summary with Cost breakdown for each of the three systems. Each cost line item will include a cost factor to include increases or decreases based on special requirements within certain jurisdictions with more stringent requirement. An example of this would be environmental regulations which go beyond Federal EPA requirements. AE shall make a recommendation on the best overall system.

Overview

Contributing Cost Line Item Descriptions

Standards for System Construction, Operation and Maintenance
    See Applicable Documents above

Contributing Life Cycle Cost Items (AE may choose to add others)

A. Construction Costs (including site preparation)
1. System physical parts (tanks, piping, pumps including loading pumps for above grade tanks, normal tank vents, emergency vents, electrical wiring, monitors & sensors, concrete cover or pad or vault, etc.)
2. Labor costs for qualified installers

3. Equipment costs
4. Testing and Environmental compliance costs
5. Other costs

B. Operational costs
    1. Electrical costs (pumps, fans, monitoring and system costs excluding canopy lighting)
    2. Manpower costs
    3. Added Fuel delivery costs associated with pumping to above ground tanks
    4. Other costs (that the contractor recommends and should be considered for a useful comparison).

C. Maintenance Costs
    1. Inspection, testing, including structural features and electrical and monitoring systems
    2. Overfill or spill cleanup (including spill bucket emptying)
    3. Repairs expected & cost (such as off-loading pumps for Above-grade ASTs)
    5. Surface coating.
    6. Other costs (that the contractor recommends and should be considered for a useful comparison).

D. Regulatory and Environmental Compliance Costs
    1. Registration fees,
    2. Registration process costs (filling out paperwork, etc.,)
    3. Spill notification,
    4. Site cleanup in event of a spill
    5. Site closure costs
    6. Inspection costs under 40 CFR 112
    7. Inspection costs under 40 CFR 280 as currently proposed by USEPA
    8. Inspection costs under 40 CFR 63 CCCCCC
    9. Spill Response Plan costs under 40 CFR 112 (creating, updating)
    10. Other costs (that the contractor recommends and should be considered for a useful comparison).

Opinions/Findings:

Provide a basic determination whether the systems have an EPA third party certification for leak detection. (Pressurized lines and tank tightness).

Safety/Force Protection. Comment on the safety and Anti-Terrorism/Force Protection capabilities/risks of each system.

Estimated costs to remove each system at end of life, less any salvage value. This should include costs to close and remove the system in accordance with applicable regulations.

Appendix will include qualifications and experience of AE personnel who prepared the study.

Reports: AE Qualifications will be provided with the cost and technical proposal. Draft Report will be completed within 30 days of Notice to proceed. AAFES will return comments on the Draft report with 21 days. Final Report will be completed with 14 days following receipt of AAFES comments.

Exchange POC will be:
Patrick Mumme
Exchange Real Estate Division
214-312-4342 mummepg@aafes.com

Appendix 2 – KICKOFF MEETING MINUTES

AAFES LCC Study – 1/27/17 Kickoff Phonecon Minutes

Participants:
Mark Furr, Larry Beasley – Robert and Company
Pat Mumme, Robert Largent, Cpt. Green, Greg Smith – AAFES

Discussion Items:

1. Study to focus on operational / regulatory / compliance costs (harder to quantify than construction costs).
2. Look at total LCCs, including all environmental costs.
3. UG piping on AST systems is not typically regulated, but UG piping on UST systems is regulated.
4. Consider local factors and impacts.
5. Check environmental compliance requirements.
6. For AST and AST vaulted systems, consider the larger required site footprint / site development costs. Also need fencing / bollards for these type systems.
7. Use a 30 year analysis period for LCC.
8. Vaulted option: consider vault transportation costs – critical cost items for this scenario. Core Engineers is a suggested source for these vaults.
9. Scenarios do not need to consider the dispensers and associated LCC costs, as these are identical regardless of the scenario.
10. All UG piping to dispensers is the flexible DW type (typical commercial type). Lengths of UG piping shall be shorter for the UST tank system than the other options.
11. AST option shall use FireGuard UL 2085 type tanks.
12. AST option uses just one offload pumping system which is connected to all 3 tanks.
13. Assume typical Veeder Root tank control systems.

Appendix 3 – DETAILED CONSTRUCTION COST ESTIMATES

CONSTRUCTION COST ESTIMATE SUMMARY

CONTRACTOR	Corrected Final Submittal	ADDRESS	
CONTRACT FOR(WORK TO BE PERFORMED)	***Gasoline Storage and Dispensing Systems at Express Stores***	***COST SUMMARY***	PROPOSED TOTAL CONTRACT PRICE
PURCHASE REQUEST NUMBER	PROJECT NUMBER	WORK LOCATION	

LINE		UNIT OF		MATERIAL COST		LABOR COST			DIRECT	LINE
NO.	ITEM	MEASURE	QUANTITY	UNIT	TOTAL	MANHOURS	RATE	TOTAL	COSTS	TOTAL
	SUMMARY									
1	***Scenario 1*** Direct Buried USTs									747,077
2	***Scenario 2*** Three (3) ASTs									1,316,029
3	***Scenario 3*** Below Grade Vaulted Tanks									1,785,393

Note: Costs herein are estimated for only the fueling-related features and installations of each scenario. This work is assumed to be a streamlined part of a larger overall service station development project, with some shared costs for project overhead, site work, vehicle access, utilities, etc.

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal | ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Direct Buried USTs*** ***Scenario #1*** | PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER: | PROJECT NUMBER: | WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	SUMMARY									
1	***SUBTOTAL GENERAL CONDITIONS***				5,992			36,639	12,998	55,629
2	***SUBTOTAL ARCHITECTURAL***				0			0	0	0
3	***SUBTOTAL CIVIL***				33,750			34,304	0	68,054
4	***SUBTOTAL STRUCTURAL***				10,000			8,712	0	18,712
5	***SUBTOTAL MECHANICAL***				172,000			199,424	0	371,424
6	***SUBTOTAL ELECTRICAL***				33,000			23,141	0	56,141
	LINE TOTALS				254,742			302,219	12,998	569,959
	OVERHEAD (15%)									85,494
	SUBTOTAL									655,453
	PROFIT (10%)									56,996
	SUBTOTAL									712,449
	TAX (8%)									20,379
	BOND (2.0%)									14,249
	TOTAL PROJECT PRICE									747,077

DATE: 7-Jul-17 **FIRM NAME:** *Robert and Company*

TITLE: Estimator **BY:** CPS

YOUR NAME

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal
ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Direct Buried USTs*** ***Scenario #1***
PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER:
PROJECT NUMBER:
WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	GENERAL CONDITIONS									
1	***Field Office (expenses+rent)***	MO	2.0	711.00	1,422				30	1,452
2	***General Purpose Laborer***	WK	8.0				840.00	6,720		6,720
3	***Project Manager***	WK	8.0				1285.00	10,280	1,200	11,480
4	***Superintendent***	WK	8.0				1210.00	9,680	1,200	10,880
5	***Builder's Insurance***	JOB	1.0						2,000	2,000
6	***Permits***	JOB	1.0						2,500	2,500
7	***Surveying (3-man crew)***	DAY	2.0				1500.00	3,000		3,000
8	***Testing Lab Service***	LS	1.0						2,500	2,500
9	***Construction Fence***	LF	1,000.0	2.25	2,250	40.00	15.00	600		2,850
10	***Portable Toilet***	WK	8.0	40.00	320				64	384
11	***Truck Rental - Superintendent***	WK	8.0	215.00	1,720				1,004	2,724
12	***Cleanup (after job completion)***	JOB	1.0						2,500	2,500
13	***Dumpsters***	WK	8.0	35.00	280					280
	SUBTOTAL THIS PAGE				5,992			30,280	12,998	49,270
	LABOR BURDEN (21%)							6,359		
	SUBTOTAL GENERAL CONDITIONS				5,992			36,639	12,998	55,629

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR Corrected Final Submittal	ADDRESS
CONTRACT FOR(WORK TO BE PERFORMED) *Direct Buried USTs* *Scenario #1*	PROPOSED TOTAL CONTRACT PRICE
PURCHASE REQUEST NUMBER	PROJECT NUMBER / WORK LOCATION

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	ARCHITECTURAL									
1										
2										0
3										0
4										0
5										0
6										0
7										0
8										0
9										0
10										0
11										0
12										0
13										0
	SUBTOTAL THIS PAGE				0			0	0	0
	LABOR BURDEN (21%)							0		
	SUBTOTAL ARCHITECTURAL				0			0	0	0

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal

ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Direct Buried USTs*** ***Scenario #1***

PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER:

PROJECT NUMBER:

WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	CIVIL									
1	***Site Work and Rough Grading***	AC	1.0	7,500.00	7,500	30.00	45.00	1,350		8,850
2	***Concrete Truck Pavement***	SY	150.0	175.00	26,250	4.00	45.00	27,000		53,250
	SUBTOTAL THIS PAGE				33,750			28,350	0	62,100
	LABOR BURDEN (21%)							5,954		
	SUBTOTAL CIVIL				33,750			34,304	0	68,054

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR		ADDRESS
Corrected Final Submittal		
CONTRACT FOR(WORK TO BE PERFORMED)	*Direct Buried USTs* *Scenario #1*	PROPOSED TOTAL CONTRACT PRICE
PURCHASE REQUEST NUMBER	PROJECT NUMBER	WORK LOCATION

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	STRUCTURAL									
1	***Concrete Anchors Below Tanks***	EA	4.0	2,500.00	10,000	40.00	45.00	7,200	0	17,200
	SUBTOTAL THIS PAGE				10,000			7,200	0	17,200
	LABOR BURDEN (21%)							1,512		
	SUBTOTAL STRUCTURAL				10,000			8,712	0	18,712

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal | ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Direct Buried USTs*** ***Scenario #1*** | PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER: | PROJECT NUMBER: | WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	Mechanical System									
1	***Submersible Pumps***	EA	3.0	2,750.00	8,250	50.00	45.00	6,750	0	15,000
2	***Underground FlexWorks Piping***	LF	850.0	55.00	46,750	1.25	45.00	47,813	0	94,563
3	***Underground FRP USTs and Devices***									
4	***15000 GAL***	EA	1.0	55,000.00	55,000	450.00	45.00	20,250	0	75,250
5	***20000 GAL***	EA	1.0	62,000.00	62,000	500.00	45.00	22,500	0	84,500
6	***Excavation Backfill and Compaction***	CY	1,500.0			1.00	45.00	67,500		67,500
	SUBTOTAL THIS PAGE				172,000			164,813	0	336,813
	LABOR BURDEN (21%)							34,611		
	SUBTOTAL MECHANICAL				172,000			199,424	0	371,424

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR	Corrected Final Submittal	ADDRESS	
CONTRACT FOR(WORK TO BE PERFORMED)	***Direct Buried USTs***	***Scenario #1***	PROPOSED TOTAL CONTRACT PRICE
PURCHASE REQUEST NUMBER		PROJECT NUMBER	WORK LOCATION

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	Electrical									
1	***Tank Monitoring System (2 tanks)***	EA	1.0	18,000.00	18,000	175.00	45.00	7,875	0	25,875
2	***Site Electrical Power for Pumps and Devices (Panel, wiring, controls)***	LS	1.0	15,000.00	15,000	250.00	45.00	11,250	0	26,250
	SUBTOTAL THIS PAGE				33,000			19,125	0	52,125
	LABOR BURDEN (21%)							4,016		
	SUBTOTAL ELECTRICAL				33,000			23,141	0	56,141

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal		ADDRESS	
CONTRACT FOR(WORK TO BE PERFORMED): *Three (3) ASTs*	*Scenario #2*	PROPOSED TOTAL CONTRACT PRICE	
PURCHASE REQUEST NUMBER	PROJECT NUMBER	WORK LOCATION	

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	SUMMARY									
1	***SUBTOTAL GENERAL CONDITIONS***				7,342			37,002	13,498	57,842
2	***SUBTOTAL ARCHITECTURAL***				0			0	0	0
3	***SUBTOTAL CIVIL***				135,125			117,503	0	252,628
4	***SUBTOTAL STRUCTURAL***				54,500			25,047	0	79,547
5	***SUBTOTAL MECHANICAL***				372,125			131,089	0	503,214
6	***SUBTOTAL ELECTRICAL***				60,000			39,476	0	99,476
LINE TOTALS					629,092			350,117	13,498	992,707
OVERHEAD (15%)										148,906
SUBTOTAL										1,141,613
PROFIT (10%)										99,271
SUBTOTAL										1,240,884
TAX (8%)										50,327
BOND (2.0%)										24,818
TOTAL PROJECT PRICE										1,316,029

DATE: 7-Jul-17 **FIRM NAME:** *Robert and Company*

TITLE: Estimator **BY:** CPS

YOUR NAME

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal | ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): *Three (3) ASTs* *Scenario #2* | PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER: | PROJECT NUMBER: | WORK LOCATION:

LINE	ITEM	UNIT OF	QUANTITY	MATERIAL COST		LABOR COST			DIRECT	LINE
NO.		MEASURE		UNIT	TOTAL	MANHOURS	RATE	TOTAL	COSTS	TOTAL
	GENERAL CONDITIONS									
1	***Field Office (expenses+rent)***	MO	2.0	711.00	1,422				30	1,452
2	***General Purpose Laborer***	WK	8.0				840.00	6,720		6,720
3	***Project Manager***	WK	8.0				1285.00	10,280	1,200	11,480
4	***Superintendent***	WK	8.0				1210.00	9,680	1,200	10,880
5	***Builder's Insurance***	JOB	1.0						2,000	2,000
6	***Permits***	JOB	1.0						2,500	2,500
7	***Surveying (3-man crew)***	DAY	2.0				1500.00	3,000		3,000
8	***Testing Lab Service***	LS	1.0						2,500	2,500
9	***Construction Fence***	LF	1,600.0	2.25	3,600	60.00	15.00	900		4,500
10	***Portable Toilet***	WK	8.0	40.00	320				64	384
11	***Truck Rental - Superintendent***	WK	8.0	215.00	1,720				1,004	2,724
12	***Cleanup (after job completion)***	JOB	1.0						3,000	3,000
13	***Dumpsters***	WK	8.0	35.00	280					280
	SUBTOTAL THIS PAGE				7,342			30,580	13,498	51,420
	LABOR BURDEN (21%)							6,422		
	SUBTOTAL GENERAL CONDITIONS				7,342			37,002	13,498	57,842

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR	ADDRESS
Corrected Final Submittal	

CONTRACT FOR(WORK TO BE PERFORMED)	PROPOSED TOTAL CONTRACT PRICE
Three (3) ASTs *Scenario #2*	

PURCHASE REQUEST NUMBER	PROJECT NUMBER	WORK LOCATION

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST		LABOR COST			DIRECT COSTS	LINE TOTAL
				UNIT	TOTAL	MANHOURS	RATE	TOTAL		
	ARCHITECTURAL									
1										
2										0
3										0
4										0
5										0
6										0
7										0
8										0
9										0
10										0
11										0
12										0
13										0
	SUBTOTAL THIS PAGE				0			0	0	0
	LABOR BURDEN (21%)							0		
	SUBTOTAL ARCHITECTURAL				0			0	0	0

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal
ADDRESS:
CONTRACT FOR(WORK TO BE PERFORMED): *Three (3) ASTs* *Scenario #2*
PROPOSED TOTAL CONTRACT PRICE:
PURCHASE REQUEST NUMBER:
PROJECT NUMBER:
WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	CIVIL									
1	***Site Work and Rough Grading***	AC	1.5	7,500.00	11,250	60.00	45.00	4,050		15,300
3	***Concrete Truck Pavement***	SY	225.0	175.00	39,375	4.00	45.00	40,500		79,875
4	***Containment Basin***	EA	1.0	25,000.00	25,000	400.00	45.00	18,000		43,000
5	***Drain Piping (Length Varies)***	LS	1.0	12,500.00	12,500	200.00	45.00	9,000		21,500
6	***Straight and Roll-Over Curbs***	LF	130.0	110.00	14,300	1.00	45.00	5,850		20,150
7	***Drainage Structures***	EA	2.0	4,500.00	9,000	80.00	45.00	7,200		16,200
8	***Bollards***	EA	8.0	900.00	7,200	6.00	45.00	2,160		9,360
9	***Transition Sump***	EA	1.0	6,500.00	6,500	130.00	45.00	5,850		12,350
11	***Fencing***	LF	400.0	25.00	10,000	0.25	45.00	4,500		14,500
	SUBTOTAL THIS PAGE				135,125			97,110	0	232,235
	LABOR BURDEN (21%)							20,393		
	SUBTOTAL CIVIL				135,125			117,503	0	252,628

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal | ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Three (3) ASTs*** ***Scenario #2*** | PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER: | PROJECT NUMBER: | WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	STRUCTURAL									
1	***Concrete Housekeeping Pads***	EA	1.0	15,000.00	15,000	140.00	45.00	6,300	0	21,300
2	***Miscellaneous Pipe Supports***	LS	1.0	12,500.00	12,500	95.00	45.00	4,275	0	16,775
3	***Tank Foundations***	EA	3.0	9,000.00	27,000	75.00	45.00	10,125		37,125
	SUBTOTAL THIS PAGE				54,500			20,700	0	75,200
	LABOR BURDEN (21%)							4,347		
	SUBTOTAL STRUCTURAL				54,500			25,047	0	79,547

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal
ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): *Three (3) ASTs* *Scenario #2*
PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER:
PROJECT NUMBER:
WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	Mechanical System									
1	***Truck 300 GPM Offloading Skid***	EA	1.0	50,000.00	50,000	100.00	45.00	4,500	0	54,500
2	***Aboveground CS Piping***	LF	175.0	65.00	11,375	1.50	45.00	11,813	0	23,188
3	***Underground FlexWorks Piping***	LF	1,000.0	55.00	55,000	1.25	45.00	56,250	0	111,250
4	***12,000 GAL Tanks (Fire Protected)***	EA	3.0	70,000.00	210,000	150.00	45.00	20,250	0	230,250
5	***Tank Coatings***	EA	3.0	12,500.00	37,500	65.00	45.00	8,775	0	46,275
6	***Submersible Pumps***	EA	3.0	2,750.00	8,250	50.00	45.00	6,750	0	15,000
	SUBTOTAL THIS PAGE				372,125			108,338	0	480,463
	LABOR BURDEN (21%)							22,751		
	SUBTOTAL MECHANICAL				372,125			131,089	0	503,214

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal

ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): *Three (3) ASTs* *Scenario #2*

PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER:

PROJECT NUMBER:

WORK LOCATION:

LINE		UNIT OF		MATERIAL COST		LABOR COST			DIRECT	LINE
NO.	ITEM	MEASURE	QUANTITY	UNIT	TOTAL	MANHOURS	RATE	TOTAL	COSTS	TOTAL
	Electrical									
1	***Site Lighting (2 poles, wiring, controls)***	LS	1.0	9,000.00	9,000	150.00	45.00	6,750	0	15,750
2	***Tank Monitoring System (3 tanks)***	EA	1.0	21,000.00	21,000	250.00	45.00	11,250	0	32,250
3	***Site Electrical Power for Pumps and Devices (MCC / Panel, wiring, controls)***	LS	1.0	30,000.00	30,000	325.00	45.00	14,625	0	44,625
	SUBTOTAL THIS PAGE				60,000			32,625	0	92,625
	LABOR BURDEN (21%)							6,851		
	SUBTOTAL ELECTRICAL				60,000			39,476	0	99,476

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR	ADDRESS
Corrected Final Submittal	

CONTRACT FOR(WORK TO BE PERFORMED)	PROPOSED TOTAL CONTRACT PRICE
Below Grade Vaulted Tanks ***Scenario #3***	

PURCHASE REQUEST NUMBER	PROJECT NUMBER	WORK LOCATION

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	SUMMARY									
1	***SUBTOTAL GENERAL CONDITIONS***				7,342			37,002	13,498	57,842
2	***SUBTOTAL ARCHITECTURAL***				0			0	0	0
3	***SUBTOTAL CIVIL***				33,125			148,513	0	181,638
4	***SUBTOTAL STRUCTURAL***				484,500			48,461	0	532,961
5	***SUBTOTAL MECHANICAL***				317,500			144,701	0	462,201
6	***SUBTOTAL ELECTRICAL***				69,000			39,476	0	108,476
LINE TOTALS					911,467			418,153	13,498	1,343,118
OVERHEAD (15%)										201,468
SUBTOTAL										1,544,586
PROFIT (10%)										134,312
SUBTOTAL										1,678,898
TAX (8%)										72,917
BOND (2.0%)										33,578
TOTAL PROJECT PRICE										1,785,393

DATE: 7-Jul-17 **FIRM NAME:** *Robert and Company*

TITLE: Estimator **BY:** CPS

YOUR NAME

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal | ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Below Grade Vaulted Tanks*** ***Scenario #3*** | PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER: | PROJECT NUMBER: | WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	GENERAL CONDITIONS									
1	***Field Office (expenses+rent)***	MO	2.0	711.00	1,422				30	1,452
2	***General Purpose Laborer***	WK	8.0				840.00	6,720		6,720
3	***Project Manager***	WK	8.0				1285.00	10,280	1,200	11,480
4	***Superintendent***	WK	8.0				1210.00	9,680	1,200	10,880
5	***Builder's Insurance***	JOB	1.0						2,000	2,000
6	***Permits***	JOB	1.0						2,500	2,500
7	***Surveying (3-man crew)***	DAY	2.0				1500.00	3,000		3,000
8	***Testing Lab Service***	LS	1.0						2,500	2,500
9	***Construction Fence***	LF	1,600.0	2.25	3,600	60.00	15.00	900		4,500
10	***Portable Toilet***	WK	8.0	40.00	320				64	384
11	***Truck Rental - Superintendent***	WK	8.0	215.00	1,720				1,004	2,724
12	***Cleanup (after job completion)***	JOB	1.0						3,000	3,000
13	***Dumpsters***	WK	8.0	35.00	280					280
	SUBTOTAL THIS PAGE				7,342			30,580	13,498	51,420
	LABOR BURDEN (21%)							6,422		
	SUBTOTAL GENERAL CONDITIONS				7,342			37,002	13,498	57,842

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal

ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Below Grade Vaulted Tanks*** ***Scenario #3***

PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER:

PROJECT NUMBER:

WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	ARCHITECTURAL									
1										
2										0
3										0
4										0
5										0
6										0
7										0
8										0
9										0
10										0
11										0
12										0
13										0
	SUBTOTAL THIS PAGE				0			0	0	0
	LABOR BURDEN (21%)							0		
	SUBTOTAL ARCHITECTURAL				0			0	0	0

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal

ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Below Grade Vaulted Tanks*** ***Scenario #3***

PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER:

PROJECT NUMBER:

WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	CIVIL									
1	***Site Work and Rough Grading***	AC	1.5	7,500.00	11,250	60.00	45.00	4,050		15,300
2	***Excavation Backfill, and Compaction***	CY	2,200.0	0.00	0	1.00	45.00	99,000		99,000
3	***Concrete Truck Pavement***	SY	125.0	175.00	21,875	3.50	45.00	19,688		41,563
	SUBTOTAL THIS PAGE				33,125			122,738	0	155,863
	LABOR BURDEN (21%)							25,775		
	SUBTOTAL CIVIL				33,125			148,513	0	181,638

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal | ADDRESS:

CONTRACT FOR(WORK TO BE PERFORMED): ***Below Grade Vaulted Tanks*** ***Scenario #3*** | PROPOSED TOTAL CONTRACT PRICE:

PURCHASE REQUEST NUMBER: | PROJECT NUMBER: | WORK LOCATION:

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	STRUCTURAL									
1	***Miscellaneous Pipe Supports***	LS	1.0	4,500.00	4,500	65.00	45.00	2,925	0	7,425
2	***Tank Vault***	EA	3.0	145,000.00	435,000	150.00	45.00	20,250		455,250
3	***Tank Foundations***	EA	3.0	15,000.00	45,000	125.00	45.00	16,875		61,875
	SUBTOTAL THIS PAGE				484,500			40,050	0	524,550
	LABOR BURDEN (21%)							8,411		
	SUBTOTAL STRUCTURAL				484,500			48,461	0	532,961

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR	ADDRESS
Corrected Final Submittal	

CONTRACT FOR(WORK TO BE PERFORMED)	PROPOSED TOTAL CONTRACT PRICE
Below Grade Vaulted Tanks ***Scenario #3***	

PURCHASE REQUEST NUMBER	PROJECT NUMBER	WORK LOCATION

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	Mechanical System									
1	***12,000 Gal Single Wall Tanks***	EA	3.0	60,000.00	180,000	150.00	45.00	20,250	0	200,250
2	***Submersible Pumps***	EA	3.0	2,750.00	8,250	50.00	45.00	6,750	0	15,000
3	***Underground FlexWorks Piping***	LF	850.0	55.00	46,750	1.25	45.00	47,813	0	94,563
4	***Tank Coatings***	EA	3.0	12,500.00	37,500	65.00	45.00	8,775	0	46,275
5	***Vault Ventilation System***	LS	1.0	20,000.0	20,000	400.00	45.00	18,000	0	38,000
6	***Vault Fire Supression System***	EA	1.0	25,000.00	25,000	400.00	45.00	18,000	0	43,000
	SUBTOTAL THIS PAGE				317,500			119,588	0	437,088
	LABOR BURDEN (21%)							25,113		
	SUBTOTAL MECHANICAL				317,500			144,701	0	462,201

CONSTRUCTION COST ESTIMATE BREAKDOWN

CONTRACTOR: Corrected Final Submittal	ADDRESS
CONTRACT FOR(WORK TO BE PERFORMED): ***Below Grade Vaulted Tanks*** ***Scenario #3***	PROPOSED TOTAL CONTRACT PRICE
PURCHASE REQUEST NUMBER	PROJECT NUMBER / WORK LOCATION

LINE NO.	ITEM	UNIT OF MEASURE	QUANTITY	MATERIAL COST UNIT	MATERIAL COST TOTAL	LABOR COST MANHOURS	LABOR COST RATE	LABOR COST TOTAL	DIRECT COSTS	LINE TOTAL
	Electrical									
1	***Tank Monitoring System (3 tanks)***	EA	1.0	21,000.00	21,000	250.00	45.00	11,250	0	32,250
2	***Site Electrical Power for Pumps and Devices (Panel, wiring, controls)***	LS	1.0	18,000.00	18,000	275.00	45.00	12,375	0	30,375
3	***Vault Lighting (Explosion proof fixtures, wiring, controls)***	LS	1.0	30,000.00	30,000	200.00	45.00	9,000	0	39,000
	SUBTOTAL THIS PAGE				69,000			32,625	0	101,625
	LABOR BURDEN (21%)							6,851		
	SUBTOTAL ELECTRICAL				69,000			39,476	0	108,476

Appendix 4 –LIFE CYCLE COST DATA

NIST BLCC 5.3-16: Lowest LCC

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

General Information

File Name:	C:\Users\Shawn\Google Drive\RAC Work\1700300 AAFES Service Station\Cost Estimate Files\17003 Updated 7'11'17 mhf edits\1700300 AAFES Tank Comparison 7'11'17.xml
Date of Study:	Tue Jul 11 15:35:26 EDT 2017
Analysis Type:	MILCON Analysis, Non-Energy Project
Project Name:	AAFES Gasoline Station Tank
Project Location:	U.S. Average
Analyst:	Robert and Company
Base Date:	April 1, 2017
Beneficial Occupancy Date:	April 1, 2018
Study Period:	30 years 0 months (April 1, 2017 through March 31, 2047)
Discount Rate:	3.5%
Discounting Convention:	Mid-Year

Lowest LCC

Comparative Present-Value Costs of Alternatives

(Shown in Ascending Order of Initial Cost, * = Lowest LCC)

Alternative	Initial Cost (PV)	Life Cycle Cost (PV)	
Scenario #1 Dual Fiberglass UST's	$747,077	$2,236,973	*
Scenario #2 Three (3) AST's	$1,316,029	$3,432,170	
Scenario #3 Three (3) Tanks in a Vault	$1,785,393	$4,936,920	

NIST BLCC 5.3-16: Summary LCC

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

General Information

File Name:	C:\Users\Shawn\Google Drive\RAC Work\1700300 AAFES Service Station\Cost Estimate Files\17003 Updated 7'11'17 mhf edits\1700300 AAFES Tank Comparison 7'11'17.xml
Date of Study:	Tue Jul 11 15:34:55 EDT 2017
Analysis Type:	MILCON Analysis, Non-Energy Project
Project Name:	AAFES Gasoline Station Tank
Project Location:	U.S. Average
Analyst:	Robert and Company
Base Date:	April 1, 2017
Beneficial Occupancy Date:	April 1, 2018
Study Period:	30 years 0 months (April 1, 2017 through March 31, 2047)
Discount Rate:	3.5%
Discounting Convention:	Mid-Year

Discount and Escalation Rates are NOMINAL (inclusive of general inflation)

Alternative: Scenario #1 Dual Fiberglass UST's

LCC Summary

	Present Value	Annual Value
Initial Cost Paid By Agency	$747,077	$40,623
Energy Consumption Costs	$0	$0
Energy Demand Costs	$0	$0
Energy Utility Rebates	$0	$0
Water Usage Costs	$0	$0
Water Disposal Costs	$0	$0
Routine Annually Recurring OM&R Costs	$1,398,021	$76,018
Routine Non-Annually Recurring OM&R Costs	$91,875	$4,996
Major Repair and Replacement Costs	$0	$0
Less Remaining Value	$0	$0
	------------	------------
Total Life-Cycle Cost	$2,236,973	$121,637

Alternative: Scenario #2 Three (3) AST's

LCC Summary

	Present Value	Annual Value
Initial Cost Paid By Agency	$1,316,029	$71,560
Energy Consumption Costs	$26,972	$1,467
Energy Demand Costs	$0	$0
Energy Utility Rebates	$0	$0
Water Usage Costs	$0	$0
Water Disposal Costs	$0	$0
Routine Annually Recurring OM&R Costs	$1,933,929	$105,158
Routine Non-Annually Recurring OM&R Costs	$155,239	$8,441
Major Repair and Replacement Costs	$0	$0
Less Remaining Value	$0	$0
	------------	------------
Total Life-Cycle Cost	$3,432,170	$186,626

Alternative: Scenario #3 Three (3) Tanks in a Vault

LCC Summary

	Present Value	Annual Value
Initial Cost Paid By Agency	$1,785,393	$97,082
Energy Consumption Costs	$35,963	$1,956
Energy Demand Costs	$0	$0
Energy Utility Rebates	$0	$0
Water Usage Costs	$0	$0
Water Disposal Costs	$0	$0
Routine Annually Recurring OM&R Costs	$2,912,544	$158,371
Routine Non-Annually Recurring OM&R Costs	$203,019	$11,039
Major Repair and Replacement Costs	$0	$0
Less Remaining Value	$0	$0
	------------	------------
Total Life-Cycle Cost	$4,936,920	$268,448

NIST BLCC 5.3-16: Detailed LCC Analysis

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

General Information

File Name:	C:\Users\Shawn\Google Drive\RAC Work\1700300 AAFES Service Station\Cost Estimate Files\17003 Updated 7'11'17 mhf edits\1700300 AAFES Tank Comparison 7'11'17.xml
Date of Study:	Tue Jul 11 15:33:51 EDT 2017
Analysis Type:	MILCON Analysis, Non-Energy Project
Project Name:	AAFES Gasoline Station Tank
Project Location:	U.S. Average
Analyst:	Robert and Company
Base Date:	April 1, 2017
Beneficial Occupancy Date:	April 1, 2018
Study Period:	30 years 0 months (April 1, 2017 through March 31, 2047)
Discount Rate:	3.5%
Discounting Convention:	Mid-Year

Discount and Escalation Rates are NOMINAL (inclusive of general inflation)

Alternative: Scenario #1 Dual Fiberglass UST's

Initial Cost Data (not Discounted)

Initial Capital Costs

(adjusted for price escalation)

Initial Capital Costs for All Components: $747,077

Component: Scenario #1 Dual Fiberglass UST's

Cost-Phasing

Date	Portion	Yearly Cost
April 1, 2017	100%	$747,077
	------------	------------
Total (for Component)		$747,077

Life-Cycle Cost Analysis

	Present Value	Annual Value
Initial Capital Costs	$747,077	$40,623
Energy Costs		
Energy Consumption Costs	$0	$0
Energy Demand Charges	$0	$0
Energy Utility Rebates	$0	$0
	------------	------------
Subtotal (for Energy):	$0	$0
Water Usage Costs	$0	$0
Water Disposal Costs	$0	$0
Routine Operating, Maintenance & Repair Costs		
Component: Scenario #1 Dual Fiberglass UST's		
Routine Annually Recurring Costs	$1,398,021	$76,018
Routine Non-Annually Recurring Costs	$91,875	$4,996
	------------	------------
Subtotal (for OM&R):	$1,489,896	$81,014
Major Repair and Replacements		
Component: Scenario #1 Dual Fiberglass UST's	$0	$0
	------------	------------
Subtotal (for Repair and Replacements):	$0	$0
Residual Value of Original Capital Components		
Component: Scenario #1 Dual Fiberglass UST's	$0	$0
	------------	------------
Subtotal (for Residual Value):	$0	$0
Residual Value of Major Repair and Replacements		
Component: Scenario #1 Dual Fiberglass UST's	$0	$0
	------------	------------
Subtotal (for Residual Value):	$0	$0
Total Life-Cycle Cost	$2,236,973	$121,637

Emissions Summary

Energy Name	Annual	Life-Cycle
Total:		
CO_2	0.00 kg	0.00 kg
SO_2	0.00 kg	0.00 kg
NO_x	0.00 kg	0.00 kg

Alternative: Scenario #2 Three (3) AST's

Initial Cost Data (not Discounted)

Initial Capital Costs

(adjusted for price escalation)

Initial Capital Costs for All Components: $1,316,029

Component: Scenario #2 Three (3) AST's

Cost-Phasing

Date	Portion	Yearly Cost
April 1, 2017	100%	$1,316,029
	------------	------------
Total (for Component)		$1,316,029

Energy Costs: Offload System Electrical Costs

(base-year dollars)

Average Annual Usage	Price/Unit	Average Annual Cost	Average Annual Demand	Average Annual Rebate
9,000.0 kWh	$0.12000	$1,080	$0	$0

Life-Cycle Cost Analysis

	Present Value	Annual Value
Initial Capital Costs	$1,316,029	$71,560
Energy Costs		
Energy Consumption Costs	$26,972	$1,467
Energy Demand Charges	$0	$0
Energy Utility Rebates	$0	$0
	------------	------------
Subtotal (for Energy):	$26,972	$1,467
Water Usage Costs	$0	$0
Water Disposal Costs	$0	$0
Routine Operating, Maintenance & Repair Costs		
Component: Scenario #2 Three (3) AST's		
Routine Annually Recurring Costs	$1,933,929	$105,158
Routine Non-Annually Recurring Costs	$155,239	$8,441
	------------	------------
Subtotal (for OM&R):	$2,089,169	$113,600
Major Repair and Replacements		

Component: Scenario #2 Three (3) AST's	$0	$0
	------------	------------
Subtotal (for Repair and Replacements):	$0	$0
Residual Value of Original Capital Components		
Component: Scenario #2 Three (3) AST's	$0	$0
	------------	------------
Subtotal (for Residual Value):	$0	$0
Residual Value of Major Repair and Replacements		
Component: Scenario #2 Three (3) AST's	$0	$0
	------------	------------
Subtotal (for Residual Value):	$0	$0
Total Life-Cycle Cost	$3,432,170	$186,626

Emissions Summary

Energy Name		Annual	Life-Cycle
Offload System Electrical Costs:			
	CO2	5,884.05 kg	170,617.27 kg
	SO2	29.65 kg	859.73 kg
	NOx	8.78 kg	254.63 kg
Total:			
	CO2	5,884.05 kg	170,617.27 kg
	SO2	29.65 kg	859.73 kg
	NOx	8.78 kg	254.63 kg

Alternative: Scenario #3 Three (3) Tanks in a Vault

Initial Cost Data (not Discounted)

Initial Capital Costs

(adjusted for price escalation)

Initial Capital Costs for All Components: $1,785,393

Component: Scenario #3 Three (3) Tanks in a Vault

Cost-Phasing

Date	Portion	Yearly Cost
April 1, 2017	100%	$1,785,393
	------------	------------
Total (for Component)		$1,785,393

Energy Costs: Ventilate and Continually Monitor Vault

(base-year dollars)

Average Annual Usage	Price/Unit	Average Annual Cost	Average Annual Demand	Average Annual Rebate
12,000.0 kWh	$0.12000	$1,440	$0	$0

Life-Cycle Cost Analysis

	Present Value	Annual Value
Initial Capital Costs	$1,785,393	$97,082
Energy Costs		
Energy Consumption Costs	$35,963	$1,956
Energy Demand Charges	$0	$0
Energy Utility Rebates	$0	$0
	------------	------------
Subtotal (for Energy):	$35,963	$1,956
Water Usage Costs	$0	$0
Water Disposal Costs	$0	$0
Routine Operating, Maintenance & Repair Costs		
Component: Scenario #3 Three (3) Tanks in a Vault		
Routine Annually Recurring Costs	$2,912,544	$158,371
Routine Non-Annually Recurring Costs	$203,019	$11,039
	------------	------------
Subtotal (for OM&R):	$3,115,563	$169,410
Major Repair and Replacements		

Component: Scenario #3 Three (3) Tanks in a Vault	$0	$0
	------------	------------
Subtotal (for Repair and Replacements):	$0	$0
Residual Value of Original Capital Components		
Component: Scenario #3 Three (3) Tanks in a Vault	$0	$0
	------------	------------
Subtotal (for Residual Value):	$0	$0
Residual Value of Major Repair and Replacements		
Component: Scenario #3 Three (3) Tanks in a Vault	$0	$0
	------------	------------
Subtotal (for Residual Value):	$0	$0
Total Life-Cycle Cost	$4,936,920	$268,448

Emissions Summary

Energy Name		Annual	Life-Cycle
Ventilate and Continually Monitor Vault:			
	CO2	7,845.40 kg	227,489.69 kg
	SO2	39.53 kg	1,146.31 kg
	NOx	11.71 kg	339.51 kg
Total:			
	CO2	7,845.40 kg	227,489.69 kg
	SO2	39.53 kg	1,146.31 kg
	NOx	11.71 kg	339.51 kg

NIST BLCC 5.3-16: Cash Flow Analysis

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

General Information

File Name:	C:\Users\Shawn\Google Drive\RAC Work\1700300 AAFES Service Station\Cost Estimate Files\17003 Updated 7'11'17 mhf edits\1700300 AAFES Tank Comparison 7'11'17.xml
Date of Study:	Tue Jul 11 15:34:19 EDT 2017
Analysis Type:	MILCON Analysis, Non-Energy Project
Project Name:	AAFES Gasoline Station Tank
Project Location:	U.S. Average
Analyst:	Robert and Company
Base Date:	April 1, 2017
Beneficial Occupancy Date:	April 1, 2018
Study Period:	30 years 0 months (April 1, 2017 through March 31, 2047)

Mid-year cash-flow convention used

All costs in current dollars (including general inflation)

Alternative: Scenario #1 Dual Fiberglass UST's

Initial Capital Costs

Component: Scenario #1 Dual Fiberglass UST's

Year Beginning	Total
Apr 2017	$747,077
Total	$747,077

Capital Investment Costs

Year Beginning	Initial	Total
Apr 2017	$747,077	$747,077
Apr 2018	$0	$0
Apr 2019	$0	$0
Apr 2020	$0	$0
Apr 2021	$0	$0
Apr 2022	$0	$0
Apr 2023	$0	$0
Apr 2024	$0	$0
Apr 2025	$0	$0
Apr 2026	$0	$0
Apr 2027	$0	$0
Apr 2028	$0	$0
Apr 2029	$0	$0
Apr 2030	$0	$0

Apr 2031	$0	$0
Apr 2032	$0	$0
Apr 2033	$0	$0
Apr 2034	$0	$0
Apr 2035	$0	$0
Apr 2036	$0	$0
Apr 2037	$0	$0
Apr 2038	$0	$0
Apr 2039	$0	$0
Apr 2040	$0	$0
Apr 2041	$0	$0
Apr 2042	$0	$0
Apr 2043	$0	$0
Apr 2044	$0	$0
Apr 2045	$0	$0
Apr 2046	$0	$0
------------	------------	------------
Total	$747,077	$747,077

Operating-Related Costs

Year Beginning	Recurring	Non-Recurring	Total
Apr 2017	$0	$0	$0
Apr 2018	$61,808	$0	$61,808
Apr 2019	$63,045	$0	$63,045
Apr 2020	$64,306	$0	$64,306
Apr 2021	$65,592	$10,283	$75,875
Apr 2022	$66,903	$0	$66,903
Apr 2023	$68,242	$0	$68,242
Apr 2024	$69,607	$10,913	$80,520
Apr 2025	$70,999	$0	$70,999
Apr 2026	$72,418	$0	$72,418
Apr 2027	$73,867	$11,580	$85,447
Apr 2028	$75,345	$0	$75,345
Apr 2029	$76,851	$0	$76,851
Apr 2030	$78,387	$12,289	$90,676
Apr 2031	$79,956	$0	$79,956
Apr 2032	$81,556	$0	$81,556
Apr 2033	$83,186	$54,225	$137,411
Apr 2034	$84,849	$0	$84,849
Apr 2035	$86,547	$0	$86,547
Apr 2036	$88,279	$13,840	$102,119
Apr 2037	$90,043	$0	$90,043
Apr 2038	$91,843	$0	$91,843

Apr 2039	$93,681	$14,686	$108,368
Apr 2040	$95,556	$0	$95,556
Apr 2041	$97,466	$0	$97,466
Apr 2042	$99,414	$15,586	$114,999
Apr 2043	$101,403	$0	$101,403
Apr 2044	$103,433	$0	$103,433
Apr 2045	$105,500	$16,540	$122,040
Apr 2046	$107,606	$0	$107,606
------------	------------	------------	------------
Total	$2,397,688	$159,942	$2,557,629

Sum of All Cash Flows

Year Beginning	Capital	OM&R	Total
Apr 2017	$747,077	$0	$747,077
Apr 2018	$0	$61,808	$61,808
Apr 2019	$0	$63,045	$63,045
Apr 2020	$0	$64,306	$64,306
Apr 2021	$0	$75,875	$75,875
Apr 2022	$0	$66,903	$66,903
Apr 2023	$0	$68,242	$68,242
Apr 2024	$0	$80,520	$80,520
Apr 2025	$0	$70,999	$70,999
Apr 2026	$0	$72,418	$72,418
Apr 2027	$0	$85,447	$85,447
Apr 2028	$0	$75,345	$75,345
Apr 2029	$0	$76,851	$76,851
Apr 2030	$0	$90,676	$90,676
Apr 2031	$0	$79,956	$79,956
Apr 2032	$0	$81,556	$81,556
Apr 2033	$0	$137,411	$137,411
Apr 2034	$0	$84,849	$84,849
Apr 2035	$0	$86,547	$86,547
Apr 2036	$0	$102,119	$102,119
Apr 2037	$0	$90,043	$90,043
Apr 2038	$0	$91,843	$91,843
Apr 2039	$0	$108,368	$108,368
Apr 2040	$0	$95,556	$95,556
Apr 2041	$0	$97,466	$97,466
Apr 2042	$0	$114,999	$114,999
Apr 2043	$0	$101,403	$101,403
Apr 2044	$0	$103,433	$103,433
Apr 2045	$0	$122,040	$122,040
Apr 2046	$0	$107,606	$107,606

	------------	------------	------------	------------
Total	$747,077	$2,557,629	$3,304,706

Alternative: Scenario #2 Three (3) AST's

Initial Capital Costs

Component: Scenario #2 Three (3) AST's

Year Beginning	Total
Apr 2017	$1,316,029
Total	$1,316,029

Capital Investment Costs

Year Beginning	Initial	Total
Apr 2017	$1,316,029	$1,316,029
Apr 2018	$0	$0
Apr 2019	$0	$0
Apr 2020	$0	$0
Apr 2021	$0	$0
Apr 2022	$0	$0
Apr 2023	$0	$0
Apr 2024	$0	$0
Apr 2025	$0	$0
Apr 2026	$0	$0
Apr 2027	$0	$0
Apr 2028	$0	$0
Apr 2029	$0	$0
Apr 2030	$0	$0
Apr 2031	$0	$0
Apr 2032	$0	$0
Apr 2033	$0	$0
Apr 2034	$0	$0
Apr 2035	$0	$0
Apr 2036	$0	$0
Apr 2037	$0	$0
Apr 2038	$0	$0
Apr 2039	$0	$0
Apr 2040	$0	$0
Apr 2041	$0	$0
Apr 2042	$0	$0
Apr 2043	$0	$0
Apr 2044	$0	$0
Apr 2045	$0	$0

Apr 2046	$0	$0
	------------	------------
Total	$1,316,029	$1,316,029

Operating-Related Costs

Year Beginning	Recurring	Non-Recurring	Energy Consumption	Energy Demand	Energy Rebate	Total
Apr 2017	$0	$0	$0	$0	$0	$0
Apr 2018	$85,501	$0	$1,135	$0	$0	$86,636
Apr 2019	$87,212	$0	$1,181	$0	$0	$88,393
Apr 2020	$88,957	$0	$1,220	$0	$0	$90,177
Apr 2021	$90,735	$3,247	$1,252	$0	$0	$95,235
Apr 2022	$92,549	$0	$1,283	$0	$0	$93,832
Apr 2023	$94,401	$0	$1,315	$0	$0	$95,716
Apr 2024	$96,290	$3,446	$1,349	$0	$0	$101,086
Apr 2025	$98,215	$0	$1,385	$0	$0	$99,600
Apr 2026	$100,178	$0	$1,419	$0	$0	$101,596
Apr 2027	$102,183	$3,657	$1,451	$0	$0	$107,290
Apr 2028	$104,228	$74,603	$1,484	$0	$0	$180,315
Apr 2029	$106,311	$0	$1,518	$0	$0	$107,829
Apr 2030	$108,436	$3,881	$1,550	$0	$0	$113,867
Apr 2031	$110,606	$0	$1,578	$0	$0	$112,184
Apr 2032	$112,819	$0	$1,605	$0	$0	$114,424
Apr 2033	$115,074	$45,302	$1,631	$0	$0	$162,007
Apr 2034	$117,374	$0	$1,657	$0	$0	$119,031
Apr 2035	$119,723	$0	$1,682	$0	$0	$121,405
Apr 2036	$122,119	$4,370	$1,710	$0	$0	$128,200
Apr 2037	$124,560	$0	$1,739	$0	$0	$126,299
Apr 2038	$127,049	$121,252	$1,770	$0	$0	$250,071
Apr 2039	$129,592	$4,638	$1,800	$0	$0	$136,030
Apr 2040	$132,186	$0	$1,831	$0	$0	$134,017
Apr 2041	$134,828	$0	$1,864	$0	$0	$136,692
Apr 2042	$137,522	$4,922	$1,898	$0	$0	$144,342
Apr 2043	$140,275	$0	$1,933	$0	$0	$142,208
Apr 2044	$143,082	$0	$1,968	$0	$0	$145,051
Apr 2045	$145,942	$5,223	$2,004	$0	$0	$153,169
Apr 2046	$148,855	$0	$2,041	$0	$0	$150,895
------------	------------	------------	------------	------------	------------	------------
Total	$3,316,801	$274,541	$46,255	$0	$0	$3,637,597

Sum of All Cash Flows

Year Beginning	Capital	OM&R	Total
Apr 2017	$1,316,029	$0	$1,316,029
Apr 2018	$0	$86,636	$86,636

Apr 2019	$0	$88,393	$88,393
Apr 2020	$0	$90,177	$90,177
Apr 2021	$0	$95,235	$95,235
Apr 2022	$0	$93,832	$93,832
Apr 2023	$0	$95,716	$95,716
Apr 2024	$0	$101,086	$101,086
Apr 2025	$0	$99,600	$99,600
Apr 2026	$0	$101,596	$101,596
Apr 2027	$0	$107,290	$107,290
Apr 2028	$0	$180,315	$180,315
Apr 2029	$0	$107,829	$107,829
Apr 2030	$0	$113,867	$113,867
Apr 2031	$0	$112,184	$112,184
Apr 2032	$0	$114,424	$114,424
Apr 2033	$0	$162,007	$162,007
Apr 2034	$0	$119,031	$119,031
Apr 2035	$0	$121,405	$121,405
Apr 2036	$0	$128,200	$128,200
Apr 2037	$0	$126,299	$126,299
Apr 2038	$0	$250,071	$250,071
Apr 2039	$0	$136,030	$136,030
Apr 2040	$0	$134,017	$134,017
Apr 2041	$0	$136,692	$136,692
Apr 2042	$0	$144,342	$144,342
Apr 2043	$0	$142,208	$142,208
Apr 2044	$0	$145,051	$145,051
Apr 2045	$0	$153,169	$153,169
Apr 2046	$0	$150,895	$150,895
------------	------------	------------	------------
Total	$1,316,029	$3,637,597	$4,953,626

Alternative: Scenario #3 Three (3) Tanks in a Vault

Initial Capital Costs

Component: Scenario #3 Three (3) Tanks in a Vault

Year Beginning	Total
Apr 2017	$1,785,393
Total	$1,785,393

Capital Investment Costs

Year Beginning	Initial	Total
Apr 2017	$1,785,393	$1,785,393

Apr 2018	$0	$0
Apr 2019	$0	$0
Apr 2020	$0	$0
Apr 2021	$0	$0
Apr 2022	$0	$0
Apr 2023	$0	$0
Apr 2024	$0	$0
Apr 2025	$0	$0
Apr 2026	$0	$0
Apr 2027	$0	$0
Apr 2028	$0	$0
Apr 2029	$0	$0
Apr 2030	$0	$0
Apr 2031	$0	$0
Apr 2032	$0	$0
Apr 2033	$0	$0
Apr 2034	$0	$0
Apr 2035	$0	$0
Apr 2036	$0	$0
Apr 2037	$0	$0
Apr 2038	$0	$0
Apr 2039	$0	$0
Apr 2040	$0	$0
Apr 2041	$0	$0
Apr 2042	$0	$0
Apr 2043	$0	$0
Apr 2044	$0	$0
Apr 2045	$0	$0
Apr 2046	$0	$0
------------	------------	------------
Total	$1,785,393	$1,785,393

Operating-Related Costs

Year Beginning	Recurring	Non-Recurring	Energy Consumption	Energy Demand	Energy Rebate	Total
Apr 2017	$0	$0	$0	$0	$0	$0
Apr 2018	$128,766	$0	$1,514	$0	$0	$130,280
Apr 2019	$131,343	$0	$1,575	$0	$0	$132,918
Apr 2020	$133,972	$0	$1,627	$0	$0	$135,599
Apr 2021	$136,649	$4,330	$1,670	$0	$0	$142,649
Apr 2022	$139,381	$0	$1,711	$0	$0	$141,091
Apr 2023	$142,170	$0	$1,753	$0	$0	$143,923
Apr 2024	$145,015	$3,446	$1,799	$0	$0	$150,260
Apr 2025	$147,914	$0	$1,847	$0	$0	$149,761

Apr 2026	$150,870	$0	$1,892	$0	$0	$152,762
Apr 2027	$153,889	$3,657	$1,934	$0	$0	$159,481
Apr 2028	$156,969	$93,254	$1,978	$0	$0	$252,202
Apr 2029	$160,107	$0	$2,024	$0	$0	$162,131
Apr 2030	$163,307	$3,881	$2,067	$0	$0	$169,255
Apr 2031	$166,575	$0	$2,105	$0	$0	$168,680
Apr 2032	$169,909	$0	$2,140	$0	$0	$172,049
Apr 2033	$173,305	$52,166	$2,175	$0	$0	$227,645
Apr 2034	$176,768	$0	$2,209	$0	$0	$178,977
Apr 2035	$180,306	$0	$2,243	$0	$0	$182,549
Apr 2036	$183,915	$4,370	$2,280	$0	$0	$190,565
Apr 2037	$187,590	$0	$2,319	$0	$0	$189,910
Apr 2038	$191,340	$181,877	$2,360	$0	$0	$375,577
Apr 2039	$195,169	$4,638	$2,400	$0	$0	$202,207
Apr 2040	$199,075	$0	$2,441	$0	$0	$201,516
Apr 2041	$203,054	$0	$2,486	$0	$0	$205,539
Apr 2042	$207,112	$4,922	$2,531	$0	$0	$214,565
Apr 2043	$211,257	$0	$2,577	$0	$0	$213,834
Apr 2044	$215,485	$0	$2,625	$0	$0	$218,110
Apr 2045	$219,792	$6,964	$2,672	$0	$0	$229,429
Apr 2046	$224,179	$0	$2,721	$0	$0	$226,900
------------	------------	------------	------------	------------	------------	------------
Total	$4,995,183	$363,505	$61,673	$0	$0	$5,420,361

Sum of All Cash Flows

Year Beginning	Capital	OM&R	Total
Apr 2017	$1,785,393	$0	$1,785,393
Apr 2018	$0	$130,280	$130,280
Apr 2019	$0	$132,918	$132,918
Apr 2020	$0	$135,599	$135,599
Apr 2021	$0	$142,649	$142,649
Apr 2022	$0	$141,091	$141,091
Apr 2023	$0	$143,923	$143,923
Apr 2024	$0	$150,260	$150,260
Apr 2025	$0	$149,761	$149,761
Apr 2026	$0	$152,762	$152,762
Apr 2027	$0	$159,481	$159,481
Apr 2028	$0	$252,202	$252,202
Apr 2029	$0	$162,131	$162,131
Apr 2030	$0	$169,255	$169,255
Apr 2031	$0	$168,680	$168,680
Apr 2032	$0	$172,049	$172,049
Apr 2033	$0	$227,645	$227,645

Apr 2034	$0	$178,977	$178,977
Apr 2035	$0	$182,549	$182,549
Apr 2036	$0	$190,565	$190,565
Apr 2037	$0	$189,910	$189,910
Apr 2038	$0	$375,577	$375,577
Apr 2039	$0	$202,207	$202,207
Apr 2040	$0	$201,516	$201,516
Apr 2041	$0	$205,539	$205,539
Apr 2042	$0	$214,565	$214,565
Apr 2043	$0	$213,834	$213,834
Apr 2044	$0	$218,110	$218,110
Apr 2045	$0	$229,429	$229,429
Apr 2046	$0	$226,900	$226,900
------------	------------	------------	------------
Total	$1,785,393	$5,420,361	$7,205,754

NIST BLCC 5.3-16: Input Data Listing

Consistent with Federal Life Cycle Cost Methodology in OMB Circular A-94

General Information

File Name:	C:\Users\Shawn\Google Drive\RAC Work\1700300 AAFES Service Station\Cost Estimate Files\17003 Updated 7'11'17 mhf edits\1700300 AAFES Tank Comparison 7'11'17.xml
Date of Study:	Tue Jul 11 15:33:07 EDT 2017
Analysis Type:	MILCON Analysis, Non-Energy Project
Project Name:	AAFES Gasoline Station Tank
Project Location:	U.S. Average
Analyst:	Robert and Company
Base Date:	April 1, 2017
Beneficial Occupancy Date:	April 1, 2018
Study Period:	30 years 0 months (April 1, 2017 through March 31, 2047)
Discount Rate:	3.5%
Discounting Convention:	Mid-Year

Discount and Escalation Rates are NOMINAL (inclusive of general inflation)

Alternative: Scenario #1 Dual Fiberglass UST's

Component: Scenario #1 Dual Fiberglass UST's

Initial Investment

Initial Cost (base-year $):	$747,077
Annual Rate of Increase:	2%
Expected Asset Life:	30 years 0 months
Residual Value Factor:	0%

Cost-Phasing

Cost Adjustment Factor: 2%

Years/Months (from Date)	Date	Portion
0 years 0 months	**April 1, 2017**	100%

Routine Recurring OM&R: Annual Maintenance

Amount:	$50,000
Annual Rate of Increase:	2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	Remaining	100%

Routine Recurring OM&R: 1. Maintenance of Leak Detection System Devices

Amount:	$5,000
Annual Rate of Increase:	2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	Remaining	100%

Routine Recurring OM&R: Release Detection Equipment Testing

Amount:	$5,000
Annual Rate of Increase:	2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	Remaining	100%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	3 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	6 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	15 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	21 years 0 months
Amount:	$5,000

Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	27 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Leak Detection System Replacement Year 15

Years/Months:	15 years 0 months
Amount:	$30,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Overfill Prevention Inspections (operational checks)

Years/Months:	3 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Overfill Prevention Inspections (operational checks)

Years/Months:	6 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Overfill Prevention Inspections (operational checks)

Years/Months:	9 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Overfill Prevention Inspections (operational checks)

Years/Months:	12 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Overfill Prevention Inspections (operational checks)

Years/Months:	15 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Overfill Prevention Inspections (operational checks)

Years/Months:	18 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Overfill Prevention Inspections (operational checks)

Years/Months:	21 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Overfill Prevention Inspections (operational checks)

Years/Months:	24 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Overfill Prevention Inspections (operational checks)

Years/Months:	27 years 0 months
Amount:	$1,500
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	9 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	12 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	18 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	3 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	6 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	9 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	12 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	15 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	18 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	21 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	24 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	27 years 0 months

Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Sump/Spill Bucket Test

Years/Months:	24 years 0 months
Amount:	$5,000
Annual Rate of Increase:	2%

Alternative: Scenario #2 Three (3) AST's

Energy: Offload System Electrical Costs

Annual Consumption:	9,000.0 kWh
Price per Unit:	$0.12000
Demand Charge:	$0
Utility Rebate:	$0
Location:	Alabama
Rate Schedule:	Residential
State:	U.S. Average

Usage Indices

From Date	Duration	Usage Index
April 1, 2018	**Remaining**	100%

Escalation Rates

From Date	Duration	Escalation
April 1, 2016	**1 year 0 months**	1.35%
April 1, 2017	**1 year 0 months**	2.94%
April 1, 2018	**1 year 0 months**	4.31%
April 1, 2019	**1 year 0 months**	3.74%
April 1, 2020	**1 year 0 months**	2.84%
April 1, 2021	**1 year 0 months**	2.43%
April 1, 2022	**1 year 0 months**	2.51%
April 1, 2023	**1 year 0 months**	2.4%
April 1, 2024	**1 year 0 months**	2.85%
April 1, 2025	**1 year 0 months**	2.53%
April 1, 2026	**1 year 0 months**	2.29%
April 1, 2027	**1 year 0 months**	2.21%
April 1, 2028	**1 year 0 months**	2.31%
April 1, 2029	**1 year 0 months**	2.36%
April 1, 2030	**1 year 0 months**	1.9%

April 1, 2031	**1 year 0 months**	1.71%
April 1, 2032	**1 year 0 months**	1.64%
April 1, 2033	**1 year 0 months**	1.63%
April 1, 2034	**1 year 0 months**	1.48%
April 1, 2035	**1 year 0 months**	1.63%
April 1, 2036	**1 year 0 months**	1.66%
April 1, 2037	**1 year 0 months**	1.79%
April 1, 2038	**1 year 0 months**	1.71%
April 1, 2039	**1 year 0 months**	1.68%
April 1, 2040	**1 year 0 months**	1.79%
April 1, 2041	**1 year 0 months**	1.84%
April 1, 2042	**1 year 0 months**	1.81%
April 1, 2043	**1 year 0 months**	1.84%
April 1, 2044	**1 year 0 months**	1.84%
April 1, 2045	**1 year 0 months**	1.81%
April 1, 2046	**Remaining**	1.83%

Component: Scenario #2 Three (3) AST's

Initial Investment

Initial Cost (base-year $):	$1,316,029
Annual Rate of Increase:	2%
Expected Asset Life:	30 years 0 months
Residual Value Factor:	0%

Cost-Phasing

Cost Adjustment Factor: 2%

Years/Months (from Date)	Date	Portion
0 years 0 months	**April 1, 2017**	100%

Routine Recurring OM&R: Copy of: Annual Maintenance

Amount:	$50,000
Annual Rate of Increase:	2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	**Remaining**	100%

Routine Recurring OM&R: Manpower for Offload System

Amount:	$20,000
Annual Rate of Increase:	2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	**Remaining**	100%

Routine Recurring OM&R: Offload System Maintenance

Amount:	$10,000
Annual Rate of Increase:	2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	**Remaining**	100%

Routine Recurring OM&R: 7. STI SP001 Annual Inspection

Amount:	$3,000
Annual Rate of Increase:	2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	**Remaining**	100%

Routine Non-Recurring OM&R: Leak Detection System Replacement Year 15

Years/Months:	15 years 0 months
Amount:	$30,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Formal STI SP001 Inspection Year 20

Years/Months:	20 years 0 months
Amount:	$20,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Tank Painting Year 10

Years/Months:	10 years 0 months
Amount:	$50,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Tank Painting Year 20

Years/Months:	20 years 0 months
Amount:	$50,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Pipe Painting Year 10

Years/Months:	10 years 0 months
Amount:	$10,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Pipe Painting Year 20

Years/Months:	20 years 0 months
Amount:	$10,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	3 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	6 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	9 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	12 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	15 years 0 months

Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	18 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	21 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	24 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	27 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Alternative: Scenario #3 Three (3) Tanks in a Vault

Energy: Ventilate and Continually Monitor Vault

Annual Consumption:	12,000.0 kWh
Price per Unit:	$0.12000
Demand Charge:	$0
Utility Rebate:	$0
Location:	Alabama
Rate Schedule:	Residential
State:	U.S. Average

Usage Indices

From Date	Duration	Usage Index
April 1, 2018	**Remaining**	100%

Escalation Rates

From Date	Duration	Escalation
April 1, 2016	1 year 0 months	1.35%
April 1, 2017	1 year 0 months	2.94%
April 1, 2018	1 year 0 months	4.31%
April 1, 2019	1 year 0 months	3.74%
April 1, 2020	1 year 0 months	2.84%
April 1, 2021	1 year 0 months	2.43%
April 1, 2022	1 year 0 months	2.51%
April 1, 2023	1 year 0 months	2.4%
April 1, 2024	1 year 0 months	2.85%
April 1, 2025	1 year 0 months	2.53%
April 1, 2026	1 year 0 months	2.29%
April 1, 2027	1 year 0 months	2.21%
April 1, 2028	1 year 0 months	2.31%
April 1, 2029	1 year 0 months	2.36%
April 1, 2030	1 year 0 months	1.9%
April 1, 2031	1 year 0 months	1.71%
April 1, 2032	1 year 0 months	1.64%
April 1, 2033	1 year 0 months	1.63%
April 1, 2034	1 year 0 months	1.48%
April 1, 2035	1 year 0 months	1.63%
April 1, 2036	1 year 0 months	1.66%
April 1, 2037	1 year 0 months	1.79%
April 1, 2038	1 year 0 months	1.71%
April 1, 2039	1 year 0 months	1.68%
April 1, 2040	1 year 0 months	1.79%
April 1, 2041	1 year 0 months	1.84%
April 1, 2042	1 year 0 months	1.81%
April 1, 2043	1 year 0 months	1.84%
April 1, 2044	1 year 0 months	1.84%
April 1, 2045	1 year 0 months	1.81%
April 1, 2046	Remaining	1.83%

Component: Scenario #3 Three (3) Tanks in a Vault

Initial Investment

Initial Cost (base-year $):	$1,785,393
Annual Rate of Increase:	2%
Expected Asset Life:	30 years 0 months
Residual Value Factor:	0%

Cost-Phasing

Cost Adjustment Factor: 2%

Years/Months (from Date)	Date	Portion
0 years 0 months	April 1, 2017	100%

Routine Recurring OM&R: Annual Maintenance

Amount: $50,000

Annual Rate of Increase: 2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	Remaining	100%

Routine Recurring OM&R: Ventilation / Vapor Monitoring System Maintenance / Repair Costs

Amount: $45,000

Annual Rate of Increase: 2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	Remaining	100%

Routine Recurring OM&R: Copy of: 7. STI SP001 Annual Inspection

Amount: $10,000

Annual Rate of Increase: 2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	Remaining	100%

Routine Recurring OM&R: Confined Space Equipment and Training Costs

Amount: $20,000

Annual Rate of Increase: 2%

Usage Indices

From Date	Duration	Factor
April 1, 2018	Remaining	100%

Routine Non-Recurring OM&R: Vault Ventilation / Monitoring System Replacement Year 15

Years/Months:	15 years 0 months
Amount:	$35,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Tank Painting Year 10

Years/Months:	10 years 0 months
Amount:	$75,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Tank Painting Year 20

Years/Months:	20 years 0 months
Amount:	$75,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Formal STI SP001 Inspection Year 20

Years/Months:	20 years 0 months
Amount:	$45,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	3 years 0 months
Amount:	$4,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	6 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	9 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	12 years 0 months

Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	15 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	18 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	21 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

Years/Months:	24 years 0 months
Amount:	$3,000
Annual Rate of Increase:	2%

Routine Non-Recurring OM&R: Copy of: Copy of: Vapor Balance Testing per 40 CFR 63CCCCCC

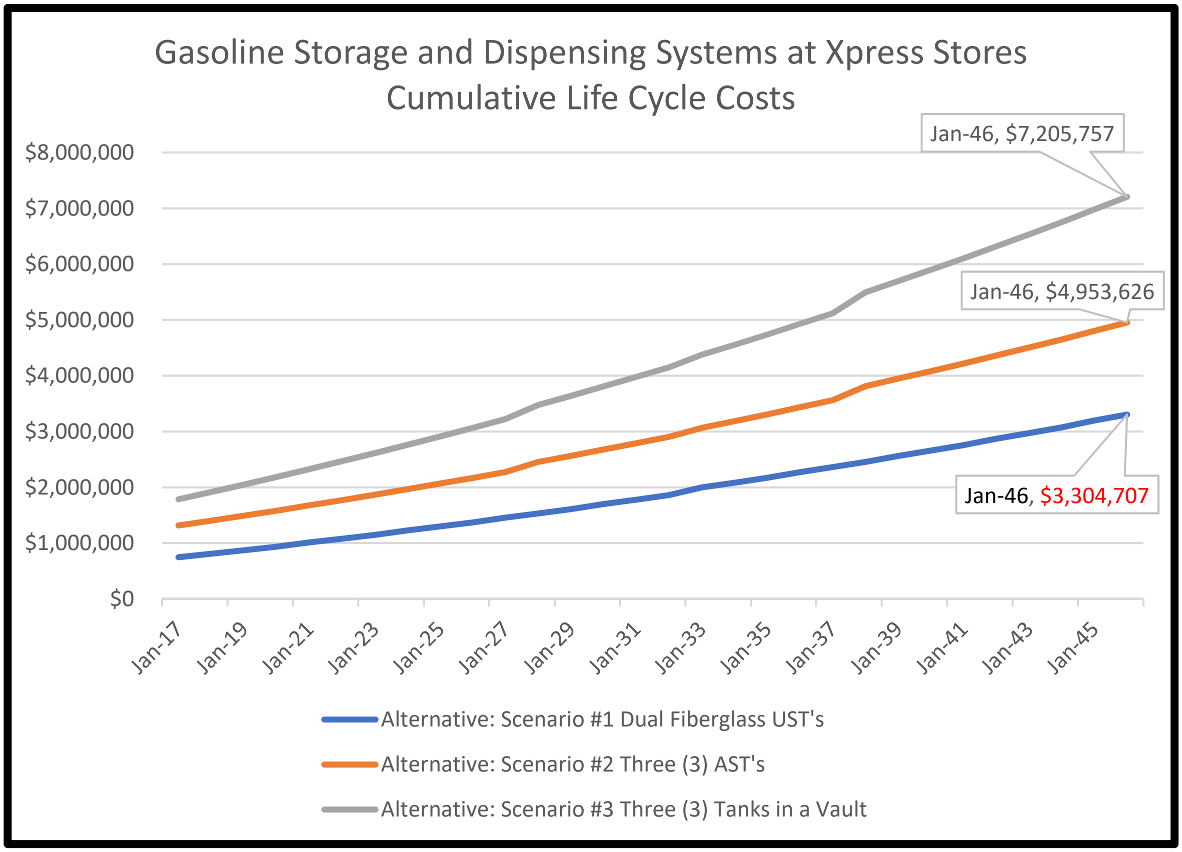
Years/Months:	27 years 0 months
Amount:	$4,000
Annual Rate of Increase:	2%

Gasoline Storage and Dispensing Systems at Xpress Stores

Comparison of Life Cycle Costs (LCC) [1]

Year Beginning	Cumulative LCC		
	Alternative: Scenario #1 Dual Fiberglass UST's	Alternative: Scenario #2 Three (3) AST's	Alternative: Scenario #3 Three (3) Tanks in a Vault
Apr-17	$747,077	$1,316,029	$1,785,393
Apr-18	$808,885	$1,402,665	$1,915,673
Apr-19	$871,930	$1,491,058	$2,048,591
Apr-20	$936,236	$1,581,235	$2,184,190
Apr-21	$1,012,111	$1,676,470	$2,326,839
Apr-22	$1,079,014	$1,770,302	$2,467,930
Apr-23	$1,147,256	$1,866,018	$2,611,853
Apr-24	$1,227,776	$1,967,104	$2,762,113
Apr-25	$1,298,775	$2,066,704	$2,911,874
Apr-26	$1,371,193	$2,168,300	$3,064,636
Apr-27	$1,456,640	$2,275,590	$3,224,117
Apr-28	$1,531,985	$2,455,905	$3,476,319
Apr-29	$1,608,836	$2,563,734	$3,638,450
Apr-30	$1,699,512	$2,677,601	$3,807,705
Apr-31	$1,779,468	$2,789,785	$3,976,385
Apr-32	$1,861,024	$2,904,209	$4,148,434
Apr-33	$1,998,435	$3,066,216	$4,376,079
Apr-34	$2,083,284	$3,185,247	$4,555,056
Apr-35	$2,169,831	$3,306,652	$4,737,605
Apr-36	$2,271,950	$3,434,852	$4,928,170
Apr-37	$2,361,993	$3,561,151	$5,118,080
Apr-38	$2,453,836	$3,811,222	$5,493,657
Apr-39	$2,562,204	$3,947,252	$5,695,864
Apr-40	$2,657,760	$4,081,269	$5,897,380
Apr-41	$2,755,226	$4,217,961	$6,102,919
Apr-42	$2,870,225	$4,362,303	$6,317,484
Apr-43	$2,971,628	$4,504,511	$6,531,318
Apr-44	$3,075,061	$4,649,562	$6,749,428
Apr-45	$3,197,101	$4,802,731	$6,978,857
Apr-46	**$3,304,707**	$4,953,626	$7,205,757
Standard Deviation			**$1,598,931**
Differential between Initial Cost and Total of Expenditures	$2,557,630	$3,637,597	$5,420,364

1 Present Values Generated using NIST BLCC 5.3-11



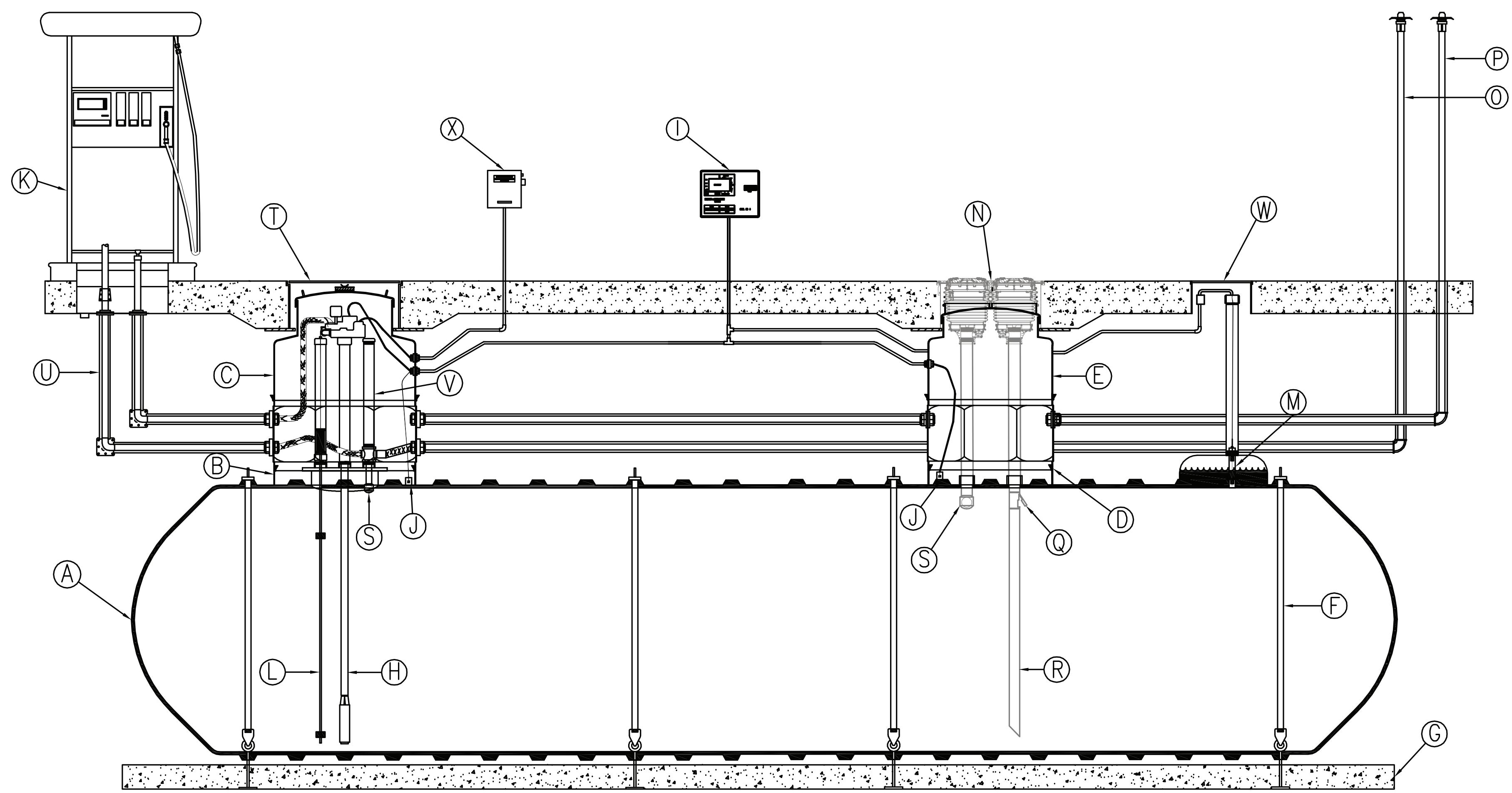
1 Present Values Generated using NIST BLCC 5.3-11

Appendix 5 – Equipment Cut Sheets

1. Containment Solutions Double Wall FRP USTs
2. Modern Welding Double Wall UL 2058 Fire-Protected AST
3. Core Engineering Below-Grade Concrete Vault
4. Modern Welding Single Wall UL 142 AST (in-vault)
5. OPW Flexworks Double Wall Flexible Piping
6. Typical Offload Equipment (UFC 3-460-01 Plate 5) for AST System
7. OPW Flexworks Transition Sump for AST System

MARK	QTY	SIZE	EQUIPMENT LISTING	MARK	QTY	SIZE	EQUIPMENT LISTING	MARK	QTY	SIZE	EQUIPMENT LISTING
A	1	8'	HYDROSTATIC DOUBLE WALL TANK	I	1*		INVENTORY & LEAK DETECTION PANEL	Q	1*		OVERFILL PREVENTION VALVE
B	1	48"	SINGLE WALL CONTAINMENT COLLAR	J	2*		CONTAINMENT COLLAR SENSOR	R	1*	4"	DROP TUBE
C	1	48"	SW PTS WATER TIGHT TURBINE SUMP	K	1*		FUEL DISPENSER w/UDC	S	2*	4"	BALL FLOAT ASSEMBLY
D	1	42"	SINGLE WALL CONTAINMENT COLLAR	L	1*		TANK INVENTORY GAUGE	T	1*	36"	WATERTIGHT MANHOLE
E	1	42"	SW PTS FILL/VAPOR SUMP	M	1*		HYDROSTATIC TANK RESERVOIR SENSOR	U	*	3"x2"	DOUBLE WALL FRP PIPE
F	4		HOLD DOWN SPLIT STRAP ASSEMBLY	N	1*	36"	FILL/VAPOR MANHOLE	V	1*	4"	EXTRACTOR HOUSING w/CAP
G	4	16'	12"x 12" CONCRETE DEADMAN ANCHORS	O	1*	2"	PRIMARY TANK VENT	W	1*	18"	MANHOLE
H	1*		SUBMERSIBLE PUMP w/LEAK DETECTION	P	1*	2"	SUMP VENTS	X	1*		PUMP CONTROL PANEL

NOTE: * SUPPLIED BY OTHERS



CONTAINMENT SOLUTIONS

Pub. No. TYP-812DW-STD 1/1/2014

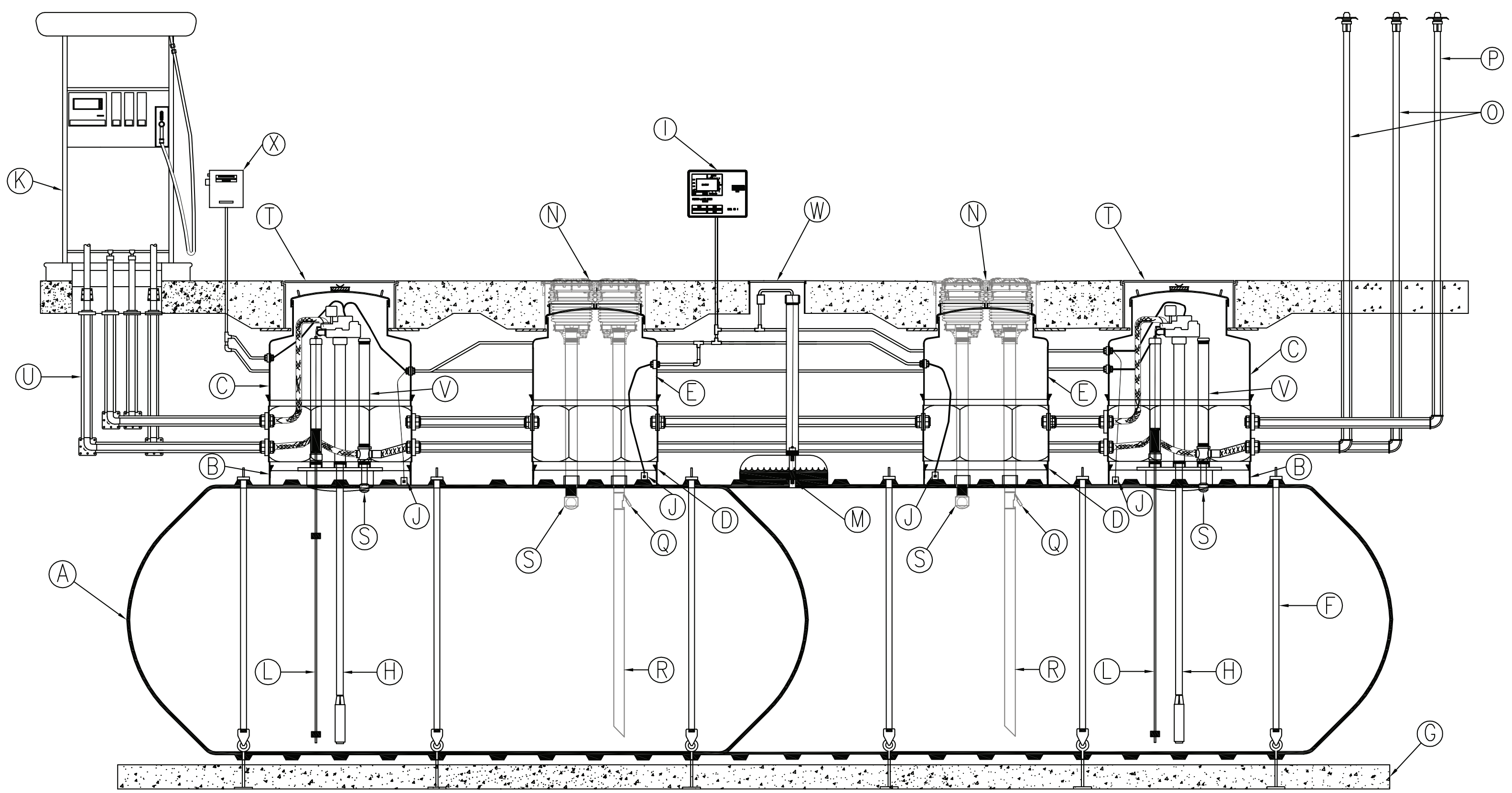
TYPICAL PETROLEUM ILLUSTRATION DRAWING
(8') 12,000 DOUBLE-WALL TANK
W / SINGLE-WALL TURBINE AND FILL / VAPOR SUMPS

MARK	QTY	SIZE	EQUIPMENT LISTING
A	1	8'	HYDROSTATIC DOUBLE WALL COMPARTMENT TANK
B	2	48"	SINGLE WALL CONTAINMENT COLLAR
C	2	48"	SW PTS WATER TIGHT TURBINE SUMP
D	2	42"	SINGLE WALL CONTAINMENT COLLAR
E	2	42"	SW PTS FILL/VAPOR SUMP
F	6		HOLD DOWN SPLIT STRAP ASSEMBLY
G	4	12'	12"x 12" CONCRETE DEADMAN ANCHORS
H	2*		SUBMERSIBLE PUMP w/LEAK DETECTION

MARK	QTY	SIZE	EQUIPMENT LISTING
I	1*		INVENTORY & LEAK DETECTION PANEL
J	4*		CONTAINMENT COLLAR SENSOR
K	1*		FUEL DISPENSER w/UDC
L	2*		TANK INVENTORY GAUGE
M	1*		HYDROSTATIC TANK RESERVOIR SENSOR
N	2*	36"	MULTI-PORT SPILL CONTAINMENT MANHOLE
O	2*	2"	PRIMARY TANK VENT
P	1*	2"	SUMP VENTS – (MANIFOLDED)

MARK	QTY	SIZE	EQUIPMENT LISTING
Q	2*		OVERFILL PREVENTION VALVE
R	2*	4"	DROP TUBE
S	4*	4"	BALL FLOAT ASSEMBLY
T	2*	36"	WATERTIGHT MANHOLE
U	*	3"x2"	DOUBLE WALL FRP PIPE
V	2*	4"	EXTRACTOR HOUSING w/CAP
W	1*	18"	MANHOLE
X	1*		PUMP CONTROL PANEL

NOTE: * SUPPLIED BY OTHERS



TYPICAL PETROLEUM ILLUSTRATION DRAWING
(8') 6,000 / 6,000 DOUBLE-WALL COMPARTMENT TANK
W / SINGLE-WALL TURBINE AND FILL / VAPOR SUMPS

CONTAINMENT SOLUTIONS

Pub. No. TYP-866DDB2-STD JANUARY 2014

FIREGUARD®

FIRE-RATED ABOVEGROUND TANKS

U.S. Patent #5695089 & #5809650

modern®

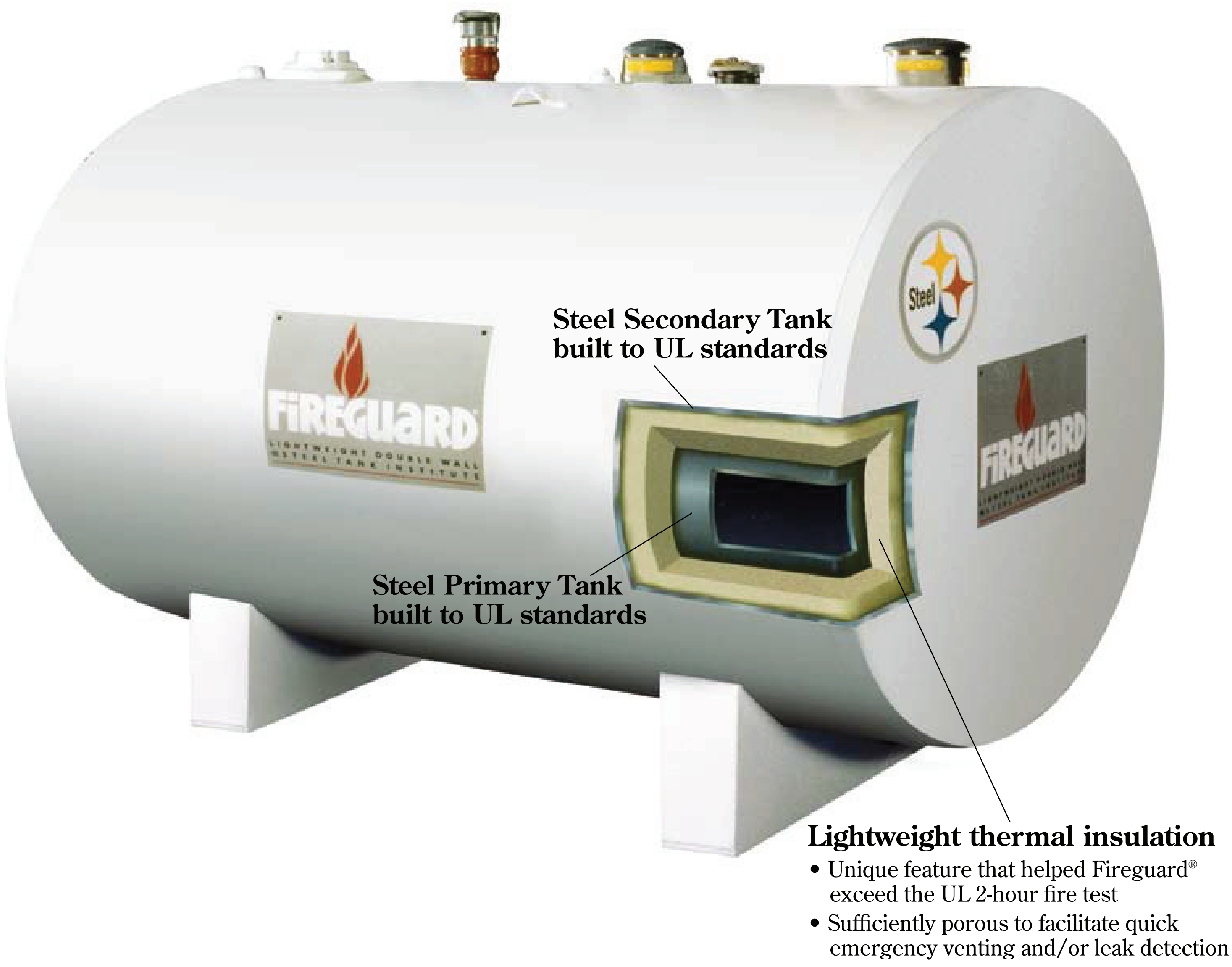
MODERN WELDING CO., INC.
1 800 922 1932
www.modweldco.com

UL 2085 Protected AST

FiREGUARD®

The New Generation of fire-rated AST's, going far beyond those "first generations" tanks which were merely enclosed in concrete.

- Fireguard® was the first AST of its design to obtain a UL Listing for secondary containment.
- Fireguard®'s secondary containment can be tightness tested on-site with standard testing procedures!
- Fireguard®'s exterior steel wall provides superior weatherability and low-cost maintenance. Unlike concrete, cracking or spalling will never be a problem!
- Fireguard®'s unique thermal insulating material is 75% lighter than concrete... Shipping, installation and relocation costs are reduced!
- The Fireguard® technology is patented under U.S. Patent #5695089 and #5809650 for "Lightweight Double Wall Storage Tank."



Is Your Aboveground Tank Everything It's Cracked Up To Be?

FIREGUARD®	VS. Concrete Encased
• Secondary containment is testable on-site using standard, economical testing procedures. • Fireguard®'s steel outer wall provides low-cost maintenance and protects the insulation material from weathering. • An average 12,000 gallon Fireguard® weighs under 30,000 pounds - well within the legal load limit for trucking.	• The secondary containment on certain designs may require elaborate and expensive procedures to be tested on-site. • Exposed concrete outer wall is susceptible to cracking, spalling and weathering - problems that are expensive to correct and are usually not covered by warranty. • An average 12,000 gallon concrete-encased tank weighs upwards of 100,000 pounds - imagine the hassles involved in handling that tank.

FIREGUARD®: THE ONLY TANK THAT MEETS ALL OF THESE STANDARDS

- UL-2085 Listed "Protected" Aboveground Tanks for Flammable and Combustible Liquids
- Both inner and outer tanks built per UL-142 Standard for Steel Aboveground tanks for Flammable and Combustible Liquids
- Uniform Fire Code, "Protected Tank"
- UL-2080 Listed "Fire Resistant" Tanks for Flammable and Combustible Liquids
- NFPA 30 and 30A, National Fire Protection Association
- NFPA 1, Uniform Fire Code™, of the National Fire Protection Association, "Protected Aboveground Tank
- Steel Tank Institute (STI) Standard F941 for Thermally Insulated Aboveground Storage Tanks
- International Fire Code (IFC)
- ULC-S655 Underwriters Laboratories of Canada Standard for Aboveground Tanks for Flammable and Combustible Liquids
- Other Standards…
- Ballistics protection per UL-2085
- Vehicle impact protection per UL-2085
- Hose Stream tested per UL-2085
- California Air Resources Board (CARB) testing requirements for air emissions
- Many fire codes and environmental regulations will accept Fireguard® Secondary Containment Tanks as an alternate to diking requirements

If your project is required to follow NFPA 30 or 30A guidelines... Check with your area "Authority Having Jurisdiction" related to maximum allowable tank capacity for the class fuel being stored and secondary containment requirements.

FIREGUARD® SPECIFICATIONS			
CYLINDRICAL DESIGN			
SAMPLE OUTER TANK DIMENSIONS			
ALL DIAMETERS AND LENGTHS ARE NOMINAL			
GALLONS	DIAMETER	LENGTH	APPROX WEIGHT (lbs.)
186	48	54	2,119
250	48	68	2,513
300	50	72	2,821
500	54	70	2,413
560	54	78	2,606
1,000	54	134	5,338
1,000	70	78	5,005
1,500	70	114	6,537
2,000	70	150	8,309
2,500	70	186	9,644
3,000	70	222	10,979
4,000	78	233	13,523
4,000	90	175	14,072
5,000	79	290	18,998
5,000	103	169	17,149
6,000	79	347	21,961
6,000	103	199	19,206
8,000	103	259	23,319
10,000	103	331	28,256
12,000	103	391	32,370
15,000	127	313	35,821
20,000	127	415	44,506
25,000	127	517	55,891
30,000	127	619	64,575

Please note that all dimensions and weights are approximate. Individual tanks may vary from these values.

FIREGUARD® SPECIFICATIONS				
RECTANGULAR DESIGN				
SAMPLE OUTER TANK DIMENSIONS				
ALL DIAMETERS AND LENGTHS ARE NOMINAL				
GALLONS	LENGTH	WIDTH	HEIGHT	APPROX. WEIGHT (lbs.)
186	45	45	56	2,256
250	118	37	37	3,305
250	79	51	37	2,916
500	141	52	37	4,991
750	93	73	37	3,950
1,000	128	73	37	4,607
1,000	89	73	51	4,102
1,500	125	89	45	5,772
2,000	141	87	51	6,679
2,000	141	73	61	6,486
2,500	141	89	61	7,453
3,000	251	73	51	11,572
3,000	118	103	73	9,379
4,000	332	73	51	14,990
4,000	155	103	73	11,640
5,000	337	73	61	16,615
5,000	192	103	73	13,901
6,000	403	73	61	19,631
6,000	229	103	73	16,162
8,000	371	103	61	22,872
8,000	303	103	73	20,684
10,000	461	103	61	27,992
10,000	377	130	73	25,205
12,000	452	103	73	29,788
15,000	387	103	103	38,510
18,000	463	103	103	45,290
24,700	466	138	103	54,539

MODERN WELDING CO., INC.

Corporate Offices

2880 New Hartford Road • Owensboro, KY 42303
Phone: 270-685-4400 • Fax: 270-684-6972
www.modweldco.com • E-mail: modern@modweldco.com

Modern Welding Company of Ohio, Inc.
One Modern Way, Newark, Ohio 43055
Phone: (740) 344-9425 Fax: (740) 344-6018
modern5@modweldco.com

Modern Welding Company of Iowa, Inc.
2818 Mt. Pleasant Road, Burlington, Iowa 52601
Phone: (319) 754-6577 Fax: (319) 754-8428
modern8@modweldco.com

Modern Welding Company of Georgia, Inc.
300 Prep Phillips Drive, Augusta, Georgia 30901
Phone: (706) 722-3411 Fax: (706) 724-8133 (Fax)
modern14@modweldco.com

Modern Welding Co. of Owensboro, Inc.
1450 E. Parrish Ave., Owensboro, Kentucky 42303
Phone: (270) 683-5323 Fax: (270) 684-5245
modern1@modweldco.com

Modern Welding Co. of Florida, Inc.
1801 Atlanta Ave., Orlando, Florida 32806
Phone: (407) 843-1270 Fax: (407) 423-8187
modern6@modweldco.com

Modern Welding Co. of Texas, Inc.
715 Sakowitz St., Houston, Texas 77020
Phone: (713) 675-4211 Fax: (713) 673-4062
modern7@modweldco.com

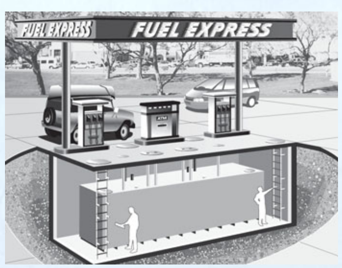
Modern Welding Co. of Texas, Inc.
200 N. Main St., Rhome, Texas 76078
Phone: (817) 636-2215 Fax: (817) 636-2680
modern15@modweldco.com

Modern Welding Co. of California, Inc.
4141 N. Brawley Ave., Fresno, California 93722
Phone: (559) 275-9353 Fax: (559) 275-4381
modern10@modweldco.com

Design / Build & Innovation Brings ExxonMobil to Core Engineered Solutions for C-Store Expansion

Project:
UL 2245 Belowgrade Vault

Client:
ExxonMobil



ExxonMobil is the world's largest publicly traded international oil and gas company. However, they ran into problems constructing a new C-Store in New Hampton, NH. Local New Hampshire Department of Environmental Services (NHDES) setback regulations (due to an on-site water well) made installing UST's at this facility impossible. With space at a premium, the large footprint of an AST meant that installing aboveground tanks was impractical as well.

For a solution, ExxonMobil called on Core Engineered Solutions and our innovative Liquid Containment Vault (LCV) system. This unique concrete sectional vault incorporates a specially formulated concrete mix, factory poured in two parts that encompasses a steel tank. Because the storage tanks are located within a vault that allows for easy accessibility and visual inspection by your personnel, they are sometimes classified by the EPA as Aboveground Storage Tanks (AST) even though they are located at or belowgrade. LCV systems offer uncompromising environmental protection to soil and groundwater, resists corrosion and rising water tables and even the sudden trauma of earthquake activity.

To complete this turnkey design/build project Core partnered with Stephens-Marquis Associates a commercial General Contractor and Construction Management company who specializes in petroleum and restaurant construction. The finished project included 4200 square foot On-The-Run convenience store with a Deli, five island gable canopy, and 36' car wash. The two 15,000 gallon vaulted LCV tanks provide Regular, Premium, and Diesel fuel self service.

To discuss your above or belowgrade fueling applications with a Core specialist or to learn more about our capabilities, contact us:

Core Engineered Solutions:
P: 800.628.5502
E: info@core-es.com
W: www.core-es.com

MODERN WELDING CO., INC.

Aboveground Horizontal Storage Tanks

- 300 to 50,000 gallon capacity
- Material of construction maybe carbon or stainless steel
- Underwriters Laboratories Construction, UL-142
- Single or double wall steel configurations available
- Also available in rectangular constructions up to 24,000 gallons
- Available with multiple compartments for multiple fuel storage
- Compatible with gasoline, diesel, fuel oil, ethanol, methanol and additives
- Lined internally for special applications, such as jet fuel or potable water storage
- Tanks maybe supported on stationary saddles, anti-roll stabilizers or structural skid configurations
- Tanks available with pump platforms and accessories
- Fuel dispensing equipment available

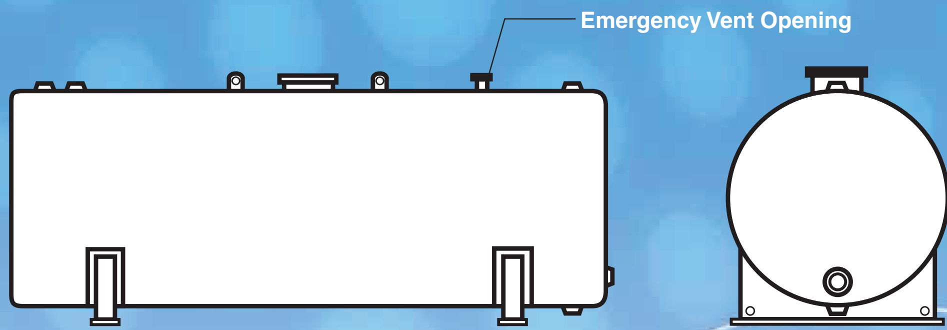
Horizontal Configurations:

These are steel atmospheric tanks intended for aboveground storage of non-corrosive, stable, flammable, and combustible liquids that have a specific gravity not exceeding that of water. Maximum allowable working pressure is 0.5 psig as measured from top of tank.

Special Fabrication:

Modern can incorporate stationary support saddles, anti roll supports or structural skids. Only new steel materials are used in tank constructions. Each tank is sized with the appropriate normal and emergency vent openings as defined in the tank's standard of construction. Horizontal tanks maybe single or double wall construction. If the tank is a double wall configuration, then it has interstitial monitoring capabilities. Tanks may also be built with or without multiple compartments for multiple fuel storage. Tanks are built to Underwriters Laboratories specification standard UL-142.

Horizontal Aboveground Single Wall Storage Tank



APPROX. CAPACITY (GALLONS)	NOM. DIAMETER	NOM. LENGTH
300	38”	6’-0”
560	48”	6’-0”
1,120	48”	12’-0”
1,000	64”	6’-0”
2,000	64”	12’-0”
3,000	64”	18’-0”
4,000	64”	24’-0”
4,000	96”	10’-8”
6,000	96”	16’-0”
8,000	96”	21’-4”
10,000	96”	26’-8”
12,000	96”	32’-0”
10,000	120”	17’-0”
12,000	120”	20’-6”
15,000	120”	25’-6”
20,000	120”	34’-6”
25,000	120”	42’-9”
20,000	126”	31’-0”
25,000	126”	38’-10”
30,000	126”	46’-6”
40,000	144”	47’-3”
50,000	144”	59’-2”
Tank lengths listed above are based on nominal tank dimensions. Overall tank lengths will vary during actual manufacturing.		

STANDARD SPECIFICATIONS

- Built per Underwriters Laboratories UL 142 standard.
- Modern’s standard opening locations and required lifting lugs.
- Exterior coated with one (1) coat of standard shop primer and not blast cleaned.
- Check with Modern for type of Emergency Vent Openings supplied. Support may be two (2) saddles, stabilizers, or skid configuration.
- Other exterior and interior coating systems available upon request.
- Other tank sizes available upon request.

MODERN WELDING CO., INC.

FlexWorks Next Generation Supply Piping

Why a new pipe?

OPW Fueling Containment Systems has developed a Next Generation FlexWorks Pipe in response to the voice of the customer.
You asked and we delivered!
The new pipe is more flexible, lighter and has reduced memory.

UL APPROVAL

- Motor Vehicle Fuels
- High Blend Fuels
- Concentrated Fuels
- Aviation and Marine

3rd PARTY APPROVED FOR DEF

What Makes This Pipe Different?

Lower installation costs

- **Increased Pipe Flexibility** – the force required to bend the pipe has been reduced to facilitate piping layout. This makes installation quicker and easier, especially in cold weather.
- **Pipe Weight** – has been reduced to facilitate shipping and handling
- **Pipe Memory** – Inherent pipe memory has been reduced significantly to facilitate connection of pipes inside sumps
- **Redesigned Profile** – enhanced leak detection performance
- **Next Generation** – enhanced Kynar liner

FlexWORKS BY OPW FUELING CONTAINMENT SYSTEMS *The complete Environmental System for underground fuel transfer and containment for the 21st century.*

Ordering Specifications - Sizing Matrix

New Pipe Part Number	ID	Description
C075A-250		Double Wall Primary Pipe, 250'
C075A-1000		Double Wall Primary Pipe, 1000'
C075A-SB	3/4"	Double Wall Primary Pipe 3/4" I.D. Short Box
C075A-SR		Double Wall Primary Pipe 3/4" I.D. Short Reel
CO75A-MR		Double Wall Primary Pipe, Mega Reel, 2000'
C10A-250		Double Wall Primary Pipe, 250'
C10A-1000		Double Wall Primary Pipe, 1000'
C10A-SB	1"	Double Wall Primary Pipe 1.0" I.D. Short Box
C10A-SR		Double Wall Primary Pipe 1.0" Short Reel
C10A-MR		Double Wall Primary Pipe, Mega Reel, 2000'
C15A-250		Double Wall Primary Pipe, 250'
C15A-500		Double Wall Primary Pipe, 500'
C15A-1000		Double Wall Primary Pipe, 1000'
C15A-1225		Stick Pipe 1 -1/2" 12 Pieces At 25'
C15A-1233	1-1/2"	Stick Pipe 1-1/2" 12 Pieces At 33'
C15A-1240		Stick Pipe 1-1/2" 12 Pieces At 40'
C15A-SB		Double Wall Primary Pipe 1.5" I.D. Short Box
C15A-SR		Double Wall Primary Pipe 1.5" I.D. Short Reel
C15A-MR		Double Wall Primary Pipe, Mega Reel, 1400'
C20A-250		Double Wall Primary Pipe, 250'
C20A-500		Double Wall Primary Pipe, 500'
C20A-1225		Stick Pipe 2.0" Double Wall 12 Pieces At 25'
C20A-1233	2"	Stick Pipe 2.0" Double Wall 12 Pc @ 33'
C20A-SB		Double Wall Primary Pipe, 2.0" I.D. Short Box
C20A-SR		Double Wall Primary Pipe, 2.0" I.D. Short Reel
C20A-MR		Double Wall Primary Pipe, Mega Reel, 800'
C30A-200		Call For Availability 3" Dbl Wall Primary Pipe 200'
C30A-MR	3"	3" Double Wall Primary Pipe, 250'
C30A-SR		Call For Avalibility Dbl Wall Primary Pipe 3" Srt.

FlexWorks Next Generation Supply Piping

OPW Fueling Containment Systems' Next Generation FlexWorks Pipe is more flexible, lighter and has reduced memory to aid installation and is UL approved for all fuels.

Flexible Supply Piping

OPW Fueling Containment Systems FlexWorks flexible piping utilizes fully bonded, premium PVDF construction throughout to offer complete peace-of-mind protection, performance, installation ease and advantages over rigid and semi-rigid pipe.

Features & Benefits:

- **Lower installation costs**
- **Eliminates the hassles** –installation time and potential leak points of rigid pipe installations
- **Easy installation** – results in less installation time
- **Eliminates burdensome cutting, fitting, and cleaning**
- **No adhesives** – heat assists, curing problems or electrofusion welding of joints
- **Easy to bend** – no special fittings to install in order to make bends

Eliminates potential underground leak points:

- **No underground** – fittings or joints
- **No hand-built field joints**
- **All termination points are contained in sumps**
- **Termination joints precision swaged to simulate factory-made assemblies**

Double Wall Flexible Piping:
UL 971 Listed, Integral Primary/Secondary, Normal Vent & Vapor Piping, Gasoline, Aviation & Marina Fuels:

A UL-listed, double-wall, flexible supply piping system designed for installation within Access piping. The outer containment pipe includes inner stand-off ribs to create a small interstitial space which allows for optimum fluid migration, continuous monitoring and easy periodic testing. This piping features an enhanced construction that meets the new UL971 standard. OPW FCS's FlexWorks double-wall piping has both the primary and secondary containment pipe UL-listed and is labeled as follows: **INTEGRAL PRIMARY/SECONDARY FOR MOTOR VEHICLE FUELS.**

Ordering Specifications* - FlexWorks Double Layer Access Pipe

Part #	Application	Minimum Bend Radius		Packaging		Dimensions				Box/Reel Size	Box/Reel Weight	
						I.D.		O.D.				
		in.	mm			in.	mm	in.	mm	(in.)	lbs.	kg
C075A-250	Double-Wall Primary Pipe, ¾"	18	457	Box	250 ft	.75	19	1.18	29	44x44x25	134	61
C075A-1000	Double-Wall Primary Pipe, ¾"	18	457	Reel	1000 ft	.75	19	1.18	29	58x58x48	527	239
C10A-250	Double-Wall Primary Pipe, 1"	18	457	Box	250 ft	1.0	25	1.50	38	44x44x25	169	77
C10A-1000	Double-Wall Primary Pipe, 1"	18	457	Reel	1000 ft.	1.0	25	1.50	38	58x58x48	605	274
C15A-250	Double-Wall Primary Pipe, 1.5"	24	610	Box	250 ft.	1.5	38	2.00	51	38x45x30	240	109
C15A-500	Double-Wall Primary Pipe, 1.5"	24	610	Reel	500 ft.	1.5	38	2.00	51	58x58x48	605	274
C15A-1000	Double-Wall Primary Pipe, 1.5"	24	610	Reel	1000 ft.	1.5	38	2.00	51	58x58x48	980	444
C20A-250	Double-Wall Primary Pipe, 2"	36	914	Box	250 ft	2	51	2.50	63.5	63x63x33	192	87
C20A-500	Double-Wall Primary Pipe, 2"	36	914	Reel	500 ft.	2	51	2.50	63.5	68x68x48	770	349
C30A-200	Double-Wall Primary Pipe, 3"	72	1828	Reel	200 ft	3	76	3.50	88	63x63x33	652	296

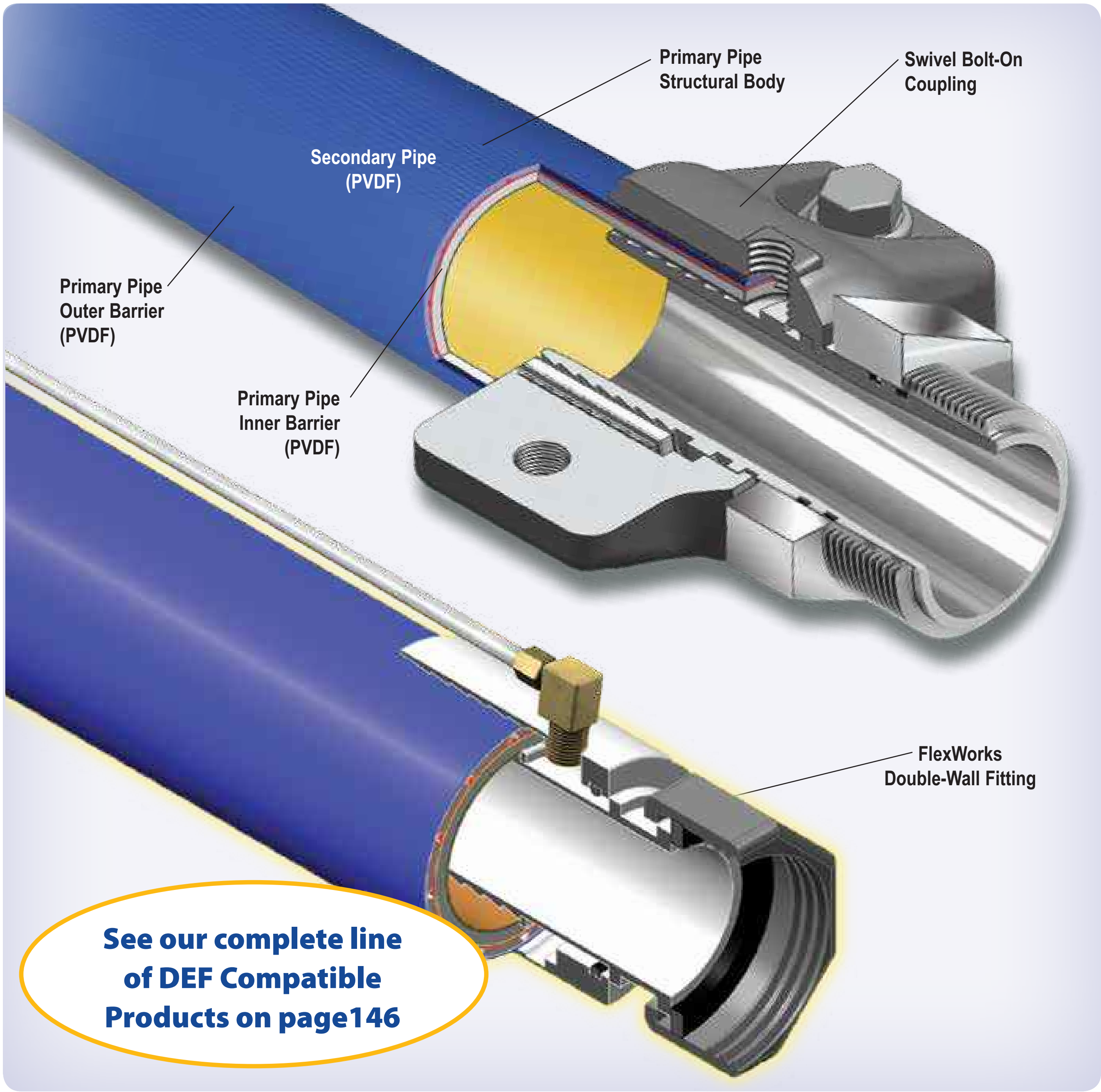
* OPW Fueling Containment Systems also offers short and custom lengths of pipe, as well as pipe packaged and shipped on Mega Reels. Please contact our Customer Service department at 1-800-422-2525, or visit us on the web at www.opwglobal.com for the most up-to-date information.

Flexible Piping Manual Order Number: **UPM-0001**

FlexWORKS BY OPW FUELING CONTAINMENT SYSTEMS

The complete Environmental System for underground fuel transfer and containment for the 21st century.

Flexible Supply Piping



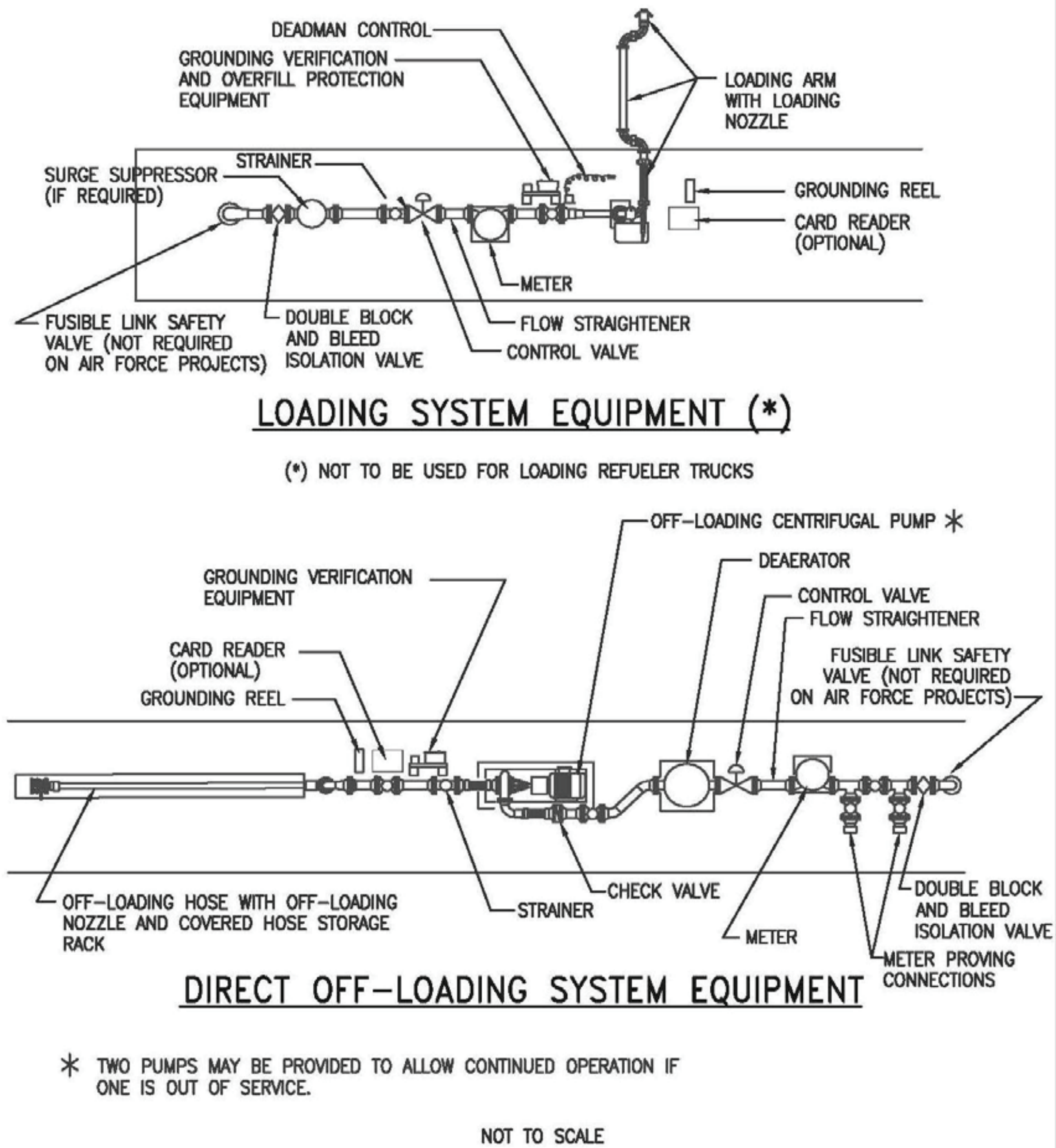
Product #	Size in.	Size cm	Description	Working Pressure PSIG	Working Pressure BAR	Temperature Rating F	Temperature Rating C	Burst Pressure
C15A	1.5	3.8	Double-Wall Primary Pipe	100	6.9 bar	-20° to +120° F	-29° to +49° C	
C20A	2	5	Double-Wall Primary Pipe	75	5 bar			Exceeds 5X Working Pressure
C30A	3	7.6	Double-Wall Primary Pipe	75	5 bar			

Listings and Certifications

E85 85% Ethanol   c UL US   UL971 LISTED

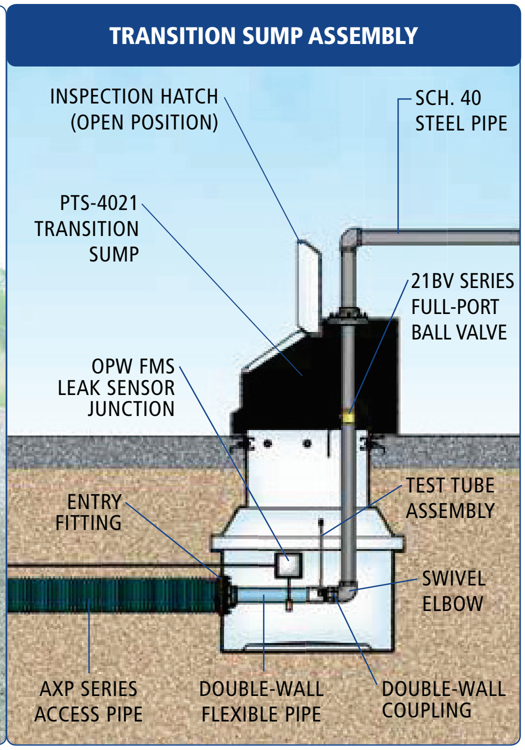
\1\

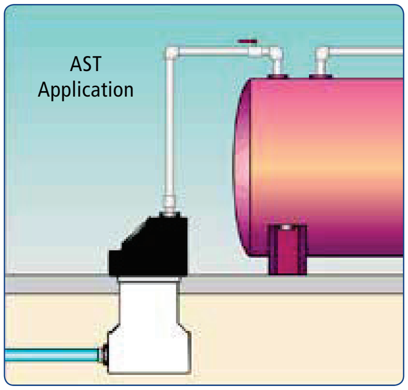
Plate 005 – Tank Truck and Tank Car Loading System and Direct Off-Loading System

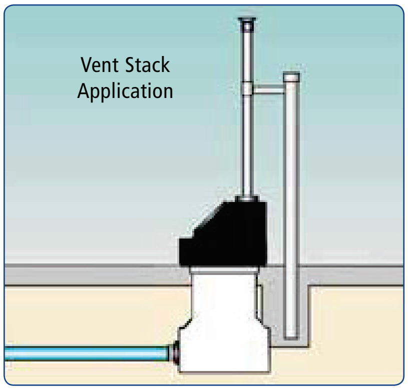


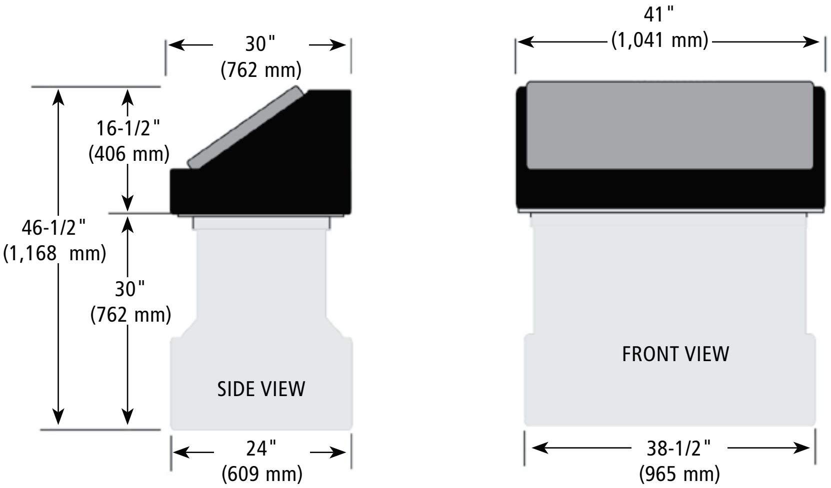
TITLE	DATE	FACILITY PLATE
Tank Truck and Tank Car Loading System and Direct Off-Loading System	06/13	005

/1/









Transition Sumps

Model PTS-4021 Transition Sump

(2 Piece - Polyethylene Sump/ Polyethylene Top)

- Non-corroding, polyethylene sump container
- Weatherproof lockable cover
- Exterior anchoring system

AST Application: Provides secondary containment and accessibility to the fittings that connect the underground supply piping to the rigid supply piping that leads from an above ground storage tank.

Vent Stack Application: Transition sump is used for containment and accessibility to the fittings. At the vent stack, where the underground vent piping connects to the rigid vent stack piping.

FlexWORKS The complete Environmental System for underground fuel transfer and containment for the 21st century.

Appendix 6 –A/E QUALIFICATIONS

Resumes are included for these Report Development Team members:

- **Mark Furr, PE – Mechanical Fueling**
- **Mike VanBriggle, PE – Civil / Environmental**
- **Hasan Daysal, PE, API 653 / 570 – Structural / Tank Inspections**
- **William Heyward, PE, API 653 / 570 – Tank Inspections**
- **Gerald Dupuie, API 653 – Tank Inspections**
- **Shawn Craig, PMP – Cost Estimating and Life Cycle Cost**

E. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT

(Complete one Section E for each key person.)

12. Name:	13. Role in this Contract:	14. Years Experience a. Total	14. Years Experience b. With Current Firm
Mark Furr, PE	**Mechanical Engineer/Project Manager**	**23**	**23**

15. Firm Name and Location *(City and State)*: **Robert and Company | 229 Peachtree Street NE | Intl Tower Suite 2000 | Atlanta, GA**

16. Education *(Degree and Specialization)*:	17: Current Professional Registration (State and Discipline):
B.S /Engineering Management (Mechanical)/1992 **MS/Business Management/1996**	**Professional Mechanical Engineer in Georgia**

18. Other Professional Qualifications *(Publications, Training, Awards)*:

Training: ACEC/Georgia Young Professional Program

Professional Societies: American Society of Mechanical Engineers; American Society of Engineering Management

19. RELEVANT PROJECTS

a

(1) Title and Location *(City and State)*: **Replace Underground Fuel Piping, NFLC Jacksonville, FL** — ***Project Featured in Section F***

(2) Year Completed: Professional Services **2014**; Construction (if applicable) **2016**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: Full plans, specifications, and PCAS Services to replace the underground fuel piping at the Naval Fleet Logistics Center (Fuel Depot at Jacksonville, FL. The piping system was designed per the requirements of ASME B31.3 **Cost:** $6.3M

Specific Role: Mechanical Engineer – Responsible for designing 12" aboveground piping system from Pier 111 to Pumphouse 48. Designed extensive modifications to Pumphouse 18", 10" and 12" piping headers to allow incorporation of new JP-5 fuel lines. Designed pig launching and receiving facility, pit valve manifolds, and pier meter proving station.

b

(1) Title and Location *(City and State)*: **Fuel Distribution Facilities, Tinker AFB, OK** — ***Project Featured in Section F***

(2) Year Completed: Professional Services **2014**; Construction (if applicable) **2017**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: Full plans and specifications for Fuel Distribution Facilities at Tinker AFB, OK. **Cost:** $36M

Specific Role: Mechanical Engineer - Responsible for layout of system piping and tanks, produced a hydraulic analysis for the pump and surge suppressor sizing and tank level controls.

c

(1) Title and Location (City and State): **Replace Hydrant System, Nellis AFB, NV** — ***Project Featured in Section F***

(2) Year Completed: Professional Services **2016**; Construction (if applicable) **2018**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: DLA MILCON Type III Hydrant Fuel System **Cost:** $35.5M

Specific Role: Mechanical Engineer – Responsible for development of scope of work, process narrative, layout of fuel piping and storage tanks, construction phasing plan, Hydraulic analysis for pump sizing, and economic analysis/justification for the new system.

d

(1) Title and Location (City and State): **JP-5 Jet Fuel System Replacement, MCAS Beaufort, SC**

(2) Year Completed: Professional Services **2013**; Construction *(if applicable)* **2018**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: Design designed of a new fuel distribution line from the pier to the bulk storage tanks at Fuel Farm A at MCAS Beaufort, SC **Cost:** $36M

Specific Role: Project Manager/Mechanical Engineer - Responsible for overall project management from pre-award to completion. Coordinated site visits, schedules, review and submission of deliverable, submission of annotated review comments, and project close-out.

e

(1) Title and Location (City and State): **Airlift Ramp and Fuel Facilities, Al Mussanah AB, Oman** — ***Project Featured in Section F***

(2) Year Completed: Professional Services **2012**; Construction *(if applicable)* **2014**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: Design and construction inspection services (Title II) for a fuel storage and distribution system. **Cost:** $36M

Specific Role: Mechanical Engineer - Responsible for design of piping, tanks, and fillstands. Generated system hydrant analysis, sized pumps, and equipment selection.

E. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT *(Complete one Section E for each key person.)*			
12. Name: **Mike VanBriggle, PE**	13. Role in this Contract: **Civil Engineer/Project Manager**	14. Years Experience a. Total **38**	b. With Current Firm **4**

15. Firm Name and Location *(City and State)*: **Robert and Company | 229 Peachtree Street NE | Intl Tower Suite 2000 | Atlanta, GA**

16. Education *(Degree and Specialization)*:	17: Current Professional Registration (State and Discipline):
B.S. Civil Engineering, 1978 **University of Nebraska, Lincoln, NE**	**#2007031076, Missouri, 2007, #PE72600, Ohio,2007, #10473, Tennessee, 1998,#24634, North Carolina, 1999,#11149, Kansas, 1988,#16472, Georgia, 1987, #22593, Alabama, 1998, #13808, Mississippi, 1998, #53614, Florida 1998, #E5834, Nebraska, 1984, #19174, South Carolina, 1998**

18. Other Professional Qualifications *(Publications, Training, Awards)*:
Georgia Soil and Water Conservation Commission (GSWCC) Level II Certified Design Professional, #0000006959

19. RELEVANT PROJECTS

	(1) Title and Location	(2) Year Completed: Professional Services	Construction (if applicable)
a	**Replace Underground Fuel Piping** **NFLC Jacksonville, FL** *Project Featured in Section F*	**2014**	**2016**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: Full plans, specifications, and PCAS Services to replace the underground fuel piping at the Naval fleet Logistic Center (Fuel Depot) at Jacksonville, FL. The piping system was designed per the requirements of ASME B31.3. **Cost**: $6.3M **Specific Role**: Civil Engineer – Civil engineering design for site development, drainage, aircraft and vehicle access, and pavements.		
b	**Replace Hydrant System** **Nellis AFB, NV** *Project Featured in Section F*	**2016**	**2018**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: DLA MILCON Type III Hydrant Fuel System **Cost:** $35.5M **Specific Role:** Civil Engineer - Responsible for grading and drainage design, site layout, erosion control best practice design, and storm water calculations and pavement design.		
c	**Replace JP-8 Truck Fill Stands Project Brochure** **Shaw AFB, SC** *Project Featured in Section F*	**2014**	**FY 2018 MILCON**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: DLA MILCON Requirements Document (RD) **Cost:** $20M **Specific Role:** Civil Engineer - Responsible for civil engineering design for the site development, drainage, aircraft and vehicle access, and pavements.		
d	**Bulk Fuel Storage System** **Cape Canaveral Air force Station, Florida**	**2014**	**2015**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: The construction of a new bulk fuel storage facility at Cape Canaveral AFS, Florida **Cost:** $6.1M **Specific Role:** Project Manager/Civil Engineer - Point of contact with design/build contractor. Provided design bulletin and project team and subconsultant coordination.		
e	**Government Fueling Station** **Tinker AFB, OK** *Project Featured in Section F*	**2014**	**2016**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: Design for replacement of a military service station at Tinker AFB. Cost: $3.5M **Specific Role:** Civil Engineer - Responsible for site/civil engineering design for site development, drainage, aircraft and vehicle access, and pavements.		

E. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT
(Complete one Section E for each key person.)

12. Name:	13. Role in this Contract:	14. Years Experience	
		a. Total	b. With Current Firm
Hasan Daysal, PE, SECB, API 570, API 653	**Structural Engineer**	**32**	**17**

15. Firm Name and Location *(City and State)*: **Robert and Company | 229 Peachtree Street NE | Intl Tower Suite 2000 | Atlanta, GA**

16. Education *(Degree and Specialization)*:	17: Current Professional Registration (State and Discipline):
Bachelor of Science / Civil Engineering / 1973 **Master of Science / Civil Engineering / 1982**	**Professional Engineer PA #035199E/Structural/1986, Also Registered in GA, IL, IN, WI, API 570 #45105, API 653 #27811**

18. Other Professional Qualifications *(Publications, Training, Awards)*:
Professional Affiliations: American Soc. Of Civil Engineers; National Society of Professional Engineers
Publications; "Soil Structure Interaction Effects on the Response of Cylindrical Tanks to Base Excitation, " with W.A. Hash Vol 112 No. 1, Journal of Structural Engineering, American society of Civil Engineers, January 1986

19. RELEVANT PROJECTS

a

(1) Title and Location *(City and State)*	(2) Year Completed: Professional Services	Construction (if applicable)
Integrity Management Plans - POL Piping **Southeast Region 8**	**2011**	**N/A**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — X Project Performed with Current Firm

Project Scope: Evaluation and Assessment **Cost:** N/A
Specific Role: Structural Engineer – Provided physical inspection of the fuel systems, indentified highest risk elements that were visible, and if needed, follow-on system assessments. Responsible for visual inspection, ultrasonic testing for pipe thickness and coating assessment, collected historical data on existing systems and underground fuel lines. Prepared a final report with recommendations for corrective action as required.

b

(1) Title and Location *(City and State)*	(2) Year Completed: Professional Services	Construction *(if applicable)*
Replace Hydrant System **Nellis AFB, NV** ***Project Featured in Section F***	**2016**	**2018**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — X Project Performed with Current Firm

Project Scope: DLA MILCON Type III Hydrant Fuel System **Cost:** $35.5M
Specific Role: Structural Engineer - Design horizontal tank foundation, catwalk/platforms, performed pipe stress analysis, and evaluated high seismic zone requirements. Designed secondary containment and vault for operating tanks.

c

(1) Title and Location (City and State)	(2) Year Completed: Professional Services	Construction *(if applicable)*
Engineering Assessments & RFP Development of Fuel Facilities **Multiple Locations**	**2011**	**ongoing**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — X Project Performed with Current Firm

Project Scope: Assessments and RFP Packages **Cost:** N/A
Specific Role: Structural Engineer – Developed assessments to indentify, validate and clarify structural deficiencies per UFC 3-460-01 at ten (10) DLA-E coded facilities. Developed RFP package for needed repairs complete within cost estimates.

d

(1) Title and Location (City and State)	(2) Year Completed: Professional Services	Construction (if applicable)
Fuel Distribution Facilities **Tinker AFB, OK** ***Project Featured in Section F***	**2014**	**2017**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — X Project Performed with Current Firm

Project Scope: Full plans and specifications for Fuel Distribution Facilities at Tinker AFB, OK. **Cost:** $36M

Specific Role: Structural Engineer - Responsible for design of tank foundations and repairs to two existing fuel storage tanks. Responsible for foundation for new Type III pumphouse and pipe stress analysis.

e

(1) Title and Location (City and State)	(2) Year Completed: Professional Services	Construction *(if applicable)*
Airlift Ramp and Fuel Facilities **Al Mussanah AB, Oman** ***Project Featured in Section F***	**2012**	**2014**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — X Project Performed with Current Firm

Project Scope: Design and construction services for a fuel storage and distribution system at Al Mussanah AB **Cost:** $65M
Specific Role: Structural Engineer - Responsible for design of two 20,000 BBL "cut and cover" fuel storage tanks with pumphouse to include structural walls, foundations, anchorage, slab calculations, steel column base plate design, architectural precast-wall panel and connection design. Design included seismic and wind load calculation per ASCE 7-05 Chapter 11, 12,13 Seismic Design Criteria.

E. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT *(Complete one Section E for each key person.)*			
12. Name: **Will Heyward, PE, FPE, LEED-AP BD+C, API 570, API 653**	13. Role in this Contract: **Mechanical Engineer** **Fire Protection Engineer**	14. Years Experience a. Total **32**	b. With Current Firm **8**
15. Firm Name and Location *(City and State)*: **Robert and Company | 229 Peachtree Street NE | Intl Tower Suite 2000 | Atlanta, GA**			
16. Education *(Degree and Specialization)*: **Georgia Institute of Technology 1981** **Bachelor of Mechanical Engineering - 1986**	17*:* Current Professional Registration *(State and Discipline)*: **PE Georgia #26038, Mechanical** **PE Georgia, Fire Protection**		
18. Other Professional Qualifications *(Publications, Training, Awards)*: **API-570 and API-653 Certifications, NCEES #17779, LEED-AP BD+C**			

19. RELEVANT PROJECTS

	(1) Title and Location *(City and State)*	(2) Year Completed Professional Services	Construction (if applicable)
a	**Integrity Management Plans - POL Piping** **Southeast Region 8**	**2011**	**N/A**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: Evaluation and Assessment **Cost:** N/A **Specific Role:** Mechanical Engineer/Fire Protection Engineer – Provided physical inspection of the fuel systems, indentified highest risk elements that were visible, and if needed, follow-on system assessments. Responsible for visual inspection, ultrasonic testing for pipe thickness and coating assessment, collected historical data on existing systems and underground fuel lines. Prepared a final report with recommendations for corrective action as required.		
b	(1) Title and Location *(City and State)* **Engineering Assessments & RFP Development of Fuel Facilities** **Various Locations**	(2) Year Completed Professional Services **2011**	Construction (if applicable) **N/A**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: Assessments and RFP Development **Cost:** N/A **Specific Role:** Mechanical Engineer/Fire Protection Engineer - Developed assessments to identify, validate, and clarify mechanical and fire protection deficiencies per UFC 3-600-01 and UFC 3-600-01 at 10 DLA-E coded facilities. Developed RFP package for needed repairs complete with cost estimates.		
c	(1) Title and Location (City and State) **Replace Hydrant System** **Nellis AFB, NV** ***Project Featured in Section F***	(2) Year Completed Professional Services **2016**	Construction *(if applicable)* **2018**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: DLA MILCON Type III Hydrant Fuel System **Cost:** $35.5M **Specific Role:** Mechanical Engineer/Fire Protection Engineer - Responsible for HVAC, plumbing, and potable water system design. Evaluated fire hydrant coverage per UFC 3-600-01, obtained and evaluated fire hydrant flow test, and designed distribution system to meet required gpm and pressure needed at site.		
d	(1) Title and Location (City and State) **Fire Protection Evaluations** **Multiple Locations, Air Mobility Command**	(2) Year Completed Professional Services **2011**	Construction *(if applicable)* **N/A**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: Fire Protection Evaluations **Cost:** N/A **Specific Role:** Fire Protection Engineer - Performed site investigation and developed repair and compliance recommendations for aircraft hangar fire protection systems at eight (8) US Air Force bases.		
e	(1) Title and Location (City and State) **Airlift Ramp and Fuel Facilities** **Al Mussannah AB, Oman** ***Project Featured in Section F***	(2) Year Completed Professional Services **2012**	Construction *(if applicable)* **2014**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	X Project Performed with Current Firm	
	Project Scope: Design and construction inspection services (Title II) for a fuel storage and distribution system. **Cost:** $36M **Specific Role:** Mechanical Engineer/Fire Protection Engineer - Responsible for design of automatic fire suppression sprinkler systems, 120,000 gallons of water storage per NFPA 22, pumphouses with fire pumps, water distribution lines, and alarm systems per NFPA 72 and UFC 3-600-01,		

E. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT

(Complete one Section E for each key person.)

12. Name:	13. Role in this Contract:	14. Years Experience a. Total	b. With Current Firm
Gerald Dupuie	API 653 Inspector/ Tank Cleaning Supervisor	**25**	**7**

15. Firm Name and Location *(City and State)*: **Robert and Company | 229 Peachtree Street NE | Intl Tower Suite 2000 | Atlanta, GA**

16. Education *(Degree and Specialization)*:	17: Current Professional Registration (State and Discipline):
API 653 Certification **STI SP001 Certification**	

18. Other Professional Qualifications *(Publications, Training, Awards)*:
OSHA 30 hour Construction
40Hr Hazwoper
Confined Space Entry

19. RELEVANT PROJECTS

a

(1) Title and Location *(City and State)*

UST/AST API 653 Tank Inspections
Multiple Government Facilities - CONUS USACOE
Project Featured in Section F

(2) Year Completed — Professional Services: **2010** | Construction (if applicable): **N/A**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: IDIQ Architectural, Mechanical, Structural and Electrical Services

Cost: $1,100,000.

Description: The scope included tank cleaning and API 653 inspection to include inspection of tank foundations, bottom shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange. For all tanks the scope also included inspecting containment berms, valves, pumps, product recovery tanks, piping and secondary containment system. The scope included 20 tanks which required API 653 out of service, and in-service inspections at 8 locations.

Specific Role: Project Manager/ Tank Cleaner – Responsible for the safe cleaning and API 653 Inspection.

b

(1) Title and Location *(City and State)*

UST/AST API 653 Tank Inspections
Multiple Government Facilities - CONUS HQ AFCESA
Project Featured in Section F

(2) Year Completed — Professional Services: **2010** | Construction (if applicable): **N/A**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: IDIQ Architectural, Mechanical, Structural and Electrical Services

Cost: $827,975.

Description: The scope included tank cleaning and API 653 inspection to include inspection of tank foundations, bottom shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange. For all tanks the scope also included inspecting containment berms, valves, pumps, product recovery tanks, piping and secondary containment system. The scope included 21 tanks which required API 653 out of service, and in-service inspections at 11 locations.

Specific Role: Project Manager/ Tank Cleaner – Responsible for the safe cleaning and API 653 Inspection

c

(1) Title and Location (City and State)

UST/AST API 653 Tank Inspections
Multiple Government Facilities – CONUS NAFAC
Project Featured in Section F

(2) Year Completed — Professional Services: **2012** | Construction (if applicable): **N/A**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: **Scope:** IDIQ Architectural, Mechanical, Structural and Electrical Services

Cost: $123,088.

Description: The scope included the inspection of tank foundations, bottom shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange. For all tanks the scope also included inspecting containment berms, valves, pumps, product recovery tanks, piping and secondary containment system. The scope included 10 tanks which required API 653 out of service, and in-service inspections at 3 locations.

Specific Role: Project Manager/ Tank Cleaner – Responsible for the safe cleaning and API 653 Inspection

(1) Title and Location (City and State) | (2) Year Completed

	(1) Title and Location (City and State)	(2) Year Completed	
d	**UST/AST API 653 Tank Inspections** **Multiple Government Facilities - CONUS USACOE**	Professional Services **2016**	Construction *(if applicable)* **N/A**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	**X** Project Performed with Current Firm	
	Project Scope: IDIQ Architectural, Mechanical, Structural and Electrical Services **Cost:** $578,925.00 **Description:** The scope included tank cleaning and API 653 inspection to include inspection of tank foundations, bottom shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange. For all tanks the scope also included inspecting containment berms, valves, pumps, product recovery tanks, piping and secondary containment system. The scope included 24 tanks which required API 653 out of service, and in-service inspections at 9 locations. **Specific Role: Project Manager/ Tank Inspector/ Tank Cleaner** – Responsible for the safe cleaning and API 653 Inspection		
	(1) Title and Location (City and State)	(2) Year Completed	
e	**UST/AST API 653 Tank Inspections** **Multiple Government Facilities - CONUS USACOE** ***Project Featured in Section F***	Professional Services **2017**	Construction *(if applicable)* **N/A**
	(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role	**X** Project Performed with Current Firm	
	Project Scope: IDIQ Architectural, Mechanical, Structural and Electrical Services **Cost:** $527,680.00 **Description:** The scope included tank cleaning and API 653 inspection to include inspection of tank foundations, bottom shell, structure, roof, attached appurtenances, and nozzles to the face of the first flange. For all tanks the scope also included inspecting containment berms, valves, pumps, product recovery tanks, piping and secondary containment system. The scope included 18 tanks which required API 653 out of service, and in-service inspections at 7 locations. **Specific Role: Project Manager/ Tank Inspector/ Tank Cleaner** – Responsible for the safe cleaning and API 653 Inspection		

E. RESUMES OF KEY PERSONNEL PROPOSED FOR THIS CONTRACT

(Complete one Section E for each key person.)

12. Name:	13. Role in this Contract:	14. Years Experience a. Total	b. With Current Firm
L. Shawn Craig, PMP	**Cost Estimator**	**24**	**20**

15. Firm Name and Location *(City and State)*: **Robert and Company | 229 Peachtree Street NE | Intl Tower Suite 2000 | Atlanta, GA**

16. Education *(Degree and Specialization)*:	17. Education *(Degree and Specialization)*:
BS Construction Management / 1991	**PMP #2336848 (Project Management Professional)**

18. Other Professional Qualifications *(Publications, Training, Awards)*:

19. RELEVANT PROJECTS

a

(1) Title and Location *(City and State)*	(2) Year Completed Professional Services	Construction *(if applicable)*
Replace Hydrant Fuel System **Nellis AFB, NV** ***Project Featured in Section F***	**2016**	**2018**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: DLA MILCON Type III Hydrant Fuel System **Cost:** $35.5M

Specific Role: Cost Estimator - provided estimating for design submittals required. Provided life cycle cost (LCC) analysis for project justification. Cost estimates prepared MCACES (MII) Cost Estimating Software.

b

(1)Title and Location *(City and State)*	(2) Year Completed Professional Services	Construction (if applicable)
Fuel Distribution Facilities **Tinker AFB, OK** ***Project Featured in Section F***	**2014**	**2017**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: Full plans and specifications for Fuel Distribution Facilities at Tinker AFB, OK. **Cost:** $36M

Specific Role: Cost Estimator - provided estimating for design submittals required. Cost estimates prepared MCACES (MII) Cost Estimating Software**.**

c

(1) Title and Location (City and State)	(2) Year Completed Professional Services	Construction (if applicable)
Construct Government Fueling Station **Tinker AFB, OK** ***Project Featured in Section F***	**2014**	**2016**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: Design for replacement of a military service station at Tinker AFB. **Cost:** $3.5M

Specific Role: Cost Estimator - provided estimating for design submittals required. Cost estimates prepared MCACES (MII) Cost Estimating Software.

d

(1) Title and Location (City and State)	(2) Year Completed Professional Services	Construction *(if applicable)*
Replace JP-8 Truck Fill Stands Project Brochure **Shaw AFB, SC** ***Project Featured in Section F***	**2014**	**FY 2018 MILCON**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X** Project Performed with Current Firm

Project Scope: DLA MILCON Requirements Document (RD) **Cost:** $20M

Specific Role: Cost Estimator - provided estimating for design submittals required. Provided life cycle cost analysis (LCC) for project justification. Cost estimates prepared MCACES (MII) Cost Estimating Software.

e

(1)Title and Location (City and State)	(2) Year Completed Professional Services	Construction (if applicable)
Conducted AST Inspection of DLA Fuel Tanks **Ft. Hood, TX and Louis Munoz Martin, PR**	**2015**	**N/A**

(3) Brief Description (Brief scope, size, cost, etc.) and Specific Role — **X**

Project Scope: API Inspections

Specific Role: Cost Estimator: Responsible for preparing immediate, short form, and long range cost estimates for future DLA funded projects. Cost estimates prepared using MCACES (MII) cost estimating software.