

300 LINE PROJECT

**FINAL
ENVIRONMENTAL REPORT**

RESOURCE REPORT NO. 11

RELIABILITY AND SAFETY

PUBLIC

Submitted by:

Tennessee Gas Pipeline Company
1001 Louisiana Street
Houston, Texas 77002

JULY 2009

RESOURCE REPORT 11 – RELIABILITY AND SAFETY

SUMMARY OF FILING INFORMATION

INFORMATION	FOUND IN
Describe how the Project facilities would be designed, constructed, operated and maintained to minimize potential hazard to the public from the failure of Project components as a result of accidents or natural catastrophes.(§ 380.12 (m)).	11.1; 11.2

TABLE OF CONTENTS

11.0	INTRODUCTION	1
11.1	RELIABILITY AND SAFETY OF TENNESSEE’S 300 LINE PROJECT	1
11.1.1	System Overview	1
11.2	SPECIFIC MEASURES TO PROTECT THE PUBLIC	2
11.2.1	Pipeline Design Specifications.....	2
11.2.2	Odorant	8
11.2.3	Corrosion Protection	8
11.2.4	Inspection Equipment	9
11.2.5	System Monitoring Equipment	9
11.2.6	Restricted Access at Aboveground Facility Locations	10
11.2.7	Procedures for Operations, Maintenance, and Emergency Response	10
11.2.8	Field Patrols/Leak Detection Surveys.....	11
11.2.9	Liaison Procedures with Local Authorities.....	11
11.2.10	Emergency Plan	11
11.2.11	Aboveground Facility Design Specifications.....	12
11.3	NATURAL GAS PIPELINE INDUSTRY SAFETY OVERVIEW	13
11.3.1	Gas Transmission Pipeline Incident Data for 1990 to 2004.....	14
11.3.2	Incident Data on 20-Inch to 28-Inch Gas Transmission Pipelines.....	14
11.3.3	Pipeline Incidents Relative to Other Modes of Transportation.....	15
11.4	SUMMARY	15
11.5	REFERENCES	16

LIST OF TABLES

11.2-1	Class Locations For The 300 Line Project Pipeline Facilities	4
11.2-2	High Consequence Areas For The 300 Line Project Pipeline Facilities	7
11.3-1	Transmission Pipeline Incidents Between 1990 And 2004 (U.S).. Error! Bookmark not defined.	
11.3-2	Incident Data by Decade of Installation for 20- to 28-Inch Gas Transmission Systems, 1985 Through 1997	Error! Bookmark not defined.
11.3-3	Nationwide Accidental Deaths	15

11.0 INTRODUCTION

Resource Report 11 addresses the reliability and safety aspects associated with the proposed Tennessee 300 Line Project (“Project”). Section 11.1 of this Resource Report identifies the reliability and safety of Tennessee’s existing system and the proposed Project. The procedures and design features to ensure operational reliability and safety are detailed in Section 11.2. A discussion of the key safety considerations associated with the Project is presented in Section 11.3. The material in Section 11.3 also provides a perspective of Tennessee’s operating experience with respect to safety and reliability compared to industry-wide operational data. Section 11.4 summarizes the major causes of pipeline incidents and explains how Tennessee’s proposed Project incorporates the best available measures to minimize the potential for incidents to occur. Section 11.5 provides the references used in the preparation of this resource report.

The analysis in this resource report is based on the design, operation, and maintenance of the existing Tennessee facilities with respect to the applicable regulations, historical trends, natural gas transmission line incidents, and other related data.

11.1 RELIABILITY AND SAFETY OF TENNESSEE’S 300 LINE PROJECT

The proposed Project, including the proposed pipeline loops and all aboveground facilities, have been designed and will be constructed, operated, and maintained to meet the requirements of the U.S. Department of Transportation (“DOT”) “Transportation of Natural Gas or Other Gas by Pipeline; Minimum Federal Safety Standards” in Title 49 CFR Part 192.

11.1.1 System Overview

Tennessee’s existing pipeline infrastructure consists of approximately 13,400 miles of pipeline designated as the 100, 200, 300, 500, and 800 Lines based on the region served by the pipeline. The proposed Project involves the existing 300 Line, which consists of a 24-inch diameter pipeline which starts at the discharge of Compressor Station 219 in Mercer County, Pennsylvania, travels east through Pennsylvania, New Jersey, New York, Connecticut, and ends at the discharge of Compressor Station 261 in Hampden County, Massachusetts. Tennessee’s system interconnects with many facilities along its route, including other interstate natural gas pipeline systems and local natural gas distributors throughout New York and New England.

Natural gas transmission facilities, such as Tennessee’s pipeline system, that are designed and maintained in accordance with DOT regulations and industry standards have an excellent record of public safety and reliability. For the Project, Tennessee will employ the same system design, construction, operation and maintenance practices that it currently uses for its existing pipeline system in order to maintain this excellent record. For transmission systems and compressor stations in general, empirical information illustrates an extremely low potential for public hazard from incidents associated with the operation of interstate natural gas facilities such as the proposed Project facilities (see Section 11.3 below for a safety overview of the natural gas pipeline industry).

11.2 SPECIFIC MEASURES TO PROTECT THE PUBLIC

The proposed Project facilities will be designed, constructed, operated, and maintained in accordance with the DOT federal safety standards, 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public from natural gas pipeline failures. Part 192 specifies material selection and qualification, design requirements, and protection from internal, external, and atmospheric corrosion.

Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic, but is classified as a simple asphyxiant, possessing only an inhalation hazard. As with all gases, if inhaled in high enough concentration, oxygen deficiency could occur and result in suffocation. Given the unconfined, outdoor conditions of the pipeline right-of-way for the Project's pipeline facilities, asphyxiation from a pipeline leak is improbable.

The greatest hazard of a natural gas transmission line is a major pipeline leak or pipeline rupture that results in a fire or explosion. Methane has an auto-ignition temperature of 1,000 degrees Fahrenheit and is flammable at concentrations between 5 to 15 percent in air. Unconfined mixtures of methane in air are not explosive. However, a flammable concentration within an enclosed space in the presence of an ignition source can result in a potential hazard. The specific gravity of methane, normalized to air at standard temperature and pressure, is 0.58; therefore, being lighter than air, methane has the tendency to rise and dissipate into the atmosphere.

The following information addresses how Tennessee proposes to design, operate, and maintain the proposed Project pipeline facilities in accordance with DOT requirements to ensure safe and reliable operation, consistent with Tennessee's existing transmission system.

11.2.1 PIPELINE DESIGN SPECIFICATIONS

Tennessee's pipeline system includes many pipeline design and equipment features, in addition to routine inspection and maintenance programs, that are designed to increase the overall safety of the system and protect the public from any system failures due to operations, incidents or natural catastrophes. These features and programs are also applicable to proposed pipeline facilities. The pipeline design incorporates the use of high strength micro-alloyed steel pipe, which has extremely good fracture toughness. This increases resistance to pipe deformation and penetration by excavating equipment, optimizes leak-before-break characteristics in the event of penetration, and prevents the initiation and propagation of pipeline ruptures by providing self-arrest of the rupture. Resistance to damage will be further augmented by using mainline pipe with a heavy wall thickness as described below.

Part 192.5 of the DOT Regulations defines pipeline class locations based on population density in the vicinity of a pipeline. More rigorous safety requirements are applicable for populated areas. The class location unit is an area that extends 220 yards on either side of the centerline of any continuous one-mile length of pipeline. The four class locations are generally defined as:

Class 1: Location with 10 or fewer buildings intended for human occupancy or is an offshore area.

Class 2: Location with more than 10 but less than 46 buildings intended for human occupancy.

Class 3: Location with 46 or more buildings intended for human occupancy, is within 100 yards of any building, or has a small, well-defined outside area occupied by 20 or more people during normal use, such as playground.

Class 4: Location with buildings of four or more stories aboveground is prevalent.

The current class locations along the pipeline corridor for the proposed loops are detailed in Table 11.2-1 below. In addition, the areas that are currently High Consequence Areas (“HCAs”) as defined in 49 CFR Part 192 for the proposed pipeline loops is included in Table 11.2-2. The HCAs are based upon the current mainline pipe diameter and maximum allowable operating pressure (“MAOP”).

As noted above, class locations representing more populated areas require higher safety factors for pipeline design, testing, and operation. In accordance with the Section 192.327 49 CFR Part 192, pipelines constructed in Class 1 locations must be installed with a minimum depth of cover of 30 inches in normal soil, and 18 inches in consolidated rock. Class 2, 3, and 4 locations, as well as drainage ditches of public roads and railroad crossings, require 36 inches in normal soil and 24 inches in consolidated rock. Onshore class locations (Section 192.179, 49 CFR Part 192) also specify the maximum distance from any point along the pipeline to sectionalizing block valve: 10 miles in Class 1, 7.5 miles in Class 2, 4 miles in Class 3, and 2.5 miles in Class 4. Pipeline design pressures, hydrostatic test pressures, MAOP, inspection and weld testing, and frequency of pipeline patrols and leak surveys must also conform to higher standards in more populated areas.

For the Project’s pipeline facilities, Tennessee is proposing a typical buried pipeline depth of at least three feet. A discussion of the burial depth and valve site locations is provided in Resource Report 1 of this ER Description). Tennessee anticipates the use of, API-5L DSAW, Grade X70 line pipe for the looping sections. Wall thicknesses will be sized based on class locations and other required design factors. The MAOP of the existing 300 Line and new loop pipeline facilities varies from 844 to 1,170 pounds-per-square-inch-gauge (“psig”). Normal operating pressures for the existing 300 Line varies from 700 to 1,000 psig.

TABLE 11.2-1 CLASS LOCATIONS FOR THE 300 LINE PROJECT PIPELINE FACILITIES			
Facility	Enter Milepost	End Milepost	Class
Loop 313	0.00	16.68	1
Loop 315	0.00	5.09	1
	5.09	6.3	2
	6.3	8.95	1
	8.95	9.80	2
	9.80	13.92	1
	13.92	15.27	2
	15.27	16.84	1
Loop 317	0.00	14.15	1
	14.15	15.26	2
	15.26	15.63	1
	15.63	16.18	2
	16.18	22.32	1
Loop 318	0.00	1.13	1
Loop 319	0.00	5.88	1
	5.88	6.39	2
	6.39	6.41	1
	6.41	7.17	2
	7.17	16.58	1

**TABLE 11.2-1
CLASS LOCATIONS FOR THE 300 LINE PROJECT
PIPELINE FACILITIES**

Facility	Enter Milepost	End Milepost	Class
Loop 321	0.00	2.65	1
	2.65	3.00	2
	3.00	3.35	1
	3.35	3.70	2
	3.70	7.44	1
	7.44	8.15	2
	8.15	11.07	1
	11.07	11.64	2
	11.64	11.80	1
	11.80	12.47	2
	12.47	14.02	1
	14.02	14.60	2
	14.60	14.94	1
	14.94	17.73	2
	17.73	17.89	1
	17.89	18.35	2
	18.35	18.43	1
	18.43	18.95	2
	18.95	21.03	1
	21.03	22.09	2

TABLE 11.2-1 CLASS LOCATIONS FOR THE 300 LINE PROJECT PIPELINE FACILITIES			
Facility	Enter Milepost	End Milepost	Class
Loop 323	0.00	0.07	1
	0.07	0.81	2
	0.81	0.99	1
	0.99	1.59	2
	1.59	9.51	1
	9.51	10.05	2
	10.05	10.32	1
	10.32	10.68	2
	10.68	11.17	1
	11.17	12.26	2
	12.26	14.79	1
Loop 325	0.00	0.41	2
	0.41	1.55	1
	1.55	2.73	3
	2.73	2.79	1
	2.79	3.58	3
	3.58	3.90	1
	3.90	4.52	3
	4.52	5.73	1
	5.73	5.84	2
	5.84	6.37	3

TABLE 11.2-1 CLASS LOCATIONS FOR THE 300 LINE PROJECT PIPELINE FACILITIES			
Facility	Enter Milepost	End Milepost	Class
Loop 325	6.37	7.43	1
	7.43	7.90	2
	7.90	12.80	1
	12.80	14.46	3
	14.46	14.62	2
	14.62	16.59	1
	16.59	16.81	2
	16.81	16.89	3
	16.89	17.00	2

TABLE 11.2-2 HIGH CONSEQUENCE AREAS FOR THE 300 LINE PROJECT PIPELINE FACILITIES				
Facility	Enter Milepost	End Milepost	HCA^a	PIR^b
Loop 315	8.91	9.51	Identified Site	708.05 ft
Loop 317	14.79	15.51	Identified Site	708.05 ft
Loop 321	16.95	17.37	Identified Site	708.05 ft
	21.51	21.90	Identified Site	708.05 ft
Loop 325	1.30	2.15	20+ Structures	708.05 ft
	2.30	3.71	Combination	708.05 ft
	3.89	4.57	Combination	708.05 ft

**TABLE 11.2-2
HIGH CONSEQUENCE AREAS FOR THE 300 LINE PROJECT
PIPELINE FACILITIES**

Facility	Enter Milepost	End Milepost	HCA ^a	PIR ^b
	5.79	6.39	20+ Structures	708.05 ft
	12.86	14.05	Combination	708.05 ft
	16.58	17.01	Identified Site	708.05 ft

a – HCA = High Consequence Area

b – PIR = Potential Impact Radius

Each sectionizing block valve for the Project’s pipeline facilities will contain a means to vent, or blowdown, the contents of the pipeline to decrease the internal pressure of the pipeline in an emergency situation. These blowdown vents will typically consist of vertical riser piping on each side of the block valve, containing manually operated vent valves. Existing mainline valves can be operated remotely via telecommunications or satellite technology to aid in isolating loop sections. In addition, the taps off the mainline for the looping sections will have manually operated block valves with manually operated vent valves to provide additional isolation and venting capabilities of the loop sections.

11.2.2 Odorant

In accordance with Section 192.625, 49 CFR Part 192, natural gas transported by Tennessee’s mainline system is currently odorized. For the 300 Line, odorant is injected at Tennessee’s Compressor Station 321 located in Uniondale, Pennsylvania. All pipeline facilities located downstream of the Compressor Station 321 are odorized in accordance with this requirement as well. Tennessee does not currently propose to install any additional odorant injection facilities as part of the Project. Readings of odorant levels are taken periodically at various points along the existing pipeline system to ensure compliance with the DOT requirement, and this will continue following construction of the Project facilities.

11.2.3 Corrosion Protection

Section 192.451, 49 CFR Part 192 prescribes minimum requirements for the protection of metallic pipelines from external, internal, and atmospheric corrosion. Tennessee’s current pipeline system complies with this requirement. For this Project, this requirement will be accomplished by externally coating the pipeline with a fusion bond epoxy coating system, which has an outstanding record for preventing external corrosion. The effectiveness of this coating is augmented by a cathodic protection system to be installed along the new pipeline loops. Cathodic protection prevents corrosion of pipeline facilities by providing DC electrical current flow to the pipeline. This offsets the natural soil, groundwater or salt water corrosion potential that can degrade the integrity of the pipe. Coating and cathodic protection are an integral part of ensuring the structural integrity of Tennessee’s existing transmission system, as will be the case for the Project’s pipeline facilities. Tennessee’s cathodic protection system is inspected at regular intervals to ensure proper operating conditions consistent with DOT requirements for corrosion mitigation. For the Project facilities, Tennessee will augment or replace existing systems to provide cathodic protection. See Resource Report 1 of this ER for additional information on proposed cathodic protection facilities.

11.2.4 Inspection Equipment

Tennessee's existing pipeline system incorporates launchers and receivers to accommodate the passage of internal inspection tools. Periodic inspections of the pipeline using these inspection tools are part of the Tennessee maintenance activities to detect damage and/or corrosion in the pipeline allowing for remedial action to be undertaken. The new pipeline loop segments will incorporate internal inspection facilities as well.

11.2.5 System Monitoring Equipment

Tennessee's gas control center is maintained in Houston, Texas. The center monitors system pressures, flows, and customer deliveries 24 hours a day, 365 days a year. Tennessee also operates area offices along its pipeline route, which allow Tennessee's personnel to provide quick response to any emergency situations and to direct safety operations as necessary. Additionally, Tennessee maintains a backup location for gas control operations in the event the primary location is placed out of service.

Tennessee's Supervisory Control and Data Acquisition ("SCADA") system is an essential component of its gas control center. Data collection, monitoring, and control of Tennessee's compressor, meter stations, and mainline block valves are accomplished by the SCADA system. If operating conditions fall outside predetermined ranges, alarms are activated at the Tennessee's gas control center to enable a timely diagnosis and mitigation of the alarm condition. The current mainline block valves on the Tennessee system can be operated remotely from the Gas Control Center as well as manually at the field locations.

In the event of emergency shutdowns and alarms for Tennessee's pipeline facilities, including the facilities to be added as part of the Project, emergency procedures currently contained in the El Paso Pipeline Group Emergency Operating Procedures Manual ("EOP")¹ would be utilized. Local contact phone numbers, external contact information, equipment or resources available for mobilization, and any specific procedures to be followed for the Project facilities will be incorporated into the EOP prior to commencement of pipeline operations through the Project facilities.

The manual also contains procedures for responding to, investigating, and correcting the cause of unintended valve closures or shutdowns, changes in pressure or flow outside normal operating limits, loss of communication, operation of safety devices, and any foreseeable malfunction of a component, deviation from normal operation, or personnel error which may result in hazard to people or property. These procedures are applicable to Tennessee's existing system and will be applicable to the Project facilities.

As for existing facilities, remote monitoring and control of the Project facilities will be conducted by Tennessee's gas control group in conjunction with Field Operations. The Gas Control group will remotely monitor pressure, flow, and other critical operating data, and will control critical station control functions to achieve specified flow and pressure set points for the Project facilities.

¹ Tennessee is a subsidiary of El Paso Corporation ("El Paso") and is a member of El Paso's pipeline group.

11.2.6 Restricted Access at Aboveground Facility Locations

The Project involves the construction of several aboveground facilities, including two new compressor stations, and modifications to existing compressor stations. In a similar manner to the existing compressor stations, the two new compressor stations locations will be securely fenced to prevent unauthorized access to the facilities.

11.2.7 Procedures for Operations, Maintenance, and Emergency Response

As discussed above, the EOP will be implemented for the Project facilities. Among other things, the EOP describes how to identify and classify notices of events requiring immediate response, such as gas detected inside or near a building, fire or explosion located near or involving a pipeline facility, or natural disaster. Local contact phone numbers, external contact information, equipment or resources available for mobilization, and any specific procedures to be followed for the Project facilities will be incorporated into the EOP manual prior to commencement of pipeline operations through the Project facilities.

Any potential hazards will be minimized by emergency shutdown and pressure restriction in any necessary section of pipeline. After any such shutdown or pressure restriction, any service outage will be safely restored. The actions are required by the DOT's regulations at Sections 192.615 and 617, 49 CFR Part 192.

Field operations in the applicable area will establish and maintain liaison with appropriate fire, police, and public officials in a variety of ways. Annual communications will include the following information:

- The potential hazards associated with Tennessee's facilities located in their service area and prevention measures undertaken.
- The types of emergencies may occur on those facilities.
- The purpose of pipeline markers and the information contained on such markers.
- Pipeline location information and the availability of the National Pipeline Mapping System.
- How to recognize and respond to pipeline emergencies.
- How to contact the Tennessee for additional information.

These annual communications may involve individual meetings with agency personnel, group meetings or direct mailings. In addition, periodic table top emergency exercises and mock emergency drills will be performed. Agencies are and will be encouraged to participate in these activities as well. Tennessee personnel are and will continue to be aware of the responsibility of each government organization responding to a pipeline emergency, and the officials are and will continue to be acquainted with Tennessee's ability to respond to a pipeline emergency.

Coordination of mutual response will be accomplished through the use of the Incident Command System ("ICS"). This system is utilized by all emergency responders. Tennessee personnel have been and will continue to be trained on this system and understand their roles and responsibilities within the ICS structure. Following any emergency situation, Tennessee personnel actions in an emergency will be reviewed to determine if procedures were effectively followed.

11.2.8 Field Patrols/Leak Detection Surveys

The Project's pipeline facilities, similar to Tennessee's existing pipeline system, will be marked aboveground to indicate the presence of the pipeline, as required by 49 CFR Part 192. Regular patrols of the pipeline facilities are performed to monitor and control encroachment by third parties. Any unusual situation or condition is reported and investigated immediately. Additionally, Tennessee performs periodic leak detection surveys in accordance with DOT regulations. The facilities constructed by Tennessee as described in this docket will have similar field survey procedures. Tennessee will follow similar field survey procedures for the Project's pipeline facilities

Tennessee is a member of the one-call system for pre-excavation notification in Pennsylvania and New Jersey. Through these organizations, contractors provide notification to a central agency of proposed excavation, and Tennessee is then informed of the excavation locations. In the event that Tennessee's facilities are located in the area of proposed excavation activity, a representative of Tennessee is dispatched to mark the area, consult with the excavator as needed, and witness the excavation as necessary to prevent damage to the pipeline. Tennessee educates the public on use of the one-call notification system prior to excavation and other damage prevention activities, possible hazards associated with unintended releases from a pipeline facility, physical indications that such a release may have occurred, steps that should be taken for public safety in the event of a pipeline release and procedures to report such an event. All of these efforts will continue following the construction of the Project facilities.

11.2.9 Liaison Procedures with Local Authorities

Liaison with fire, police, public officials, and local utilities is maintained along the pipeline system, and will continue following construction of the Project facilities. Key components of the liaison program include:

- Periodic visits with emergency agencies to inform them of the Tennessee facilities and to coordinate emergency response in the event of an incident.
- Special information meetings and training at the invitation of the municipalities.
- Circulation of literature listing emergency telephone numbers and other pertinent data.

11.2.10 Emergency Plan

Under Section 192.615 of the DOT regulations at 49 CFR Part 192., each pipeline operator must establish an Emergency Plan that provides written procedures to minimize the hazards from a gas pipeline emergency. Key elements of this plan include procedures for:

1. Receiving, identifying, and classifying emergency events--gas leakage, fires, explosions, and natural disasters.
2. Establishing and maintaining communications with local fire, police, and public officials, and coordinating emergency response.
3. Making personnel, equipment, tools, and materials available at the scene of an emergency.
4. Protecting people first and then property from actual or potential hazards.
5. Emergency shutdown of system and the safe restoration of service.

Each pipeline operator must establish and maintain liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a gas pipeline emergency, and coordinate mutual assistance in responding to emergencies. The pipeline operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to appropriate public officials.

11.2.11 Aboveground Facility Design Specifications

In addition to the measures described above for the pipeline facilities, the following information addresses how Tennessee proposes to design, operate, and maintain the proposed Project aboveground facilities in accordance with DOT requirements to ensure safe and reliable operation, consistent with Tennessee's existing transmission system.

The proposed Compressor Stations 303 and 310 will be designed, constructed, and operated using the same or similar techniques that were applied to successfully design, construct, and operate Tennessee's existing compressor stations along the existing 300 Line system. Similar features of the existing stations will be incorporated into the compressor stations design so that the safety and reliability of the new stations will be equivalent to that of the existing stations. These features include station material selection, a high degree of equipment monitoring, unit/station shutdown protection, and a number of "fail-safe" systems. In the event that an emergency requires depressurization of the piping to and within a compressor station, the venting of the gas would take approximately five to ten minutes.

The two new compressor stations will be designed and constructed to meet the safety standards established by the DOT in its regulations at 49 CFR Part 192. These regulations are intended to ensure adequate protection for the public from natural gas pipeline and compressor facilities. Minimum standards are established for:

- Materials selection
- System design
- Welding and joining components
- Construction
- Corrosion control
- Testing
- Inspection
- Maintenance
- Personnel qualifications
- Pipeline integrity management

Station and unit control computers will monitor the essential functions of the turbo compressor and will trigger an appropriate sequence of remedial actions if an upset condition is detected. If the compressor station computers detect an alarm condition, appropriate action within the station controls will be commenced automatically. The piping system at the new compressor stations will meet the DOT requirements of 49 CFR Part 192. Tennessee's pipeline is already designed to safely handle the additional gas volumes that would be transported through the system by the additional compressor units.

The compressor packages will be centrifugal compressors driven by natural gas-fueled turbines. This offers the advantage of reduced vibration and pulsation effects, and thus vibration and fatigue induced failures compared with reciprocating engines and compressor units. The turbo compressor packages are proposed to incorporate dry gas seal systems, which eliminate the high pressure seal oil system, and thus some points of potential failure. The turbo compressor packages, including the turbine engines and gas compressors, will be enclosed within non skid enclosures that provide turbine lube oil containment.

The proposed compressor stations will be equipped with a full range of automatic emergency detection and shut down systems. The new compressor stations will have a hazardous gas and fire detection alarm system, a compressor unit enclosure fire suppression system, and emergency equipment shut down system. These safety and emergency systems will be monitored 24 hours a day by Tennessee's SCADA system and the local control systems.

Standard fire protection, first aid, and safety equipment will be maintained at the two compressor stations, and station maintenance personnel will be trained in proper equipment use and in first aid. The fire-fighting equipment that is maintained on-site includes dry chemical fire extinguishers. Tennessee also will coordinate with the local emergency response services concerning the equipment at the station.

11.2.11.1 System Monitoring Equipment

The two proposed compressor stations will be designed for unattended operation and self-monitoring and will include a communications and monitoring system which will be designed to ensure a response in the event that a mechanical problem or a potentially unsafe condition is detected. These facilities will be monitored by Tennessee's gas control center in Houston, Texas 24 hours a day, 365 days a year. In addition, systems data will be collected in Tennessee's SCADA System.

The compressor stations' primary communications system will be via wide area network ("WAN"). In the event a WAN communication outage occurs, the communications system will revert to the satellite secondary backup system or tertiary dial modem. In the event of an AC power loss at the station, a natural gas fired back-up generator automatically will come on line and provide station power until commercial power service is restored. A battery system will provide DC power for essential equipment during the interim outage period.

11.2.11.2 Emergency Shut-Down System

49 CFR Part 192 specifies that each compressor station must have an emergency shut-down system that can be manually operated from at least two points. In addition to a higher number of manual shutdown points, Tennessee existing stations have a number of turbo compressor and building monitoring systems that will initiate a shutdown automatically. The turbo compressor enclosure will also be equipped with fire, heat and gas detection systems.

11.3 NATURAL GAS PIPELINE INDUSTRY SAFETY OVERVIEW

The following information provides a perspective of Tennessee's experience with respect to safety and reliability compared to industry-wide operational data. The information presented also helps to define the key industry-related safety issues and its relevance to the Project.

11.3.1 Gas Transmission Pipeline Incident Data for 1990 to 2004

Since 1970, all operators of transmission and gathering systems under the jurisdiction of the DOT have been required to report pipeline incidents to the Pipeline and Hazardous Materials Safety Administration (“PHMSA”) Office of Pipeline Safety (“OPS”). The OPS is the federal safety authority for the nation's 2.3 million miles of natural gas and hazardous liquid pipelines. The DOT changed reporting requirements after June 1984 to gather more comprehensive information, including property damage in excess of \$50,000, injury resulting in hospitalization, death, or other incidents that are otherwise considered significant by the operator resulting from a release of gas. This comprehensive data has been used to review all pipeline incidents for the 15-year period between 1990 and 2004. During this 15-year period, 1,284 incidents have occurred on approximately 325,220 miles of natural gas transmission and gathering pipelines within DOT jurisdiction. Based on this data, the number of incidents per mile-year calculates to 2.54×10^{-4} incidents/mile-year.

11.3.2 Incident Data on 20-Inch to 28-Inch Gas Transmission Pipelines

Kiefner et al. (1999) studied incident data between 1985 and 1997 of pipeline systems between 20 and 28 inches in diameter. In Table 11.3-2, these incidents are classified into 22 distinct causes and by decade of installation for the purposes of this analysis. Three causes -- third party damage, internal corrosion and external corrosion account--for just over half (51.4 percent) of these incidents. More importantly, it is evident from this analysis that the frequency of incidents is strongly dependant on pipeline age. Pipelines built in the 1960s and before account for 80 (76%) of the 105 incidents that have been reported.

Older pipelines have a higher frequency of corrosion incidents since the pipeline coatings and cathodic protection systems available to the industry at the time of installation were not as advanced as is currently available. The use of both an external protective coating and a cathodic protection system, required on all pipelines installed after July 1971, has significantly reduced the rate of corrosion failure for new pipelines as compared to previously installed pipe. Older pipelines also tend to have a higher frequency of outside incidents partly because the precise location of older pipelines may be less well known and less well marked than newer lines.

For the installation of the Project facilities, Tennessee will be using the pipeline technology developed over the past thirty years to:

- A. Minimize the potential for third party damage with pre-notification programs, precise pipeline marking and surveying and the use of damage resistant pipe.
- B. Prevent external corrosion through the use of a fusion bond epoxy pipeline coating and cathodic protection.
- C. Prevent internal corrosion by the transportation of sweet natural gas.
- D. Verify the ongoing integrity of the pipeline with in-line pipeline inspection technology.

11.3.3 Pipeline Incidents Relative to Other Modes of Transportation

The nationwide totals of accidental fatalities due to various manmade and natural hazards are listed in Table 11.3-3 to provide a relative measure of the industry-wide safety of natural gas pipelines. Direct comparisons between accident categories should be made cautiously since individual exposures to hazards are not uniform among all categories. Furthermore, the fatality rate is more than one order of magnitude lower than the fatalities from natural hazards, such as lightning, tornadoes, floods, and earthquakes.

TABLE 11.3-3 NATIONWIDE ACCIDENTAL DEATHS	
Type of Accident	Fatalities ^{1/}
All accidents	92,200
Motor vehicles	41,200
Falls	16,600
Poisoning	8,400
Drowning	4,100
Fires and burns	3,700
Suffocation by ingested object	3,200
Aircraft	909
Tornadoes and floods (1994-1996 average)	91
Lightning (1994-1996 average)	74
Natural gas transmission and gathering pipeline reportable incidents (1990-2004 average)	2.1 ^{2/}

Notes:

^{1/} All data, except where noted, reflects 1998 statistics from the National Safety Council, "Injury Facts 1999 Edition."

^{2/} USDOT-OPS website: <http://ops.dot.gov/stats/stats.htm> [accessed October 6, 2005]

11.4 SUMMARY

The DOT incident statistics have been reviewed to assess the relative risk of the proposed Project. Based on this analysis, it is clear that:

1. Gas transmission pipelines provide the least risk to the public of all modes of transportation.
2. Approximately 75 percent of all pipeline incidents are attributable to those pipelines installed over thirty years ago.
3. The leading three causes of pipe incidents are external corrosion, internal corrosion, and third party damage.

The design features of the proposed Tennessee facilities were reviewed in light of these findings and the following observations made:

1. The proposed pipeline will utilize coating technologies including fusion bond epoxy pipeline coating and a cathodic protection system to combat external corrosion.
2. The pipeline will transport sweet natural gas to prevent internal corrosion.

3. The pipeline will be made from damage resistant steel and be precisely surveyed, well marked, regularly patrolled and part of the state's one-call program.
4. The proposed compressor stations will incorporate design and features based upon current industry practices.

The proposed Project facilities have incorporated features that will reduce the risk of pipeline incidents to well below the national average and will maximize the safety and reliability of the proposed facilities. As described in the previous sections of this Resource Report 11, Tennessee designs its facilities to meet DOT regulations at 49 CFR Part 192 and augments those regulations with Tennessee's own design and operating procedures. Tennessee's design, operations, safety, and security measures meet DOT's minimum safety standards. As an example, Tennessee utilizes high strength pipe with toughness that provides for greater puncture resistance and strength. In addition, Tennessee's existing compressor stations currently have three modes of communication for remote operation from its gas control center. These modes of communication include a WAN satellite, and telephone. In most cases, if the station is un-manned, Tennessee's Gas Control has the ability to start and stop the stations remotely as needed based on demand. The gas control center is manned 24 hours a day, 365 days out of the year.

As discussed above, the compressor stations utilize both a unit control and station control system to ensure proper operation. These systems are designed so that if an upset condition is detected (such as vibration, gas, fire or heat), control center staff will make the facility safe by shutting down if necessary and potentially depressurizing the piping in the station. The turbine itself will be located in a unit enclosure with gas, fire, and heat detection. The unit enclosure is located in the compressor building which will also has heat, fire and gas detection. In addition, the unit enclosure will have a fire suppression system in the event of a detection of fire. Each compressor station has a natural gas fired back-up power generator sized appropriately to allow continued operation of the station during interruption of commercial power. Each station has a security system to detect intrusion into the building and the ability to monitor the fence perimeter. In addition, security cameras are located throughout the station yard. Existing mainline valves have hydraulic operators which can open and close the valve on site as well remotely from Tennessee's gas control center.

11.5 REFERENCES

Injury Facts 1999 Edition.

Kiefner, J. F., Mesloh, R. E., and Kiefner, B. A., "Analysis of DOT Reportable Incidents for Gas Transmission and Gathering Systems Pipelines, 1985 Through 1997" September 1999.

Research and Special Programs Administration, "Pipeline Safety Regulations: Minimum Safety Standards, Part 192 – Transportation of Natural and Other Gas by Pipeline", U.S. Department of Transportation.

U.S. Department of Transportation website: <http://ops.dot.gov/stats/stats.htm>.