FRS

Fuel Reduction System

By alfaphonet
The first choice in telecommunications and networks

The system was developed to meet strict technical requirements of real and active Base Stations in Greece.

The Problem

- Most of the off-grid mobile telephony base stations are powered by diesel gensets operating on a 24-hour basis.

- The cost of electricity generated in this way is remarkably higher compared to that from the grid.

These installations suffer from:

- High fuel consumption compared to the energy produced.

- High energy cost, as a direct consequence.

- High gas emissions (carbon dioxide, oxides of nitrogen, oxides of sulfur, carbon monoxide, unburned hydrocarbons and particulates).

- Increased genset maintenance costs plus consumables costs (lubricants, filters, spare parts).

- Increased engine replacement costs from the increased wear due to the specific way of operation.

The genset before FRS

The genset usually operates continuously, with a light load equal to a small fraction of its rated power.

In such conditions, fuel consumption is rather constant and not proportional to the load, resulting in a very bad efficiency factor.

Engine wear also is higher, since heavily loaded diesel engines are subjected to less wear than lightly loaded ones.

The FRS
Fuel Reduction System
IS THE SOLUTION

It is a system developed by Alfaphonet Ltd.

Its purpose is to reduce fuel consumption by intermittent operation of the genset.

FRSs are operating in Base Stations in Greece since August 2006.

The design was tailored to meet strict technical requirements of a Mobile Telecom Operator.

Nine FRSs are operating up to now in Telecom Base Stations mainland and the islands, of Greece.

The Benefits:

- **Fuel reduction**, ranging from 50% to 75%. Fuel consumption is now proportional to the actual energy consumption (kWh) of the BTS.
- **Gas emissions reduction** at the same percentage as fuel reduction.
- **Engine operating time reduction** down to 4-8 hours per day resulting to:
  - **Noise reduction** proportional to the engine operating time reduction.
  - **Engine maintenance intervals increase from 2 weeks to 6-8 weeks** with a proportional reduction in maintenance costs.
  - **Engine service life increase by a factor of 3-4** with a proportional reduction in engine replacement cost.

The FRS Concept

On the contrary, the FRS runs the genset at almost full power, where fuel efficiency is best and engine wear is less. The surplus of the generated energy is stored in a 48V battery bank and when it is fully charged, the engine is turned off and the station is supplied with the stored energy from the battery. This cycle is repeated several times per day. Therefore the engine runs only for a few hours per day and the fuel consumption is very close to the ideal one. When the engine is turned off, all the 48Vdc loads (i.e. telecom equipment) are directly powered from the storage battery. Other equipment operating on 230 Vac (i.e. air condition, aviation lights, etc) is powered by suitable high power – high efficiency inverters.

The FRS Physical Description

The FRS is a self-contained system that comes in two versions according to the transportation and installation needs.

FRS S-300

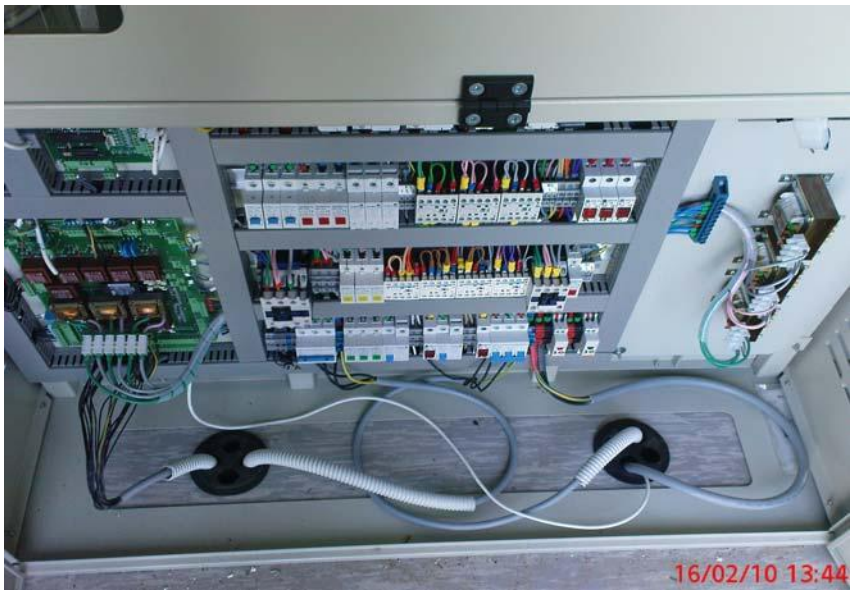
The FRS and the batteries are built in a 1.6X2.8X2.3 m (W x L x H), robust, all weather shelter, easy to transport by means of a truck equipped with a lifting device. The weight of the complete system is 3000 kg.

FRS C-300

It consists of **three** robust, all weather shelter, **separate cabins** (two for the batteries and one for the rest of the equipment). This design offers higher flexibility in transportation and installation. The dimensions of the FRS cabin are 0,6X1,2X1,8 and of the battery cabins 1X1X1,6 (W x L x H) and their corresponding weights are 350 kg and 1050 kg accordingly.

FRS interconnection with the Existing Installation Equipment

The FRS installation does not require any serious modifications to the wiring of the existing installation. A minimum number of electrical connections are made to the following points of the existing installation: 1) generator output, 2) engine interface conductors, 3) the main power supply (48V rectifier) output, 4) the AC input of the telecom compartment power distribution panel.



Important: 🕘 By means of only two turnover switches the operator can easily select operation of the station with or without the FRS (FRS completely bypassed).

🕘 If an FRS is no longer needed at a particular installation (for example, if the particular installation is now connected to the grid), it can be easily disconnected and moved to another installation.

System Control and Management

Although the FRS is **a fully automatic stand-alone system**, it is continuously monitored through a sophisticated *Telemonitoring and Telecontrol system*.

This feature offers the possibility to have always a complete real-time image of the system.

All data is saved in a database and can be retrieved easily in history mode in case you want to see what has happened at any past moment.

The data monitored by the Control and Management System is compared to previous historical data values, in order to help us foresee and so to prevent damages before they occur.

An Extra Benefit

for the owner of the FRS is that **he can also monitor and control**, through the *Telemonitoring and Telecontrol facility*, **the rest of the installation equipment,** beyond the FRS itself:

- Fuel level, engine temperature, oil pressure, engine room temperature, starter battery, and everything else related to the genset, plus voltages currents and temperatures on the station equipment, open doors and more, are among the indications of the Telemonitoring system.
- All these are visible in real-time and available for any moment in the past.

- Telecontrol makes possible every operation on the installation, (start or stop the genset, change its parameters, etc), with no need for physical presence.

The FRS components

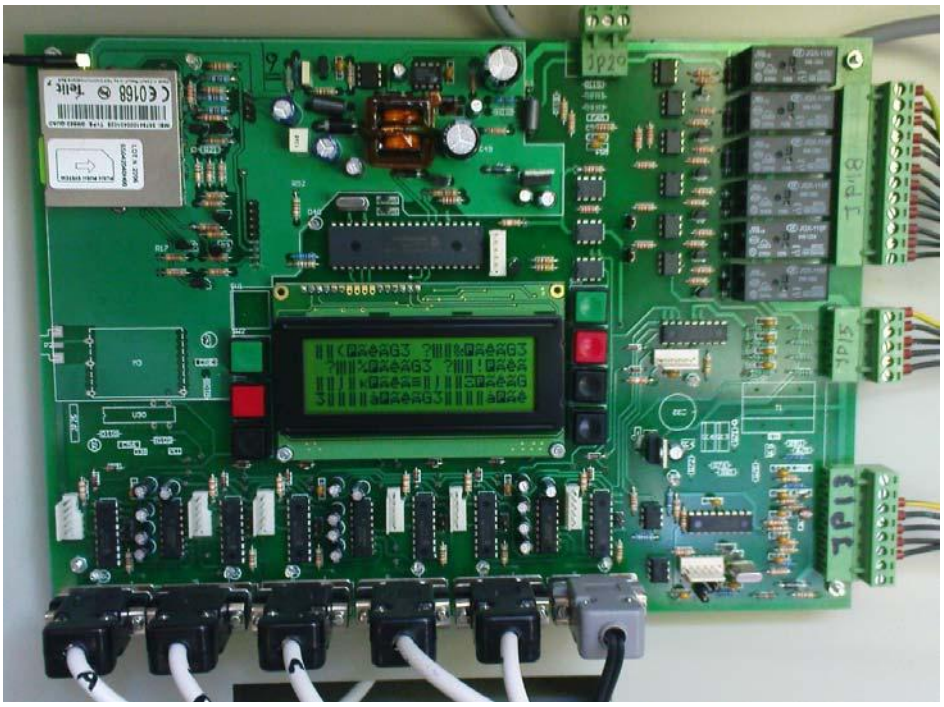
1. **A 48V Battery bank** (usually 1200 Ah capacity) **tubular OPZS open vent type**.
2. **Three PMS units** (Power Management Systems). They are two-way 48Vdc

– 230Vac heavy-duty power converters with embedded micro controllers and special event loggers. The PMS's handle all power conversion functions (battery charging and AC load supply). They can deliver very high peak AC power (up to 30 kW) for air conditioner starting.

1. **Power Distribution Panel.** It consists of the necessary switches, fuses and relays for the control of power flow through the system.
2. **Controllers**. The main controller and the Diesel controller

The System Controller

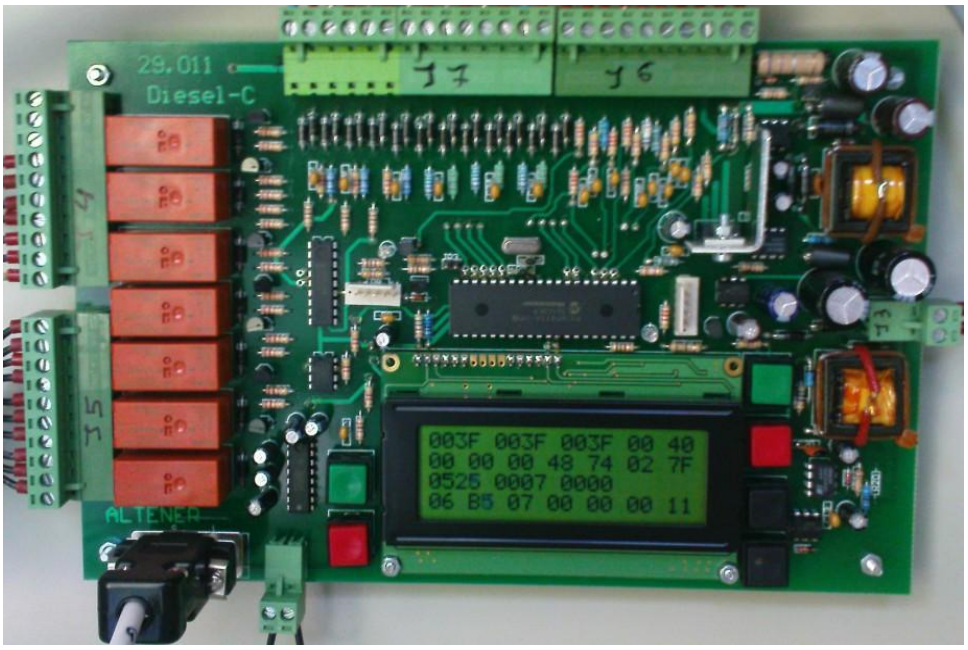
All high-level control functions are carried out by the custom designed System Controller of the FRS, which:



- Is connected (with RS232 independent links) to the embedded controllers in the other components of the FRS, (PMS, Diesel Controller, metering equipment) and optimizes their functionality.
- Controls directly the power flow through the power distribution panel.
- Connects by means of a built-in GSM/GPRS modem to the central FRS server for the Telemonitoring and Telecontrol functions.
- Have spare communication ports and software control extensions to readily integrate photovoltaics and small wind generators to the system for additional power contribution.

The Diesel Controller

is a dedicated controller for the genset of the FRS, which:



- Monitors and processes all its operating parameters (temperatures, oil pressure, starter battery voltage, etc) and will issue specialized alarms if necessary.
- Will start or stop the genset according to System Controller commands and will log special events for further investigation.
- In case of prolonged lack of communication with the System Controller, it will turn on the genset permanently and will issue hardwired alarms to the BTS monitoring

Software for Telemonitoring & Telecontrol

Every one of the existing FRS units establish an incoming two-way connection with the FRS central server.

A specially developed software running on this server, receive the incoming reports from all the connected FRS units, store them in a suitable data base and also displays them in real time.

These reports contain detailed information about the operation of the FRS, voltages, currents, temperatures, events but also alarms, damages etc as well as entries to the dedicated data loggers of the FRS components.

Real time commands for manual control can be sent from the central FRS server to any of the FRS units.

Database information can be read back as real time reports in history view, but they can also be processed to create charts, tables or to extract specialized information for further processing.

Reliability Redundancy Autonomy

- **High quality materials and components and proven techniques** are used for the manufacturing of the FRS.

- **Expected storage battery life is over 10 years**, due to the specific battery treatment of the system.

- Each one of the three PMS's will support in most cases all the AC loads of the installation. This design follows the rule N+2 resulting in a **very high redundancy of the system**, which will operate properly even when one or two PMSs are temporally or permanently not available (due to overload, overheat or damage).

- The large storage battery of the FRS **extends the power autonomy of the installation to several hours**. This, combined with the detailed description of damages from the database of the Telemonitoring system and with the capability for manual control will greatly increase the flexibility of the maintenance team to handle issues effectively and without loss in the functionality of the installation.

A Complete Image of the Entire Installation

- Thanks to the *sophisticated Telemonitoring and Telecontrol facility*, the owner has not only a complete image of the FRS, but also of the entire installation (to know when the door is opened, the fuel level, air-conditioner operation etc).
- Upcoming issues and damages can be detected and fixed before they actually occur.
- Information from reports and from data logger entries, can be used to investigate damages and detect their origin.

The FRS will readily integrate any Green Energy Resource Equipment

The FRS will integrate, with no need of any extra equipment, small wind turbines and photovoltaic.

We have already installed wind meters to evaluate the wind potential for the future installation of additional small wind turbines.

Prevention of Damages

- In many cases, the evaluation of the Telemonitoring system information, has led to the detection of upcoming damages to the lubrication and the water cooling systems of the generator engine, to the starter motor and the starter battery, to the battery charger (alternator), fuel leaks etc. All these issues were reported immediately and were fixed by the maintenance personnel before they turn to real damages.

- In many cases also, damages in the installation equipment have been diagnosed and resolved at the very moment they occurred. Therefore the service personnel were prepared to fix the particular damage and worse problems were avoided. Examples are damages to the engine room ventilation, to the generator, room air-conditioner etc.

- Very often, when the maintenance personnel in the installation is working to fix a particular issue or change a spare part etc, they are supported by the personnel of the help desk (the personnel of our company) and they both act as a team with increased efficiency.

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