Easy Fuel System Operational Description

Concept:

Easy Fuel combines Long-range and Proximity RF technologies offering a revolutionary solution to gasoline management.

Long range RF communication between the station fueling controller and the vehicles, combined with a short range proximity RF communication between the vehicles and the fueling nozzles, enable quick and easy secured controlled refueling transactions.

The RF communication replaces hardwired communication between station components, hence greatly simplifying system installation at the gasoline station and reducing the maintenance expenses.

EF system comprises three elements:

- NID (Nozzle IDentification unit):
  A very low power RF transmitter, mounted on the refueling nozzles. The NID periodically transmit its ID when off hook.
  This ID is used to identify the specific requested nozzle to the station controller.
- VID (Vehicle IDentification unit):
  The VID is mounted in the vehicle.
  It is connected to fuel inlet antenna to retrieve the Nozzle ID and to an RF antenna to communicate with the SC.
- SC (Site Controller):
  The SC is usually mounted at the station office.
  It communicates with the vehicle's VIDs via an RF antenna and with the station controller via serial communication line.

Operational Scenario:

When a nozzle is inserted into a vehicle fuelling inlet, the vehicle VID reads the NID ID.
Its Long-range transceiver communicates this nozzle ID, together with the Vehicle ID, to the Site Controller.

The Site Controller transfers the combined NID and vehicle IDs information to the station controller to approve the refueling.

When the nozzle is removed from the vehicle's fuel inlet, RF communication between the vehicle tag and the nozzle tag is interrupted. This information is transmitted to the Site Controller that routes it to the station controller that disables the fuel flow to the specific nozzle.

Antenna Types:

NID antenna:

The NID antenna comprises 6 turns on the PCB perimeter with an average area of about 3x1.3=4cm^2. The coil inductance is about 2µH.
The coil is driven differentially via serial capacitors so as to form a serial resonance.
A 74VHC86 digital XOR chip, operating at VCC=3.6V with about 15mADC current consumption, supply the driving signal.

This average input current pose a theoretical worst case upper limit to the coil current in the range of few tens of mA.
It should be noted that very little of the antenna magnetic field is actually transmitted away from the antenna. This is due to the use of a very small loop antenna, which makes it a very inefficient radiator, or in other words antenna which has a very low Radiation Resistance so the radiated power is actually spent as heat in the antenna ohmic resistance, and the magnetic field around the antenna is of reactive type where energy is exchanged back and forth between the current in the antenna and the small volume around it during each carrier cycle.
Radiation resistance of small loop is $Rr = 31200A^2/\lambda^4$ where A is the loop antenna area. This formula yields an extremely small radiation resistance ($2.08x10^{-8}$ohm). This resistance may be considered as if connected in series with the antenna ohmic resistance (and the driver output resistance). This explains why only a minute fraction of the magnetic field energy actually propagates away from the antenna.
This also why no attempt is exercised to define exactly the NID transmitted output power as it is both hard to define and as the common rule of thumb calculation, of the far field RF power versus the transmitted power, has little bearing in this case (output power of 10 mW would be a reasonable estimate).

VID Antenna:

The VID antenna is a special vertical window mounted Omni-directional 50 Ohm matched antenna with a gain of about 0 dBi.

SC Antenna:

The SC controller uses an off the shelf 1/4λ vertical 50 Ohm matched antenna with a common gain in the range of 0 dBi.

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