Fairfax County is an urban/suburban community located in the northeastern corner of Virginia in the Washington, D.C., metropolitan area. It has a net land area of approximately 400 square miles and a population of approximately 850,000, projected to grow to 1.2 million by 2010. The County currently ranks as the 45th most populous county in the nation. Within its boundaries are located three incorporated towns, Clifton, Herndon and Vienna, which are underlying units of government with the County. The governing body of the County is a 10-member Board of Supervisors, headed by a Chairman who is elected at-large. The Board of Supervisors appoints a County Executive to act as the administrative head of the County. During the last 30 years, Fairfax County has grown from a rural farming community serving the nation's capital to a major business center and one of the most desirable residential communities in the metropolitan region. Fairfax County provides a comprehensive range of public services characteristic of its form of government under Virginia law and its integral position within the Washington metropolitan area.

Crossing Fairfax County are four interstate transmission pipelines: two hazardous liquid pipelines operated by Colonial Pipeline Company and Plantation Pipeline Company, and two natural gas transmission pipelines operated by Transcontinental Gas Pipeline Company and the Columbia Gas Transmission Corporation. Collectively, these lines and their spurs represent several hundred linear miles of working pipeline through what is now an urban environment.

During the past 14 years, Fairfax County citizens have been impacted by three major hazardous liquid pipeline releases. They include the 1980 Manassas failure which released approximately 336,000 gallons of aviation-grade kerosene into the Occoquan watershed. This spill resulted from thinning of the pipe wall by corrosion. The 1987 Centreville failure which released approximately 16,000 gallons of premium-grade gasoline into a townhouse community under construction. This very dangerous spill was the result of direct contact of a piece of construction machinery with the pipeline. Finally, the Reston failure in 1993 released approximately 408,000 gallons of #2 fuel oil into Sugarland Run and the Potomac River. This spill resulted from the fatigue failure at a crack which was probably

initiated by mechanical damage from heavy construction equipment. Fairfax County and its citizens cannot tolerate future releases. As a result, the County has conducted engineering evaluations, initiated investigations, established an ongoing dialogue with the Federal Office of Pipeline Safety, lobbied for further delegation of inspection functions to the state, supported changes in the one-call system and proposed changes to the Fairfax County Code for land-use policy and subsurface utility engineering requirements near pipelines. While engaged in these activities, several relevant and important issues have been identified.

First and foremost, we note that our experience in Fairfax County is not unique. Other jurisdictions are responding to similar occurrences in scope and magnitude as a result of hazardous liquid pipeline failures. For example, 27 releases larger than the 408,000 gallon Reston release have been reported in the United States since December of 1985. This does not even begin to take into consideration the releases smaller than 408,000 gallons, but which may have also had an impact on public safety, health or the surrounding environment.

Second, our technical assessment of pipeline requirements has revealed what Fairfax County believes are major regulatory deficiencies. Many of these issues have been previously identified in various National Transportation Safety Board investigations during the last 15 years. A review of technical issues and associated regulatory matters concerning the Reston failure further supports the need for increased focus on this area (technical issues).

- The County's observations include:
  
  - The current hazardous liquid pipeline design code and Federal Regulations result in:
    - Thinnest pipe wall thickness of any of the major national piping codes (e.g., the pipe has the least margin to failure). (See Attachment A.)
    - Failures that are most likely to be catastrophic (e.g., no warning leakage before pipe breaks catastrophically). Thus, it is very difficult to have a meaningful leak detection system (i.e., there is warning while the leakage is still small). Because of the thin wall, the pipe fails catastrophically all at once with no warning.

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2National Transportation Safety Board Pipeline Accident Brief No. DCA93MP007, March 18, 1993.

3Letter from National Transportation Safety Board to the Chairman of the Fairfax County Board of Supervisors, April 11, 1994.
Design codes/federal regulations for hazardous liquid pipelines do not require the design of the pipeline to take into consideration population density or environmentally sensitive areas (water supply). Natural gas pipeline codes or other design codes require thicker walls in sensitive areas and/or reduction in operating pressure in sensitive areas where population changes have occurred after the pipeline is installed. (See Attachment B.)

Design codes/federal regulations do not require that pipeline design take into consideration pressure induced cyclic fatigue—the lines are often operated with a high number of pressure cycles. These cycles can cause fatigue of very small defects (regardless of whether defect caused by manufacture, installation, third party damage, etc.) to grow to a point where catastrophic failure can occur.

Design codes/federal regulations do not require the pipeline to incorporate features which will readily permit periodic internal inspections of the line.

There currently is no requirement for the periodic inspections and assessment of the condition of the pipeline.

It is our belief that fundamentally we have an industry which does not have the necessary basic regulatory underpinnings for today's conditions.

Third, it is important to realize that our pipeline systems are getting older. Influences on the systems, such as cyclic fatigue, corrosion and external force damage are becoming more important considerations.

Fourth, and of vital importance, is that failures will continue to occur. Systems design, construction, maintenance, repair and inspection should take this fact into account and use the best available technology to reduce the number and impact of leaks or rupture. It is a process that requires continued evaluation and periodic updating of design, safe operations, maintenance and inspection.

Finally, engineering analysis suggests the need to consider further the cyclic stresses on pipelines in relationship to fatigue. Past studies do not appear to have taken into account the effects of cyclic stresses on the various types of conditions found within the physical structures of the pipelines.

Considering these issues and reflecting upon our experience with the processes concerning hazardous liquid pipeline safety, the County believes firmly that action must be taken and sustained in nine fundamental ways. It is important to note that no one single solution is available to solve the more comprehensive problem. It requires a concerted and sustained effort backed by proper resources in several distinct areas simultaneously. Fairfax County believes that those areas are as follows (not necessarily in order of importance):
1. There must be increased oversight of pipeline systems by all levels of government and their constituents. This includes enhancing the communications between the levels of government, particularly the local level. This goes beyond public information efforts or pipeline summits to the level of establishing continuous mechanisms of interaction and ensuring that challenging questions are welcomed and considered, to the delegation of responsibilities to the full extent of the law and, finally, to ensuring that, collectively, priorities are identified and acted on in a systematic way.

2. Critical, rigorous and practical engineering evaluation of physical and operational conditions must be further conducted. A process for continuing re-evaluation must be established. The approach should be one of challenging the status quo and the initial efforts should focus specifically on:
   - the cyclic fatigue questions,
   - leak before break issues, and
   - internal pig inspection technology and methodology.

3. Regulatory code and standard revisions must be undertaken (many have already been mandated under legislative acts such as the Pipeline Safety Act of 1992) which specifically include 1) mandated internal inspections and inspection intervals; 2) the application of class areas to hazardous liquid pipelines; 3) the implementation of isolation valving requirements; and 4) the compensation for fatigue effects on the pipelines through a change in operating parameters (e.g., reduction in operating pressure) or construction requirements.

4. The physical regulatory structure must be revised to provide for increased field resources for failure response, investigation and routine inspections, as well as to provide for consistent and adequate technical support (i.e., engineering evaluations and opinions).

5. The system, either through the National Transportation Safety Board or the Office of Pipeline Safety, must provide for more frequent and comprehensive (including more critical) accident analyses. Investigations should be made a priority and should be conducted under a set of established criteria. It is imperative that appropriate investigations with comprehensive findings are conducted on a consistent basis to effectively identify trends and make preventative corrections in system components or operations.
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6. Industry and communities must increase site specific release planning. This planning must be done at the state and local levels with support and guidance from the federal government and should include both basic and advanced techniques, including diversion and containment areas, evacuation zones and innovative equipment deployment schemes. Planning should be based on the worst-case scenario as reflected in national experience.

7. State and local codes should be evaluated and strengthened in the areas of land use and dig laws. They should specifically address increased set-backs, restricted development and the use of new technology for identifying line locations, as well as increased penalties for failure to comply with one-call dig regulations.

8. Increased public participation in the Office of Pipeline Safety’s newly implemented risk assessment process must be encouraged. This should go beyond the simple publication of a notice in the Federal Register to an active outreach program in communities through which the pipelines traverse.

9. Last, but certainly not least, there must be a change in attitude in all of us; industry, government and the public. We must not accept the status quo. We must challenge industry to find new and better solutions to making the system safer through design, construction, maintenance, repair, inspection and oversight. We must anticipate that with aging systems in the ground we will be confronted with new problems. We must be prepared to realize this, accept it and act upon it. We must move from response (reactive) to prevention (proactive).

Fairfax County, and we hope other jurisdictions having pipelines or responsibilities for pipelines, is prepared and committed to participating in what is hoped to be a new and better process for confronting and solving the issues of pipeline safety currently facing the industry. We are willing and committed to sharing any and all of our information, insights and experiences with those who share our desires to reduce and ultimately prevent significant releases from hazardous liquid and natural gas pipelines.
## Minimum Wall Thickness for 36" Diameter Pipe as Required by Various Design Codes and Resulting Critical Crack Size

<table>
<thead>
<tr>
<th>Design Code</th>
<th>Applicability of Design Code</th>
<th>Minimum Wall Thickness (inches) for Piping Made of X-52 and Operated at 700 psig/100°F (per Design Code Equations)</th>
<th>Critical Crack Size (inches) ≤ 700 psig for 36&quot; Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 ANSI B31.1, 1992</td>
<td>Piping Design Code for Power Plants, Boilers, Etc.</td>
<td>0.709</td>
<td>15.7</td>
</tr>
<tr>
<td>2 ANSI B31.3, 1993</td>
<td>Piping Design Code for Chemical Plants and Petroleum Refineries</td>
<td>0.519</td>
<td>10.0</td>
</tr>
<tr>
<td>3 ASME Boiler and Pressure Vessel Code, Section III, Subsection NC, 1992</td>
<td>Non-Reactor Piping in Nuclear Power Plant</td>
<td>0.709</td>
<td>15.7</td>
</tr>
<tr>
<td>4 ANSI B31.8, 1975</td>
<td>Natural Gas Transmission and Distribution Piping</td>
<td>0.606 (populated areas)</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.337 (uninhabited areas)</td>
<td>4.4</td>
</tr>
<tr>
<td>5 AWWA M11</td>
<td>Steel Water Pipe</td>
<td>0.485</td>
<td>9.0</td>
</tr>
<tr>
<td>6 ANSI B31.4, 1979</td>
<td>Liquid Petroleum Transportation Piping</td>
<td>0.337</td>
<td>4.4</td>
</tr>
</tbody>
</table>

*Note: The longer the critical crack size is, the more margin or more fault tolerance the piping system has before the piping ruptures catastrophically; therefore, one has a reasonable chance finding and fixing a "leak before rupture."

MPR Associates, Inc.  
January 4, 1994

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**Figure 2A**

Prepared by the Institute for Transportation at New Jersey Institute of Technology  
B5-7
## Minimum Wall Thickness for 36" Diameter Pipe as Required by Various Design Codes and Resulting Critical Crack Size

<table>
<thead>
<tr>
<th>Design Code</th>
<th>Applicability Description</th>
<th>Minimum Allowable Wall Thickness (inches)</th>
<th>Critical Crack Size (inches)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ANSI B31.1, 1992, Piping Design Code for Power Plants, Boilers, Inc.</td>
<td>0.709</td>
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</tr>
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<td>2</td>
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<td>ASME Boiler and Pressure Vessel Code, Section III, Subsection NC, 1992, Non-Reactor Piping in Nuclear Power Plant</td>
<td>0.709</td>
<td>15.7</td>
</tr>
<tr>
<td>4</td>
<td>ANSI B31.8, 1975, Natural Gas Transmission and Distribution Piping (populated areas)</td>
<td>0.606</td>
<td>12.6</td>
</tr>
<tr>
<td></td>
<td>(uninhabited areas)</td>
<td></td>
<td>4.4</td>
</tr>
<tr>
<td>5</td>
<td>AWWA M11, Steel Water Pipe</td>
<td>0.485</td>
<td>9.0</td>
</tr>
<tr>
<td>6</td>
<td>ANSI B31.4, 1979, Liquid Petroleum Transportation Piping (same as 49 CFR, Ch. 1, Part 192.106)</td>
<td>0.337</td>
<td>4.4</td>
</tr>
</tbody>
</table>

*Note: The larger the critical crack size is, the more margin or fault tolerance the piping system has before the piping ruptures catastrophically; therefore, one has a reasonable chance finding and fixing a "leak before rupture."

Figure 2A

Prepared by the Institute for Transportation at New Jersey Institute of Technology
B5-8
<table>
<thead>
<tr>
<th>Class</th>
<th>Location</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.6</td>
<td>Class 4</td>
<td>Locations: Multi-story buildings, factories, numerous other utilities, four or more floors above ground, heavy traffic, and mobile homes.</td>
</tr>
<tr>
<td>7.4</td>
<td>Class 3</td>
<td>Location: Suburban housing, public assembly areas, hospitals, schools, places of assembly, business, commercial centers, residential development, shopping centers.</td>
</tr>
<tr>
<td>5.8</td>
<td>Class 2</td>
<td>Location: Industrial areas, reach of mountainous, desert, waterways, and flood areas.</td>
</tr>
<tr>
<td>4.2</td>
<td>Class 1</td>
<td>Location: Waterways, deserts, and flood areas.</td>
</tr>
<tr>
<td>4.2</td>
<td>All Locations</td>
<td>Design Code: [(\text{API 5L-X-22})] [(\text{NPSM})] [(\text{PSL})].</td>
</tr>
</tbody>
</table>

Maximum Allowable Pressure and Critical Crack Size for 36" Diameter. 

**Critical Crack**

*Pipe not regulated by ANSI B31.4 (Liquid Petroleum Gas Transportation Pipe)*

*Pipe regulated by ANSI B31.3 (Gas Transmission and Distribution Pipeline System)*

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Attachment C