

STANDBY GENERATION: MAXIMISING YOUR ASSET, MINIMISING THE COST

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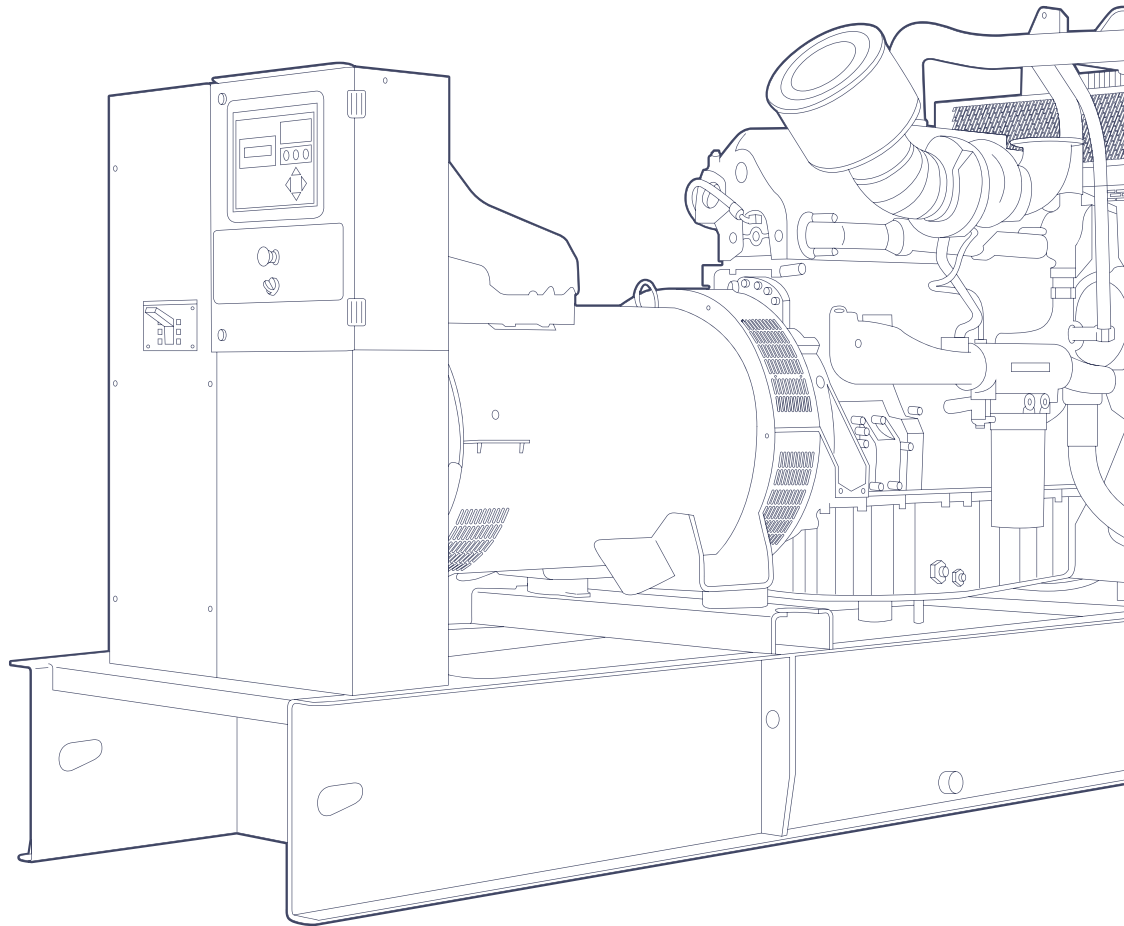


POWER ELECTRICS
GENERATORS

i INTRODUCTION

Standby generators are an essential piece of life-critical equipment in every hospital. Quite simply, they keep the power on and patients safe when the mains supply lets you down.

They are also a large capital investment. Equally, operating and keeping them in reliable running order represents a necessary but significant expense. But there are ways of amortising your outlay as well as cutting overall energy bills by up to 20%. Leigh Preece, Sales Director, sets out the facts you need to know.



1 STANDBY GENERATION - AN OVERVIEW

There are over 450 NHS Trusts in the UK, between them owning thousands of standby generators. Like many pieces of technical equipment, you only become aware of them when something goes wrong. It doesn't happen often, but when there's a mains power failure and the standby generator fails to cut in quickly, lives are put at risk.

A common reason for a failure is inadequate maintenance: after all, these are high capacity pieces of engineering that very rarely have the chance to wear out!

Hospitals generally have a good record of undertaking maintenance programmes. When a maintenance contract is put out to tender by a Trust, it may differ radically from another: some will replicate the manufacturer's recommendations, others follow the HTM (Health Technical Memorandum) specification - which is significantly more onerous - and some will repeat a basic specification from a previous contract, which can sometimes be to a less than ideal standard.


The latter approach can make it difficult for anyone tendering for a contract, and used to maintaining a generator to a standard they believe to be safe.

We understand that Trusts need to make economies wherever they can, but the maintenance programme for one of their most vital (if hidden) pieces of capital equipment shouldn't be one of those areas. Indeed, they needn't be: with a little imagination and technical know-how, a generator will soon stop being viewed as expensive and rarely required, but instead as an important asset with the potential to repay its outlay and ongoing costs.

This paper will also look at the all-too-common disconnect between the contractors installing a new generator and those responsible for maintaining it. If both sides can be involved at the design stage, major savings in time and effort can be achieved.

2 BASIC MAINTENANCE


A basic maintenance programme for a standby generator will often look something like this:



Weekly	Monthly	Six Monthly	Annually
<input type="checkbox"/> Check engine oil level <input type="checkbox"/> Check coolant level <input type="checkbox"/> Check fuel level <input type="checkbox"/> Check air filter <input type="checkbox"/> Check for any obstructions <input type="checkbox"/> Visually check for any fluid leaks <input type="checkbox"/> Run set off load for a maximum 5 minute period	<input type="checkbox"/> All weekly checks <input type="checkbox"/> Check battery terminals for corrosion <input type="checkbox"/> Check all hoses <input type="checkbox"/> Check condition of fan & alternator belts <input type="checkbox"/> Check & drain exhaust system condensate traps (if fitted) <input type="checkbox"/> Perform full operational check by running the set on 50% load for 1 to 2 hours	<input type="checkbox"/> Full inspection service Type 'B'	<input type="checkbox"/> Major inspection, engine service & site load or load bank test Type 'A'


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Failure to maintain this Generator may invalidate the manufacturers warranty



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AUTHORISED DEALER

WEEKLY

Check: engine oil level, coolant level, fuel level, air filter, for any obstructions. Visually check for any fluid leaks. Run set off load for a maximum five-minute period.

MONTHLY

All weekly checks; check: battery terminals for corrosion; all hoses; condition of fan & alternator belts; check & drain exhaust system condensate traps (if fitted); perform full operational check by running the set on 50% load for 1 - 2 hours.

ANNUAL SERVICE - MAJOR SERVICE

Change oil & filters
 Check lubricating system, fuel system, cooling system, air intake system, control panel & instruments, exhaust system, engine electrical system, alternator and general engine maintenance.

SIX MONTH SERVICE - MINOR SERVICE

Check lubricating system, fuel system, cooling system, air intake system, control panel & instruments, exhaust system, engine electrical system, alternator and general engine maintenance.

Six monthly and annual regimes are based on a generator running in total for less than 500 hours over 12 months. If the generator runs for more hours than that, a full (Major) service is required at every 350 to 500 hours.

Many, if not all, weekly and monthly tasks can be carried out by onsite staff, but some hospital engineering teams will have the specific skills required to undertake the six monthly and annual tasks.

3 PLANNED PREVENTATIVE MAINTENANCE (PPM)

In this section I wanted to look at how a regular, modest investment in planned preventative maintenance programme can reduce the chances of more expensive repairs and maintenance work being necessary in the future.

FUEL SAMPLING

Tests should be carried out on a six-monthly basis to ensure that there have been no contaminating crossovers between engine oil, coolant and water in the system.

If there's water in the oil it shows there's a leak between two parts. If there's fuel in the oil it shows there's a leak between two parts. If there's a lot of metal in the oil it shows there's degradation in the engine. The same goes when anything appears in the coolant that shouldn't be there. So this area of PPM helps identify problems which could result in large costs further down the line.

Testing the fuel has become essential since the introduction of 10% bio-diesel into red diesel, which has a 6 – 12 month shelf life and hygroscopically absorbs water into the diesel. Not only does this mean that the freeze temperature rises; it can also lead to water being pushed through the engine, eventually causing engine damage and misfiring.

Undertaking these tests ensures that other problems aren't building up between the larger maintenance programmes. Moreover, if you've got a large engine with several hundred litres of oil in it, a lab test costing tens of pounds compares very favourably with replacing the hundreds of pounds' worth of oil usually specified in maintenance programmes. Over a series of generators this can add up to net savings of thousands of pounds each year.

BATTERY TESTING AND REPLACEMENT

There are only a few reasons why a back up generator fails to work: it's cold, it's run out of fuel, it didn't see the electrical fault in the first place... or the battery is flat. Battery lives have extended significantly, but they should never be taken for granted: once its charge goes below 75% we always advise replacement.

3 PLANNED PREVENTATIVE MAINTENANCE (PPM)

REMOTE MONITORING

A modest investment in remote condition monitoring can reduce maintenance costs and ensure equipment is in full running order: virtually everything can be now monitored remotely on modern generator systems, as well as remote start, switch on etc., with faults being texted, emailed, etc.

THERMAL IMAGING

Thermal imaging is another non-intrusive technology that can pay dividends – particularly on LV/HV switchgear, highlighting raised temperatures, or “hot spots” indicating a loose connection, degradation or overloading.

4 DESIGN FOR MAINTENANCE

At the core of the HTM is the incredibly important premise that “the system shall be designed with maintenance in mind”. It goes on to say that: “the means of completing the necessary testing should be included at the design stage”.

This is an area where we regularly have discussions with clients, because input at the design stage from those who maintain a generator can go a very long way.

When we talk to our clients about “designing for maintenance” we make the case of building in small but critically important elements into the design brief to save money long term, covering key aspects such as:

- Having space around a generator for safe working (normally one metre)
- Isolation taps on the jacket/sump heaters to allow quick replacement
- Sensible access to the generator for repairs and removal – if it’s on the roof or in the basement, can it be removed, for instance, without using a massive crane or demolishing walls? Louvre doors should be larger than the generator footprint.
- How easy will it be to replace the oil? Taking 200 litres of oil up to the roof in lifts can be tricky!
- How easy is it to refill the fuel? Tanks located on the roof, for instance, and anything up to several hundred thousand litres in capacity, will need ground floor fuelling points.
- Having temporary connection points is important too – ideally two: one for the generator and one for load bank, so you can feed in a temporary supply if the mains goes down, or test it, without interfering with the mains supply.

The “takeaway” messages for every Trust looking to reduce on-going costs and make their life simpler is to plan ahead. Following an old maintenance specification when designing a replacement system is not the way to achieve that - and can build up huge problems in the future.

Hospital trusts who will end up footing the bill need to challenge the team in charge of specifying generators. We regularly work with consultants to ensure this thinking is incorporated in the design and save the hospital money long term.

5 MEETING THE HTM SPECIFICATION

What the Health Technical Memorandum (HTM), has to say on generator maintenance directly relating to hospitals represents a very small, but important part of the document. And while it represents the “gold standard” specification, designed to maximise safety within hospitals, the evidence (from the very different ways in which maintenance is carried out on different sites) is that it is not always followed closely.

Often this reflects how much risk different trusts have experienced. If a loss of power has caused a major incident, having plenty of standby capacity and rigorous maintenance procedures for those generators go to the top of their list.

Is it really necessary to follow their specification to the letter? In our experience, there are ways in which some perfectly sensible compromises can be achieved with no risk to safety. But if a Trust is keen to follow the letter of the specification, it will know in the case of a failure that it has taken every step to follow the safest possible procedures.

Ultimately, having a standby generator is an insurance policy. And, like any policy, ideally one you have in place before, not after, problems occur. Owning and maintaining a standby generator is an expensive insurance policy and a big outlay. But as I set out in section 9, there are ways to substantially amortise some of these costs.

The HTM also makes the key points that: the “Ops management team have the system under a operation and maintenance plan”; and that “a mixture of on-site staff maintenance with the support of external experts should be considered” for carrying this out – recognising that the level of knowledge of some specific aspects of maintenance may be beyond the expertise of on-site staff – especially the major services.

Estates engineers can come from a range of backgrounds – and not always a mechanical or electrical one. A plumber by background could be faced with a 2MVA generator which has just gone offline, so having contractors embedded in the maintenance programme can be essential – along with training of on-site engineers.

So what are the key elements of the HTM specification relating to on-going maintenance, why do they matter, and can economies be made? Here is our potted guide.

6 HTM ROUTINE TESTING - KEY POINTS

- Standby generators should be tested online with the building load every month and for at least one hour, preferably two.
- Running offline for five minutes afterwards allows it to let the engine cool down steadily and not stop abruptly – which can cause damage over time.
- Having a permit to work in place increase safety – and can prevent potential hold-ups in the maintenance programme - preventing a contractor from being held up while someone is found who can authorise them to work.
- While different manufacturers will specify varying durations, a longer, three-four hour, full load test should be conducted annually. This is important, but sometimes overlooked.
- During this test, the opportunity should be taken to simulate fault shutdown conditions. In our experience this is rarely done, but is not a factor which has ever led to subsequent problems.
- There should be a cool-down running period of ten minutes after this test, as it has been going for much longer.
- Maintenance tests should also include a test of any automated switchgear used to transfer power from the primary supply to the secondary supply. The issue this raises is the demarcation between the generator maintainer and the switchgear maintainer. The generator maintainer will maintain that generator once a year minimum. The switchgear maintainer can do their work every five years. Establishing who is responsible for maintaining each part of the system is essential, and so too is liaising with any other responsible provider.

6 HTM ROUTINE TESTING - KEY POINTS

- Maintenance tasks should include weekly non-intrusive visual inspections – checking levels and looking for any signs of leaks. Keeping the area clean is vital as an accumulation of dust and oil can pose a fire risk.
- A non-intrusive functional test is required at least every three months – including testing the battery voltage, measuring the coolant level, inspecting the condition of the radiator and exhaust guarding or insulation. Again, in our experience, there are often big variations in what is done between hospitals, but these are basic tests which will go a long way to head off future problems.
- A full service is required annually or where usage exceeds annual intervals (eg, 500 hours). This section also mentions having a ‘comprehensive overhaul of the AC alternator and control systems. I have never seen this done before, not least because it can be difficult to gain access.
- Alternative additional mobile generator may need to be brought in for the duration of the full service. While ensuring maximum safety for patients, this can represent a significant additional cost if followed to the letter. However by bringing in additional mobile generators during the major services increases the safety of the patients by reducing the risk of loss of the electricity supply to the Hospital.
- Having a simple, single line diagram of the electrical infrastructure is an obvious but all-too-often neglected requirement which can save huge amounts of time. The original system may have been installed 40+ years ago but the diagram has not been updated when modernised, or the documents lost.

6 HTM ROUTINE TESTING - KEY POINTS

- The batteries selected should be chosen with regard to the risk, cost and planned maintenance. Replacing batteries regularly is a low-cost measure that can help avoid an expensive failure, and replacing a lead-acid battery more frequently may represent cost savings over buying NiCad ones unless they are required for a harsh environment.

- Every generator needs to have locally (ie: in a side tank / base tank) 10 hours of fuel for full load running, so 100KVA = 250 litres an hour. So 10 hours running will require 2,500 litres. Elsewhere on site there needs to capacity for 200 hours' full load running for each standby generator. That can add up to hundreds of thousands of litres – necessary because, in the event of a power failure, other problems may be occurring locally or nationally preventing you from getting more fuel on site.

7 SO DO YOU FOLLOW HTM SPEC...OR NOT?

The challenge for any Trust is how much do they invest in maintenance. But potentially there is another big issue to consider: contractors following all the guidance of the HTM would probably not win a tender against contractors following less stringent criteria.

The heart of this is the hospital tender. If it contains a detailed spec to HTM then every contractor has to abide by that. If it goes to manufacturer's recommendations that is understood; but sometimes the wording is less specific, almost leaving it to the contractor's discretion - thus it may not be carried out to the safest standards possible.

Arguably the best option for a Trust is consulting with a provider who can deal with either requirement, but who can tell you what is really required, then build your specification to that.

8 FUEL DEGRADATION

The last point in the HTM specification on having large amounts of fuel stored on site leads to issues around the maintenance of generator fuel systems. Since 2011, all plant has to use 10% bio-diesel minimum content (B10). Introduce it into your fuel supply and you run the risk after six months that the additions of water, oxygen and heat will lead to increasing bacterial generation – creating sludge. This will cause injector issues and a build up of wax in cold conditions.

And while this regulation does not apply to standby generation, the problem hospital trusts regularly face is actually sourcing diesel without B10 in it. We recommend that trusts talk to their fuel supplier to see if they can acquire it on their behalf.

The other important action is to test your fuel regularly and, if it has problems with water, biomass/bacteria or sludge build up, polish it. This is essentially a two-stage filtering system where a centrifuge separates out the water and filters out bacteria. You can have a unit permanently available, hire it, or bring someone in to do it for you.

9 AMORTISING YOUR GENERATOR COSTS THROUGH TRIAD AVOIDANCE

Half-Hour Demand Tariffs						
Zone	Zone Name	16/17 (£/kW)	17/18 (£/kW)	18/19 (£/kW)	19/20 (£/kW)	20/21 (£/kW)
1	Northern Scotland	40.97	29.73	35.59	35.84	51.32
2	Southern Scotland	40.24	30.45	34.64	36.55	49.53
3	Northern	42.93	38.16	44.38	47.98	60.86
4	North West	42.83	43.59	49.66	54.12	67.87
5	Yorkshire	42.49	44.13	50.88	55.42	69.28
6	N Wales & Mersey	42.68	45.50	51.73	56.33	70.21
7	East Midlands	44.72	47.01	53.94	58.54	72.66
8	Midlands	45.74	48.26	54.90	59.81	73.90
9	Eastern	46.54	49.02	56.09	60.42	74.54
10	South Wales	42.31	45.44	52.55	58.06	72.10
11	South East	49.20	51.83	58.58	62.85	76.70
12	London	51.87	54.37	61.23	65.78	79.94
13	Southern	50.08	52.83	60.14	64.84	78.61
14	South Western	48.58	51.43	58.77	66.05	79.66

Source: National Grid

Using standby generation for STOR, TRIAD (TuOS) Avoidance and avoidance of Red Zone (DuOS) charges opens the door to hospital trusts reducing their power costs to the point where they can significantly, and even totally, amortise the costs of standby generation ownership. Indeed, many hospitals already exploit this potential.

9 AMORTISING YOUR GENERATOR COSTS THROUGH TRIAD AVOIDANCE

TRIAD charges are imposed retrospectively by the National Grid to larger users (charged by the half hour). They will, in simple terms, determine the three points of peak demand between 1st November and the end of February (with no less than ten days between them) and charge customers at a separate rate for the energy used during those three specific half hour periods.

Typically this will be at around £40 per kW – a potential 1,000-fold increase which can easily add tens of thousands of pounds to a hospital's power costs for each peak.

We have looked at some hospital projections where power costs – despite projected reductions in total energy consumption – are set to increase by over 50% over the next few years. Some of this will be FIT, but the vast majority relate to TRIAD – where charges are set to almost double in some instances.

Many hospitals now avoid TRIAD charges by receiving peak consumption predictions and using standby generators at this time. Providers of this data will typically aim to give you around 20 – 30 possible times to ensure you cover the three peak periods.

There will be costs incurred, not least the diesel. But this will amount to a fraction of the alternative cost, the periods you use can replace your regular tests, and you will have a larger turnover of diesel in your storage tanks – reducing the incidence of sludge building up.

Our experience is that hospitals can reduce their overall annual power costs by between 15 and 20% in this way – and that is at current TRIAD charges, putting the cost of standby generation ownership into a very different perspective. Moreover, as more users avoid the TRIAD Charges and reduce these peaks, the TRIAD points will be less pronounced spikes – making it even more critical to be proactively looking to avoid them – and (where possible) feeding into the grid.

10 CONCLUSION

But of course, making full use of this capacity - and turning a capital liability into a revenue-generating asset - will only be possible if your standby generation equipment is well maintained and serviced...

If you would like to discuss any of the aspects covered in this paper, do get in touch. We are happy to act in a consultative capacity to ensure your standby generation equipment is designed for the future.

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