**An Analysis of Photovoltaic Performance within Existing Fire Station Buildings by Dan Clark**

## Executive Summary.

The aim of this project has been to objectively investigate and report on the performance and viability of existing photovoltaic technology, which has been retrofitted to existing manned fire station properties. The focus of this report has been to identify the actual site generation readings provided by a remote monitoring website and compare these with original consultant simulations, industry recommended calculations and approved software modeling tools.

14 stations have been the subject of this report, however 5 no have had to be discounted due to insufficient information or errors in the meter recordings, and a further 2 no later in this document omitted due to incorrect data supplied by the client. Please see sections 6.2 and 12.4 for further detail.

The full brief been presented as laid out by Ian Shaw of London Fire Brigade and Professor Tony Day of London South Bank University. This follows with sections examining the operation behind photovoltaic technology, its advantages for application within fire stations and an examination of potential causes (and symptoms) of faults to aid the client in monitoring the system in the future.

Examination of the actual photovoltaic yields against the original consultant documentation shows an average margin of error across the building stock of +16.8% in their calculations. This has inflated potential environmental benefits and financial gain over what can actually be expected. Simulations have also revealed that the IES Virtual Environment Modeling Software Tool is the most accurate when compared with consultant figures and industry recommended calculation, with an average margin of error of +14.3% across the building stock.

Utilising the modeling tool to simulate the effects of repositioning and efficiency indicate that that with upgrades to more efficient monocrystalline panel technology, accompanied with inclination changes to 30˚ and orientation changes to due south, improvements of up to 40%

could be reached in some stations. This however has purely been a theoretical exercise to give a best case scenario – as the expenditure required not only for refitting, but also the sheer capital cost of the installation results in the change being un profitable over the lifetime of the installation.

The environmental anaylsis has revealed that the installation has a greatly beneficial effect on the reduction of Carbon Dioxide ($CO_2$) emissions and the contribution toward reducing the effects of climate change. Simulations using ADL2A 2006 [8], the applicable regulations at the time of installation have revealed that approximately 29.64 tonnes of $CO_2$ could be saved per annum across the 8 remaining viable stations, or 741 tonnes $CO_2$ across the 25 year manufacturers guarantee on the photovoltaic panels.

Investigations into the financial element show that the costs quoted by the installer of the Sanyo 215 model photovoltaic panels are approximately twice the current market value, which dramatically affects the payback of the models – and this was not detailed on the consultant information originally supplied to the client.

The inclusion of the new government Feed in Tariff (FiT) has also been applied and has shown at simple payback of generation savings against capital cost that a reduction to within the 25 year warranty could be achieved. This essentially has gone a great way to minimise the losses which could have been expected by the client, which were not made known by the consultant at the original feasibility stage.

Net present value (NPV) analysis of the whole life of the photovoltaic installation across the building stock, including inverter equipment replacement and re-roofing costs has revealed that due to the larger than expected capital outlay, the client will fall short of a payback by approximately £94,086.45. Examining the potential for roof risk assessment and run to failure of components, sensitivity analysis shows that the client can minimise losses to the value of £8,299.06 across 30 years.

However, analysing the effects of the current market value, a profit could have been expected (including FiTs) of approximately £158,327.76. This indicates that providing a more in depth analysis at feasibility stage to mirror installation parameters, if current market values are

available, then the installation of Photovoltaics across the rest of the stock could be a profitable investment.

It is however executive conclusion of this document that the current installation accepted and installed on behalf of The London Fire Brigade – although beneficial to the environment, will not be a viable long term financial investment due to the high initial capital outlay.