ULTIMATE SERVICE ASSOCIATES
A NORTH AMERICAN SITE SERVICES CO.

The ultimate solution for maintaining your nationwide generator network

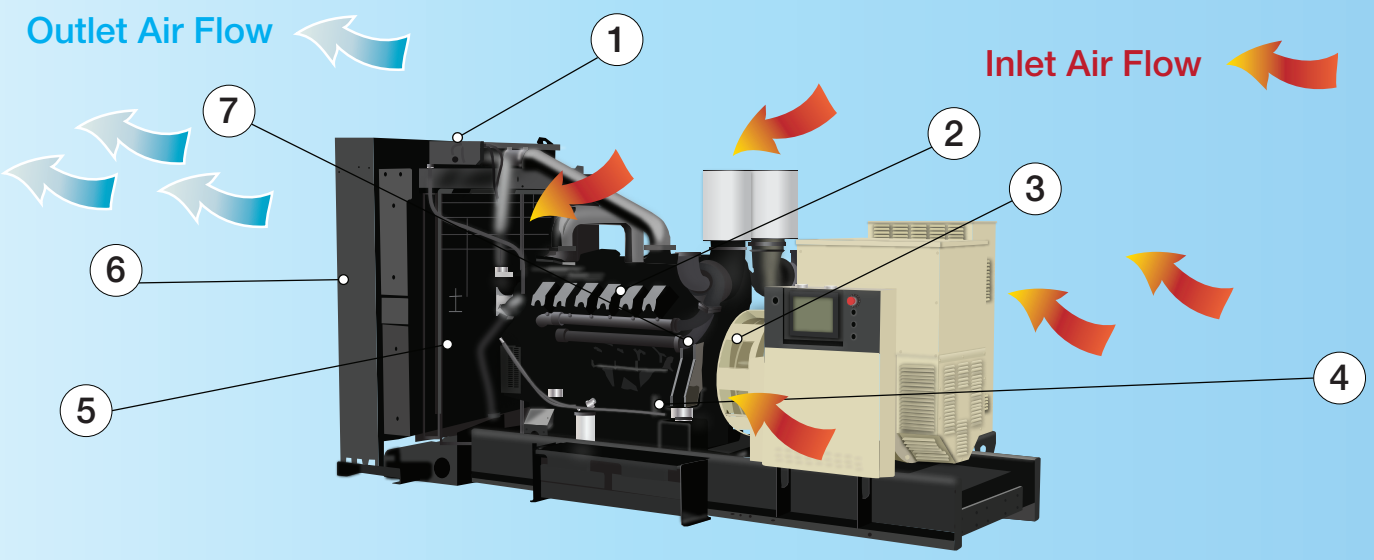
Generator System Operation During High Ambient Temperatures

1.0 Introduction:

During the second decade of the twenty first century, most areas of the world have been experiencing much higher ambient temperatures with daily temperature records exceeding many set during the twentieth century. Currently it's being predicted the frequency of record breaking summertime temperatures are set to continue for several decades. While the cause for higher temperatures is still debated, the actuality is now generally accepted. Many generator systems were designed and applied to run in a temperature range that is no longer the norm. Designers and operators of generator systems are going to have to adapt to a new norm. System designers are already taking account of higher ambient temperatures, but existing installations will have to be reviewed to ensure reliable operation during prolonged hot weather events.

This information sheet discusses how very high ambient temperatures impact generator performance, service considerations to ensure reliability, and changes that may have to be made to existing generator systems.

Figure 1 High Ambient Temperature Effects on an Engine/Generator System



Key Maintenance Points for Generators Operating in High Ambient Temperatures		
Item#	**Service Sector**	**Service Item**
1	Coolant	Ensure coolant is topped up and rated for high ambient temperatures
2	Power Rating	Ensure connected load does not exceed power derated for ambient temp
3	Generator Fan	Checking cooling fan and generator rating when operating in high ambients
4	Lube Oil	Ensure lubricating oil is renewed and graded within rated temperatures
5	Engine Fan & Belt	Check for any damage and ensure fan is secure and in good condition
6	Radiator	Ensure there is no blockage within radiator with free flow of air
7	Other Components	Check fittings, hoses, wiring insulation, etc that can deteriorate in high ambients

To fulfill our commitment to be the leading network service provider in the Power Generation Industry, the USA, Inc. team maintains up-to-date technology and information standards on Power Industry changes, regulations and trends. As a service, our **Information Sheets** are circulated on a regular basis, to existing and potential Power Customers to maintain awareness of changes and developments in engineering standards, electrical codes, and technology impacting the Power Generation Industry.

2.0 What is the Impact on a Generator System:

Generator system designers and manufactures design their equipment to operate in a wide range of temperatures. However, in designing the systems they use records of highs and lows over a period of time in the twentieth century that are now being challenged in the twenty first century. Prolonged periods of elevated temperatures will have the following effects on generator system performance:

1.1 Ratings – All equipment producing power is assigned a rating that assumes an established Normal Temperature and Pressure (NTP) range. When equipment is operated in conditions outside of that established for NTP the manufacturer will provide a formula for lowering the NTP rating should altitude, humidity and temperature be higher than that assumes for NTP. Derations for temperature and humidity should have already been calculated for existing installations, but were the assumptions based on lower average temperatures that current and projected levels.

1.2 Cooling – Generator systems, above 15kW usually incorporate water-cooled prime movers, gasoline, gaseous or diesel. Water used to take away engine heat is cooled by fans pushing air through a radiator, remote or engine mounted. The higher the ambient temperature the greater the amount of air flow through the radiator is required. When the ambient temperature rises above that calculated for NTP the maximum power from the engine has to be lowered to avoid over-heating.

1.3 Batteries – Batteries are at their most efficient when cold. At higher temperatures the ampere-hour capacity of a battery is reduced. If excessive ambient temperatures are going to be the norm, battery size may have to be recalculated.

1.4 Generators – Generators have a built in fan attached to the rotor to ensure sufficient cooling of the generator coils while producing full NTP rated power.

1.5 Wiring – Current flowing through a wire meets resistance which manifests itself as heat. Wiring size is calculated for NTP, as the temperature increases wiring conductivity reduces leading to greater resistance and more heat generated in the coils. Conversely the colder the temperature the greater wiring conductivity. MRI scans use liquid helium to cool electrical coils to super conductivity levels so a lot of power can flow through a smaller wiring dimension.

1.6 Components – A generator system is an electro-magnetic device and a sum of many parts both mechanical and electrical. If a generator is going to be left standing in very high ambient temperatures during service the technician will make a check of the following components to ensure no heat generated deterioration has occurred:

- **Rubber connections** - Cooling hoses, harnesses, any fuel connections
- **Wiring Insulation** - Insulation material can become brittle
- **Fasteners** - Heat can cause them to loosen and/or cracked
- **Coolants** - Check coolant levels
- **Radiators and Fans** - Check radiators and fans are in good order and clean and replace as necessary
- **Belts** - They can become brittle in excess heat

2.0 Recommendations to Ensure Generator Reliability in High Ambient Temperatures:

If an existing generator installation starts to have problems related to very high ambients, after all the usual factors have been eliminated, a review of the installation itself should be made including:

2.1 Open Non-Enclosed Generator – Is the generator installed in direct sunlight? If an open installation, consider installing a canopy to shield the unit from the suns direct rays. Surfaces can become too hot to touch.

2.2 Enclosed Generator – Check the air intake louvers are not drawing air from an enclosed area where the ambient air is not well ventilated and starts to rise in temperature beyond that of the ambient air. Verify outlet air is not restricted and limiting the air cooling flow. Radiators for engine coolant and charge-air cooling have to have a free flow of ambient air.

2.3 Motorized Louvers – Some installations have motorized louvers fitted to the air inlet and outlet to prevent the ingress of snow during the winter. These same locations can have high ambient summer temperatures. The service technician will ensure during summer the louvers and fully opening.

2.4 Cooling System Maintenance – Planned maintenance (PM) programs ensure the coolant, pulley belts, radiators and belts are checked for operation and condition. Your manufacturer authorized generator distributor will have PM programs for regular maintenance of the cooling system.

3.0 Addressing Continued High Ambient Temperature Operation:

Operators and designers of generator systems have become very aware of rising summer temperatures and adapting to the new norms as regards ambient temperature. The following are areas that will have to be addressed for complete reliability:

3.1 Derating Due to Temperature – The rating for NTP temperature is assumed as 70°F. Depending whether the engine prime mover is naturally aspirated, turbocharged and/or charge-air cooled, will determine the level of power available above 70°F.
Where average summer temperatures are now higher than the norms of 20 to 30-years ago the site rating available during summer will be lower. Derating is the term given to reduce the amount of power given for NTP. For every 10°F above NTP the output power available can be reduced (derated) between 2 and 4%. As air heats up it becomes less dense, so the reduced air fuel mixture reduces the energy to power the prime-mover.

3.2 Derating Due to Humidity – In addition to temperature the fuel air mixture can be changed by excess humidity. Humidity deration can be up to 6%, depending on the ambient temperature, for the available number consult the distributor.

3.3 Insulation of Enclosed Installations – Enclosures for outside installations can be insulated to prevent excessive direct sun over-heating the interior.

3.4 Interior Installations – If ambient temperatures are forecast to be rising above prior norms, in certain areas consideration should be given to installing an open generator in an interior building location.

3.5 Connected Load – Ensure the connected load does not exceed the derated output for high ambient temperatures.

USA ULTIMATE SERVICE ASSOCIATES A NORTH AMERICAN SITE SERVICES CO.

Ultimate Service Associates, LLC.
5514 South Lewis Ave.
Tulsa, OK 74105

Ph: 918.836.8701
Fx: 918.835.2748

www.usa-svc.com

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