**Appendix B: Tables to Aid Probability Estimation Using a Qualitative Analysis**

Appendix B provides a structure which describes what information would be required from a qualitative analysis in order to run the leak detection marginal benefit estimation tool. The first piece of data needed is an understanding of the probability distribution of the time distance between the simulation start time and a leak occurring. This can be deduced from the data provided in order to complete table 1

*Leak Probabilities*

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 1: Frequency Distribution of Leak Occurring** | | | |
| Spill Size (BBL) | Mean Frequency | 90th Percentile | 10th Percentile |
| Below Ground |  |  |  |

Once a leak occurs a probability distribution of the leak location should be estimated. A method for doing this is to assume that the probability is equal at all above ground locations and all below ground locations. With the assumptions a relative likelihood specified in table 2 can be used to determine the probability distribution can be determined using information about the pipeline itself.

|  |  |
| --- | --- |
| **Table 2: Relative Likelihood of a Leak Above Ground/Below Ground** | |
| AG/BG | Relative Likelihood |
| Below Ground | **1** |
| Above Ground |  |

The probability distribution of the leak rate can then be determined by estimating the relative likelihood of each leak rate as specified in table 3. These numbers can be translated into a distribution function.

|  |  |
| --- | --- |
| **Table 3: Relative Leak Rate Probabilities** | |
| Spill Size (BBL) | Relative Frequency |
| .1 BBL/Hr. or Less | **1** |
| 1 BBL/Hr. |  |
| 10 BBL/Hr. |  |
| 100 BBL/Hr. |  |
| 1,000 BBL/Hr. |  |
| 10,000 BBL/Hr. |  |
| 50,000 BBL/Hr. |  |

*Leak Detection System Performance*

For each leak detection system including the system being analyzed the performance needs to be specified. Because each system functions differently there may be different performance criteria used to estimate the performance. However this analysis is done the result should be sufficient enough to fill out either table 5 or table 6. Table 5 is geared towards measuring performance in terms of leak rates and time to detect. Table 6 is geared towards measuring performance in terms of frequency of observation and oil spill volume. For these systems the performance will most likely depend on location as well so this factor must be considered.

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 5: Form Used to Assist in Qualitative System Performance Analysis** | | | |
| **Milepost** |  | **Date** |  |
|  | Detection Success | Time to Detect | |
| Leak Rate (BBL/Hr.) | Probability | Average | Standard Deviation |
| 1 or Less |  |  |  |
| 10 |  |  |  |
| 100 |  |  |  |
| 1,000 |  |  |  |
| 10,000 |  |  |  |
| 100,000 |  |  |  |
| 1,000,000 or Greater |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Table 6: Form Used to Assist in Qualitative System Performance Analysis** | | | |
| **Milepost** |  | **Date** |  |
|  | Detection Success | Frequency | |
| Leak Volume (BBL) | Probability | Average | Standard Deviation |
| 1 or Less |  |  |  |
| 10 |  |  |  |
| 100 |  |  |  |
| 1,000 |  |  |  |
| 10,000 |  |  |  |
| 100,000 |  |  |  |
| 1,000,000 or Greater |  |  |  |

*Leak Costs*

It is advised to at a minimum consider the oil spill response, environmental and socio-economic costs of an oil spill. The hydraulics of the oil spill should be considered when determining the cost of a leak volume at each milepost. This is required because the oil spill costs depend heavily on the environmental classification of the area that is impacted. A topographical map of the location under consideration should be the minimum requirement to complete these objectives. Taken these into consideration the data specified in table 4 should be estimated.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Table 4: Leak Volume Cost At Different Mile Posts** | | | | | |
| **Milepost** |  | | **Date** | |  |
| **Leak Volume Cost** | | | | | |
| Spill Size (BBL) | | Approximate Cost (2013 USD) | | Marginal Cost (2013 USD) | |
| 1 or Less | |  | | N/A | |
| 10 | |  | |  | |
| 100 | |  | |  | |
| 1,000 | |  | |  | |
| 10,000 | |  | |  | |
| 100,000 | |  | |  | |
| 1,000,000 or Greater | |  | |  | |