

**DEVELOPMENT OF A DYNAMIC RISK ASSESSMENT  
FRAMEWORK FOR LPG TRANSPORTATION  
PIPELINES**

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## DECLARATION

I declare that this dissertation is my own work, and it does not contain any material previously submitted for a degree or diploma at any other university or institute of higher learning without acknowledgment, and it does not contain any material previously published or written by another person, except where acknowledgement is made in the text.

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## ABSTRACT

The present study introduces an innovative methodology for dynamic risk assessment of a hypothetical Liquid Petroleum Gas (LPG) offloading pipeline. The study mainly focuses on the determination of the probability of a catastrophic event dynamically, which is a major component in risk assessment. The output of this study is an open model for dynamic risk assessment of an LPG offloading pipeline with the potential of adopting it in any other application.

The developed model presents the identification of the site and an analysis of the surrounding land uses, design, and related operations. Then it identifies the potential hazards. The traditional Bow-Tie diagram is created based on the identified risks and safety barriers. The Bow-Tie Diagram is then converted to a Bayesian network. The Bayesian network uses conditional probability tables which can be further improved for better reliability by introducing updated knowledge and experience.

The method was trialled using a hypothetical scenario followed by a consequence analysis. A jet fire simulation is done using FLACS<sup>®</sup>, which is an industrial Computational Fluid Dynamics (CFD) code, to support the risk analysis. Financial losses connected with environmental damage, cleanup, evacuation, and lost output are among the consequences.

The dynamic risk assessment framework presented in this study facilitates systematic decision-making on the LPG pipeline at almost any probable event. Further, it can be trained with experience and expert judgement.

**Keywords:** Dynamic Risk Assessment, LPG offloading Pipeline, Bayesian network, FLACS<sup>®</sup>, CFD

## **DEDICATION**

To my loving parents, Somapala Galagedara and Indrani Kolambage, who brought me up to this level, and to my loving wife, Lekshika, for all the support given.

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## LIST OF ABBREVIATIONS

BN	Bayesian network
BT	Bow-Tie
CFD	Computational Fluid Dynamics
COF	Consequence of Failure
CPT	Conditional Probability Tables
DRA	Dynamic Risk Assessment
DyPASI	Dynamic Procedure for Atypical Scenarios Identification
EC	Environmental consequence Cost
ETA	Event Tree Analysis
FT	Fault Tree
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
IC	Inspection Cost
IO	Integrated Operations
LDS	Leak Detection System
LNG	Liquefied Natural gas
LOP	Lost Production Cost
LPG	Liquefied Petroleum Gas
MLV	Main Line Valve
OREDA	Offshore and On shore Reliability Data
PCA	Principle Component Analysis
QRA	Quantitative Risk Analysis