ExxonMobil SYU LFC Interim Trucking
Industrial Risk Analysis

Application to County of Santa Barbara

Planning & Development Department
Energy & Minerals Division

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1.0 Introduction

ExxonMobil is requesting approval for Interim Trucking to transport Santa Ynez Unit (SYU) processed crude oil (product) from the Las Flores Canyon (LFC) facility to market destinations due to the shutdown of Line 901/903 operated by Plains All American Pipeline Company (PAAPL). This industrial risk analysis (IRA) evaluates scenarios associated with the truck loading process at the LFC facility that could potentially lead to a loss of containment or a spill.

Based on this IRA, most of the hazardous events that could occur from the truck loading activities are considered unlikely. Some events have a higher likelihood of happening; however they would result in negligible consequences and would not result in any significant risk to the public. Therefore, the risk impacts within the LFC facility from the truck loading activities are considered less than significant (Class III).

It should be noted that the destination unloading facilities (i.e., Phillips 66 Station in Santa Maria and Pentland PAAPL station in Maricopa) are designed for truck unloading and already unload many trucks per day from various suppliers. Trucks with ExxonMobil product will be received and unloaded within the permitted and design capacities of these facilities. There is no expected change in the unloading facilities operations and no increase in risk will result from the truck unloading of ExxonMobil product at these designated unloading facilities.

The LFC facility is not accessible to the public; therefore, there is virtually no potential for public exposure to any hazards that occur within the LFC facility boundaries associated with the trucking loading activities.

Santa Barbara County does not specify risk thresholds for hazards that do not impact public safety. Therefore, this IRA was prepared in accordance with industry best practice in process safety to help identify major hazards arising from truck loading operations and measure their likelihood and severity. [Refs. 1 and 2]. Failure rate data selected for this study is representative of industry experience and the specific operations under consideration [Refs 3, 4, 5 and 6].

2.0 Description of the Proposed LFC Crude Oil Truck Loading

Truck loading of product at the LFC facility would occur at the Truck Loading Area, located in a previously disturbed open graded area immediately north of the crude oil storage tanks. Facility modifications include the installation of loading stations and the extension of piping to transfer product to the loading stations and the truck vapors back into the LFC vapor recovery system. Land disturbance may include installation of footings for pipe supports and equipment as well as potential paving of loading lanes across the Truck Loading Area. Piping to and from the loading stations will be routed along pipe racks and within the existing containment area for the Crude Storage Tanks.

Each loading station will include a Lease Automatic Custody Transfer (LACT) Unit for custody transfer as required by the Bureau of Safety and Environmental Enforcement (BSEE). Loading connections will be of the dry-lock type to eliminate potential leaks and additional emissions points. Also, each LACT unit will incorporate grounding and overfill protection to stop the loading process

in the case of interrupted ground or a high level scenario. Appendix 1 includes a Truck Loading Schematic that illustrates the truck loading process. The LFC truck loading stations and facility modifications are shown in Appendix 2. Spill containment measures are discussed in Section 3.2.

Trucks will follow the main plant road from the front gate on Calle Real to access the Truck Loading Area. Truck routings to and from the Truck Loading Area will follow one of two options under consideration. Option 1: Trucks will enter the Truck Loading Area to the left hand side, and after loading, leave the Truck Loading Area and continue on the same road to the north, which loops back around to the main plant road. Option 2: Trucks will enter the Truck Loading Area on the right hand side, and once finished loading leave the Truck Loading Area and continue on the same road to the south, which loops back around to the main plant road. Appendix 3 shows an aerial view of the Truck Loading Area and the truck routing within the LFC facility.

Empty trucks will arrive at LFC and proceed to one of the four loading stations via one of the route shown in Appendix 3. Once the trucks are at the proper loading location, the truck wheels will be chocked. The truck will then undergo a safety inspection by the ExxonMobil operator prior to loading. The loading hose and vapor recovery hose will be connected to the truck. The ExxonMobil operator will open the vapor recovery system (VRS) valve and then the oil line valve to start loading. Processed crude oil (product) will be transported in a pipe from a tie-in point at the Transportation Terminal (TT) to the Truck Loading Area. The process will utilize onsite pumps – the trucks will not have to provide their own. Vapors displaced during truck loading operations will be contained and transported in a pipe to a tie-in point at the existing TT Vapor Recovery Compressors. During loading both the ExxonMobil operator and the truck driver will be in attendance at all times. The product level in the truck will be continuously monitored via a gauge. Once the truck final level is achieved, the oil and vapor recovery line valves will be closed, the hoses will be disconnected and the truck will leave the Truck Loading Area and then leave LFC to proceed to one of the unloading facilities.

Information on the product truck loading is summarized in Table 1 below.

Table 1 Truck Loading Details

Parameter	Value
Maximum number of trucks	70 trucks per day
Maximum volume of product per truck	160 barrels (bbls) (worst case scenario for a single truck incident, which is the maximum volume of oil potentially spilled from a single truck)
Annual number of truck trips	70 x 365 = 25,550
Maximum duration of Interim Trucking	From the approval of the Interim Trucking Permit until a pipeline alternative becomes available
Annual volume of oil transported	Approximately 4 million barrels (MM BBL)

The loading facility modifications are expected to consist of the following components:

- Truck loading rack with lighting for nighttime operations;
- Four LACT Units;

- Product transfer line and connections to the four loading stations;
- Vapor recovery line and connections to the four loading stations;
- Hoses to connect from the product and vapor lines to the trucks; hoses equipped with dry-lock connectors;
- Fuel gas line and connections to the vapor recovery line;
- Associated utility connections;
- Loading safety protection including trucking ground monitoring and overfill protection
- Operator shelter.

3.0 Loading Risk Assessment Methodology

The LFC Truck Loading IRA evaluated risks using the following steps:

1. Potential hazards identification
2. Existing and proposed safety and environmental controls to reduce hazards
3. Probability and consequence analysis
4. Safety risks analysis.

3.1 Hazards Identification

Hazardous events that could lead to a loss of containment and a spill could occur due to equipment failure, operator error or both. As shown below, equipment and human failures that could lead to an event (incident) include but are not limited to:

1. Piping, valve or connection leak/rupture;
2. Improper hose connection during the loading process leading to a spill (operator error);
3. Accidental hose disconnection during loading process;
4. Failure to close the loading valve leading to a truck overfilling and a spill;
5. A hole in the hose and failure to inspect before loading;
6. Catastrophic hose rupture during loading;
7. An onsite truck accident (impact with another vehicle or object).
8. Static electricity during truck filling

3.2 Existing and Proposed Safety Measures and Environmental Controls

During loading, The Truck Loading Area will have the following safety and mitigation measures to reduce or eliminate the impact of spills and fires:

- The Truck Loading Area is graded to drain into the already existing containment channel for the Crude Oil Storage Tanks that connects to the Emergency Containment Basin (ECB);
- Additional berms and containment barriers will be installed around the loading location as needed;
- Spill containment and absorption materials stored onsite;
- Containment container will be placed under truck product hose connections to capture any leakage when hoses are connected and disconnected;
- Firefighting equipment including a fire monitor (converted from a hydrant);
- ExxonMobil operator will be present during truck loading;
- Truck overfill protection, instrumented communication from truck level to LACT unit (Through Scully System or similar) to stop filling if tank is overfilled.
- Ground protection on truck with continue monitoring from LACT skid unit
- Truck driver will also be present during truck loading;
- Truck drivers and loading operators will be trained on the specific loading procedures;
- ExxonMobil operator will have access to the valve shut off for the loading line
- LFC facility has spill response plan and equipment onsite.

3.3 Probability and Consequence Analysis

The probability of each of the hazardous events reference in Section 3.1 occurring was estimated as follows:

- Nominal failure rates [Ref. 7] were considered per Table 2 below.
- Probabilities of events that need to occur at the same time in order for a spill to occur were multiplied.
- Probabilities of events that can occur independently for a spill to occur were added together.

Probabilities of events that would result in a small leak were not estimated (e.g., a small hole in a transfer hose, small leak in hose connection, etc.), because these scenarios would result in a negligible consequence that could be quickly remedied by operating personnel.

Table 2 Failure Types and Their Probabilities [Ref. 3, 5 and 7]

Type of Failure	Nominal Failure Rate Failures per year of operation
Truck Transfer: Rupture of transfer arm	3×10^{-4} per transfer arm [Ref. 7]
Truck Transfer: Rupture of transfer hose	4×10^{-2} per transfer hose [Ref. 7]
Piping (General): Rupture at valve	9×10^{-6} per valve [Ref. 7]
Piping (General): Failure of gasket	3×10^{-2} per gasket [Ref. 7]
Piping: 150-mm (6-inch) ≤d< 299-mm (12-inch) catastrophic rupture	2×10^{-7} per meter of piping [Ref. 7]
Procedure failure (operator error)	5.5×10^{-2} per operation [Ref. 7]
Incorrect hose coupling	4.4×10^{-3} per operation [Ref. 7]
Truck accidents	0.2 per million miles [Ref. 3]

Spills from a truck after an accident	9% of the accident rate [Ref. 3]
Large spill as percentage from all truck spills	25% (reasonable assumption)
Ignition of a spilled pool as percentage of all spills	2% [Ref. 5]

Table 3 Failure Types and Their Consequence

Type of Failure	Worst Case Spill
Rupture or leak of transfer arm or hose	Several barrels. Spill will be stopped when the operator identifies event and shuts off the valve that allows product flow into the hose. Contained onsite.
Rupture at the oil piping valve or connection	Several barrels. Spill will be stopped when the operator identifies event and shuts off the valve that allows product flow into the piping. Contained onsite.
Incorrect hose coupling	Several barrels. Spill will be stopped when the operator identifies event and shuts off the valve that allows product flow into the hose. Contained onsite.
Hose disconnect	Several barrels. Spill will be stopped when the operator identifies event and shuts off the valve that allows product flow into the hose. Contained onsite. (The trucks are equipped with a check valve that will prevent back flow from the filled truck if the loading hose accidently disconnects.)
Full tanker truck failure	160 bbls – full truck contents

Consequences from piping or hose ruptures or leaks would result in a product spill with the maximum volume of 160 bbls (full truck contents). The calculation details of the probabilities are provided in Appendix 4. As shown, product spill incidents from the loading operations are unlikely. Ignition of spilled product is estimated to be 2% of spills, thus a fire hazard scenario is even less likely.

3.4 Safety Risks

Risk is a combination of probability (chance of occurrence) and consequences (serious injury or fatality) of the evaluated incident scenarios. The estimated risks were compared to the U.S. Department of Transportation's Risk Matrix [Ref. 2 and 3] (see Appendix 5) to determine if adverse impacts from the proposed product transportation are potentially significant.

Class I – High probability and severe consequence events

Class II – High probability or severe consequence events

Class III – Low probability and negligible consequence events.

4.0 Probability and Consequence Analysis

The details of hazard scenarios probabilities calculations are presented in Appendix 4. Proposed product loading probability and consequence values were entered into a Risk Matrix, see Appendix 6.

5.0 Conclusions

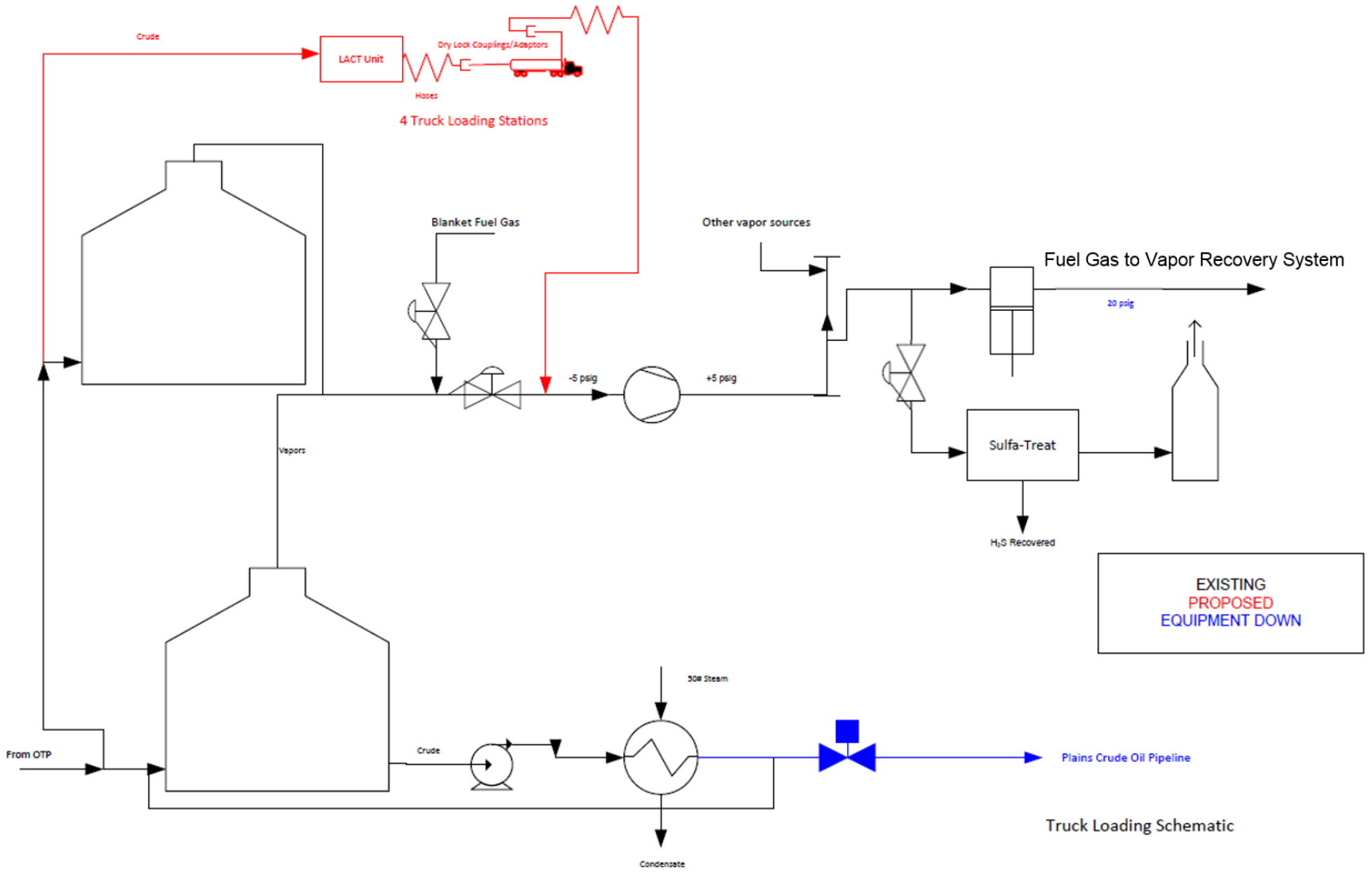
As shown on the Risk Matrix in Appendix 6, most of the hazardous events that could occur from the truck loading activities are considered unlikely. Those events that have a higher frequency of happening fall in the green area (low severity). Therefore, the risk impacts within the LFC facility from the truck loading operations are less than significant.

6.0 References

1. http://www.cgerisk.com/knowledge-base/risk-assessment/risk-matrices CGI Risk Matrix
2. https://www.fhwa.dot.gov/ipd/pdfs/p3/p3_guidebook_risk_assessment_030314.pdf Department of Transportation Risk Matrix
3. Harwood, et. al., *Procedure for Developing Truck Accident and Release Rates for Hazardous Materials Routing*, Journal of Transportation Engineering, Vol 119, No. 2, March/April 1993.
4. Marine Research Specialists (MRS), *Nuevo LPG Transportation Risk Assessment Final Draft Report*, MRS, Ventura, CA March 2004.
5. Golder Associates, *Chevron San Ardo to Coalinga Heated Crude Oil Pipeline Risk Assessment Final Report*, Golder Associates, Inc., Roseville, CA, September 2007.
6. FEMA, USDOT, and USEPA, Handbook of Chemical Hazard Analysis Procedures, Washington D.C.
7. Department of Transportation (DOT) and PHIMSA, Nominal Failure Rates, Feb 2015. https://primis.phmsa.dot.gov/lng/docs/Failure%20Rate%20Table%201.pdf

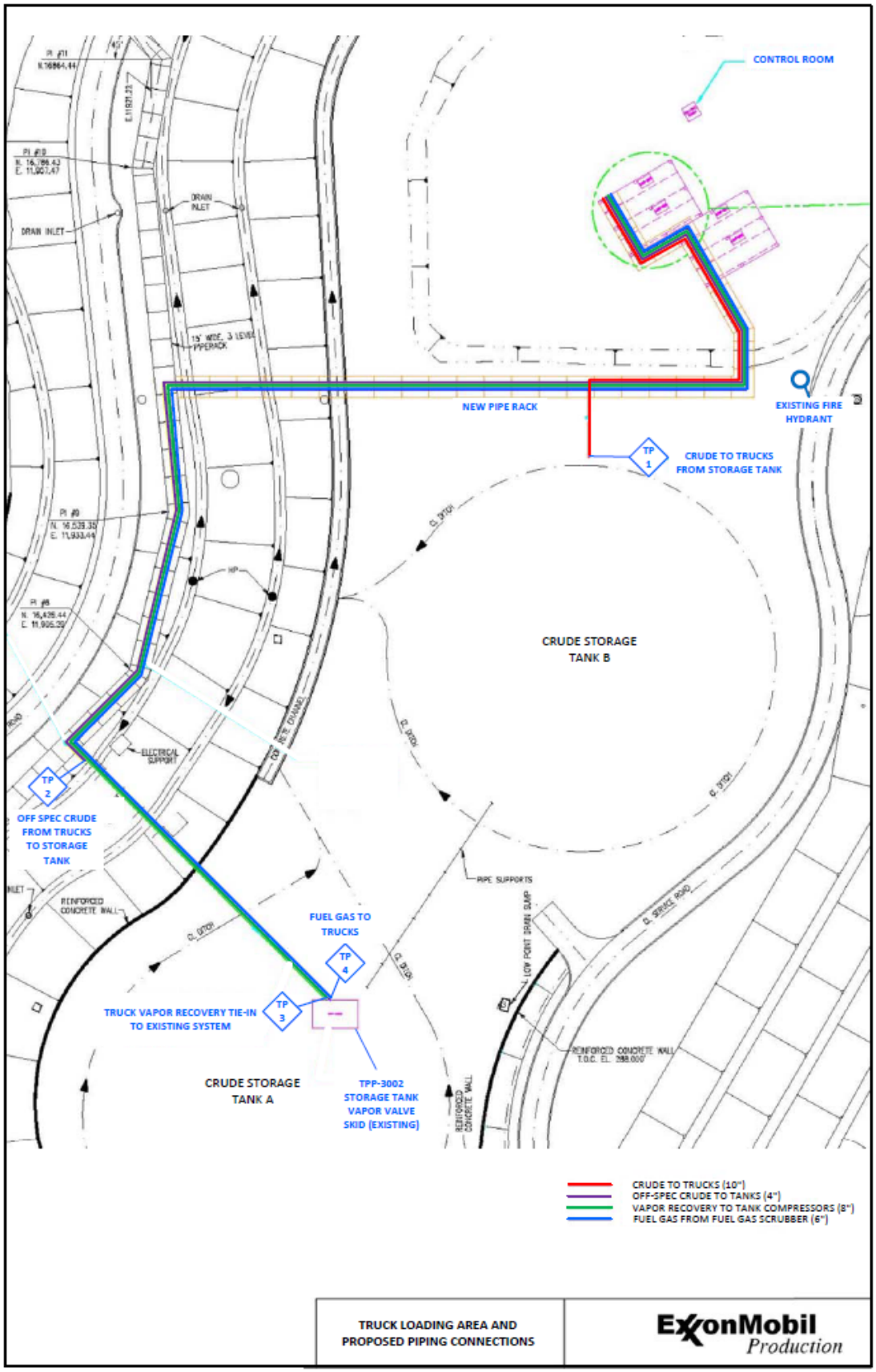
APPENDIX 1

TRUCK LOADING SCHEMATIC


Crude
LACT Unit
Dry Lock Couplings/Adaptors
Hoses
4 Truck Loading Stations
Blanket Fuel Gas
Other vapor sources
Fuel Gas to Vapor Recovery System
20 psig
-5 psig
+5 psig
Vapors
Sulfa-Treat
H2S Recovered
EXISTING
PROPOSED
EQUIPMENT DOWN
50# Steam
From OTP
Crude
Plains Crude Oil Pipeline
Truck Loading Schematic
Condensate

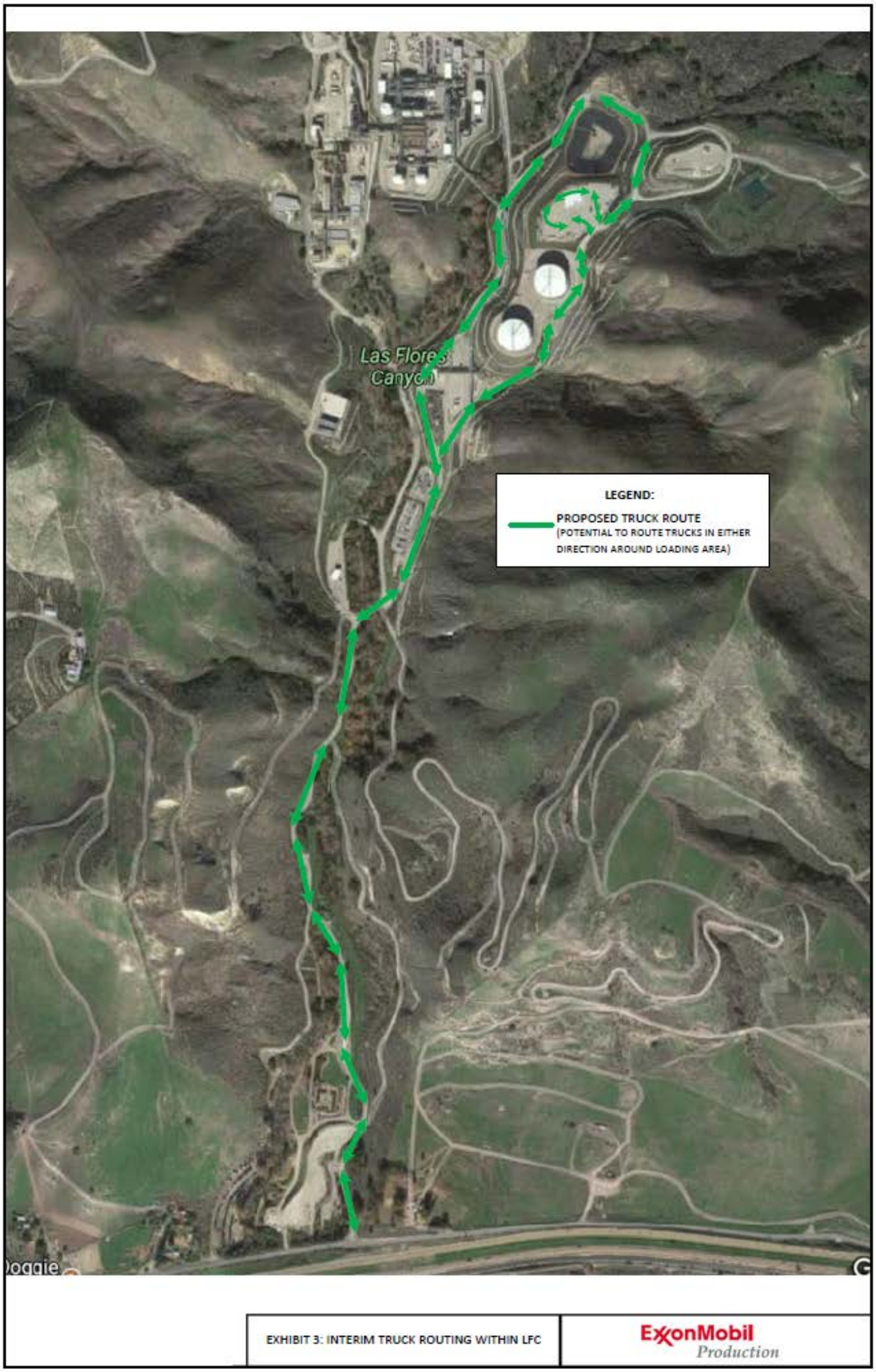
APPENDIX 2

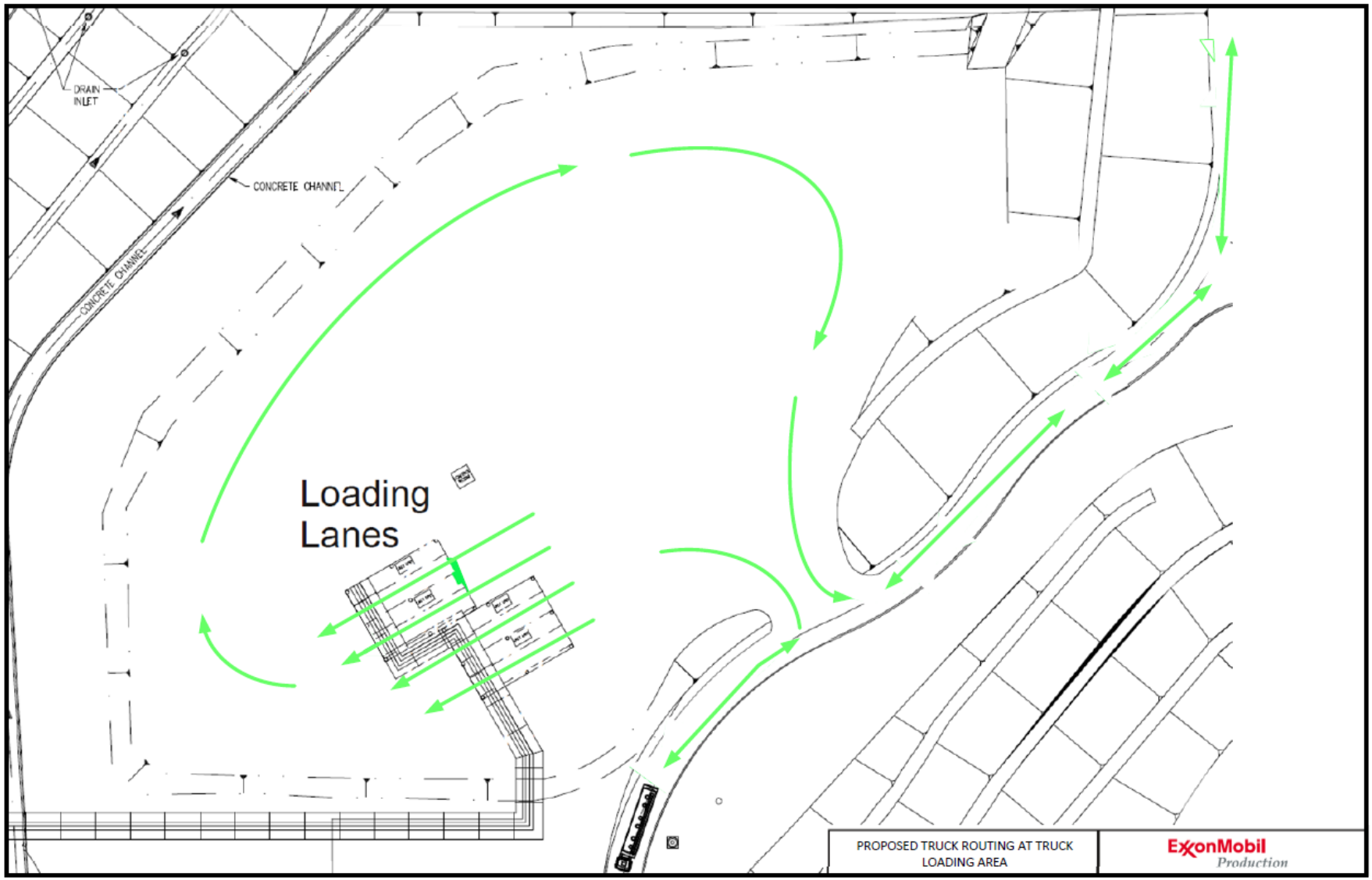
LFC TRUCK LOADING SITE PLAN


CONTROL ROOM
NEW PIPE RACK
EXISTING FIRE HYDRANT
TP 1
CRUDE TO TRUCKS FROM STORAGE TANK
CRUDE STORAGE TANK B
TP 2
OFF SPEC CRUDE FROM TRUCKS TO STORAGE TANK
FUEL GAS TO TRUCKS
TP 4
TP 3
TRUCK VAPOR RECOVERY TIE-IN TO EXISTING SYSTEM
CRUDE STORAGE TANK A
TPP-3002 STORAGE TANK VAPOR VALVE SKID (EXISTING)
PIPE SUPPORTS
DRAIN INLET
REINFORCED CONCRETE WALL
ELECTRICAL SUPPORT
CRUDE TO TRUCKS (10")
OFF-SPEC CRUDE TO TANKS (4")
VAPOR RECOVERY TO TANK COMPRESSORS (8")
FUEL GAS FROM FUEL GAS SCRUBBER (6")
TRUCK LOADING AREA AND PROPOSED PIPING CONNECTIONS
ExxonMobil Production

APPENDIX 3

TRUCK ROUTING WITHIN TRUCK LOADING AREA


Las Flores
Canyon
LEGEND:
PROPOSED TRUCK ROUTE
(POTENTIAL TO ROUTE TRUCKS IN EITHER DIRECTION AROUND LOADING AREA)
EXHIBIT 3: INTERIM TRUCK ROUTING WITHIN LFC
ExxonMobil
Production


DRAIN INLET
CONCRETE CHANNEL
CONCRETE CHANNEL
Loading Lanes
PROPOSED TRUCK ROUTING AT TRUCK LOADING AREA
ExxonMobil Production

APPENDIX 4

RISK CALCULATION DETAILS

Incremental Risk - Proposed Truck Loading: Calculations

Number	Event	Failure rate or probability	Units	Number	Event rate or probability	Reference	Total rate	Value per years (X)
Scenario 1a Release of Crude Oil and Subsequent Fire							**8.69E-11**	**X=11514104778**
1a1	Tanker Truck accident (1 mile within LFC)	1.93E-07	/mile/yr	1	1.93E-07	see QRA for this project		**Occurs every X years**
1a2	Probability of a release	9.00E-02	/accident	1	9.00E-02	see QRA for this project		
1a3	Full load spill (160 bbls)	2.50E-01	/accident	1	2.50E-01	see QRA for this project		
1a4	Probability of ignition	2.00E-02	/spill	1	2.00E-02	see QRA for this project		
Scenario 1b Release of Crude Oil, no fire							**4.34E-09**	**X=230282095**
1a1	Tanker Truck accident (1 mile within LFC)	1.93E-07	/mile/yr	1	1.93E-07	see QRA for this project		**Occurs every X years**
1a2	Probability of a release	9.00E-02	/accident	1	9.00E-02	see QRA for this project		
1a3	Full load spill (160 bbls)	2.50E-01	/accident	1	2.50E-01	see QRA for this project		
Scenario 2 Spill from oil loading - Piping							**2.08E-02**	**X=48**
2a1	Hole in pipe	2.83E-05	/miles/yr	0.095	2.68E-06			**Occurs every X years**
2a2	Leak at valve	5.54E-04	/valve.yr	6	3.33E-03	*Assume 90% of leaks are significant but not catastrophic rupture*		
2a3	Rupture of small threaded connection	2.08E-05	/conn.yr	20	4.17E-04	CCPS with correction for annual fugitive I&M program, 10% ruptures		
2a4	Rupture of small welded connection	2.63E-06	/conn.yr	20	5.26E-05	WASH 1400, weld leaks, 10% to rupture		
2a5	Pump leak	1.70E-02	/yr	1	1.70E-02	HLID, leakage, 10% to rupture		
Scenario 3 Spill from oil loading - Hose							**7.39E-01**	**X=1**
2a6	Hole in loading hose	4.00E-04	/operation	1	4.00E-04	Shell rupture per operation. Leaks assumed to be 10 times greater probability.		**Occurs every X year**
2a7	Incorrect hose coupling	4.40E-03	/operation	1	4.40E-03	Rijnmond 1982		
2a8	Failure to Close valve (operator error)	5.50E-02	/operation	1	5.50E-02	Rijnmond 1982, failure to follow instructions		
2a9	Loading operations	2800	Operations	1	2.80E+03	Number of annual loading operations		

Notes

Piping Failure Rate: Rupture	*4.50E-07*	*Average between WASH, Rijnmond, Lees and CCPS*
Piping Failure Rate: Leak	*2.83E-05*	*Average between WASH, Rijnmond, Lees and CCPS*

Data - Worst possible case (not based on the Air Quality Permit data)

Length of new piping (max)	500	feet
Number of connections	30	
Number of Valves	10	

References

1. Rijnmond,1982. Risk Analysis of Six Potentially Hazardous Industrial Objects in the Rijnmond Area, A Pilot Study
2. CCPS, 1989. Guidelines for Process Equipment Reliability Data, with Data Tables
3. WASH-1400. Reactor and Safety Study. 1975 (mechanical and human failure rates)
4. Lee's Loss Prevention in the Process Industries. 2005

APPENDIX 5

U.S. DEPARTMENT OF TRANSPORTATION RISK MATRIX

Risk Assessment Matrix - Risk Prioritization = Severity vs. Likelihood

Severity Table

#	Severity level	Workplace Safety	Workplace Health	Environment	Fire Damage
5	Critical	Fatality, single or multiple, permanent body injury	Acute Poisoning, Failure of Major Bodily Functions	Large Spills >1000 bbls to Sensitive Resources	More Than $10 million damages
4	Very Serious	Injury requiring 30 days of hospitalization and/or medical leave	Moderate exposure, Reversible injury to Bodily Functions on prolong recovery	Large Spills >1000 bbls to offsite locations, no sensitive resources impacted	More Than $1 million damages
3	Serious	Injury requiring 10 days of hospitalization and/or medical leave	Mild exposure, Reversible injury to Bodily Functions with less than 30 days recovery	Large Spills >1000 bbls outside containment within facility	More Than $100k damages
2	Marginal	Injury requiring maximum of 3 days of medical leave only	Very Mild exposure, Reversible injury to Bodily Functions with less than 3 days recovery	Medium spills 100-200 bbls within facility outside containment	More Than $10k damages
1	Negligible	First aid treatment only, no significant downtime	Very Mild exposure, Reversible injury to Bodily Functions with less than 3 days recovery	Spills inside containment	Less than $5k damages

Likelihood Table

#	Likelihood Level	Likelihood of Occurrence / Exposure Criteria
5	Frequent	Likely to occur many times per year
4	Moderate	Likely to occur once per year
3	Occasional	Might occur once in three years
2	Remote	Might occur once in five years
1	Unlikely	Might occur once in ten years

Risk Level Matrix

		SEVERITY				
		Critical (5)	**Very Serious (4)**	**Serious (3)**	**Marginal (2)**	**Negligible (1)**
LIKELIHOOD	**Frequent (5)**	**25 Not permissible**	**20 Not permissible**	**15 High priority**	**10 Review at appropriate time**	**5 Risk acceptable**
	Moderate (4)	**20 Not permissible**	**16 Not permissible**	**12 High priority**	**8 Review at appropriate time**	**4 Risk acceptable**
	Occasional (3)	**15 High priority**	**12 High priority**	**9 Review at appropriate time**	**6 Risk acceptable**	**3 Risk acceptable**
	Remote (2)	**10 Review at appropriate time**	**8 Review at appropriate time**	**6 Risk acceptable**	**4 Risk acceptable**	**2 Risk acceptable**
	Unlikely (1)	**5 Risk acceptable**	**4 Risk acceptable**	**3 Risk acceptable**	**2 Risk acceptable**	**1 Risk acceptable**

APPENDIX 6

PROPOSED PRODUCT LOADING RISK MATRIX

RISK MATRIX		SEVERITY				
		Negligible (1)	**Marginal (2)**	**Serious (3)**	**Very Serious (4)**	**Critical (5)**
LIKELIHOOD	**Frequent (5)**					
	Often (4)	Hose rupture/Leak Hose disconnect				
	Occasion (3)					
	Seldom (2)					
	Unlikely (1)	Piping or valve failure	Truck accident with a leak	Truck accident with a full tank spill		