As-Built

REV	DATE	DESCRIPTION	Approved	Checked	Prepared
AB0	26 Jun 2023	As-Built	N.Hirata	N.Hirata	K.Katekari

OWNER

VAN PHONG POWER COMPANY LIMITED

PROJECT

Van Phong 1 BOT Thermal Power Plant Project

OWNER'S ENGINEER

AFRY Switzerland Ltd.

Status
☐Approved
☐Approved with Comment
☐Not Approved
☐Reviewed
☐Reviewed with Comment

EPC CONTRACTORS

IHI-TESSC-CTCI-DHI CONSORTIUM

PROJECT DOCUMENT No	REV
VP1-C-L2-M-MAV-00002	**AB0**

DOCUMENT TITLE

System Design Description For Lube Oil System

EPC	EPC DOCUMENT No.	REV
Toshiba Energy Systems & Solutions Corporation	**DDKT04090**	**c**

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設計要項表 Design Data Sheet

名称 TITLE

SYSTEM DESIGN DESCRIPTION OF TURBINE LUBE OIL SYSTEM

客先名 CUSTOMER	:	Van Phong Power Company Ltd. (VPCL)
系統機器 EQ/SYS.	:	MAIN TURBINE GENERATOR LUBE OIL SYSTEM
製番 JOB	:	M211087 CJ
プラント PROJECT	:	Van Phone 1 Thermal Power Plant Project

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TOSHIBA ENERGY SYSTEMS & SOLUTIONS CORPORATION Keihin Product Operations

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設計要項表 Design Data Sheet

1.1.1.1 Table of Contents

TOSHIBA

設計要項表 Design Data Sheet

1. Introduction

This document covers system design description of the Main Steam Turbine & Generator Lube Oil system.

Reference Drawings

VP1-C-L2-P-MAV-00001	:	PIPING AND INSTRUMENT DIAGRAM FOR STEAM TURBINE GENERATOR LUBE OIL SYSTEM
VP1-C-L2-M-MAV-00006	:	OUTLINE DRAWING FOR MAIN OIL TANK
VP1-C-L2-M-MAV-00001	:	System Design Description for Lube Oil Conditioning System
VP1-C-L2-I-GEN-00011	:	Set Point List for LOT2 portion
VP1-C-L2-I-CB- 00005	:	Logic Diagrams for Steam Turbine Systems

2. System Overview

Turbine lubrication oil system is "closed loop" pumping oil supply system. The lubrication oil is stored in the main oil tank(*0MAV10BB001) and is pumped up by AC motor driven main oil pumps(*0MAV15AP001-M01/ *0MAV16AP001-M01) to the each shaft bearings through main oil throttle valve(*0MAV15AA003), main oil cooler (*0MAV21AC001/*0MAV21AC002), duplex oil filters(*0MAV31AT001/*0MAV31AT002) and bearing oil piping. The return oil from shaft bearings are collected to the return oil piping and come back to the main oil tank after passing through the return oil strainer installed in the main oil tank.

3. Lubrication Oil

ISO VG32 Turbine #90 is applied to the turbine lubrication oil system.
Cleanliness of lube oil shall be maintained at NAS Grade7 or better.(equivalent to ISO4406 18/16/13 or better)

Recommended Oil	
<Supplier>	<Trade Name>
Mobil	DTE 732
Shell	Turbo T32

4. Oil Pumping System

4.1. General

Two (2) x 100% main oil pumps(*0MAV15AP001KP01, *0MAV16AP001KP01) driven by AC motor and One (1) x 100% emergency oil pump(*0MAV12AP001KP01) driven by DC motor are provided to supply bearing oil to the turbine/ generator bearings while the turbine is on turning gear, while the turbine is coming up to speed, during normal conditions or in an emergency condition. They take suction oil directly from the oil tank(*0MAV10BB001)and discharge it into the bearing header after the main oil coolers(*0MAV21AC001/*0MAV21AC002) and duplex oil filters(*0MAV31AT001/*0MAV31AT002). Details of these pumps are described in chapter 6 and chapter 7.
In normal condition, one of the main oil pumps provides oil to the system. Prior to startup, an operator select running pump and stand-by pump through the turbine control system. The operating hours on the pumps and motors can be equalized by alternating which pump is running and which pump is stand-by.
In emergency condition, oil is provided to the system by emergency oil pump. This pump capability is determined by the required capacity for emergency case.

The main oil throttle valve(*0MAV15AA003) is provided as a pressure adjuster of the system so that sufficient oil can be fed to the bearings. The valve is located in main oil tank(*0MAV10BB001) and installed upstream of main oil coolers(*0MAV21AC001/*0MAV21AC002). The valve is adjusted to hold the bearing header pressure at approx. 0.18MPag at the turbine centerline.

The scope of control of all drives and valves shall be as per P & ID.

TOSHIBA

設計要項表 Design Data Sheet

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TOSHIBA

設計要項表 Design Data Sheet

4.2. Operation

In normal condition, one of the main oil pumps(*0MAV15AP001KP01, *0MAV16AP001KP01) shall be started before turning gear starts for bearing oil supply.
In emergency like AC supply failure or both of main oil pumps(*0MAV15AP001KP01, *0MAV16AP001KP01) are tripped, emergency oil pump(*0MAV12AP001KP01) will start.

4.3. Pressure adjustment

Bearing pressure can be adjusted by main oil throttle valve(*0MAV15AA003) and bypass orifice plate, those are connected in parallel in the bearing feed line. The bypass orifice line is designed to supply the minimum oil flow to the bearing header in case that the throttle valve is fully closed.
Bearing pressure shall be checked and adjusted at the initial start or first start of turbine unit after modification or repair which may affect the lubrication system characteristics. It is not mandatory requirement to adjust the pressure in normal (usual) turbine start up.
The throttle valve should be adjusted slowly not to change the bearing pressure suddenly.

Adjustment process

- Main oil throttle valve(*0MAV15AA003) is fully opened before one of the main oil pumps(*0MAV15AP001KP01, *0MAV16AP001KP01) is started.
- When a main oil pump is started, check if the bearing oil pressure at the front standard is over 0.2MPag.
- After turning operation is started, the bearing pressure will be slightly decreased. Bearing pressure shall be adjusted to approx. 0.2MPag by adjusting the throttle valve.
- During turbine speed up, the bearing pressure will be decreased as turbine speed is increased. Check the bearing oil pressure carefully and adjust the throttle valve to keep the bearing oil pressure 0.18MPag or higher.
- The viscosity of the lube oil changes with its temperature, so the lube oil pressure may change when temperature is not stabilized. The lube oil temperature is increased as turbine speed is increased and the temperature becomes stabilized some time after turbine load reaches to the rated load. Bearing pressure shall be checked periodically until the feeding oil temperature reaches sufficient stability.
- In case bearing oil pressure is changed, adjust to 0.18MPag by adjusting the throttle valve.

Purpose of each pressure indicator/transmitter

- AT BEARING HEADER(*MAV49CP001) - The bearing header pressure transmitter represents the oil pressure at the turbine operating floor elevation so it is the actual inlet pressure to the main bearings. It is normally set about 0.18MPag when the turbine is running at rated speed.
- AT OIL PUMP DISCHARGE(*0MAV15CP501, *0MAV16CP501, *0MAV12CP501) - The oil pump discharge pressure is measured at the upstream of the check valve. This indicator is used for checking if the check valve is opened or closed.
- AT FRONT STANDARD - This is for checking the bearing oil pressure at the turbine level of the system.
  A pressure indicator is mounted on the front standard.

Purpose of each Temperature indicator/element

- BEARING METAL TEMPERATURE(*0MAD10CT003, *0MAD10CT005, *0MAD10CT015,*0MAD10CT017,
- *0MAD10CT019, *0MAD10CT021, *0MAD10CT023, *0MAD10CT001, *0MAD10CT007, *0MAD10CT009,
- *0MAD10CT013, *0MAD10CT011,)
  These temperature measurements points are used for monitoring the bearing metal temperature.
- BEARING OIL DRAIN TEMPERATURE(*0MAV41CT001, *0MAV43CT001, *0MAV43CT003,
- *0MAV43CT005, *0MAV43CT007, *0MAV45CT003, *0MAV45CT001, *0MAV47CT001, *0MAV47CT003,
- *0MAV49CT001, *0MAV49CT003,)
  These temperature measurements are used for monitoring the drain oil temperature.
- MAIN OIL COOLER OUTLET OIL TEMP(*0MAV30CT001)
  These are used for control the Lube Oil TCV. Local temperature indicator(*0MAV30CT501) at Main oil cooler outlet is provided.

- MAIN OIL COOLER INLET OIL TEMP(*MAV15CT001) and MAIN OIL TANK TEMP. (*MAV10CT501) These are used for monitoring purpose. A local temperature indicator(*MAV10CT501) at Main oil cooler inlet on main oil tank(*0MAV10BB001) is provided.
- Local temperature indicators at each bearing to indicator drain oil temperature(*0MAV41CT503,
- *0MAV43CT503, *0MAV43CT505, *0MAV43CT507, *0MAV43CT501, *0MAV45CT501, *0MAV45CT503,
- *0MAV47CT503, *0MAV47CT501, *0MAV49CT501, *0MAV49CT503) are furnished at each drain oil flow sights.

4.4. Flow adjustment.

The each flow to bearing decided considering bearing type, size and load. Each lube oil supply pipe has an orifice which size is chosen to achieve the required flow.

5. Main Oil Tank

5.1. General

The main oil tank(*0MAV10BB001) has sufficient capacity to store all of the lube oil required The main oil tank is located below the turbine operating floor so that oil drainage from the turbine/generator bearings can be returned to the main oil tank by gravity, with all oil drain piping properly pitched downward to assure positive drainage at all time.

The following equipments are mounted on the main oil tank;

- Two (2) main oil pumps (MOP), AC motor driven(*0MAV15AP001KP01, *0MAV16AP001KP01)
- One (1) emergency oil pump (EOP), DC motor driven(*0MAV12AP001KP01)
- Two (2) main oil tank vapor extractors(*0MAV10AN001KN01, *0MAV10AN002KN01)
- Instrument panel(*0MAV10GH001)
- Temperature indicator/ element for alarm & monitoring purpose(*MAV10CT501, *MAV15CT001, *0MAV10CT001)
- Level Transmitter with Indicator(*0MAV10CL001)
- Return oil strainer (30mesh)

5.2. General specification of main oil tank

- Tank capacity of normal level: 35,000 L
- Normal oil level: 1114 mm (from the top surface of oil tank)
- Tank level high / low: 1014mm / 1214mm (from the top surface of oil tank)
- Tank negative pressure: 25mmAq to 38mmAq (VAC)

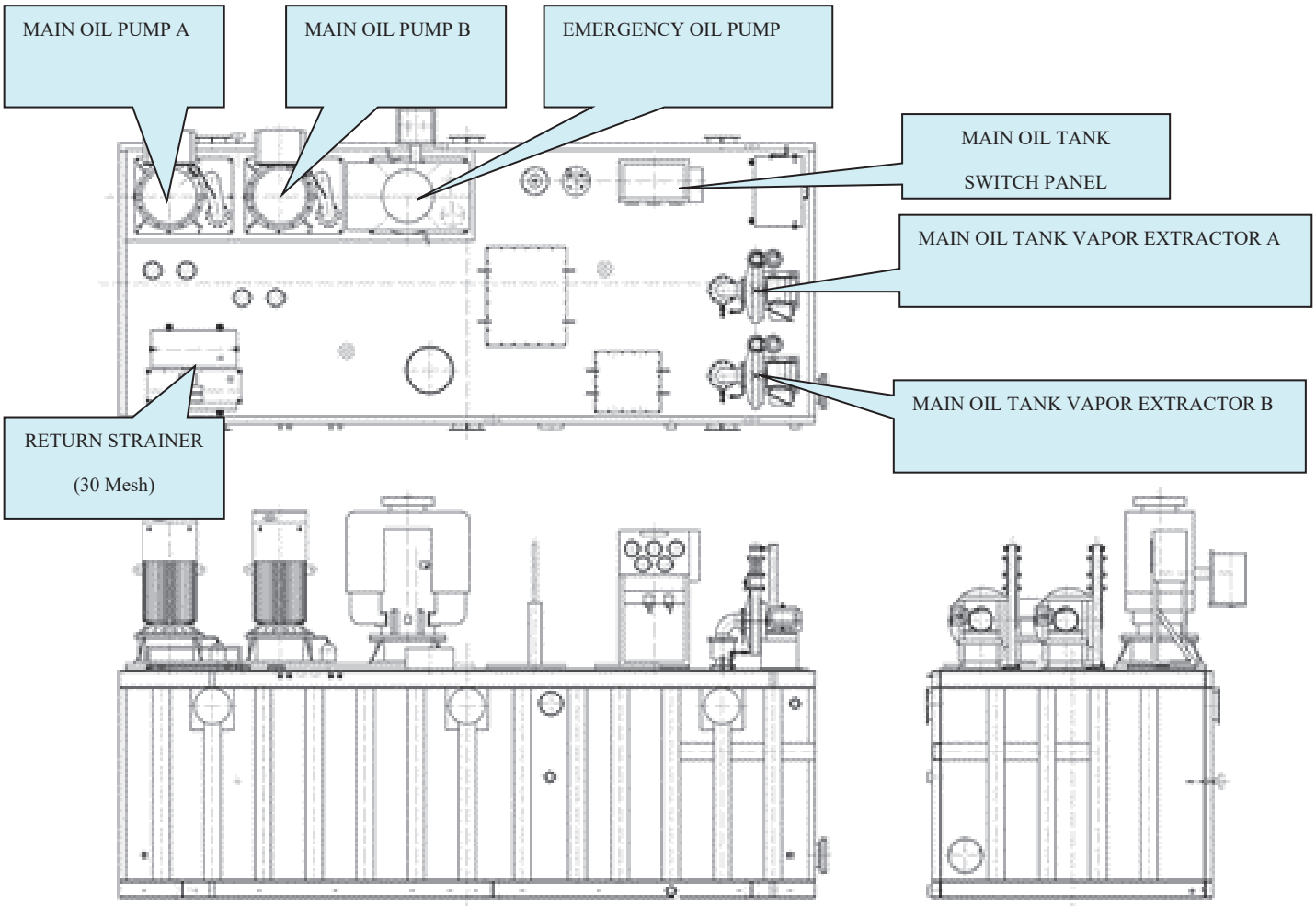
The circulation time with a standard oil volume of 35000L is approx.6 minutes.This means that oil change happens about 10 times at 1 hour.

TOSHIBA

設計要項表 Design Data Sheet

5.3. Main Oil Tank Level

During normal operation, the oil level is around normal oil level.
After turbine is shutdown, the pumping system is shutdown. Then, the most the lube oil in feed/return oil piping, bearings and other equipments flow back to the main oil tank. The main oil tank is designed considering the flow back so that the oil does not overflow at shutdown.
If oil level becomes less than low oil level, the alarm is initiated in the control room. The low oil level is high enough considering NPSH of main oil pumps(*0MAV15AP001KP01, *0MAV16AP001KP01) and emergency oil pump(*0MAV12AP001KP01) so that an operator can trip the pump in safe.
The oil level transmitters are provided with level indicators (Float type). Oil level low or level high signal from level transmitters are used to alarm for either of the two conditions. Their operating points of switches are set at factory, and should not be altered.



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設計要項表 Design Data Sheet

6. Main Oil Pump

6.1. Outline of Construction

Two (2) x 100% main oil pumps(*0MAV15AP001KP01, *0MAV16AP001KP01) are vertical, centrifugal, single suction, single stage volute pumps driven by AC motor. The pumps are mounted on main oil tank(*0MAV10BB001). The pump shaft is supported by the bearings installed in the lower and upper casing. It is of the overhung type with an impeller provided at tip end of the shaft. The ball bearing and plain bearing are used. The radial load of the revolving body and thrust load by the impeller are received by means of the ball bearing at the upper part.

6.2. General specification of main oil pump

- Fluid: Turbine oil -2 ISO VG32
- Flow Rate: 5740 L/min
- Discharge Press. 0.68MPag
- Revolution: 3,000 min^{-1}
- Motor power: 150 kW, 400VAC, 50Hz

7. Emergency Oil Pump

7.1. Outline of Construction

One (1) x 100% emergency pump(*0MAV12AP001KP01) is the vertical, centrifugal, single suction, single stage volute pump which is driven by DC motor. Other major mechanical configuration is almost same as main oil pumps.

7.2. General specification of emergency oil pump

- Fluid: Turbine oil -2 ISO VG32
- Flow Rate: 4687 L/min
- Discharge Press. 3.2 barg
- Revolution: 1,750 rpm
- Motor power: 65 kW

8. Vapor Extractor

8.1. General

Two (2) x 100% vapor extractors(*0MAV10AN001KN01, *0MAV10AN002KN01) , driven by AC motor, are furnished in order to ventilate the air in the space above the oil level, the suction connections of vapor extractors are located on the top surface of main oil tank.
The vapor extractor shall be operated continuously while the turbine-generator is in service. The vapor extractor extracts air and moisture from the lubrication system to atmosphere through the oil mist eliminator. Each bearing chambers are connected to Main Oil Tank(*0MAV10BB001) through return oil pipe. The return oil pipe size is designed to be larger than return oil volume, so that each bearing can be always kept in negative pressure by vapor extractor through return oil pipe. This provides venting of the bearing pedestals and creates a small flow of cool air through the oil deflectors in order to prevent oil accumulation and carbonization in the deflector teeth and on the turbine shaft.
Removal of saturated air above the oil level in the tank will promote evaporation of water from the oil which can be the cause of oil deterioration, rust and so on.

8.2. General specification of Vapor extractors

- Discharge volume 12 m^3/min
- Revolution: 3,000RPM
- Motor power: 3.7kW, 400VAC / 50Hz

TOSHIBA

設計要項表 Design Data Sheet

8.3. Description

The vapor extractor assembly includes a centrifugal blower(*0MAV10AN001KN01, *0MAV10AN002KN01), an AC motor, and butterfly valves(*0MAV10AA001, *0MAV10AA005).
The centrifugal blower has flanged inlet and outlet connections with a bottom horizontal discharge. The blower impeller is mounted directly on the motor shaft extension. The vapor extractor flow-rate, or the oil tank negative pressure, is regulated by the butterfly valve(*0MAV10AA001, *0MAV10AA005) at the discharge line. This valve should be adjusted to discharge to a roof vent only the amount of vapor necessary to hold the desired negative pressure in the lube oil tank between 25mmAq to 38mmAq(VAC).
The hand-operated butterfly valve(*0MAV10AA001, *0MAV10AA005) is provided with an adjustable screw for locking the valve in any desired position. Oil tank pressure is measured by the pressure indicator at instrument panel mounted on the tank.

8.4. Running

With the oil systems closed up (access doors at oil tank and at standard is closed), adjust butterfly valve to obtain negative pressure of 25mmAq to 38mmAq(VAC) at the main oil tank.
The position of butterfly valves(*0MAV10AA001, *0MAV10AA005) is locked during normal operation.
The turbine lube oil system consists of 2 x 100% main oil pumps(*0MAV15AP001KP01, *0MAV16AP001KP01).
A main oil pump (MOP) is driven by AC motors (electrical power is sourced from normal bond for one MOP, the same is sourced from emergency board for the other one.) and shall start before turning gear starts. While turbine is rotating, at any condition, MOP is used for bearing oil supply without emergency like AC supply failure or both of MOP being shut down.

9. Main Oil Cooler

Two (2) x 100% main oil coolers(*0MAV21AC001/*0MAV21AC002), cooled by DM water are provided to maintain the lubrication oil temperature in the operation range by means of the controlling the amount of cooling water. In normal condition, one (1) oil cooler is in service and the other is stand-by. Those can be switched over by main oil cooler transfer valve(*0MAV15AA001).
Lubrication oil temperature is monitored by temperature transmitter at the connecting pipe between the main oil coolers(*0MAV21AC001/*0MAV21AC002) and duplex oil filters(*0MAV31AT001, *0MAV31AT002).

10. Main Oil Filter

Two (2) x 100% duplex oil filters(*0MAV31AT001, *0MAV31AT002) are furnished at downstream of main oil coolers. In normal condition, one (1) main oil Filter is in service and the other is stand-by. Those can be switched over by manually by main oil Filter transfer valve.
In case the filter is clogged, the differential pressure transmitter(*0MAV30CP001) with indicator sends alarm signal to control panel as a notice for the filter exchange.

TOSHIBA

設計要項表 Design Data Sheet

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TOSHIBA

設計要項表 Design Data Sheet

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b		DRS-A015159	Y.Nakamura Mar.03.2021	Y.Nakamura Mar.03.2021	Y.Tanaka Mar.03.2021
c		DRS-A015174	See Cover Page	See Cover Page	See Cover Page