RESOURCE & TECH

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RRC

Sizing and Optimizing PV/BESS Around Fossil Fuel Gensets / Load Demand for Remote Locations

BACKGROUND

- Energy sources can make or break any community, and remote communities and mining sites are not exceptions.
- Traditional energy resources are scarce and import costs can be very high. Fossil Fuel Gensets (FFG) are commonly employed in these areas. Distribution systems are often weak.
- RE (PV, Wind) is a viable solution, at least as a mix, sometimes supported with BESS. However, RE/PV incorporation requires detailed analysis and due diligence.
- A cost-effective solution is usually sought that maximizes RE/PV penetration while keeping system V and f profiles in check.

OBJECTIVE

Primary Objective:
- Maximize RE/PV
- Keep V/f profiles in limit
- Minimize Pollution

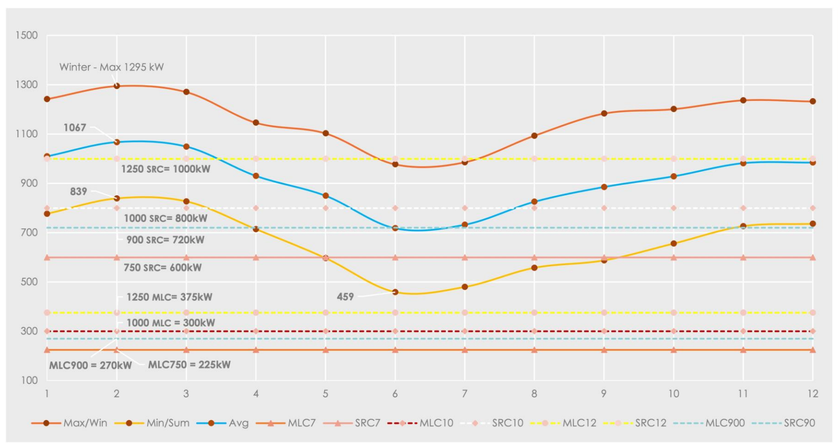
Additional Objectives for the Solution:
- Effective
- Efficient
- Economical
- Reliable
- Safe (Code Compliant / Industry Standards)

METHODS

We considered the following to achieve the listed objectives:
- Present FFG generation capacity and Community Load
- Future FFG generation requirement and Community Load
- Min and Max Load @ Seasons
- Spinning Reserve Requirement (SRC)
- Minimum Load Constraints (MLC)
- Min Generation/Load to avoid FFG Wet Stacking
- Min On/Off Cycles
- Battery Storage / Dump load
- FFG / Load / PV Complementarity
- PV Maximization / FF Minimization
- Minimum Control Requirements

RESULTS

FFG: 750kW & 900kW (1650kW/3 FFG (N-1=900 kW)/SRC 1320 kW/Staggered SRC?)



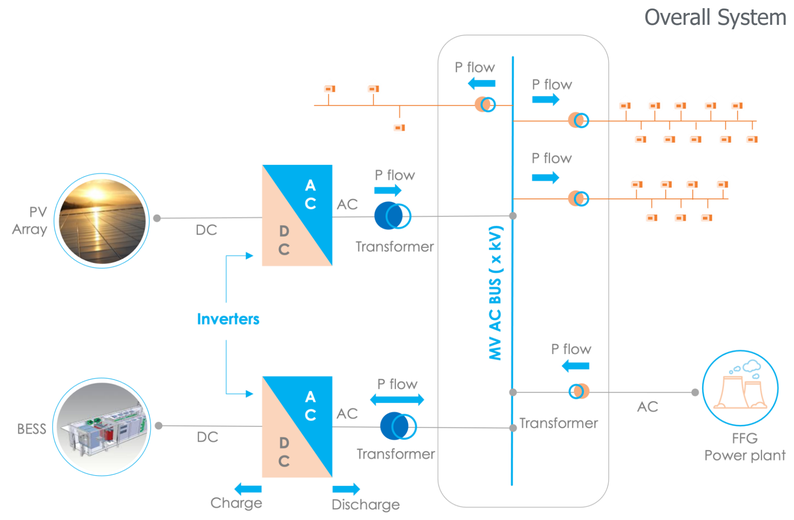
PV System: 3 Orientations

Orientation	Option - I	Option - II	Std System
South	200 kW	360 kW	600 kW
South East	200 kW	120 kW	0
South West	200 kW	120 kW	0
DC/AC Ratio	1.2	1.2	1.2

PV System Generation

PV System	Option - I	Option - II	Std System
Pk Inst. P	167 kW	300 kW	500 kW
Yearly E	632 MW	647 MW	640 MW
Penetration	Low	Low - Med	Medium-High
Control	No - Slim	Moderate	Complex
Remarks	Ok	Possible	Not Recommended

Overall System



A Solution – Option 2/647 MWh

FFG+PV Sys		Std Design	Option - I	Option - II	Ref. Design
FFG	Sizes	420-450, 750, 2 x 900 kW	420-450, 750, 2 x 900 kW	420-450, 750, 2 x 900 kW	2 x 550kW + 2 x 750 kW
	#	4 or 3 (Recommended)	4 or 3 (Recommended)	4 or 3 (Recommended)	4
	Type	Continuous + 3 Prime	Continuous + 3 Prime	Continuous + 3 Prime	Continuous
PV	Size	600kWdc-max/500kWac	600kWdc-max/500kWac	600kWdc-max/500kWac	600kWdc-max/500kWac
	Deployment	1	1 / 1 / 1	1 / 3 / 1	1
	Inverters	5 (100 kW) – 20 (25 kW)	5 (100 kW) – 20 (25 kW)	5 (100 kW) – 20 (25 kW)	5 (100 kW)
Additional	DL	Yes	No	No	Yes
	BES	Yes (20–60 min @ MOOT)	No / Yes (20 min MOOT)	No / Yes (20 min @ MOOT)	Yes (60 min)
	MLC+	No / Yes (as required)	Yes	Yes	No / Yes (as required)
	SRC	Yes	Yes	Yes	Yes
	MOOT	No / Yes	No	No	Yes
	Chargers/Inv	5 (100 kW) – 20 (25 kW)	No / 3 (100 kW) – 8 (25 kW)	5 (100 kW) – 20 (25 kW)	5 (100 kW)
Remarks	Energy (Est.)	640 MW	632 MW	647 MW	640 MW
	Effectiveness	Fair	Good	Good	Poor
	Efficiency	Fair	Good	Good	Poor
	Reliability	Fair	Good	Good	Poor
	Economical	No	Yes	Yes	No
	Recommend	May be	Yes	Yes	No

Community Load (kW)

Month	Max@2023	Min@2023	Max@2038	Min@2038
Jan	1036	648	1225	766
Feb	1080	700	1277	828
Mar	1060	690	1253	816
Apr	956	596	1130	705
May	920	498	1088	589
Jun	815	383	964	453
Jul	822	400	972	473
Aug	912	465	1078	550
Sep	987	490	1167	579
Oct	1002	547	1185	647
Nov	1032	606	1220	717
Dec	1028	614	1216	726
Total	11,650	6,637	13,776	7,848

CONCLUSIONS

The Options I and II are promising solutions but Option II with higher generation wins.

The following were targeted and achieved successfully:
- Present FFG generation capacity and Community Load
- Min and Max Load @ Seasons
- Minimum Load Constraints (MLC)
- Min On/Off Cycles
- FFG / Load / PV Complementarity
- Minimum Control Requirements
- Future FFG generation requirement and Community Load
- Spinning Reserve Requirement (SRC)
- Min Generation/Load to avoid FFG Wet Stacking
- Battery Storage / Dump load
- PV Maximization / FF Minimization

Additional - E^3RS
- Economical
- Effective
- Efficient
- Reliable
- Safe by Design & Code Compliance

Plus
- Maintainable (No BESS)
- Complementary

REFERENCES

- F. Katiraei and C. Abbey "Diesel Plant Sizing and Performance Analysis of a Remote Wind-Diesel Microgrid", 2007 IEEE Power Engineering Society General Meeting, 24-28 June 2007
- I. M. Syed, "Near-optimal standalone hybrid PV/WE system sizing method", Solar Energy 157, 727-734
- E. Muljadi, C. Wang, M.H. Nehrir, "Parallel operation of wind turbine, fuel cell, and diesel generation sources", Power Engineering Society General Meeting, 2004. IEEE

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