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PROPOSAL TO EVALUATE COMMERCIAL KITCHEN VENTILATION DESIGN WITH RESPECT TO GREEN BUILDING DESIGN AND LEED POINT POTENTIAL

OUTLINE

I. INTRODUCTION AND OVERVIEW

Commercial kitchens are found everywhere; witness the $200 billion estimate revenues. A kitchen is considered commercial if food is prepared in it that serves a relatively large public on a regular schedule. Commercial kitchens are located in restaurants, cafeterias, hotels, schools, prisons, companies and catering halls. Dining out is one of America's (and the world's) favorite activities and this is reflected in the number of food preparation facilities that exist (and constantly change with trends and business fortunes).

The design of commercial kitchens involves a myriad of professionals including architects, engineers, food service consultants, commercial kitchen ventilation experts, fire suppression specialists and a myriad of tradesmen (electricians, sheet metal workers, plumbers and building control experts). Many of these groups have professional organizations or subsets of such organizations. A good example is the technical committee (TC 5.1) or ASHRAE or the Food Service Consulting Industry (FSCI) which tests and certifies its members.

There are numerous expensive considerations made when a food service facility is designed. These expenses include the initial costs or selecting and acquiring cooking equipment and the appropriate kitchen ventilation equipment. The latter is comprised of kitchen hoods with grease filters, additional downstream grease removal devices, exhaust fans, replacement or make-up air units, make-up air distribution systems, and the corresponding duct work to connect the systems, the fire suppression systems, and the integrated control of these systems. It should be obvious that such systems are more complex than typically realized and too often that incorrect assumption combined with under qualified business representatives, results in systems that are at beast sub par and/or ineffective.

Equally if not more significant to the successful establishment of a food service facility is the ongoing costs to operate such a commercial kitchen. The energy and maintenance costs to operate the kitchen are one of the largest costs borne by the establishment. A poorly designed system wastes energy and can lead to expensive and even unsafe facility maintenance issues (greasy roofs, grease fires, slippery kitchens, heat exhaustion amongst staff, and so on).

The purpose of the expose and proposal is to explain the proper design considerations for considerations and then to demonstrate that there are aspects to that design that are Green.

II. ASPECTS OF COMMERCIAL KITCHEN VENTILATION SUBJECT TO GREENING

The parameters required for effective commercial kitchen ventilation are known and have been promulgated by such organizations as ASHRAE. There is industry-supported research that subsidizes and publishes their findings on a myriad of subjects ranging from correct amount of exhaust air to effectiveness of supply air distribution systems, capture of effluents over specific types of cooking equipment and so on. Many commercial kitchen ventilation (CKV) professionals network with each other and through websites designed for that purpose. There are also consensus test standards to refute the claims of some unethical or ignorant claimants. Designing a properly functioning commercial kitchen ventilation system is available if the facility proprietor commits to using and paying for such professionals.

What is not so common are professionals that have green principles in mind with regards to designing these commercial kitchens. That is the purpose of this proposal, namely to heighten awareness of these options and reinforce the application of these principles with the awarding of LEED™ points.

The green aspects of commercial kitchen ventilation lie in two general areas of energy consumption reduction and air pollution emission reductions. These two areas have been more fully discussed in two technical papers, authored by myself and which are attached for review. They will be briefly summarized here.

ENERGY CONSUMPTION

The first area is energy consumption. From a ventilation viewpoint, energy is consumed in an operating commercial kitchen in the following areas: electric energy to operate the exhaust fan, electric energy to operate the supply fan, heat energy to condition the replacement air (all exhaust air is replaced- whether by design or not), and electric energy to air condition the exhaust air (if it is air conditioned). The two main ways to conserve energy is to reduce the amount of air that is exhausted and to effectively reduce the energy to temper the replacement air. Each is discussed briefly.

The amount of exhaust air required is a finicky quantity to determine. It is based on what and how much of a food is cooked, on what type of cooking equipment and on how the kitchen is physically designed. There are ASHRAE proscribed lower limits, which are conservative and can be considered benchmark values. Hood manufacturers can provide UL (Underwriter Laboratories or ETL) certified hoods that approve lower exhaust rates and these lower rates are often used at the ventilation design professionals discretion (sometimes with poor but legal results). It is apparent that this is a difficult area to proscribe a point system to other than in very broad terms to not limit the design wisdom of the professional (i.e. we do not want to offer more points as the amount of air decreases in percentages) One will see a modest ¼ point accumulated for using a listed hood and using less air required by the ASHRAE guidelines.
There is, however, one area that is indisputably a major reducer of energy consumption of exhaust air. That is to uses an exhaust system that allows a major reduction of exhaust air when significant cooking (as determined by heat sensors and cooking smoke detection). These types of

systems which are available and approved by NFPA 96 (national fire protection associations' standard on commercial kitchens) allow the exhaust air volume to be reduced by a factor of 2/3 when cooking is not occurring. This is accomplished through the used of variable frequency drives on the exhaust and supply fans. Some manufacturers have programs to calculate the amount of savings realized. Some savings are realized in less fan energy, but the bulk of the energy savings are in tempering the make-up air to the kitchen especially in cold climates (gas or electric energy) or hot climates I (air conditioning). This type of system is thus awarded one full LEED™ point. These systems may also be retrofit for existing buildings.

If a properly designed exhaust system, does not select a variable volume exhaust system, there is another area where energy may be realized and that is in the amount of tempering for the make-up air in the kitchen. Commercial kitchens exhaust huge quantities of air, all of which ultimately gets replaced. The energy and costs of replacing this air with perfectly tempered (78 ºF 50% RH) is astronomical, though not without precedent. More reasonable options include tempering the air to a less stringent degree [say 60ºF in winter or 85ºF (perhaps with evaporative cooling) in summer]. Even more extremes are tolerable in milder climates. One of the keys in delivering less conditioned air is where it is introduced. Cold or modestly heated winter air should not be delivered right above the heads of workers. A much better option would be to deliver this air behind the cooking equipment and discharging it on the floor. Similarly, some lesser air conditioned air in summer could have a spot cooling effect on workers by introducing it as an air curtain above their heads (below 50 fpm to avoid draft sensation). Thus the proposed LEED™ point award ties a reduction in energy to an air delivery system. It also must consider a local climate factor. Finally, if dedicated air conditioning is used for the kitchen and the building has not received other non-cfc refrigerant points ¼ point is awarded. This concludes the energy savings considerations.

COOKING SMOKE EMISSIONS (AIR POLLUTION) REDUCTION

A seldom, but increasingly considered aspect of commercial kitchen ventilation is the emissions generated by cooking processes. The emissions from the cooking process include aerosols (called smoke and grease by laymen) and gases. These cover a large range of particle sizes (0.01 to > 10 micrometers) and the quantities depend on what is cooked, how it is cooked and what kind of fuel is used to heat the cooking equipment. Though not frequently considered as a point source of

hydrocarbon, until recently by California; there is no question that these volatile and semi-volatile hydrocarbons are precursors of ground level ozone. Further these emissions can cause additional problems: when deposited in grease duct, as fuel for grease fires (the reason why duct cleaning is required- though the efficacy is in doubt); grease deposited on roofs and adjoining buildings, and odors and complaints from nearby residents. Again, a technical paper is attached for review.

Cooking emissions may be generally removed at two locations in a commercial kitchen ventilation system. One is right at the hood and the second is further downstream and before the exhaust stream (Keep in mind, we are trying to eliminate the airborne pollutant, but this will come at the cost (considered less risk of depositing it in the sanitary sewer). Typical hood filters feature two interwoven baffles resulting in one 180 º turn and range from 15% to 20% efficient (removal by weight percent- large size filter cutoff). The remainder of the effluent gets exhausted and deposited in the duct. More efficient dry extractor cartridges (more changes in air momentum by more baffles) are more efficient and can get up to 50% efficient, again with most fine particulate (<1 micrometer) passing thru. Still this merits ¼ of a LEED point. A breakthrough packed bed technology has recently been brought to market by two manufacturers which result in 80-85% efficiencies and reach down to the submicron size level. These filters do have an additional inch of static pressure loss, which may result in a larger fan motor, but the drastic improvement in duct cleanliness and reduced emissions result in a proposed 1 LEED™ point. Developments are underway to introduce electrostatic precipitation (one of the two fine filter technologies below) which would also merit 1 LEED™ point. A continuous water curtain flow hood, while could reduce in reduction of emitted effluent is discounted because of the wasteful nature of continual water flow (this also holds for the fine particulate filtration below).

Fine particulate (<1 micrometer) is the greatest concern for air pollution considerations, both because it is difficult to remove from the exhaust air stream and because it is close to the size (and indeed can partition to the gas phase) of molecular precursors for reactive atmospheric chemical reactions. There are several technologies that may greatly reduce these; however, only two may be considered Green (the others use unacceptable amounts of resources to remove the particulates such as afterburners (gas) and water cascades (water). The two technologies are Electrostatic Filtration and HEPA filtration. While there are disadvantages and advantages to both, they both greatly reduce the fine particulate and odors (molecules) and both would merit 1 LEED™ point. Details on these technologies are found in the attached technical paper.

PROPOSED LEED™ POINTS AWARD SCENARIO

Attached is a spreadsheet that summarizes the proposed LEED point awards that would be available for commercial kitchen ventilation systems. All awarded fractions of points would be summed and rounded up to the nearest integer. The maximum number of points in each category (Exhaust Volume (1), Make-up Air (1), Hood Filtration (1) and Fine Particulate Filtration (1)) and the maximum total would be FOUR points.

SUMMARY AND CONCLUSIONS

This proposal to evaluate and reward commercial kitchen ventilation systems that adhere to sustainable design principals is logical and probably overdue. Recently in NYC a new Green Building project was completed that had specified four electrostatic precipitators for the kitchen exhaust systems. While commendable for choosing to filter the cooking emissions, the models that were chosen were of an antiquated design that used 50 million BTUs and 5 million gallons of potable water (not required for precipitator cleaning) more than a newer designed unit. Despite bringing this matter to the attention of the “Green” architect and “Green” engineer, the matter went forward unabated. Even the owner of the building, who was proudly proclaiming their dedication to Green design, while empathetic to our message, was not moved to action.

It is our hope that by formally including the designation of commercial kitchen ventilation in the Green Building umbrella, travesties such as this will not be repeated. We hope to have such a system in place with the disseminating of LEED 2.2.