Sustainable Remote Power Systems

AN HOLISTIC APPROACH

In all projects we have promoted awareness of the sustainability issues to ensure that all owners, operators, designers and installers consider designs from a sustainable approach.

This is not "city power" coming off an infinite plug from the sky.

The Installer, the Designer, the Client, the Operator, the Service Tech, and the Occupants all have responsibilities to discharge that cannot be delivered by other parties. If all cannot do their role, then the system will not deliver. The issues include:

The Single-Diesel system – Hidden Costs

(For all sizes of installations) - Numerous locations rely on one diesel genset operating "24/7" for many months. There may be a large genset for the "wet", with maybe another genset for the remainder of the year. This is energy inefficient, and unsustainable, as these gensets are always oversized and under-loaded.

The "un-sustainability" is usually hidden. The fuel costs (20% to 55% higher than need be) is paid from a different account than the repairs, and a different account than the purchase of a new machine. Personnel time is almost never recorded.

The time in solving problems and oil changes are "free" because the time of valuable people is not recorded (they could be doing other valuable things). Lights and appliances are deliberately left on to "give some load" to the genset.

Unreliability is never costed, but costs. Time is wasted writing purchase orders for failing equipment, and the boss's time is wasted. These costs are never fully brought together, so the real cost is never acknowledged. The result has been power that is expensive to build, expensive to run, and less reliable than necessary.

Genset Over-sizing

Numerous remote locations in the past, have had grossly oversized power systems. Designers normally size power systems with emphasis on the peak power kW delivered, usually referred to as the Maximum Demand (MD). This is engineering conservatism and "safe" design, but only safe for the designer.

There sometimes are reasons for this conservative approach. Some sites have a gross phase imbalance, and some sites have the large DOL (direct-on-line) punch of large motors starting. Together these can require double the size genset than would otherwise be required.

Some of these aspects of overdesign can be "Engineered" out of a system by dealing with the whole site (holistic). An attitude change is needed to accept that if a system is overloaded, it SHOULD shut down. Otherwise nothing will change.

Load Estimation

Many designers do not appreciate that in small and medium communities, the peak loads are very brief, and the minimum loads are dramatically below the peak. The minimum loads may be 5% of the MD peak, or even less, and the minimums are very sustained.

Designing to the MD kW is safe but it is unreliable and unsustainable. A sustainable system will be designed to the usual site needs, usually around a "diversified MD" or slightly larger. Operating a site at MD (everything on) will occur rarely. If it happens often it is a failure in management. The system WILL shut down, and this is correct. Without the shut-down the operators will not learn and the system will be excessively stressed.

Most sites have a likely steady progressive growth. A long window of growth must be accounted for in the fixed long-life assets such as sheds, power lines and switchboards. Solar modules can (usually) be readily expanded. Gensets can be sized for the loads required in their periodic replacement period. Each site is different, with the Clients' capital works and maintenance policies relevant also.

Energy & Load Management

We always advise comprehensively to the Clients to assist the optimum sustainable outcomes. The un-sustainable "single-diesel" systems encourage inefficient site management practices. Inefficient site management practices are of major consequence to an efficient system. Mismanagement is a major barrier and personnel that cannot change are a dead weight to even the best designed system.

Once the efficient power system is in place the occupants of the remote facility have a responsibility to manage their load and energy use. We cannot do this for them. Where

government subsidies and rebates have been provided there is a legal obligation to manage competently. In all installations there is an ethical responsibility to society to manage competently.

Fuel Savings - Small & Medium Power Systems

A renewable power system (genset + solar hybrid) is efficient delivery 24 hour power. A genset-only system is not efficient for 24 hour power supply. The cost of operating a small genset into small loads are horrendous.

For genset-only systems it is recommended to shut off power overnight. Significant fuel saving and full genset service life can be achieved by restricting power to 2 periods a day of 5 to 6 hours each run. For genset-only sites consider solar lights in public areas and central paths to reduce the need for overnight genset operation.

THE PLACE FOR RENEWABLE ENERGY & HYBRID SYSTEMS

The true place of renewable energy in isolated power systems, and the complex issues of affordability, operability, control and maintenance have to be assessed. Some very remote locations may in fact be inappropriate due to the greater complexity of renewables, a difficult conundrum to resolve. Small sites give a quicker financial return on a solar power system, compared to medium and larger sites.

POWER STATION AUTOMATION & DATA LOGGING

The appropriate use of power station automation is not simply to improve fuel efficiency, but also to extend the life of gensets, to give more reliable power. The automated stations are data-capable, and can effectively use remote data communication (sometimes called SCADA) to external service specialists. In preparation for this we suggest installing data connections (satellite internet, internet Ethernet, or mobile phone modem) possibly in advance of automation.

OPERATOR RESPONSIVE INTERFACE DESIGN

The operator interface, that is the control panel and instruments, helps or hinders the operators work. In small remote locations the level of technical ability and literacy level of power system operators results in different switchboard design from a power station operated by qualified technicians (say at a mine site).

Analogue instruments [amps, kW, volts] with large discrete and clearly labelled push buttons and indications are more suited to unskilled operators. The purpose is to make the basic functions clear and accessible. People who are qualified and literate in other occupations can be intimidated by the “specialist” look of a power station. This cannot be avoided, but these people can be assisted by logical layout, and unambiguous analogue instruments.

If we want the manager, labourer, accountant, community nurse, store man, or school teacher to fill in for the local operator at a moments notice, the design can help them.

The "soft touch" controls, PC screens, digital instruments may also be present, but are principally for the qualified technician. The analogue interface design allows more ready implementation of power operator training programmes, ultimately increasing local skills.

ENERGY "SUPPLY & DEMAND AUDITS" FOR ISOLATED COMMUNITIES

We have investigated and modelled the energy use patterns of many locations, Australian and overseas. These include Resorts, National Parks, Rural Properties and Remote Towns & Communities.

In these projects we have inspected the buildings, all energy using facilities, and have analysed the total energy use, fuel cost, power generation efficiency, payment methods, cost recovery and allocation through energy 'supply and demand" audit studies. Every energy-using item must be considered, coolrooms, water treatment and reverse osmosis, cooling and heating, lighting, PCs and IT equipment, waste water, pressure pumps, cooking (etc).

Remote power is expensive power and the studies reviewed some of the social impact of that cost, and methods of cost control and cost recovery. These studies looked at the affordability and equity issues associated with energy metering and cost recovery in general, along with a total energy. Where metering and payment are not present then the power is "free" and there is no incentive for efficiency.

REDUNDANCY

Small Power Systems

These are usually built with limited backup power. This is possible if the water supply is from an independent power source (say: solar).

- If water pumps depend on the power station, at least 2 gensets are required.
- Consider a separate dedicated feeder to supply power to water bores.
- Does the water treatment (eg UV) need 24 hour power?

Medium & Large Power Systems

Large power systems usually already have redundant power (that is: backup gensets). Consider what will occur if the backup genset available is smaller than the total load. Some 'non-essential" power will have to be turned off. This can be difficult unless pre-planned:

- Provide separate dedicated feeder to supply power to essential services (water, sewer, shop, clinic), independent of the feeders to residential buildings
- The cost may be significant, review the cost estimates and advise in Options report.

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