Field Compatible Measurement of Flare Efficiency and Emissions

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Despite significant progress in quantifying, understanding and reducing the impact of flares, flaring remains a primary issue of concern for the upstream oil and gas industry. Moreover, although different approaches have been attempted in the past, there are still no generally accepted or proven quantitative methodologies for measuring flare emissions in the fully open environment that exists under field conditions. The primary goal of this proposal is to develop a practical, quantitative, and accurate methodology for measuring flare efficiency under field conditions. Measuring flare emissions in an open environment is particularly challenging for a number of reasons including: multiple species present in the combustion products (typically in both solid and gaseous phases); uncontrolled entrainment of air which may contain several of these same species; unpredictable position and shape of the plume; inhomogeneities within the thermal and compositional structure of the plume; multiple species present in the fuel (potentially in both liquid and gaseous

phases); and unsteady nature of the flow. In addition, there are several other practical concerns which can make measurements difficult if not impossible to perform including site location and access and availability of utilities.

To mitigate these difficulties as much as possible, a novel tunable diode laser based approach will be investigated using existing technology developed by Unisearch Associates Inc. Formally called Tunable Diode Laser Absorption Spectroscopy (TDLAS), in this technique concentration measurements are made by rapidly scanning and measuring narrow-band infrared absorption of laser light over a range of frequencies specific to a particular gas or species of interest. The diode lasers in the system are essentially identical to solid state telecommunications grade lasers and emit light at rapidly variable (tunable) wavelengths. This approach offers a number of advantages for measuring atmospheric gases and is a universal method which is, in principle, applicable to all gases of atmospheric interest. Moreover, TDLAS is highly specific, providing unequivocal identification of target gases even in the presence of complex mixtures of gases and aerosols. Optical measurements are made across a series of open paths giving line averaged concentrations of the individual species. This line averaging is critical to avoiding significant problems due to inhomogeneities within the combustion plume.

Although TDLAS is a mature technology in a number of applications, the novel application of this approach to develop a field compatible methodology for measuring flare emissions will require significant research, input, design and verification on a number of fronts. As such this proposal is designed to integrate with a much larger research initiative among the University of Ottawa, National Research Council (Institute for Chemical Process and Environmental Technologies), and Unisearch Associates Inc. and will leverage anticipated funding from the Canadian Foundation for Innovation (CFI) (decisions announced in late June 2004), and a subsequent application to the NSERC/NRC partnerships program.