Chapter 10

Accidental Crude Oil Releases

10.1 INTRODUCTION

During the transport of crude oil by pipeline and by the alternative modes of rail and truck transportation, unplanned events may occur that can result in a release of crude oil. Although the probability of a large or catastrophic oil release at any specific location is extremely low, the probability of a release of some type along the entire pipeline during its lifetime is not low. In addition, the consequences of a large release can be significant. Therefore, in addition to the analysis of potential Project impacts during construction and normal operations, the potential for unanticipated releases and the potential consequences of such releases must be considered in this Environmental Impact Statement (EIS).

Modeling, statistics, and resource mapping can help predict the probability of an accidental oil release, how crude oil behaves in the environment, and what resources could be at risk should there be an oil spill. However, it is impossible to predict where a spill would happen, the quantity of oil involved, how far the impacts would extend, or exactly what resources would be affected. In part, this is because there are so many incident-specific factors involved. The weather, time of year, water levels, human error, and even what type of wildlife is present at the time a spill occurs all affect its probability and outcome.

This chapter first describes the relevant federal and state regulations for crude oil transportation by pipeline, rail, and truck and the causes of crude oil releases and then describes the analysis methods used in this chapter (Section 10.1). Section 10.2 describes the types and probabilities of failures that could result in an unanticipated release of crude oil for the alternatives. The behavior of crude oil in the environment is addressed in Section 10.3, followed by descriptions of the potential exposure of and impacts on specific resources if a spill were to occur (Section 10.4). Sections 10.5 and 10.6 describe spill prevention and response measures and clean-up and recovery measures, respectively. Lastly, Section 10.7 compares the potential exposure of resources of concern to crude oil releases for the alternatives.

10.1.1 Regulatory Context

Crude oil transport by pipeline, rail, and tanker truck is regulated by a number of state and federal guidelines and standards, which are described below.

10.1.1.1 Pipeline Safety Regulations and Standards

The federal (U.S. Department of Transportation [USDOT]) and state (Minnesota Office of Pipeline Safety [MnOPS]) regulatory requirements for oil pipelines, as well as industry standards for oil pipelines, are discussed below. These regulations and standards apply to each of the pipeline alternatives.

10.1.1.1.1 U.S. Department of Transportation Regulations

USDOT is mandated to regulate pipeline safety under Title 49 U.S. Code Chapter 601. The Pipeline and Hazardous Materials Safety Administration (PHMSA) is the agency within USDOT that has jurisdiction and is responsible for developing and enforcing regulations for the safe, reliable, and environmentally sound operation of interstate pipelines. PHMSA's regulations encompass design, construction, testing, operation, maintenance, and emergency response for hazardous liquid pipelines and related facilities.[1]

49 Code of Federal Regulations (CFR) 195 (Transportation of Hazardous Liquids by Pipeline) include Subparts A through H, establish reporting requirements, design requirements, construction requirements, pressure testing, operation and maintenance, integrity management, required qualifications of pipeline personnel, and corrosion control. For a new hazardous liquid pipeline, high consequence areas (HCAs)[2] must be identified prior to operation, and hazardous liquid pipeline operators are required to develop and submit to PHMSA a written Integrity Management Plan (IMP) within 1 year of the start of operation (49 CFR 195.452).

The Applicant's IMP must include identification of all pipeline segments that could affect HCAs; a baseline assessment plan to ensure integrity of these segments; a process for continual integrity assessment and evaluation; repair criteria to address issues identified by the integrity assessment method; a process to identify, evaluate, and implement preventative and mitigation measures to protect HCAs; and a description of how each element of the IMP would be implemented. Because populations can expand and environmental situations can change, HCA boundaries can change over time; therefore, new HCAs must be incorporated into baseline assessment plans within year of identification (PHMSA 2016). As a part of IMP implementation, the Applicant would also have to perform periodic integrity assessments on line segments that could affect HCAs at least once every 5 years.

If a pipeline is approved for the Project, it is anticipated that the Applicant's IMP for the new pipeline system would be in large part similar to its existing IMPs for the existing Enbridge pipeline system. The new IMP would include a new baseline assessment plan, identification of HCAs specific to the Project, and other Project-specific information.

10.1.1.1.2 State Pipeline Regulations

Although PHMSA is responsible for regulation, inspection, and enforcement of safety regulatory requirements for interstate pipelines as described above, it also permits individual states to adopt additional or more stringent safety regulations for intrastate pipelines. In states where such an agreement is in place, the state is the delegated inspection authority for compliance with federal rules while PHMSA retains enforcement authority. MnOPS, a division of the Minnesota Department of Public Safety, inspects pipelines within the state and has such an agreement with PHMSA to inspect pipelines.[3] PHMSA's Office of Pipeline Safety enforces its federal regulations based on the inspections conducted by MnOPS. PHMSA or MnOPS inspections or audits can occur at any time, but typically happen every 2

[1] Parts 190, 194, 195, 198, and 199 are relevant to hazardous liquid (including crude oil) pipelines. Parts 194 and 195 address issues that are directly related to pipeline system integrity and oil spill risk assessment and environmental consequences. The regulations at 49 CFR 194 (Response Plans for Onshore Oil Pipelines) contain requirements for onshore oil spill response plans that are intended to reduce the environmental impact of oil unintentionally discharged from onshore oil pipelines. Parts 190, 198, and 199 address issues that are tangential to pipeline system integrity, including rulemaking procedures, regulations for grants and state aid for safety programs, and required drug and alcohol testing for operators of pipeline facilities.

[2] HCAs are areas or features where a crude oil pipeline failure, such as a release of crude oil, may have long-term and/or permanent and major impacts on resources. They are defined and discussed in more detail in Section 10.4.1.

[3] The agreement is codified under Minnesota Statutes, Chapter 299J, Pipeline Safety.

Table 10.2-1. Estimated Annual Probabilities of Incidents and Recurrence Intervals for the Applicant's Proposed Project and Certificate of Need Alternatives

Probability and Recurrence	Applicant's Preferred Route	Existing Line 3	System Alternative SA-04	Transportation by Rail	Transportation by Truck	Existing Line 3 Supplemented by Rail	Existing Line 3 Supplemented by Truck
Annual probability of spill incident	0.249	0.404	0.568	0.960	230[a] (0.63)	0.794	76[a] (0.21)
Recurrence interval (years)	4.0	2.5	1.8	1.04	0.004 (1.59 days)	1.26	0.013 (76.9 days)

a Incidents per year; values in parentheses are daily probabilities.

10.2.4.1.1 Applicant's Preferred Route

Length is a key component in calculating failure probability, simply because a longer pipeline has a greater area that could be exposed to the primary pipeline threats (third-party damages, construction defects, manufacturing defects, corrosion, and equipment failure [e.g., valve failure]). The annual probability of a spill incident for the Applicant's preferred route was estimated as 0.249 incidents per year with a recurrence interval of 4.0 years, which applies to the entire 380-mile-long route. The main contributing threat components are third-party damages, construction defects, manufacturing defects, and equipment (e.g., valves) failure.

10.2.4.1.2 Continued Use of Existing Line 3

The annual failure probability of the existing Line 3 pipeline system under current pressure and volume conditions was calculated using the AFFs described in Section 10.2.1.3.1 and the miles of the three land-cover types along the 328-mile-long route of RA-07. The resultant estimate of the annual failure probability is 0.404, and the corresponding recurrence interval is 2.5 years.

The estimated Line 3 failure probability was compared to available Line 3 incident data reported to PHMSA for the period of 2002 to 2017. Seven spills were reported over this 16-year record, which corresponds to an annual failure probability of 0.438 (i.e., 7 incidents divided by 16 years) and a recurrence interval of 2.3 years. The close agreement between the estimated and data-driven values of annual failure probability for the existing Line 3 pipeline system underscore the increased risk associated with the older Line 3 technology and pipeline aging compared to the newer technology for the other pipeline alternatives. This agreement also validates the methods employed to estimate annual failure probabilities for the Project and alternatives.

Incremental Oil Volume Increase on Existing Pipelines

Most of the risks of unanticipated crude oil releases from a new crude oil pipeline are directly proportional to route length—that is, the longer the pipeline route, the higher the overall risk. However, the risk of an accidental spill on an existing pipeline in the Enbridge system in Wisconsin or elsewhere would not be materially different whether Line 3 operates at the current capacity of 390,000 bpd, or at the proposed 760,000 bpd. The primary risks of an accidental release incident are corrosion, manufacturing defects, and damage from third-party excavation or from natural forces. The amount of oil flowing in the pipeline does not affect any of these risks.

Although the increased flow rate of oil on the existing pipeline network would not affect the risk of an oil release, it could result in an increase in release volume if a major rupture were to occur. That is, an increase in oil flow on an existing line due to the Project could increase the amount of oil that would flow out of the pipeline in the event of a major rupture before Enbridge identifies the rupture and shuts the system down by stopping the pumping and closing the valves. For a slow leak under the higher flow rate, the difference in the volume of the release would be minor.

10.2.4.1.3 System Alternative SA-04

The route of SA-04 is 795 miles long, and it is therefore the longest of the CN pipeline alternative routes. This greater length results in an estimated annual failure probability of 0.568 incidents per year and a recurrence interval of 1.8 years, both of which are greater than those of the Applicant's preferred route and the continued use of existing Line 3. Because the primary risks of an accidental release incident are corrosion, manufacturing defects, and damage from third-party excavation or from natural forces, the increased flow in the Superior to Illinois segment does not increase the risk of a spill for the other pipeline alternatives and therefore is not considered in the calculation of risk for the other pipeline alternatives

10.2.4.1.4 Transportation by Rail

The annual probability of an incident is 0.96 for the transportation by rail alternative, with a corresponding recurrence interval of 1.04 years.

10.2.4.1.5 Transportation by Truck

To calculate the annual probability of an incident, the failure rate of 19.95 incidents per billion ton-miles reported for industry-wide oil truck transport was used (Furchtgott-Roth and Green 2013). Using that input, the resulting number of expected incidents for truck transport is 230 per year. To facilitate comparison with other alternatives, the annual failure probability value was converted into a daily failure probability of 0.63 (i.e., dividing 230 annual incidents by 365 days). The corresponding recurrence interval is 0.004 years (or 1.59 days).

As for the truck transport alternative, this alternative has a higher probability of a failure than the pipeline alternatives, but it is likely that most releases would be relatively small.

10.2.4.1.6 Existing Line 3 Supplemented by Rail

As described above, this alternative would require six loaded unit trains per day to travel from Gretna to the Clearbrook and Superior terminals. This would result in a transport value of 4.89 billion ton-miles per year, with an annual probability of an incident of 0.794 and a recurrence interval of 1.26 years.

10.2.4.1.7 Existing Line 3 Supplemented by Truck

As described above, this alternative would require 1,947 loaded trucks to travel from Gretna to the Clearbrook and Superior terminals per day. To calculate the annual probability of an incident, the failure rate of 19.95 incidents per billion ton-miles reported for industry-wide oil truck transport was used (Furchtgott-Roth and Green 2013). Using that input, the resulting numbers of expected incidents from existing Line 3 supplemented by truck each year is 76. To facilitate comparison with other alternatives, the annual failure probability value was converted into a daily failure probability of 0.21 (i.e., dividing 76 annual incidents by 365 days). The corresponding recurrence interval is 0.013 years (or 76.9 days).

10.2.4.2 Probability Based on Spill Size and Type

Spill probability was calculated for different spill sizes and for pinhole releases by Stantec and Barr Engineering (2017), Stantec et al. (2017), and DOS (2017). The probability of small, medium, large, and catastrophic spills was calculated for the Applicant's preferred route and SA-04; it was not calculated for existing Line 3 because there are historical data from Line 3 that inform the probability of different sizes of spills from it. The probability of a pinhole release was completed for the Applicant's preferred route, existing Line 3, and SA-04.

10.2.4.2.1 Spill Probability by Size for the Applicant's Preferred Route and System Alternative SA-04

Table 10.2-2 lists the estimated annual failure probabilities and recurrence intervals for small, medium, large, and catastrophic spills for the Applicant's preferred route and SA-04. Analysis of the existing Line 3 data from 2002 to 2017 indicate that spill sizes have been in the small to medium range; therefore, results for this pipeline alternative are not presented here.

In contrast to the incident data used to develop the values in Table 10.2-1, the incident data used as the basis for the values in Table 10.2-2 did not provide information on the type of land cover (i.e., wetlands, open water, and uplands) at the release location. Therefore, the values presented are the annual failure probabilities and the recurrence intervals for the entire lengths of the pipelines, and the differences in the values result from the different pipeline lengths. The results listed in Table 10.2-2 suggest that if a spill occurred, it would likely be in the small- to medium- size range.

Table 10.2-2. Annual Failure Probabilities and Recurrence Intervals for Small, Medium, Large, and Catastrophic Spills for the Applicant's Preferred Route and System Alternative SA-04

		Applicant's Preferred Route	System Alternative SA-04
	Route length (miles)	*380.4*	*795.4*
Small spills (0.1–50 barrels)	Annual probability	1.07[a] (0.003)	2.23[a] (0.007)
	Recurrence interval (years)	0.94	0.45
Medium spills (50–1,000 barrels)	Annual probability	0.076	0.159
	Recurrence interval (years)	13.1	6.3
Large spills (1,000–10,000 barrels)	Annual probability	0.061	0.127
	Recurrence interval (years)	16.4	7.9
Catastrophic spills (greater than 10,000 barrels)	Annual probability	0.011	0.024
	Recurrence interval (years)	87.6	41.9

[a] Incidents per year; values in parentheses are daily probabilities.

Calculations are based on Enbridge incident failure rates presented in DOS 2017: Table B-2.

10.2.4.2.2 Pinhole Leak Analysis for the Applicant's Preferred Route and Certificate of Need Pipeline Alternatives

Stantec and Barr Engineering (2017) estimated AFF values for pinhole leaks in regional contexts as follows:

- United States: 0.00081 incidents per year per mile;
- Upper Midwest: 0.00068 incidents per year per mile, and
- Minnesota: 0.00071 incidents per year per mile.

These estimates were based on analysis of PHMSA data for reported pinhole releases between January 2002 and December 2015 (Stantec and Barr Engineering 2017). The pinhole leak AFF for Minnesota was selected as the appropriate factor for this analysis and was multiplied by the length in miles of the Applicant's preferred route and the CN pipeline alternatives to estimate the annual probabilities of a pinhole leak. The resultant annual probabilities and recurrence intervals are presented in Table 10.2-3.

Table 10.2-3. Estimated Annual Probability of Pinhole Leaks and Recurrence Intervals for the Applicant's Preferred Route and Certificate of Need Pipeline Alternatives

Probability and Recurrence	Applicant's Preferred Route	Continued Use of Existing Line 3	System Alternative SA-04
Annual probability of pinhole leak	0.270	0.233	0.568
Recurrence interval (years)	3.7	4.3	1.8

10.2.4.3 Failure Probabilities for the Applicant's Preferred Route and Route Alternatives

10.2.4.3.1 Annual Failure Probabilities and Recurrence Intervals for the Applicant's Preferred Route and Route Alternatives

Annual failure probabilities and recurrence intervals were estimated for the Applicant's preferred route and route alternatives between Clearbrook and Carlton. These results are presented in Table 10.2-4.

Table 10.2-4. Estimated Annual Probabilities of Failure and Recurrence Intervals for the Applicant's Preferred Route and Route Alternatives between Clearbrook and Carlton

Probability and Recurrence	Applicant's Preferred Route	Route Alternative RA-03AM	Route Alternative RA-06	Route Alternative RA-07	Route Alternative RA-08
Annual probability of a spill incident	0.139	0.179	0.107	0.097	0.089
Recurrence interval (years)	7.2	5.6	9.4	10.3	11.2

The data in Table 10.2-4 were calculated as described in Sections 10.2.1. The minor differences in probabilities and recurrences are attributed to the differences in pipeline length of the route segments between Clearbrook and Carlton and the difference in the distance of each alternative pipeline segment through the three different land-cover types.