CALIFORNIA ENERGY COMMISSION

CALIFORNIA NATURAL RESOURCES AGENCY

California Energy Commission

Clean Transportation Program

FINAL PROJECT REPORT

Lodi Unified School District's Compressed Natural Gas Fueling Station Installation Project

Prepared for: California Energy Commission

Prepared by: Lodi Unified School District

Lodi Unified School District

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California Energy Commission

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PREFACE

Assembly Bill 118 (Núñez, Chapter 750, Statutes of 2007) created the Clean Transportation Program. The statute authorizes the California Energy Commission (CEC) to develop and deploy alternative and renewable fuels and advanced transportation technologies to help attain the state's climate change policies. Assembly Bill 8 (Perea, Chapter 401, Statutes of 2013) reauthorizes the Clean Transportation Program through January 1, 2024, and specifies that the CEC allocate up to $20 million per year (or up to 20 percent of each fiscal year's funds) in funding for hydrogen station development until at least 100 stations are operational.

The Clean Transportation Program has an annual budget of about $100 million and provides financial support for projects that:

- Reduce California's use and dependence on petroleum transportation fuels and increase the use of alternative and renewable fuels and advanced vehicle technologies.
- Produce sustainable alternative and renewable low-carbon fuels in California.
- Expand alternative fueling infrastructure and fueling stations.
- Improve the efficiency, performance and market viability of alternative light-, medium-, and heavy-duty vehicle technologies.
- Retrofit medium- and heavy-duty on-road and nonroad vehicle fleets to alternative technologies or fuel use.
- Expand the alternative fueling infrastructure available to existing fleets, public transit, and transportation corridors.
- Establish workforce-training programs and conduct public outreach on the benefits of alternative transportation fuels and vehicle technologies.

To be eligible for funding under the Clean Transportation Program, a project must be consistent with the CEC's annual Clean Transportation Program Investment Plan Update. The CEC issued PON-12-605 to support installation of new natural gas fueling infrastructure and upgrades to existing natural gas fueling infrastructure. In response to PON-12-605, the recipient submitted an application which was proposed for funding in the CEC's notice of proposed awards March 18, 2013 and the agreement was executed as ARV-12-054 on August 30, 2013.

ABSTRACT

The Lodi Unified School District's bus fleet has expanded its compressed natural gas-powered buses from 27 to 54. With the increase of natural gas buses, the school district needed to construct a new fueling station that could provide the increase use of natural gas fuel. Lodi Unified School District obtained grant funding from the California Energy Commission, San Joaquin Valley Air Pollution Control District, and district funds to help build the new compressed natural gas station. The construction of the fueling station was completed on Monday, September 21, 2015. Performance Mechanical Inc. was awarded the contract to construct and build the new station. The equipment was purchased from Angi Energy Systems in Janesville, Wisconsin.

The purpose of the project was to increase the amount of compressed natural gas needed to fuel Lodi's growing school bus fleet at the facility located at 820 S. Cluff Avenue in Lodi, California. The current equipment could not provide the amount of natural gas needed. With the increase of natural gas vehicles added to our fleet, this has helped clean the air in the San Joaquin Valley Basin.

Since the completion of the new compressed natural gas fueling station, Lodi Unified School District has seen a substantial reduction in the use of diesel fuel. The project has also enabled the school district to become a backup station and provide fuel to other public entities that use natural gas in the San Joaquin Valley.

Keywords: Compressed Natural Gas, Lodi Unified School District, Fueling Station

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EXECUTIVE SUMMARY

Lodi Unified School District was established as a unified school district in 1967. The District encompasses 350 square miles, serving kindergarten to 12th grade students living in the cities of Lodi and Stockton, and the communities of Acampo, Clements, Lockeford, Victor, and Woodbridge.

Lodi Unified School District has been very aggressive in helping to improve the air quality in the San Joaquin Valley Basin. In 2004, Lodi Unified School District's Transportation Department installed a compressed natural gas fueling station on site with the capability to fuel 27 natural gas buses. The school district has been actively replacing diesel powered buses with natural gas buses. The current diesel-powered buses have been retrofitted with diesel particulate matter traps. The district was able to purchase 15 additional natural gas buses; however, those buses would need to be fueled off site about 10 miles away, due to the current station being at capacity with gas flow allowed to the station, resulting in higher maintenance, fuel, and labor costs for the school district. The two other fueling sites for the buses were also reaching capacity and have limited Lodi Unified School District buses to fuel at certain times. The school district had plans to replace 12 older diesel buses with 12 natural gas buses, bringing the school districts natural gas bus fleet total to 54 buses.

In 2012, Lodi Unified School District started to explore the construction of a new compressed natural gas station. The existing infrastructure including electric and gas supplies were not adequate enough to supply replacement equipment needs. T. Mitchell Engineers Inc. provided an estimate of $1,108,468 to build a new fueling station that would provide enough natural gas fuel for 54 large transit-style school buses with a fast-fill dispenser for small support vehicles powered by natural gas. In February 2013, Lodi Unified School District applied for and was awarded $300,000 in grant funding from the California Energy Commission and a $511,454 grant from the San Joaquin Valley Air Pollution Control District. With this funding, Lodi Unified School District was able to move forward immediately with the construction of the new compressed natural gas fueling station project.

The objective of the Lodi Unified School District Compressed Natural Gas Fueling Station Installation Project is to install a new compressed natural gas fueling station with equipment that is more reliable, easier to maintain, efficient, and meets the current needs of Lodi Unified School District's natural gas school bus fleet. While Lodi Unified School District is currently planning to use the compressed natural gas fueling station for its own fleet vehicles, the fast-fill capability of the new station provides the flexibility of opening access to other natural gas light- and heavy-duty vehicles. The school district's compressed natural gas fueling station is conveniently located near the Highway 99 and Interstate 5 corridors. This could be especially useful in providing redundancy to other school districts or nearby fleets. The City of Lodi and Waste Management of Lodi have indicated interest in using Lodi Unified School District's facility for refueling their local natural gas vehicles.

T. Mitchell Engineers Inc. was contracted by Lodi Unified School District to be the lead agent for the design, construction and commissioning of the compressed natural gas fueling station. The design process started in April 2014, and the construction process started about a year later and was completed within 5 months.

Lodi Unified School District went to bid for the electrical upgrade and compressed natural gas fueling station project in January 2015. Bids were opened and awarded by the Board of Education in February 2015. Performance Mechanical Inc. was awarded the construction bid for the compressed natural gas fueling station project in the amount of $626,947 not including the cost to upgrade the gas supply line from Pacific Gas and Electric, and costs to implement the project. The original plan included a station with two compressors for the total of 393 square cubic feet per minute with both time-fill and fast-fill capabilities.

On September 17, 2015 the compressed natural gas fueling station was brought online and started to fuel district school buses and district-owned support vehicles.

Since the completion of this compressed natural gas fueling station, Lodi Unified School District has seen a substantial reduction in the use of diesel fuel. The project has also enabled the district to use a 99.9 percent natural gas bus fleet to run its Home-to-School and Special Education program. District employees and parents are extremely happy to have received these grants from the California Energy Commission and the San Joaquin Valley Air Pollution Control District that has enabled the school district to be part of cleaning the air in our San Joaquin Valley.

Lodi Unified School District is committed to continue the use of natural gas for its fleet and improving local and regional air quality.

CHAPTER 1:
Project Background

Background

Lodi Unified School District was established as a unified school district in 1967. The District encompasses 350 square miles, serving kindergarten to 12th grade students living in the cities of Lodi and Stockton, and the communities of Acampo, Clements, Lockeford, Victor, and Woodbridge.

Lodi Unified School District has been very aggressive in helping to improve the air quality in the San Joaquin Valley Basin. In 2004, Lodi Unified School District 's Transportation Department installed a compressed natural gas (CNG) fueling station on site with the capability to fuel 27 natural gas buses. The school district has been actively replacing diesel powered buses with natural gas buses. The current diesel-powered buses have been retrofitted with diesel particulate matter traps. The school district was able to purchase 15 additional natural gas buses with the assistance of various grant funding sources and district funds; however, those buses would need to be fueled off site about 10 miles away, due to the current station being at capacity with gas flow allowed to the station, resulting in higher maintenance, fuel, and labor costs. The two other fueling sites for the buses were also reaching capacity and have limited Lodi Unified School District buses to fuel at certain times. The school district had plans to replace 12 older diesel buses with 12 natural gas buses, bringing the school districts natural gas bus fleet total to 54 buses. An image of the bus fleet is shown below in Figure 1.

Figure 1: Lodi Unified School District's Bus Fleet

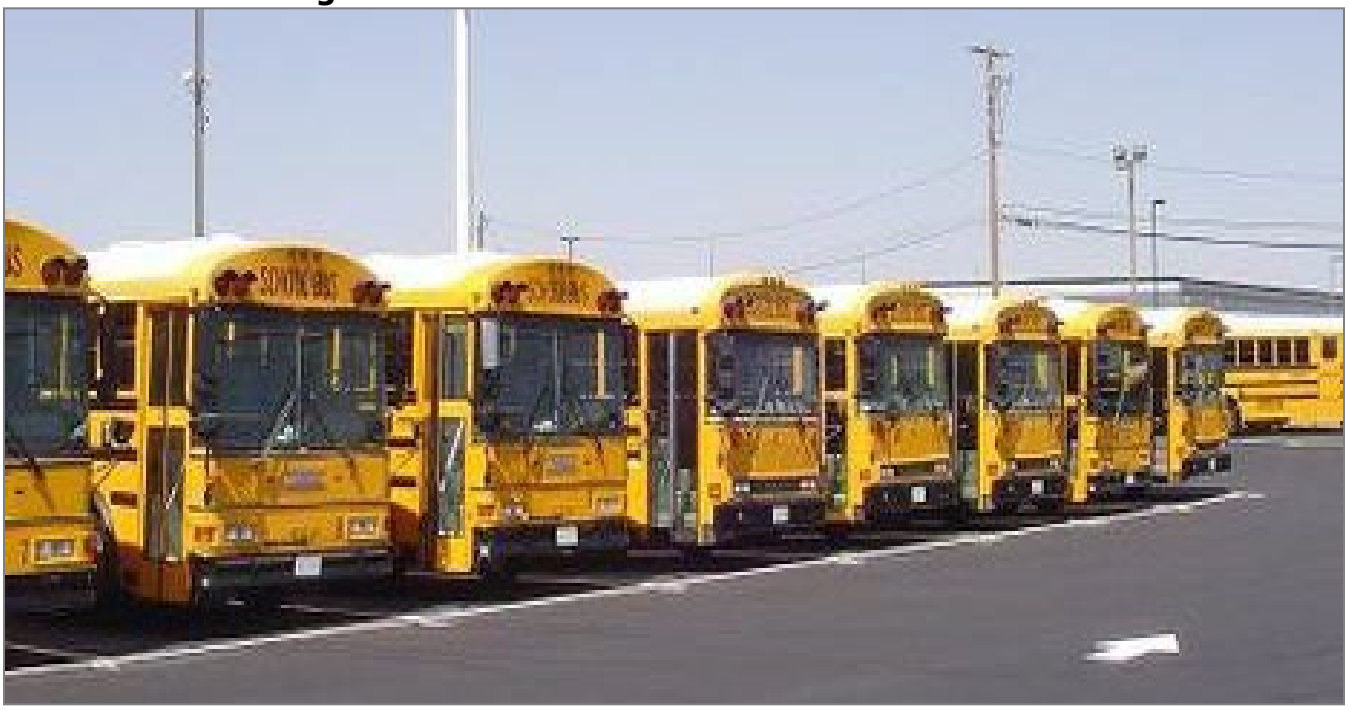


Photo Source: Lodi Unified School District

In 2012, Lodi Unified School District started to explore the construction of a new CNG fueling station. The existing infrastructure including electric and gas supplies were not adequate enough to supply replacement equipment needs. The school district was aware that the construction of a new CNG fueling station would be very expensive. T. Mitchell Engineers Inc. provided an estimate of $1,108,468 that would be needed to fund the installation of a new fueling station that would provide enough natural gas fuel for 54 large transit-style school buses with a fast-fill dispenser for small support vehicles powered by natural gas.

Funding would be the biggest obstacle for the school district to overcome however in order to help California reach its aggressive goals to help improve air quality in the region, the school district choose to keep pursing the project. With extensive research in seeking available funding opportunities, the school district found the opportunities from the California Energy Commission and the San Joaquin Valley Air Pollution Control District.

In late 2012, the Energy Commission's Alternative and Renewable Fuel and Vehicle Technology's Program announced the availability of grant funding for projects that would establish infrastructure necessary to store, distribute and dispense compressed or liquefied natural gas.

San Joaquin Valley Air Pollution Control District's Alternative Fuel Infrastructure Request For Proposals was released seeking proposals from Valley public agencies for infrastructure projects that focused on two areas: 1) the construction of a new facility where there is currently no facility, and 2) expansion of existing, in-use alternative fuel facilities so that public agencies may increase the amount of fuel throughput and vehicles serviced at their current facilities.

In February 2013, Lodi Unified School District applied for and was awarded $300,000 in grant funding from the California Energy Commission and a $511,454 grant from the San Joaquin Valley Air Pollution Control District. With this funding available, Lodi Unified School District was able to move forward immediately with the construction of the new CNG fueling station for their school district fleet.

Current Fleet

The Lodi Unified School District school bus fleet currently consists of 90 vehicles, which includes 54 CNG buses and 36 diesel powered buses equipped with diesel particulate filters to meet the California Air Resources Board's Truck and Bus Regulation.[1] The Lodi Unified School District school bus fleet runs clean and meets all strict California emissions. The transportation department fleet also has light-duty support vehicles powered by natural gas.

It is in the best interest of Lodi Unified School District to have a CNG fueling station that would have the ability to provide fuel for its fleet of 54 compressed natural gas school buses and 10 support vehicles. The fueling station would also be a backup fueling station for those public entities that have natural gas-powered vehicles in the area if ever their fueling station went out of service, and they are, the City of Lodi, Waste Management of Lodi, and United Parcel Service of Stockton. The District's compressed natural gas station is conveniently located near highway 99 in the city of Lodi and has easy access from the freeway.

[1] California Air Resource Board (http://www.arb.ca.gov/msprog/truckstop/tb/schoolbus.htm)

Goal of the Agreement

The goal of this project is to construct a new CNG station with both time-fill and fast-fill capability to fuel 27 additional CNG powered school buses and meet current and future CNG fueling needs of the school district with a grand total of 54 slow time fill stations, and 1 fast fill dispenser

Objectives of the Project

The objectives of this project are to:

- Improve fueling capabilities of the district's CNG school bus fleet.
- Provide capacity for expansion from 27 CNG buses to 54.
- Provide a better fill for existing and future vehicles.
- Provide a back-up fueling station for neighboring CNG fleets.
- Provide CNG fuel to others travelling California via Interstate 5 freeway and Highway 99 corridors.
- Decrease the dependency of diesel fuel.

CHAPTER 2:
Project Approach

Lodi Unified School District 's transportation staff brought an engineering company (T. Mitchell Engineers, Inc.) on board and shared information regarding the construction of a new fueling station for its school bus fleet. The engineering consultant drew up the drawings and gave the district a cost estimate for the construction of this project.

T. Mitchell Engineers Inc. provided an estimate of $1,108,468 that would be needed to fund the installation of a new fueling station that would provide enough natural gas fuel for 54 large transit-style school buses with a fast-fill dispenser for small support vehicles powered by natural gas. After the cost and details were discussed, Lodi Unified School District began its quests to seek funding opportunities to help fund this project.

In February 2013, Lodi Unified School District applied for and was awarded $300,000 in grant funding from the California Energy Commission and a $511,454 grant from the San Joaquin Valley Air Pollution Control District. With this funding available, Lodi Unified School District was able to move forward immediately with the construction of the new CNG fueling station for their school district fleet.

Specifications and Bid Documents

The goal of this task to finalize the specifications for the construction of a new fueling station and prepare bid documents.

The approach the school district took was to find out how much gas flow would be needed for the new fueling station. Lodi Unified School District discussed with Pacific Gas & Electric to ensure the project would have the necessary amount of gas flow needed for the equipment. After requests were granted, the school district then made the requests to build and obtain permits from the City of Lodi, which were granted. Receiving notification from both Pacific Gas & Electric and the City of Lodi, construction drawings were completed, approved, and finalized.

Engineering

The goal of this task is to prepare engineering drawings for permitting and construction.

After receiving approval from the City of Lodi and Pacific Gas & Electric for gas flow needed, drawings and permits to construct to begin construction was approved.

Order Equipment for Project

The goal of this task is to purchase the equipment needed for construction of the new fueling station.

Lodi Unified School District reached out to ANGI Corporation for the equipment needed for this project. Once the district confirmed the equipment was available, the district began the process to purchase the equipment for the project.

Equipment

Installed equipment consists of the following:

- ANGI corporation compressor package NG300E (Duplex)

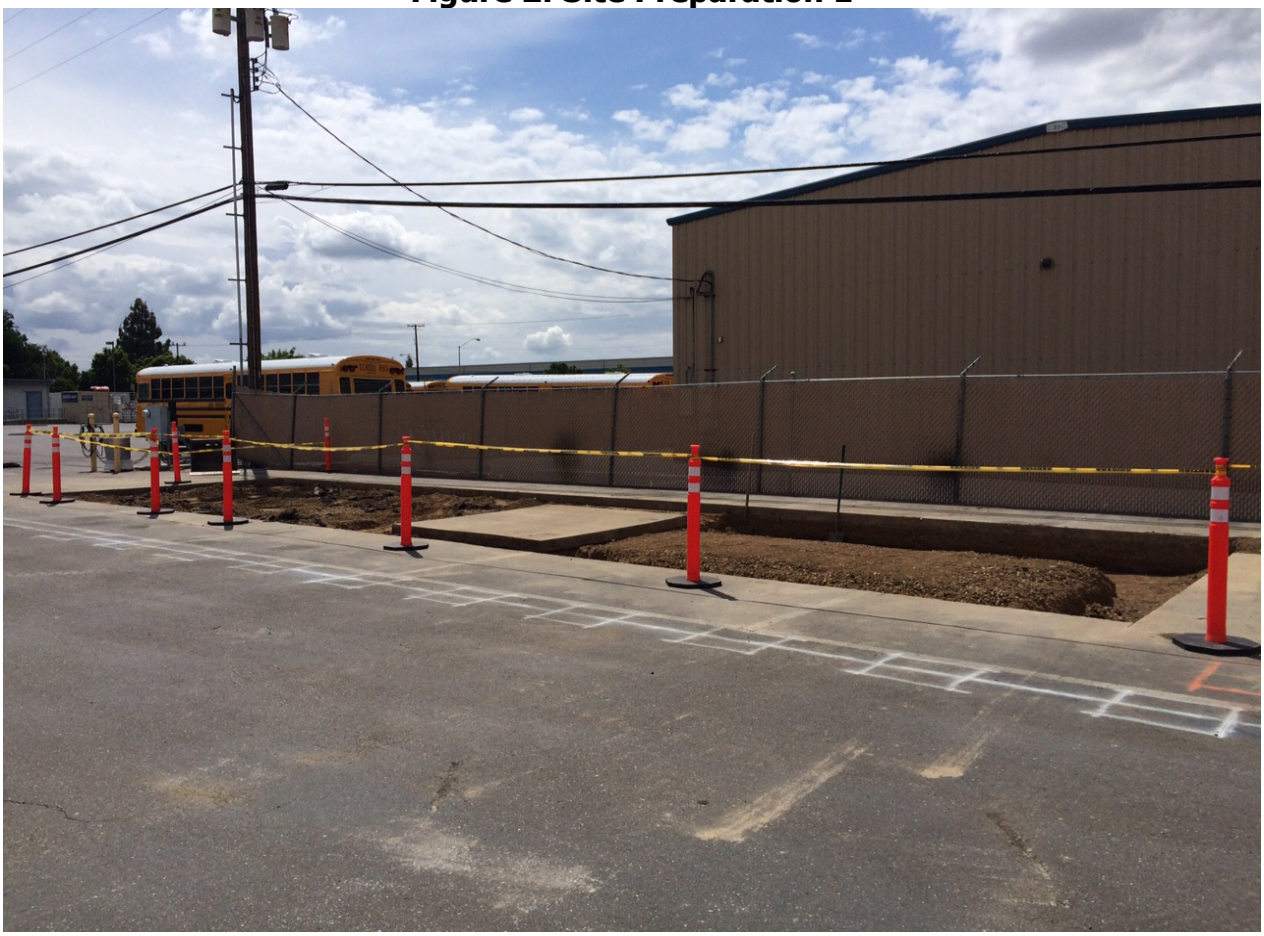
- Dual motor starter package 200 HP
- ANGI corporation CNG dryer (Model GD-036-S-M-460-150-4)
- ANGI corporation Series II fleet dispenser
- 28 ANGI corporation standard single hose post assemblies
- Electronic priority time-fill valve panel
- CP-400 communications panel
- CNG Defueling panel

Prepare Site

The goal of this task is to prepare the site for the new CNG fueling station.

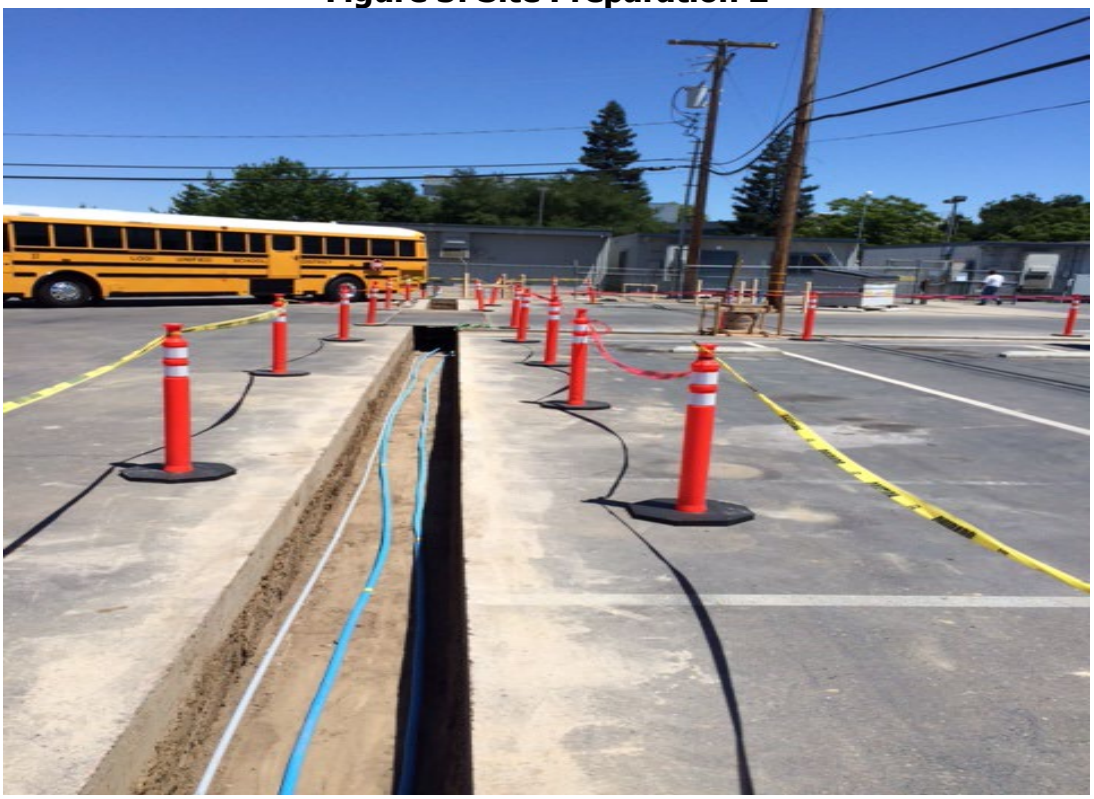
The approach for this task was to plan to prepare the site while bus activity would be low. The time frame was to do this while the majority of buses were out on their routes. Lodi Unified School District used the plans designed by T. Mitchell and Associates to ensure the site coincided with the designs. Figure 2–5 show the site preparation progress.

Figure 2: Site Preparation 1



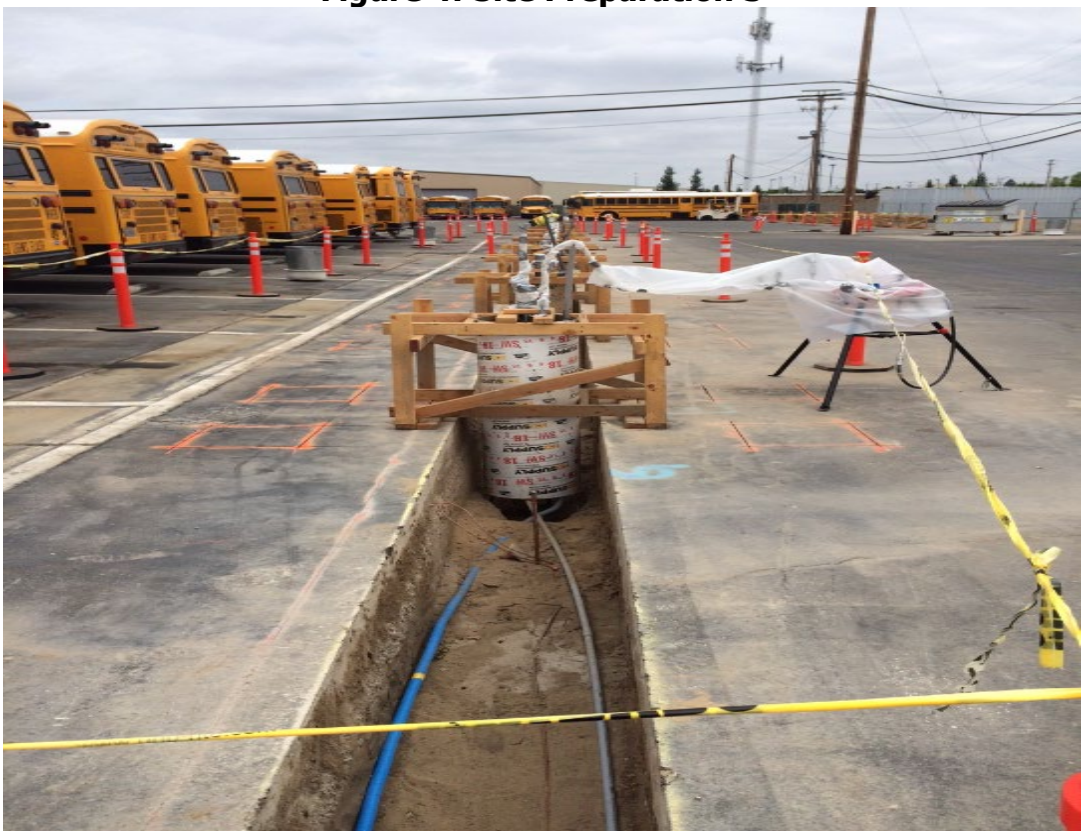
Source: Lodi Unified School District

Figure 3: Site Preparation 2



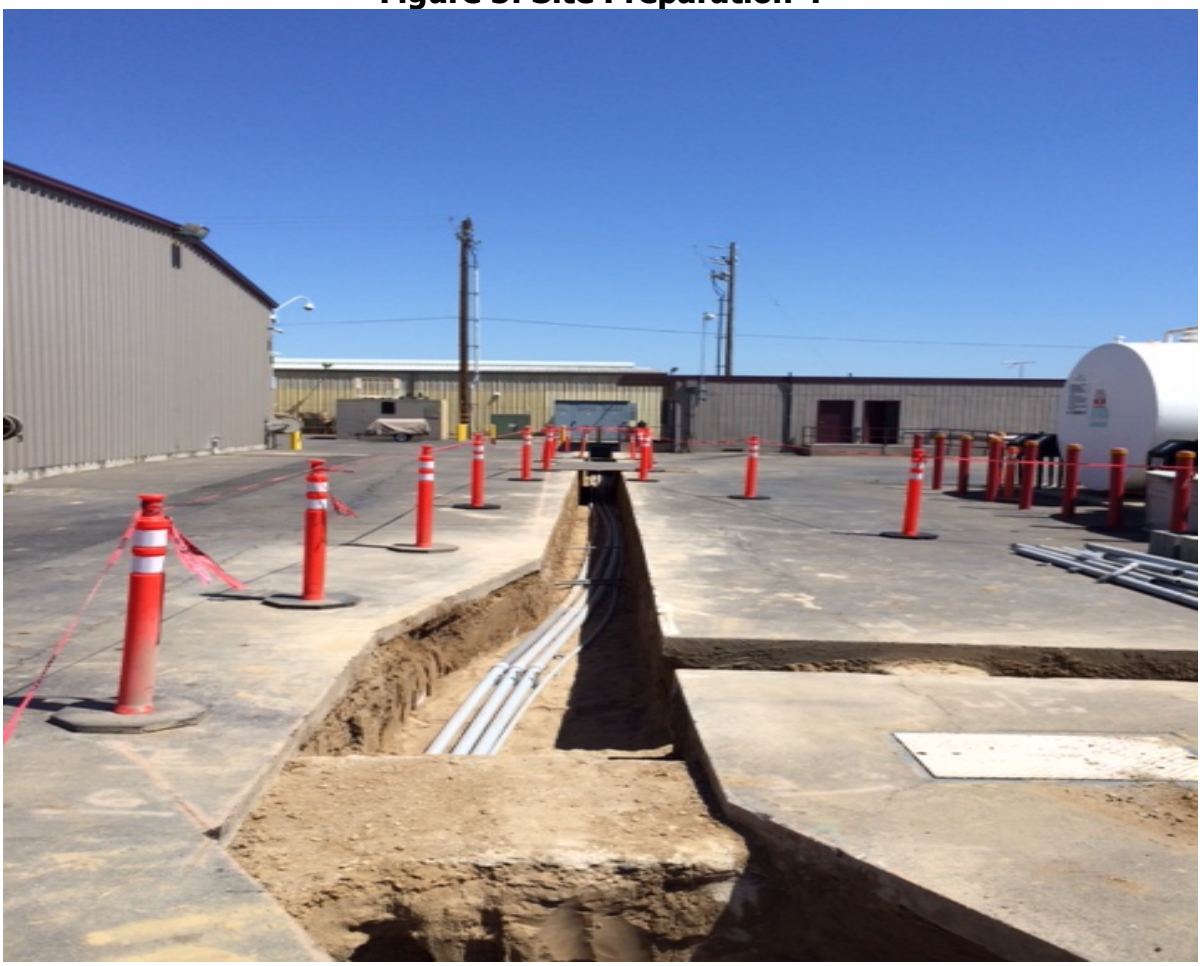
Source: Lodi Unified School District

Figure 4: Site Preparation 3



Source: Lodi Unified School District

Figure 5: Site Preparation 4



Source: Lodi Unified School District

Installation

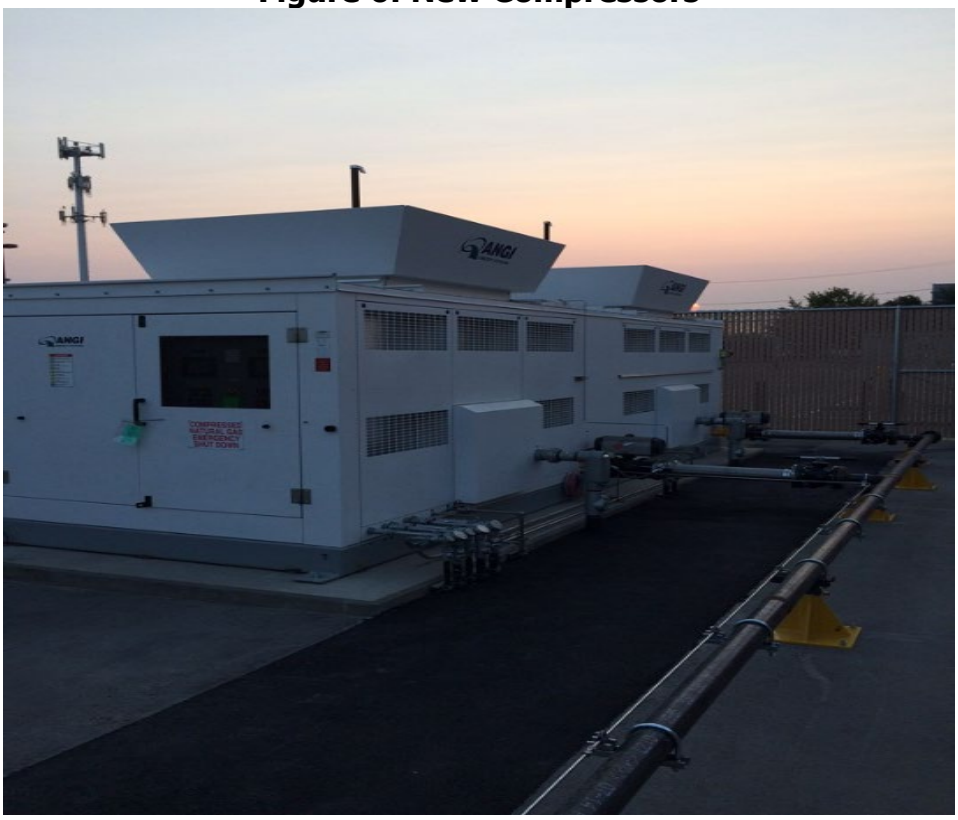
The goal of this task is to install the new CNG fueling station at the Lodi Unified School District Transportation Department.

The installation for the new equipment was scheduled during the time most buses were out of the areas needed to install equipment. The time during this process helped keep traffic to the lowest point. The following figures show the installed equipment.

The new CNG fueling station installed 25 single hose and 1 dual hose time-fill poles. The time-fill fueling poles are used to fuel the buses typically when not in use over a 5–14 hour period. The fueling dispensers automatically shut off when the buses are full. For safety precautions, the dispensers can also be manually stopped by an operator with manual shutoff valves installed at the dispensers. Portable fire extinguishers are also located near the dispensers if needed in case of emergency.

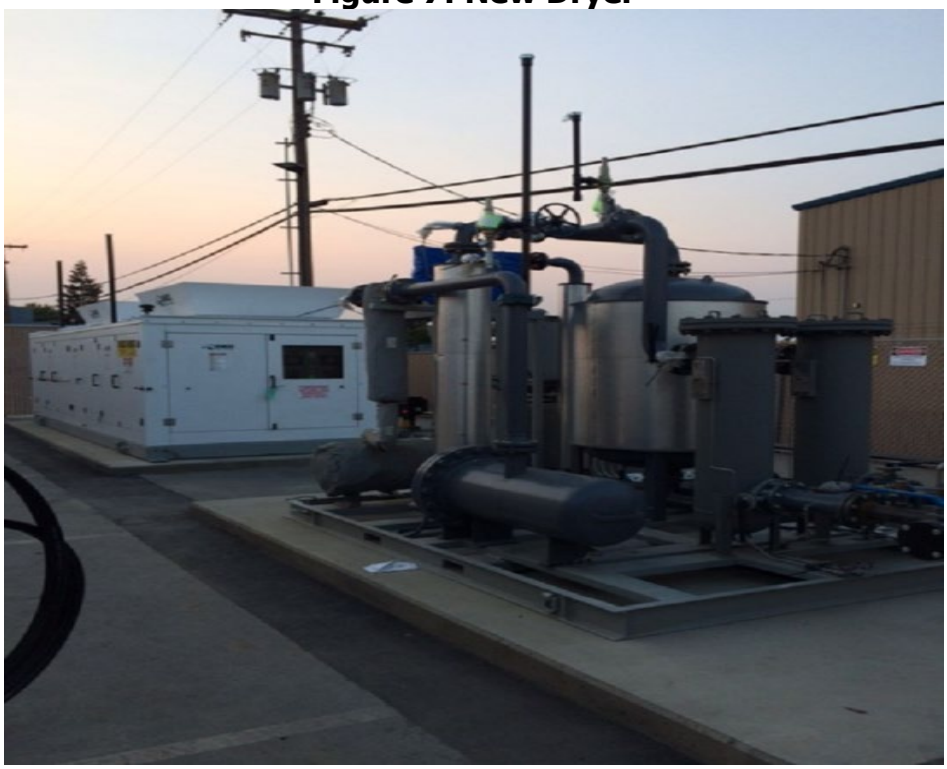
Bollards were also installed around the new fueling poles to provide protection. Figures 6–11 show other new installations.

Figure 6: New Compressors



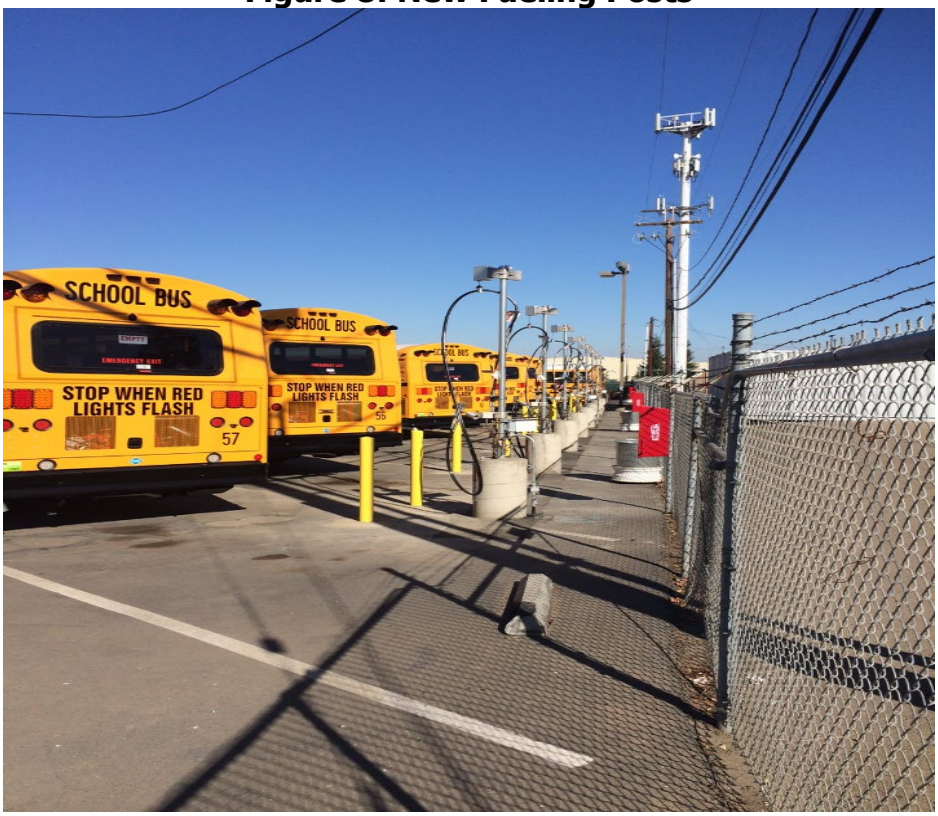
Source: Lodi Unified School District

Figure 7: New Dryer



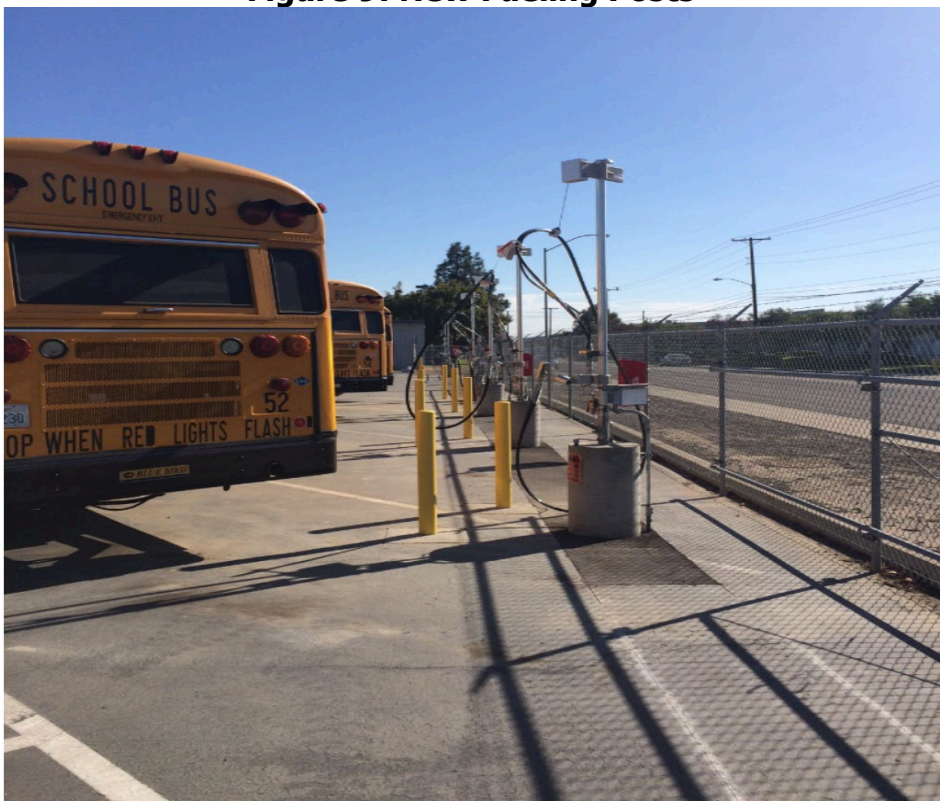
Source: Lodi Unified School District

Figure 8: New Fueling Posts



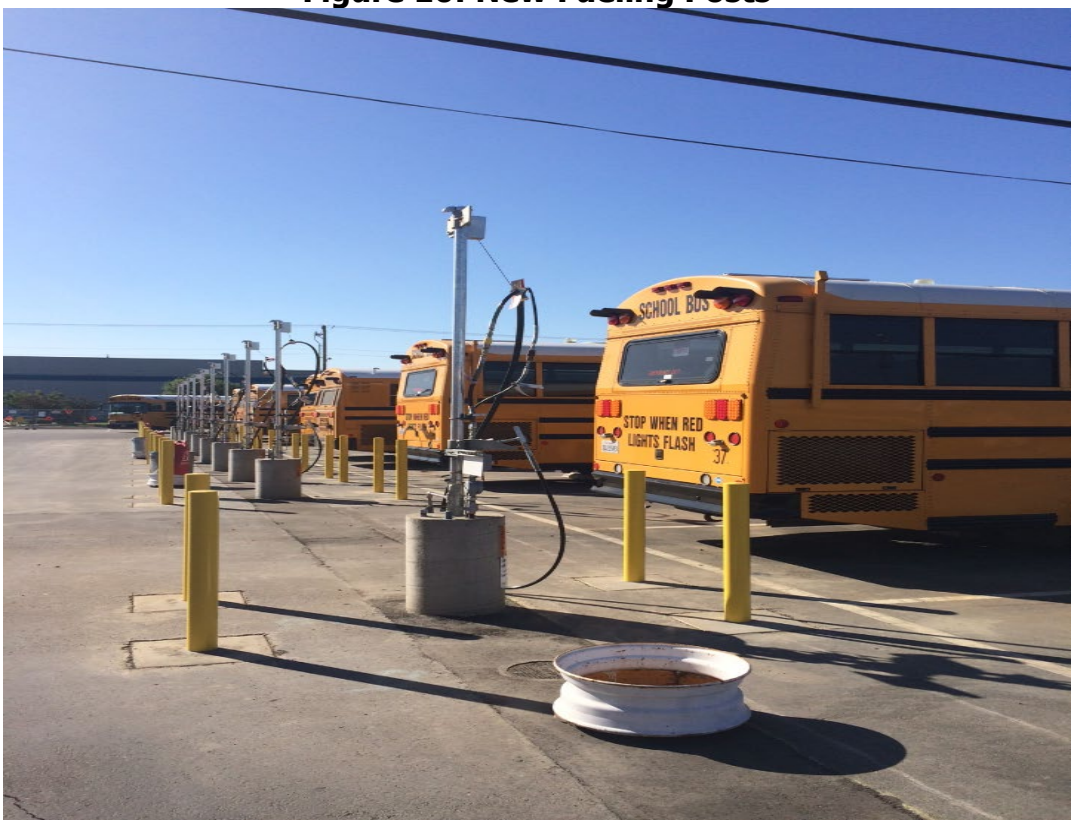
Source: Lodi Unified School District

Figure 9: New Fueling Posts



Source: Lodi Unified School District

Figure 10: New Fueling Posts



Source: Lodi Unified School District

Figure 11: New Fueling Posts

Source: Lodi Unified School District

Commissioning

The goal of this task is to commission the new fueling station.

After the final inspection of the new station, Transportation staff communicated with the company that supplied the equipment. An appointment was made to fly back a representative from the Angi Corporation, to test and run the equipment to ensure a smooth start up. After three (3) days of testing, the equipment ran smoothly. Lodi Unified then reported the start up to the City of Lodi to obtain a final inspection and the project was signed off by the City of Lodi.

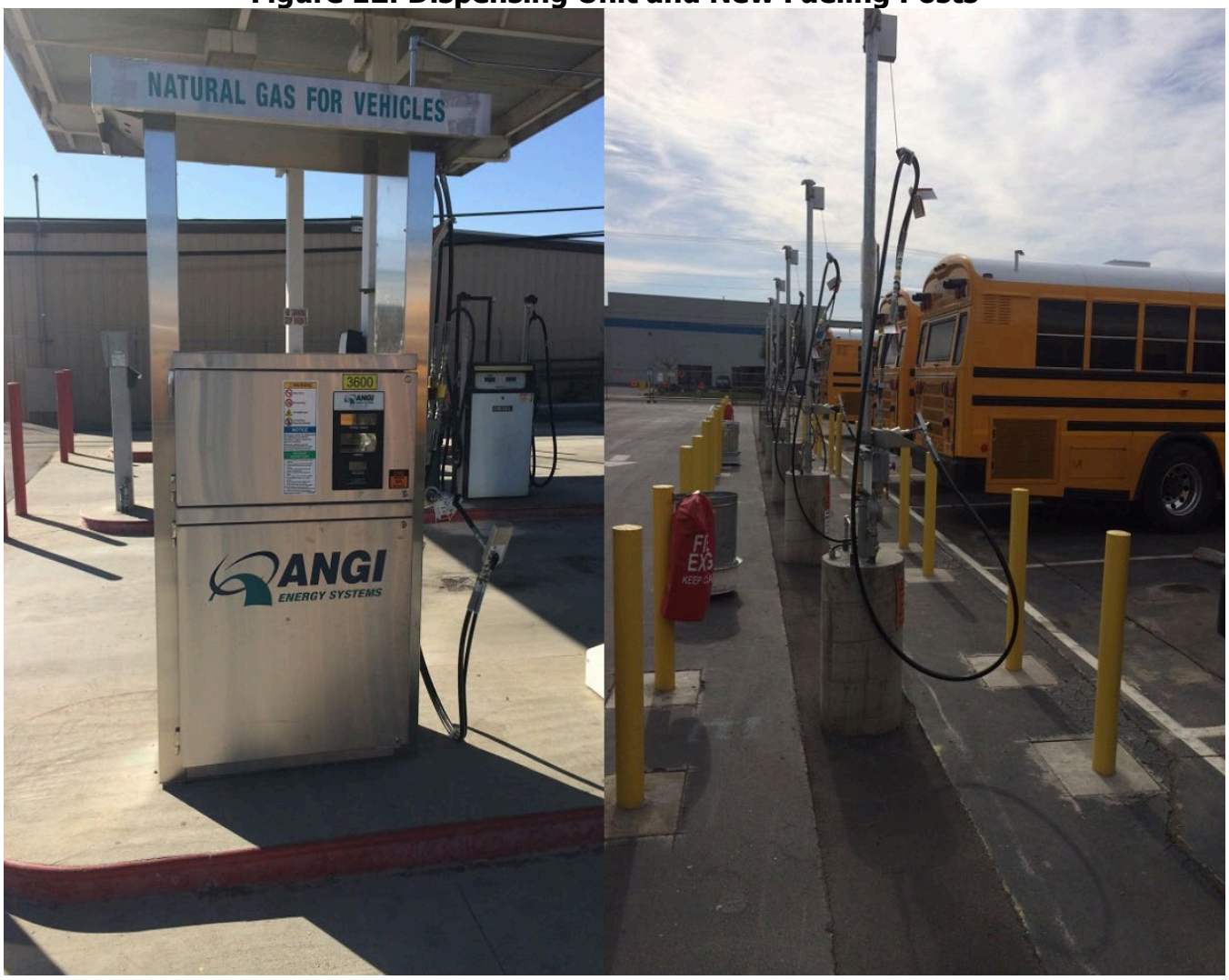
CHAPTER 3:
Project Results

Data Collection and Analysis

Data collection essentially began with the amount of therms delivered and traveling through the main natural gas meter that supplies gas to the compressors for the CNG fueling station. The number of therms per month is referenced directly from the Departmental School Project for Utility Rate Reduction monthly invoice. The total number of therms is then converted into manageable gallons of diesel equivalent.

Tracking the daily and monthly mileage of the CNG powered school buses and implementing the figures from the therms conversions, Lodi Unified School District staff calculated the number of gallons of diesel displaced by using natural gas. Below are images of these fueling stations used for bus fleet in Figure 12.

Figure 12: Dispensing Unit and New Fueling Posts



Source: Lodi Unified School District

Project Data

The goal of this task is to collect operational data from the project, to analyze that data for economic and environmental impacts. Example data is provided in Table 1 below.

Table 1: 6 Months Data Collection

	Oct 2015	Nov 2015	Dec 2015	Jan 2016	Feb 2016	Mar 2016
Therms/Month	24878	21590	17961	22550	22550	11000
Number of Non-District Vehicles Fueled per Month	0	0	0	0	0	0
Number of Type 1 Bus Fueled per Month	54	54	54	54	54	54
Number of Type 2 Bus Fueled per Month	0	0	0	0	0	0
Number of Days per Month Vehicles Were Fueled	20	19	14	19	19	13
Number of Days per Month station was inoperative	0	0	0	0	0	0
Maximum Capacity of the New Fueling System	393	393	393	393	393	393
Average Miles Traveled per Type 1 Bus by Odometer Reading	2000	2000	2000	2000	2000	2000
Average Miles Traveled per Type 2 Bus by Odometer Reading	0	0	0	0	0	0
Gallons of Gasoline and/or Diesel Fuel Displaced by Using Natural Gas (with Associated Mileage Information)	19902	17272	14368	18770	18770	9200

Source: Lodi Unified School District staff calculations

Analysis

- By replacing 27 diesel powered buses with an average of 2,400 gallons of fuel per year with CNG buses, Lodi Unified School District has displaced approximately 64,800 gallons of diesel fuel annually in respect to this project.
- The Lodi Unified School District has the ability now to continue to expand its CNG school bus fleet with the new CNG fueling station. There is enough natural gas being provided for future expansion.

- With respect to the performance of the new equipment, it has far exceeded Lodi Unified School District 's expectations regarding the efficiency of the fueling process. Lodi Unified School District has effectively doubled the number of CNG buses fueled on site but has also reduced by half the amount of time needed to fuel those buses. That, in turn, has resulted in less energy required to fuel the school bus fleet.

CHAPTER 4:
Conclusion

Since the completion of this CNG fueling station, Lodi Unified School District has seen a substantial reduction in the use of diesel fuel. The new fueling station has also enabled the district to use a fleet of buses fueled by CNG to run its transportation program. The new station is now part of a backup fueling station for those public entities that may experience problems fueling their CNG vehicles. It also now can help those traveling through the San Joaquin Valley that might need CNG fuel as they travel throughout California highways.

Moving forward, Lodi Unified School District will continue to maintain and operate the CNG fueling station and intends to continue using CNG as its main source of fuel for their existing fleet. Lodi Unified School District encourages other neighboring fleets to explore the use of natural gas vehicles over diesel vehicles to help improve the air quality in the San Joaquin Valley.

GLOSSARY

CALIFORNIA ENERGY COMMISSION (CEC)—The state agency established by the Warren-Alquist State Energy Resources Conservation and Development Act in 1974 (Public Resources Code, Sections 25000 et seq.) responsible for energy policy. The CEC's five major areas of responsibilities are:

1. Forecasting future statewide energy needs.
2. Licensing power plants sufficient to meet those needs.
3. Promoting energy conservation and efficiency measures.
4. Developing renewable and alternative energy resources, including providing assistance to develop clean transportation fuels.
5. Planning for and directing state response to energy emergencies.

Funding for the CEC's activities comes from the Energy Resources Program Account, Federal Petroleum Violation Escrow Account, and other sources.

COMPRESSED NATURAL GAS (CNG)—Natural gas that has been compressed under high pressure, typically between 2,000 and 3,600 pounds per square inch, held in a container. The gas expands when released for use as a fuel.