EDUARDO CALIXTO
CONSULTING

"Reliability and Maintainability Data Base for Oil and Gas Industry"

(Refineries, Chemical and Petrochemical plants)

2020

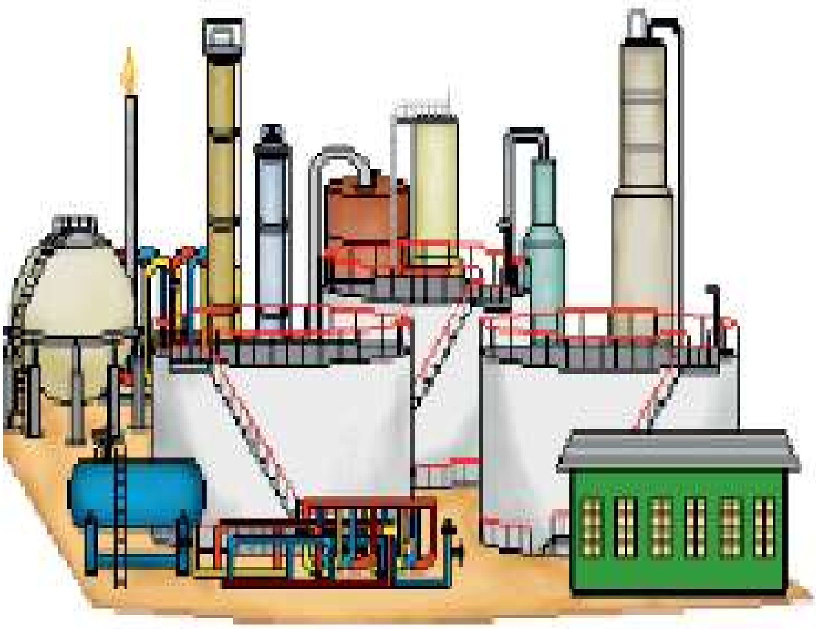


TABLE OF CONTENTS

1. INTRODUCTION

1.1 PURPOSE OF THIS DOCUMENT

The ECC reliability database aims to provide the information of equipment reliability performance of oil and gas downstream system. The reliability database provides reliability data based on Weibull 2P (to parameters) values and expected time to failure (ETF). In addition, the repair/replace time is represented by the Normal PDF.

Based on such data, this information enables to reliability, maintenance and asset management professional to apply as reference for reliability requirement, input for RAM analysis, Risk analysis.

1.2 METHODOLOGY

In order to build up such database, the historic of hundred equipment as well as my experience over 20 years as reliability engineering in oil and gas industry was considered.

However, this database, different of others, is defined in component level. Because of different equipment configuration, it was considered the most critical component that affects the equipment reliability performance.

The reliability data base is presented in level 1 (equipment) and level 2(component).

The main equipment of Oil and gas industry of downstream is divided in different types of equipment and system such as:

- Rotating;
- Static;
- Safety and Control;
- Utilities.

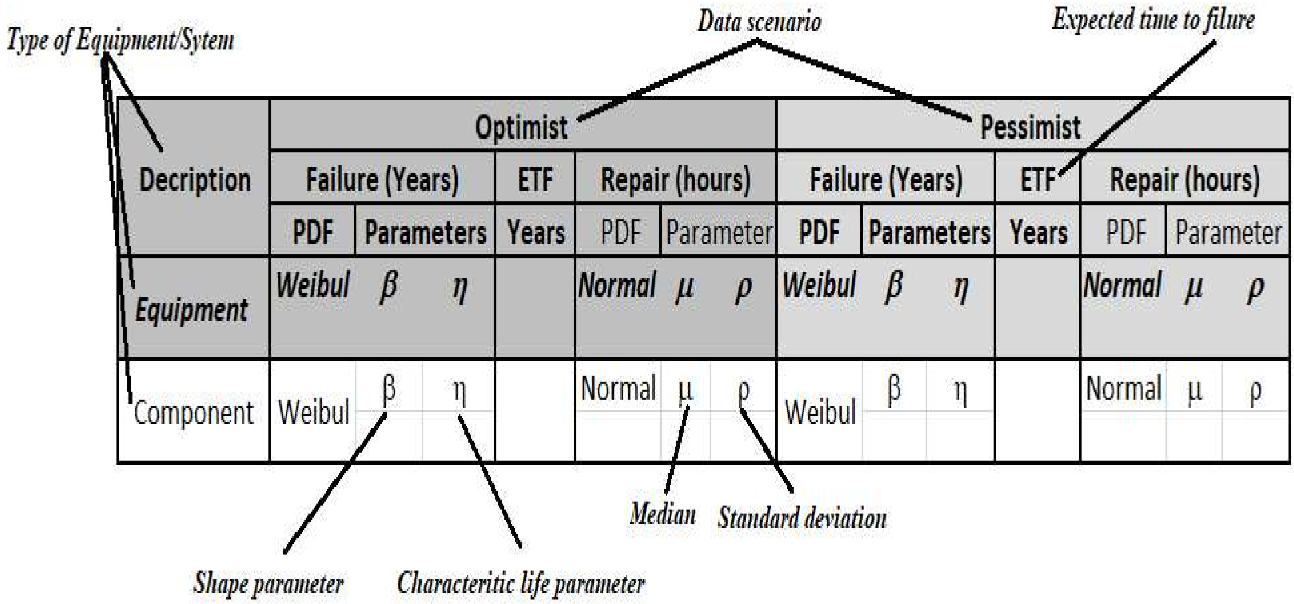
1.3 DATABASE STRUCTURE

The reliability database is structured in a template divided in two scenarios such as optimist and pessimist. In the scenario optimist the first quartile (best 25%) of the historical data are used to define the Weibull 2p PDF and Normal PDF data. By the other hand, in the pessimist scenario, use the 3rd quartile (25% worse) of the historical data.

Suh scenarios definition enables the users to choose the data that better applies to the reality of their system/ equipment.

In the first column, the equipment and component description are defined in the second and third lines. The second column is divided in failure (years), ETF and repair (hours). Below this line, the PDF and the parameters are defined for both scenarios (optimist and pessimist).

The ETF is reference of failure time to make easier the users that are not reliability experts to have an easier understand about the occurrence time of the failure. However, I suggest using the PDF parameter for any reliability performance prediction as well as graph description.



The most famous PDF among reliability engineers is the Weibull function, which based on its generic characteristics, can represent Exponential, Lognormal, Normal and Gumbel shape features. In fact, the Weibull PDF can have any of those characteristics, which means a random failure occurrence over the life cycle, or failure occurrence at the early life phase or in the wear out phase, which represents the Exponential, Normal or Gumbel PDFs. The Weibull PDF shape behavior depends on the shape parameter (β), which can be:

- $0<\beta<1$ (Asymptotic shape);
- $\beta=1$ (Exponential asymptotic Shape);
- $1<\beta<2$ (Lognormal Shape);
- $2<\beta<4$ (Normal Shape);
- $\beta>4$ (Normal and Gumbel Shape).

Regarding shape parameter, as the beta value gets higher, the PDF shape starts to change from early life phase to wear out phase. The Weibull 3P PDF has three parameters: a shape parameter (β), a characteristic life parameter (η), and a position parameter (γ). If the position parameter is zero, which is the most common case, the Weibull PDF has two parameters (Weibull 2P). The characteristic life or scale parameter means that 63.2% of failures will occur until the η value, that is, a period of time. The position parameter represents how long equipment has 100% reliability; in other words, there will be no failure until the γ value is achieved, which is a certain period of time. The brief description of the Weibull PDF is described above. For more technical details please see the appendix A.

2. ONSHORE EQUIPMENT

2.1 Rotating Equipment

2.1.1 *Pumps* (Component: Seal, Bearing, Shaft, Impeller, O-Ring, Casing, Packing, Coupling, Nozzle)

Description	Optimist							Pessimist						
	Failure (Years)			ETF	Repair (hours)			Failure (Years)			ETF	Repair (hours)		
	PDF	Parameters		Years	PDF	Parameters		PDF	Parameters		Years	PDF	Parameters	
Pump	***Weibull***	β	η		***Normal***	μ	ρ	***Weibull***	β	η		***Normal***	μ	ρ
Seal	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
Bearing	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
Shaft	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
Impeller	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
O-ring	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
Casing	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
Packing	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
Coupling	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ
Nozzle	Weibull	β	η		Normal	μ	ρ	Weibull	β	η		Normal	μ	ρ