

# Preliminary Data Analysis

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# Glosarium

This chapter provides definition of terms used in this report, which refers to relevant references such as articles or documentations.

Planned shutdown	:	Unit shutdown due to maintenance activity, either preventive (PV) or condition based-maintenance (CD)
Unplanned shutdown	:	Unit shutdown due to total black out (TBO) or furnace grid backout (FBO), or other external factor (transmission line, CB, etc)
Planned maintenance optimization (PMO)	:	



# Chapter 1

## Introduction

In this chapter, the introduction of observed and analyzed plant (Larona site) will be provided.

### 1.1 Load Operation

There are three conditions of load operation.

1. Low Load : 10 MW
2. Normal Load : 40 - 45 MW
3. High Load : 55 - 60 MW

### 1.2 Provided Preliminary Data

The parameters that used as preliminary data (provided by PTVI) are listed below.

1. Mechanical parameter (total 10 parameters)
  - (a) Speed 1 (*RPM*)
  - (b) Speed 2 (*RPM*)
  - (c) Wicked Gate Opening (%)
  - (d) Penstock Pressure ( $kg/cm^2$ )
  - (e) Penstock Flow (*Cumecs*)
  - (f) Turbine Flow (*Cumecs*)
  - (g) Efficiency (*Cumecs/MW*)
  - (h) Upper Guide Bearing (UGB) displacement at X- and Y-axis ( $\mu m$ )
  - (i) Turbine Guide Bearing (UGB) displacement at X- and Y-axis ( $\mu m$ )
  - (j) Lower Guide Bearing (UGB) displacement at X- and Y-axis ( $\mu m$ )
2. Electrical parameter (total 10 parameters)
  - (a) Active power (*MW*)
  - (b) Reactive power (*MVAr*)
  - (c) Frequency (*Hz*)
  - (d) Excitation Voltage (*V*)
  - (e) Excitation Current (*A*)
  - (f) Voltage on Phase 1, 2, and 3 (*V*)

- (g) Current on Phase 1, 2, and 3 ( $kA$ )
  - (h) Modbus MVAR
  - (i) Modbus MVA
  - (j) Power factor ( $CosPhi$ )
  - (k) Stator winding temperature 13, 14, and 15 ( $^{\circ}C$ )
  - (l) Stator core temperature ( $^{\circ}C$ )
3. Thermal and Hydrodynamic parameter (total 11 parameters)
- (a) UGB metal and oil temperature ( $^{\circ}C$ )
  - (b) LGB metal and oil temperature ( $^{\circ}C$ )
  - (c) Gen. air cooler water inlet temperature ( $^{\circ}C$ )
  - (d) Gen. air cooler air outlet temperature ( $^{\circ}C$ )
  - (e) Gen. cooler water flow ( $LPM$ )
  - (f) UGB cooler water flow ( $^{\circ}C$ )
  - (g) LGB cooler water flow ( $^{\circ}C$ )
  - (h) Lower canal level ( $msAL$ )
  - (i) TailRace level ( $msAL$ )
4. Maintainability and Availability parameter (total 2 parameters)
- (a) Planned and unplanned shutdown time and duration ( $h$ )
  - (b) Daily, monthly, and annually (physical) availability of system (%)

### 1.3 Preliminary Data Properties

Each files are observed, several parameter are checked:

1. Number of provided variable on data
2. Time sampling
3. N/A checking

## **Chapter 2**

# **Data Analysis**

### **2.1 Planned and Unplanned Shutdown**

### **2.2 PMO Hydro Data**

### **2.3 Vibration Data**

### **2.4 Failure Mode and Effect Analysis**

### **2.5 Physical Availability**

### **2.6 Raw Data from PI System**



## **Chapter 3**

## **Discussion**





## **Chapter 4**

# **PI Implementation**