

Plant Loading Optimization for Sustainability

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ENERGY DEVELOPMENT CORPORATION (EDC) IS PHILIPPINES' LARGEST VERTICALLY INTEGRATED GEOTHERMAL COMPANY







RESERVOIR RESOURCE NATURALLY DECLINES¹ OVER TIME







RESERVOIR/DOWNHOLE PRESSURES AT -1000MRSL (AS OF JUNE 2019)

Note 1. Global benchmark on the decline of geothermal fields is 5%/year according to International Finance Corporation report; UL's rate is slightly better at 4%/year



GEOTHERMAL POWER GENERATION IS AN END-TO-END PROCESS FROM GEOTHERMAL RESOURCE MANAGEMENT TO POWER OUTPUT DISPATCH



CALIBR LOADING THE UNITS BASED ON ITS EFFICIENCY RESULTED IN INCREASED **GENERATION WITH THE SAME AMOUNT OF STEAM**







Unit 1 @ 9.8kscg interface pressure

HOWEVER, THE CURRENT PROCESS IS TEDIOUS, NOT REAL TIME, AND PRONE TO HUMAN ERROR.

GATHER REQUIRED DATA AND INFORMATION



Required Parameters

Unit parameters include:

- Gross Load
- Inlet Steam Flow
- Turbine Pressure
- Turbine Steam Flow
- Cooling Tower Fans
- Condenser Vacuum

Interface parameters include:

• Wet Bulb Temperature







EXPLORATORY DATA ANALYSIS IN SEEO WORKBENCH







BUILD THE MODEL IN SEEQ WORKBENCH









FIND THE OPTIMAL LOADING



File Edit	View Insert Cell Kernel Widgets Help	Not Trusted	Python 3 (ipykernel)
8 + %			
	<pre>22 ul_vacuum_coett = normal_ul_vacuum_coett 23 unit3_max_load = unit3_max_load_loupres 24 25</pre>		
	Find the optimal solution		
In [80]	1 #set up model, variables and contraints, Load capacity		

solved in 66544.00 milliseconds in 0 iterations

Estimated Load per Unit from 313.51365661621094 kg/s Interface Flow: - Unit 1 Suggested Load = 155.84318146358146 kg/s -> 77.91336059570311 MW - Unit 3 Suggested Load = 157.67047515262948 kg/s -> 73.55297194291704 MW And based on the gross load, Net Load will be: - Unit 1 = 73.7556283933418 MW - Unit 2 = 70.72818035285832 MW That will be 144.4838087462001 MW Net Load

49	<pre>print(fact will be {} fw wet toou .format(Projected_iotal_wet_toou)) else:</pre>	
51	princ(me solver could not find an optimal solution.)	
	4)
	Solution	
Sol	ved in 91376.00 milliseconds in 0 iterations	
Solv Est	>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>	
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Solv Esti - U And	<pre>Solution ====================================</pre>	
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ENHANCED SOLUTION







CALIBRE

e n e

SEEQ RESULTS IN PI VISION

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L IPRC		Performance	C Reliability		a∰⊨ <u>WeSEE</u>	Ē	ECRS	NatCat - Resiliency	Regulatory	and Compliance			
Malitbog Plant Loading Optimization													
Projected increase of load using suggested load: Gross 1.54 MW Net 0.74 MW as of 3/24/2023 1:00:10 PM													
Note: Model used was based on the ff conditions: Unit 1: 9.3kscg and above Unit 3: 9.5kscg and above 8 CT Fans: online													
Current Loadin	ng			Suggested Gros ເ	s Load ^{Jnit} 1	Adjusti Unit 2	ments per unit to achieve projected increas Unit 3	• Current Ne	et Load vs Projected	Net Load Current Projected			
Wet Bulb Temp 25 °C Pressure 9.47 kscg Pressure 0.10 kscg 316 kg/s Pressure 0.10 kscg 9.64 kscg	Pressure 9.47 kscg Pressure 0.10 kscg	Unit 1 Flow 57.02 kg/s Flow Unit 2 Flow Gross Load 0 kg/s Unit 3 Cross Load Net Load 0 mw 0 mw Unit 3 Cross Load 73.32 MW Malitbog Facility Total Gross Load 73.32 MW Malitbog Facility Total Gross Load 151.75 MW Malitbog Facility Total Met Load 143.86 MW	Net Load 73.32 ww Net Load 0 mw Total Net Load 143.86 MW	Projected Net Lo	7.72 50 Dad Unit 1 3.58 50 50 50	Unit 2	75.62 0 Total 153.34 Unit 3 72.15 0 0 Total 145.3	V 20 40 50 40 50 40 50 40 50 40 50 40 50 40 50 40 50 40 50 40 50 40 50 40 50 50 40 50 50 50 50 50 50 50 50 50 5		70.54 72.15 Unit 3 75 Projected 153.34			
	Pressure 9.64 kscg	Flow Gross Load 159.22 kg/s 74.09 MW	Gross Load Net Load 74.09 MW 70.54 MW	Estimated Turbin 156.22	ne Steam Flow 2 kg/s	0 kg/s	159.99 kg/s	Total Net Loa	ad Current 143.86 Proje	cted 145.3			
							lotal 316 kg/s	3/23/2023 1:00:10 PM	1d 3	24/2023 1:00:10 PM			
3/23/2023 1:00:1	0 PM	U							Now	3/24/			
Minimum increase of 1 MW hourly													



BUSINESS VALUE

Efficient Use of Resource

Increased revenue









Displacement of CO2

Thank you

CONNEQT