



## Sidewall Venting into Screened Enclosures

### Executive Summary

Concern was raised within the NFPA 54 technical committee about the practice of venting gas appliances through walls and into screened enclosures. The concern is that the screened enclosure may not allow an adequate dispersion of the combustion gases and may thus result in the accumulation of carbon monoxide or other hazardous gases. Due to the complexity of the fluid mechanics phenomena involved, the NFPA 54 technical committee sought guidance on how to evaluate the risks associated with this practice and what conditions could make it acceptable or unacceptable. The scope of the study described in this and a prior report was to:

- 1) identify the most important parameters affecting the dispersion of combustion gases vented into screened enclosures;
- 2) define a set of representative configurations (sidewall vent, screened enclosure and surrounding environment) to be evaluated using CFD;
- 3) develop a broad simulation matrix that encompasses as many of the most critical parameters as feasible within the time and budget constraints of this project.

The data collection phase (Task 1) provided limited information that could be used to focus the scope of the modelling effort. Limited scientific literature and other public documentation were found that addresses the issue of sidewall venting into screened enclosures. None of the manufacturers and installers who responded to our inquiries reported allowing or performing this type of installation. Several inquiries are still outstanding; any additional information obtained following the release of this report will be reviewed and incorporated in the following tasks to the extent possible.

Based on the information obtained during the data collection effort and our staff's expertise, a list of parameters was compiled, from which the CFD modelling plan will be developed in collaboration with the project technical panel.

The goal of the modeling effort was to evaluate the sensitivity of exhaust gas dispersion within a screened enclosure to several parameters – including the size of the enclosure, the porosity of the screened walls, ambient and exhaust vent conditions. A total of 43 venting scenarios were simulated using the CFD software FLACS. The CFD modeling results indicated that, within the range of conditions examined:

- Typical screen mesh porosities allow adequate air flow into the enclosure, to mix with and dilute the exhaust stream to levels comparable with unobstructed venting conditions;

- High screen blockage ratios (greater than approximately 75-85%) tend to result in increasing accumulation of exhaust gases within the enclosure, particularly for smaller enclosure volumes;
- Sidewall venting of gas appliances into tightly sealed areas (e.g., “winterized” enclosures) can result in the accumulation of exhaust gases to dangerous levels within the entire enclosure;
- The effect of direct vent appliances is negligible for typical screen mesh porosities;
- Direct vent appliances present progressively higher hazard potential, when compared with remote intake appliances, as the screen blockage ratio increases above approximately 75-85%.

The above conclusions are based on simulations performed on a hypothetical enclosure with no furniture or other objects inside, no vegetation or other obstructions outside and exposed to no wind. Even though the general conclusions obtained from this study are not likely to change significantly with site-specific parameters, the actual gas distribution patterns are expected to be sensitive to enclosure layout, wind conditions, etc.. For the same reason, it is recommended that the results presented in this report be used with an adequate margin of safety to account for site-specific variability.