
Scalable Solar Solutions
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Summary

The following case study has been prepared based on information gathered from publicly available 43101 reports regarding mid-sized exploration camps operating in northern Canada, in order to demonstrate the benefits of installing a solar photovoltaic (PV) + battery system at a fly-in only exploration camp. While we are confident in the accuracy of these numbers, they will vary slightly from camp to camp depending on the electrical load.

A typical fly-in only exploration camp consists of 35 to 50 personnel living in a series of wall tents and semi permanent cabins powered from a single generator ranging in size from 20 KW to 50 KW depending on camp capacity and operational activities. While the drillers work on rotating 12 hour shifts the remainder of the camp personnel work from daily 12 hours shifts and it is this schedule that creates a varying electrical profile that can benefit greatly from solar and batteries. See the table below for a typical electrical profile of a 40-man exploration camp:

Hour	Electrical Load % of 30 KW Peak	Hourly kWh Consumption	Generator Fuel Consumption (Litres)
12:00:00 AM	20%	6	3.5
1:00:00 AM	20%	6	3.5
2:00:00 AM	10%	3	3.5
3:00:00 AM	10%	3	3.5
4:00:00 AM	20%	6	3.5
5:00:00 AM	20%	6	3.5
6:00:00 AM	65%	19.5	6
7:00:00 AM	65%	19.5	6
8:00:00 AM	65%	19.5	6
9:00:00 AM	40%	12	5
10:00:00 AM	40%	12	5
11:00:00 AM	40%	12	5
12:00:00 PM	50%	15	5.5
1:00:00 PM	50%	15	5.5
2:00:00 PM	50%	15	5.5
3:00:00 PM	50%	15	5.5
4:00:00 PM	50%	15	5.5
5:00:00 PM	60%	18	6
6:00:00 PM	80%	24	7.8
7:00:00 PM	80%	24	7.8
8:00:00 PM	80%	24	7.8
9:00:00 PM	80%	24	7.8

10:00:00 PM	30%	9	4
11:00:00 PM	20%	6	3.5
Average:	**46% Load**	**13.7 kWh**	**5.26 L**
		Total Fuel Usage:	**126.2 Litres per day**

As you can see in the above table the electrical load in camp drops significantly at night to as low as 10% of the generator capacity and peaks at dinner time when the vast majority of personnel have returned to camp and are using various personal electronics as well as camp amenities such as washers and dryers. This poses two problems:

1. Generators required a minimum burn rate of diesel in order to keep the engine rotating. This means that a generator with no electrical load on it burns as much fuel as a generator with 25% load on it, making it very inefficient to run generators at low demand hours such as during the night.
2. Generators are designed to run optimally at 80 to 90% of rated continuous load, as it provides the best burn rate on the fuel reducing build up and corrosion in the engine minimizing maintenance costs.

When batteries are installed, the generators operate at 80 to 90% capacity for a few hours charging up the batteries and then shut off (this is controlled by an auto-starter system to maintain electrical stability at all times) for extend periods of time reducing operating time and diesel consumption significantly. The addition of solar allows for further fuel savings by charging the batteries during daylight hours increasing the number of hours the system can run without generators.

These fuel savings can be quite significant at fly-in exploration camps as the cost of diesel once transported to site can be as high as $6 per litre depending on the location of the camp and the size of the airstrip.

Methodology

The following methodology was used to model both scenarios outlined below:

1. Using www.sedar.com, Solvest verified the following information pertaining to northern Canadian mining exploration operations; generator size, electrical load analysis, cost per kWh, and cost per litre of diesel delivered to site.
2. This information was then imputed into HOMER Energy Modeling Software and RETScreen along with the parameters for the proposed energy storage system in order to determine the fuel savings and operational cost reductions. Efficiency losses for each of the proposed components were factored in allowing for accurate energy usage calculations.

The following examples illustrate the benefits of installing PV and batteries at an exploration camp:

Case 1: Camp Operating on Diesel Generator Only.

Assumptions:

- 30 KW Generac diesel generator (Please see Appendix B for product specifications).
- All dollar figures are in CAD
- Cost per litre of diesel delivered to site is $5 per litre.
- Camp is operational for 8 months of the year from April to November.
- Camp electrical consumption is 328.5 Kwh per day.

Electrical Supply Costs

Generator Size	Daily Fuel Consumption	Cost per Litre of Diesel	Monthly Operating Cost	Annual Maintenance Costs	Annual Operating Cost
30 KW	126.2 L	$5.00	$18,930.00	$5,000.00	$156,440.00

Case 2: Camp with a 20 KW solar array and 125 Kwh battery bank installed.

Assumptions:

- 50 KW Generac diesel generator (Please see Appendix C for product specifications).
- Generator operates at 75% capacity for 5 hours per day average (less on sunny summer days).
- Cost per litre of diesel delivered to site is $5 per litre.
- Camp is operational for 8 months of the year.
- Camp electrical consumption is 328.5 Kwh per day
- 2.74 Kwh/Meter Squared average annual solar irradiation per day (See Appendix A for details).
- Solar array generates 20 to 210 KWh per day depending on the weather and time of year.

Design Criteria:

- Large battery bank to minimize generator use. Batteries must be sealed AGM cells enabling them to freeze and requires no maintenance.
- Solar array comprised of high wattage panels maximizing the output per square meter as space is limited on lease and logistics costs are very high.
- Customized low profile racking that can be constructed on uneven terrain and minimizes ballast requirements.
- High amperage charger, capable of charging a large battery bank quickly.
- A system comprised of highly durable, low maintenance components, complete with extended warranties.
- Integrated remote system access and monitoring that allows manufacturers to fix many of the potential hardware problems online without any need to access the site. This technology allows for remote monitoring of the system and daily power production.

Based on the criteria outlined above, Solvest proposes a design consisting of a large 4900 Amp Hour (at 48V) battery bank connected to a 20 KW solar array. This system would reduce daily generator use to 5 hours per day in the evening in order to handle peak loading and charge the batteries. This leads to the following savings:

Electrical Supply Costs

Generator Size	**Daily Operating Hours**	**Daily Fuel Consumption**	**Cost per Litre of Diesel**	**Monthly Operating Cost**	**Annual Operating Cost**
50 KW	4 Hours	50 litres	$5.00	$7,500.00	$60,000.00

Budget

The following table contains the estimated budget for the proposed project. This budget was estimated extremely conservatively in order to present the highest cost scenario. Many of these costs can be lowered with proper project planning and co-ordination.

Description	**Cost**	**Notes**
Materials	$120,000.00	All materials including non PV materials such as wire etc.
Installation	$27,000.00	3 x PV install crew members + 1 electrician for 5 days. Installation Supervisor for 7 days.
Shipping/Logistics	$22,000.00	Worst case scenario using multiple twin otter flights to fly materials to site.
Project Management and Engineering	$20,000.00	This is includes all design, engineering, and project management costs.
Increasing Generator Size	$16,000.00	Additional cost associated with increasing the generator size to 50 KW.
Total Cost:	**$205,000.00**	**Plus applicable taxes.**

Key Benefits:

1. Significantly reduce generator diesel consumption by up to 61%.
2. Reduce operating costs by $96,000 a season paying for the system in 2 field seasons.
3. Improve the environmental image and public perception of the exploration project.
4. Reduce wear on the generator, prolonging its service life and reducing annual maintenance costs.
5. Reduce ambient noise level in camp by only operating the generator during dinner and breakfast hours.
6. Using Solvest's commercial leasing program companies can lease these systems over 2 to 4 year terms, writing off the entire cost of the system against their taxes.

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We trust that the foregoing information is satisfactory and details the benefits our proposed technology could add to your operations, please do not hesitate to contact the undersigned.

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*****The following pages contain the supporting appendixes for this proposal*****

Appendix A: Solar Irradiance Data

The following table is available through the RetScreen modelling software and was prepared by NASA. This table displays the weather data for Mayo Yukon:

Country - region		Canada
Province / State		Yukon
Climate data location		Mayo Airport

			Source
Latitude	°N	63.6	
Longitude	°E	-135.9	
Elevation	m	504	Ground
Heating design temperature	°C	-45.4	Ground
Cooling design temperature	°C	25.0	Ground
Earth temperature amplitude	°C	25.4	NASA

	Air temperature	Relative humidity	Daily solar radiation - horizontal	Atmospheric pressure	Wind speed	Earth temperature	Heating degree-days	Cooling degree-days
	°C	%	kWh/m²/d	kPa	m/s	°C	°C-d	°C-d
Jan	-23.3	79.0%	0.20	89.1	1.4	-22.1	1,280	0
Feb	-17.3	77.3%	0.89	89.3	1.8	-19.5	988	0
Mar	-9.2	68.3%	2.34	89.3	2.6	-15.4	843	0
Apr	1.3	57.6%	4.15	89.4	2.6	-6.0	501	0
May	8.8	53.9%	5.31	89.6	2.4	3.6	285	0
Jun	15.0	55.8%	6.00	89.7	1.9	12.4	90	150
Jul	16.2	63.8%	5.47	89.9	1.6	13.7	56	192
Aug	12.9	69.3%	4.19	89.8	1.5	9.8	158	90
Sep	6.2	73.1%	2.60	89.5	1.9	2.2	354	0
Oct	-2.7	77.9%	1.22	89.1	2.3	-7.2	642	0
Nov	-16.0	79.7%	0.35	89.0	1.7	-17.7	1,020	0
Dec	-19.5	80.1%	0.08	89.0	1.6	-19.9	1,163	0
Annual	-2.2	69.6%	2.74	89.4	1.9	-5.4	7,380	432
Source	Ground	Ground	NASA	NASA	Ground	NASA	Ground	Ground
			Measured at	m	10	0		

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Appendix B: Generac Generator Fuel Consumption Chart

Protector™ Series

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GENERAC

15 • 20 • 30 • 48 • 50 kW

operating data

GENERATOR OUTPUT VOLTAGE/kW - 60 Hz

		kW (Standby)	Amp (Standby)	CB Size
RD015	120/240 V, 1Ø, 1.0 pf	15	62	70
	120/208 V, 3Ø, 0.8 pf	15	52	60
	120/240 V, 3Ø, 0.8 pf	15	45	50
RD020	120/240 V, 1Ø, 1.0 pf	20	83	100
	120/208 V, 3Ø, 0.8 pf	20	69	80
	120/240 V, 3Ø, 0.8 pf	20	60	70
RD030	120/240 V, 1Ø, 1.0 pf	30	125	150
	120/208 V, 3Ø, 0.8 pf	30	104	125
	120/240 V, 3Ø, 0.8 pf	30	90	100
	277/480 V, 3Ø, 0.8 pf	30	45	50
RD048/ RD050	120/240 V, 1Ø, 1.0 pf	48	200	200
	120/208 V, 3Ø, 0.8 pf	50	173	200
	120/240 V, 3Ø, 0.8 pf	50	150	175
	277/480 V, 3Ø, 0.8 pf	50	75	90

SURGE CAPACITY IN AMPS

		Voltage Dip @ < .4 pf	
		15%	30%
RD015	120/240 V, 1Ø	53	129
	120/208 V, 3Ø	37	90
	120/240 V, 3Ø	32	78
RD020	120/240 V, 1Ø	87	211
	120/208 V, 3Ø	59	143
	120/240 V, 3Ø	51	124
RD030	120/240 V, 1Ø	66	168
	120/208 V, 3Ø	59	144
	120/240 V, 3Ø	51	125
	277/480 V, 3Ø	26	64
RD048/ RD050	120/240 V, 1Ø	69	189
	120/208 V, 3Ø	90	218
	120/240 V, 3Ø	78	189
	277/480 V, 3Ø	36	87

ENGINE FUEL CONSUMPTION

		gal/hr	L/hr
RD015	25% of rated load	0.51	1.93
	50% of rated load	0.79	2.99
	75% of rated load	1.14	4.31
	100% of rated load	1.48	5.58
RD020	25% of rated load	0.67	2.6
	50% of rated load	1.05	3.97
	75% of rated load	1.52	5.32
	100% of rated load	1.98	7.48
RD030	25% of rated load	0.92	3.5
	50% of rated load	1.45	5.5
	75% of rated load	1.96	7.4
	100% of rated load	2.74	10.4
RD048/ RD050	25% of rated load	1.35	5.11
	50% of rated load	2.15	8.14
	75% of rated load	3.06	11.58
	100% of rated load	3.98	15.07