

**WORK PAPER TABLE - INCIDENT RATE CALCULATION OF 16"**  
**INCIDENT RATE CALCULATION OF 16" DIAMETER PIPELINE CONSTRUCTED PRIOR TO 1960**  
**APPLICATION 15-09-013 VOLUME III – COST-EFFECTIVENESS ANALYSIS**

**Calculations**

<b>16" Pipeline, pre-1960</b>				
<u>Time Period</u>	<u>Number of Incidents</u>			
1970-mid1984	65		<b><u>Failure Rate:</u></b>	
mid1984-2001	29		<b>3.54E-04</b>	
2002-2009	19			
2010 to 2014	12			
<b>Sum</b>	<b>125</b>			
<b>Total</b>	<b>125</b>			

  

<u>Mileage</u>				
<u>Time Period</u>	<u>Mileage</u> <u>Constructed</u>	<u>Constructed</u> <u>16"</u>	<u>Incident years</u> <u>(1970 to 2014)</u>	<u>Denominator</u>
pre 1940	9885.1	790.8064	45	35586.288
1940 to 1949	21425.5	1714.04152	45	77131.8684
1950 to 1959	66819.1	5345.52744	45	240548.7348
<b>Total</b>	<b>98129.7</b>	<b>7850.4</b>		<b>353266.9</b>

**Methodology**

To calculate the likelihood of pipeline incidents, Applicants used historical pipeline incident and mileage data from the Department of Transportation's Pipeline and Hazardous Materials Safety Administration (PHMSA). The Applicants downloaded PHMSA's Gas Transmission and Gathering Incident Data from 1970-1984, 1984-2001, 2002-2009, and 2010-present (filtering 2010 to present to only show incidents up to 2014, as all 2015 incidents may not yet be included). For each data set, Applicants filtered the data to exclude gathering pipelines, offshore incidents, and incidents attributable to a compressor or compressor station, all of which were not relevant to this analysis.

To analyze the risk of an incident on a pipeline like Line 1600, Applicants filtered the data to remove any pipelines constructed after 1960 or having a diameter other than 16 inches. The year 1960 was chosen based on "Integrity Characteristics of Vintage Pipelines," which identifies 1960 as approximately the cutoff date for "historic" versus "modern" pipeline manufacturing. More specifically, the report indicates that between 1950 and 1970, modern manufacturing techniques for pipelines were introduced, and "historic" practices were phased out. The report indicates that the use of flash welding, which was used in constructing Line 1600, peaked in 1950 and was phased out by 1970. To calculate the number of incidents on historic pipelines similar to Line 1600, Applicants used all of the remaining unfiltered records for each dataset. The total remaining incidents, for the period 1970 to 2014, on onshore transmission pipelines constructed prior to 1960, is 125.

The PHMSA annual mileage report provides the total miles of pipeline by decade of installation and, separately, by diameter. The incident rate for pre-1960 16-inch pipelines was determined using the PHMSA reported information. Eight percent of all installed pipe has a diameter of 16 inches. Applicants multiplied the total number of pre-1960 vintage pipeline miles by 8% to determine the number of mile-years needed to calculate the incident rate. The incident rate was then calculated to be 35.4E-05, or about 0.354 per thousand mile-years.

**WORK PAPER TABLE - INCIDENT RATE CALCULATION OF 30" - 42" PIPELINE, 2000-2014**  
 INCIDENT RATE CALCULATION FOR 30" - 42" DIAMETER PIPELINE CONSTRUCTED IN 2000 - 2014  
 APPLICATION 15-09-013 VOLUME III – COST-EFFECTIVENESS ANALYSIS

**Calculations**

30"-42" Pipeline, 2000 to 2014				
<u>Time Period</u>	<u>Number of Incidents</u>		<u>Failure Rate:</u>	
1970-mid1984				
mid1984-2001			1.30E-02	
2002-2009	1018			
2010 to 2014	0			
Sum	1018			
		This line removes one record that was stripped thread-related incident, rather		
		1 than a pipe failure		
Total	1017			
<u>Time Period</u>	<u>Mileage</u>	<u>Mileage</u>	<u>Incident years</u>	
	<u>Constructed</u>	<u>Constructed</u>	<u>(Ave Time</u>	
	<u>Constructed</u>	<u>30-42"</u>	<u>period to</u>	<u>Denominator</u>
			<u>2014)</u>	
2000 to 2009	28730.6	7182.64475	10	71826.4475
2010 to 2014	9995.8	2498.94875	2.5	6247.371875
Total	38726.4	9681.6		78073.8

**Methodology**

To determine the incident rate on a new/modern pipeline, similar to the Proposed Project, Applicants relied on a similar methodology to that described in Workpaper "Incident Rate Calculation for 16" diameter pipeline constructed prior to 1960." The team selected an incident and installation mileage date range of 2000 to 2014. Applying this filter to 36-inch pipe resulted in the identification of one incident. In order to increase the sample size to provide a more meaningful result, Applicants expanded the diameter filter to include pipelines between 30-inches and 42-inches. The PHMSA incident data reported 6 incidents that occurred on pipelines with diameters between 30-inch to 42-inch installed between 2000 and 2014. It should be noted, however, that one of these incidents was attributable to stripped threads, and the Proposed Project will not be subject to such failures by design. Thus, the comparable number of incidents of pipelines similar to the Proposed Project would be 5.

To determine the mile-years needed in the calculation of incident rate, the team collected the miles of 30-inch to 42-inch pipeline constructed between 2000 and 2009 and the miles constructed between 2010 and 2014. The share of 30-inch to 42-inch pipeline in the system is approximately 25%. Thus, the incident rate for onshore transmission 30-inch to 42-inch pipelines installed between 2000 and 2014 is 6.4 E-05, or 0.064 per thousand mile-years.

**WORK PAPER TABLE - INCIDENT RATE CALCULATION OF 12" - 20" PIPELINE, 2000-2014**  
INCIDENT RATE CALCULATION FOR 12" - 20" DIAMETER PIPELINE CONSTRUCTED IN 2000 - 2014  
APPLICATION 15-09-013 VOLUME III – COST-EFFECTIVENESS ANALYSIS

**Calculations**

12"-20" Pipeline, 2000 to 2014				
<u>Time Period</u>	<u>Number of Incidents</u>		<u>Failure Rate:</u>	
1970-mid1984				
mid1984-2001				9.15E-05
2002-2009	4			
2010 to 2014	4			
Sum	8			
Total	8			
<u>Time Period</u>	<u>Mileage Constructed</u>	<u>Mileage Constructed 12-20"</u>	<u>Incident years (Ave Time period to 2014)</u>	<u>Denominator</u>
2000 to 2009	28730.6	8044.56212	10	80445.6212
2010 to 2014	9995.8	2798.8226	2.5	6997.0565
Total	38726.4	10843.4		87442.7

**Methodology**

To determine the incident rate on a new/modern pipeline, similar to the Proposed Project, Applicants relied on a similar methodology to that described in Workpaper "Incident Rate Calculation for 16" diameter pipeline constructed prior to 1960." The team selected an incident and installation mileage date range of 2000 to 2014. Applying this filter to 16-inch pipe resulted in the identification of two incidents; an insufficient sample size. In order to increase the sample size to provide a more meaningful result, Applicants expanded the diameter filter to include pipelines between 12-inches and 20-inches. The PHMSA incident data reported 8 incidents that occurred on pipelines with diameters between 12-inch to 20-inch installed between 2000 and 2014. The share of pipelines between 12 and 20 inches is approximately 28%. Thus, the incident rate for onshore transmission 12-inch to 20-inch pipelines installed between 2000 and 2014 is 9.15E-05, or 0.0915 per thousand mile-years.