ALTERNATIVE POWER SUPPLY OPTIONS FOR SAFE SHUTDOWN OF LAKVIJAYA POWER PLANT IN A TOTAL BLACKOUT

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Degree of Master of Science

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DECLARATION

The work submitted in this dissertation is the result of my own investigation, except where otherwise stated.
It has not already been accepted for any degree, and is also not being concurrently submitted for any other degree.

…….
G.W.Vajira Priyantha

Date: ……

We/I endorse the declaration by the candidate.

…….
Prof. H.Y.Ranjith Perera

ABSTRACT

Lakvijaya Power station with a capacity of 300MW is designed to deliver generated power to national grid initially over Veyangoda transmission lines. But there is no other auxiliary power supply from the grid. In addition to above lines, there is no other auxiliary power supply from the grid. Since commissioning of the plant, two incidents have taken place showing the inadequacy of the existing arrangement.

At 12.15 hours on 7th June 2011, the Plant had been in operation at 260MW & 181MVar and Veyangoda line 1 and 2 tripped from Veyangoda end which resulted in an Island wide blackout. Lakvijaya machine tripped without stabilizing at the house load. Consequently the plant was without an electricity supply. At the same time Standby diesel generator of 800 kVA failed to start. Further, Plant DC supply failed causing an unsafe shutdown resulting damages and lifetime reductions to the plant and its subsystems such as rupturing of the diaphragm in LP turbine, drop in drum water level below tripping limit, rising condenser hot well level closer to the tripping limit, rising condenser vacuum pressure up to tripping limit, rising condenser steam temperature to a level which effect to condenser tubes and damaging of bearing due to pressure dropped in jacking oil pressure etc. A similar failure took place on 08th August 2012.

This study is carried out to investigate the different options available to improve power supply situation eliminating such incidents in future.

Initially all subsystems of the plant had been thoroughly analyzed and identified all possible bad consequences on the subsystems due to improper shutdown. A time analysis was done to find out the time taken by each subsystem to reach its tripping limits or withstanding time of subsystem before component failure during such an improper shutdown process.

After collecting data from the site, detailed power system analysis including load flow studies were conducted using the 'Power World Simulator' software package considering possible unit auxiliary standby power supply options available during blackout condition. In that analysis below mentioned seven possible options were identified and studied.

i) from Kothmale power plant,
ii) from Kelanitissa Fiat gas turbine power plant,
iii) from Kelanitissa combine cycle power plant,

iv) from Kerawalapitiya combine cycle power plant,

v) from Heladanavi diesel plant at Puttalam through 220kV line ,

vi) from Heladanavi diesel plant at Puttalam through 33kV line,

vii) from 6×2.5MW diesel plants at Lakvijaya power station

.

Finally it was identified and concluded that 6 of 2.5MW standby synchronized diesel generators with 15sec restoration time should be installed.

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ABBREVIATIONS

A	Ampere
A.P.H	Air pre heater
CCT	Circuit
CEB	Ceylon Electricity Board
CH&FGD	Chemical handling and flue gas desulphurization
DC	Direct current
DCS	Distributed control system
DEH	Digital electronic hydrolic
EDG	Emergency Diesel Generator
ES	Emergency stop
ETS	Emergency trip system
FD	Forced Draft
FGD	Flue gas desulphurization
GS	Grid Substation
H.V	High voltage
Hp	High Pressure
I&C	Instrumentation and Control
ID	Induced Draft
IP	Intermediate Pressure
L.V	low voltage
LKR	Sri Lankan Rupees
LP	Low Pressure
Lub	Lubrication
MCC	Motor control center
PC	Power Center
PCB	Power center board
PCPP	Puttalam Coal Power Plant
PCV	Pressure control valve
PD	Primary draft
PS	Power System
S/S	Start/stop
SST	Startup/standby transformer

TF	Transformer
THA	Turbine generator gross heat rate
TL	Transmission Line
TMCR	Turbine generator maximum continuous rating
TSI	turbine supervisory instrument
UAT	Unit auxiliary transformer
UBS	Unit boiler supply
UPS	Uninterrupted Power Supply
UTS	Unit turbine supply
V	voltage

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