5.3.7 Number of Viable Particles –Group Counting - Varying with Time (UV2)

UV2: UVGI output powe20W, located on the near bed wall, 7.5’ from the floor.

Note that the number of vented out number varying with time remains the same as in 5.3.1, (10W output with non-depositing model) since increase of the UVGI power output does not influence the airflow field.

Figure 5.55 shows the winter cases with different ventilation flow rate. It seems that 10 ACH results in lowest number of viable particles. For summer cases, the ventilation flow rate has little influence on the number of viable particles. This is especially true for the peak load condition as seen in Figure 5.57.

Figure 5.58 indicates that for winter cases, when the flow rate is low, the viable particle number becomes lower with high exhausts. For summer cases, the high exhausts give slightly lower number of viable particles for all range of flow rate as seen in Figure 5.59.

Figure 5.60 indicates that baseboard heating results in lower number of viable particles when the exhausts are low. Figure 5.61 compares the high and low exhausts with baseboard heating used, which does not show remarkable different between the two exhaust locations in terms of the number of viable particles.

Figure 5.62 shows that the effects of increased pressurization on the number of viable particles are different from case to case. For summer cases, the particle killing is not sensitive to the pressurization of the room as seen in Figure 5.63.

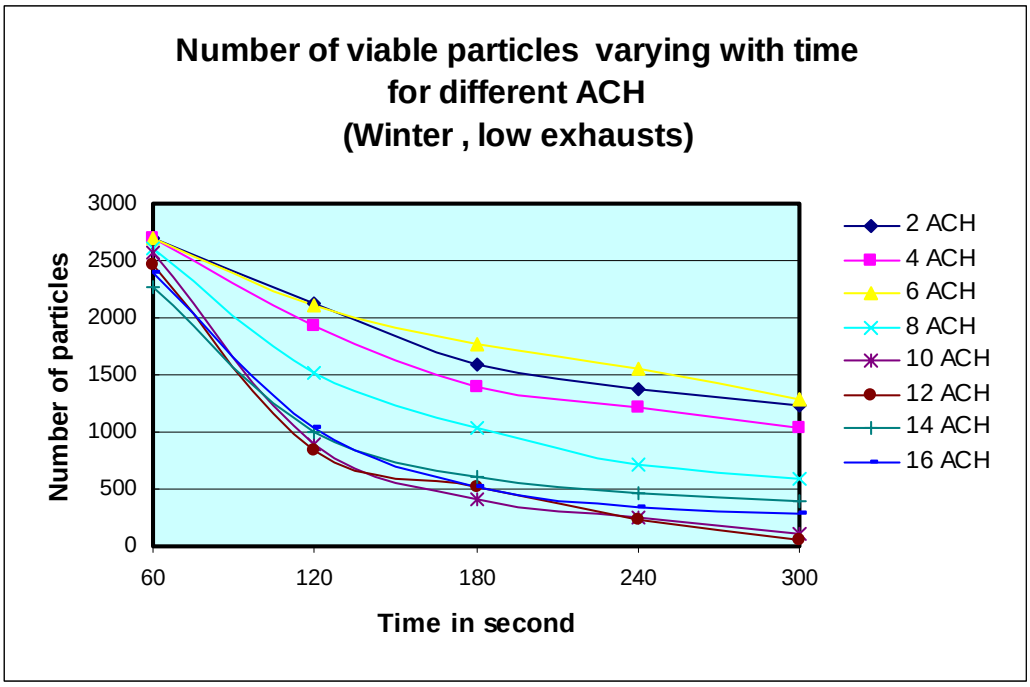

Figure 5.55. *Number of viable particles with ACH change (Winter)*

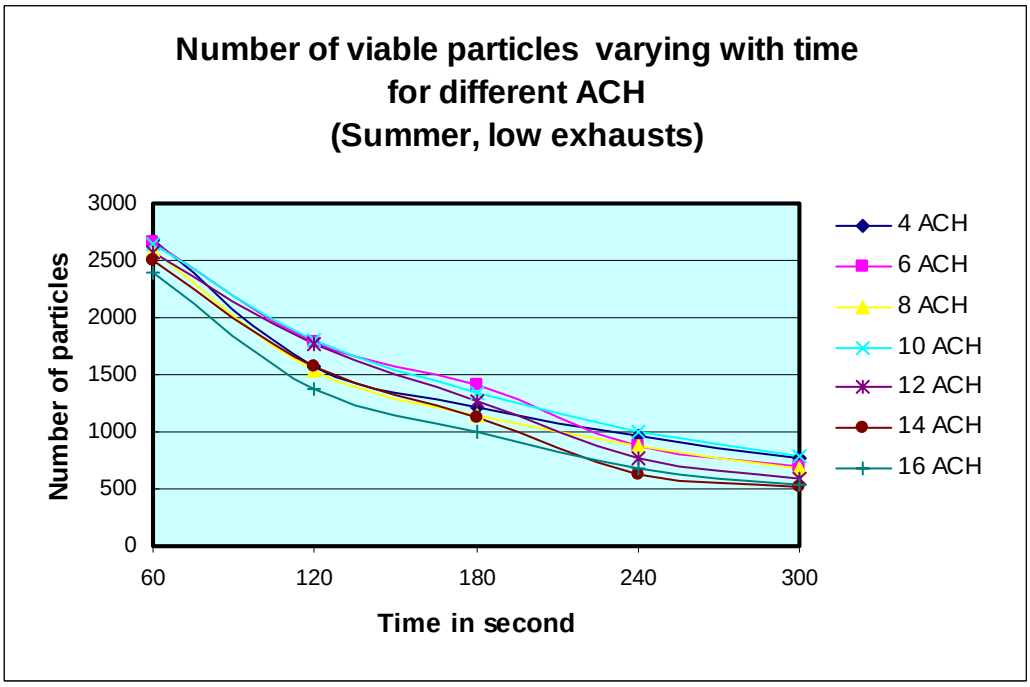

Figure 5.56. *Number of viable particles with ACH change (Summer).*

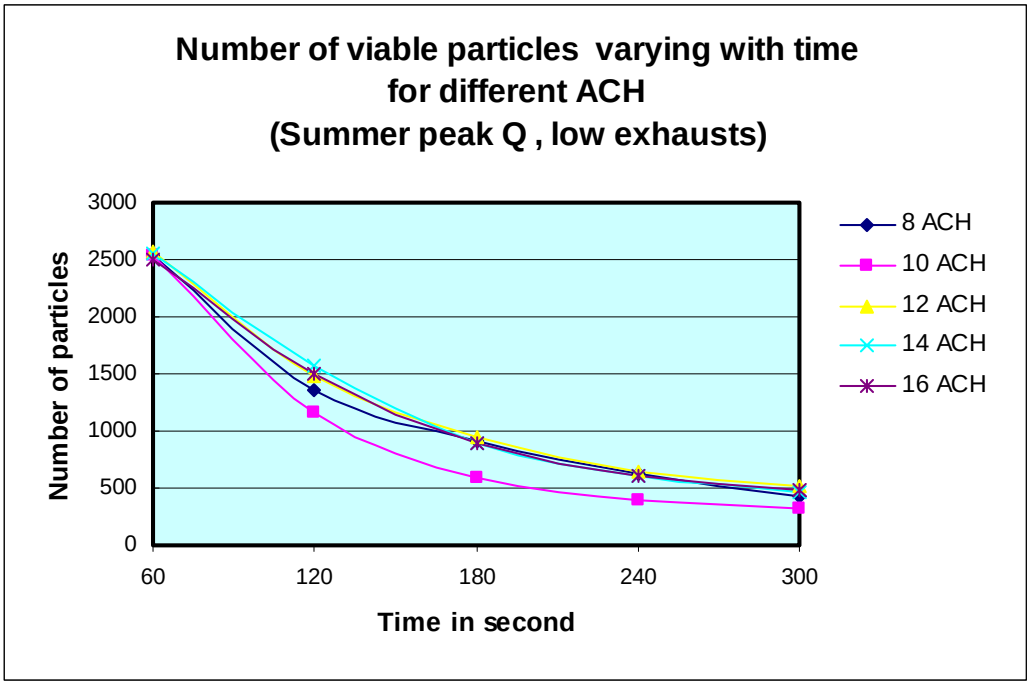

Figure 5.57. *Number of viable particles with ACH change (Summer peak Q).*

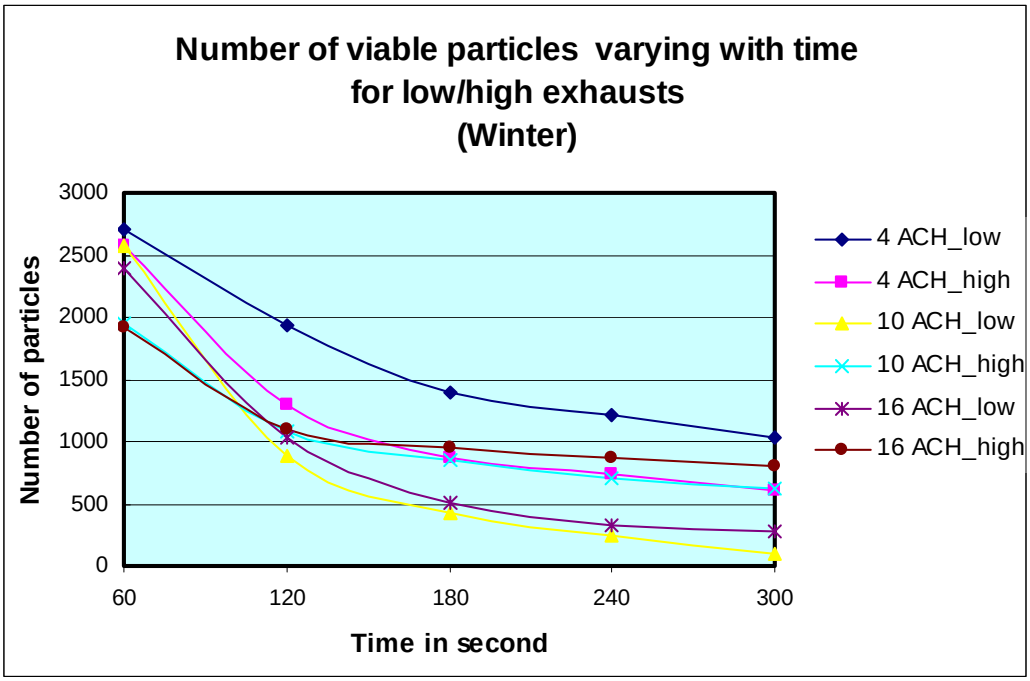

Figure 5.58. *Number of viable particles with exhaust location change (Winter).*

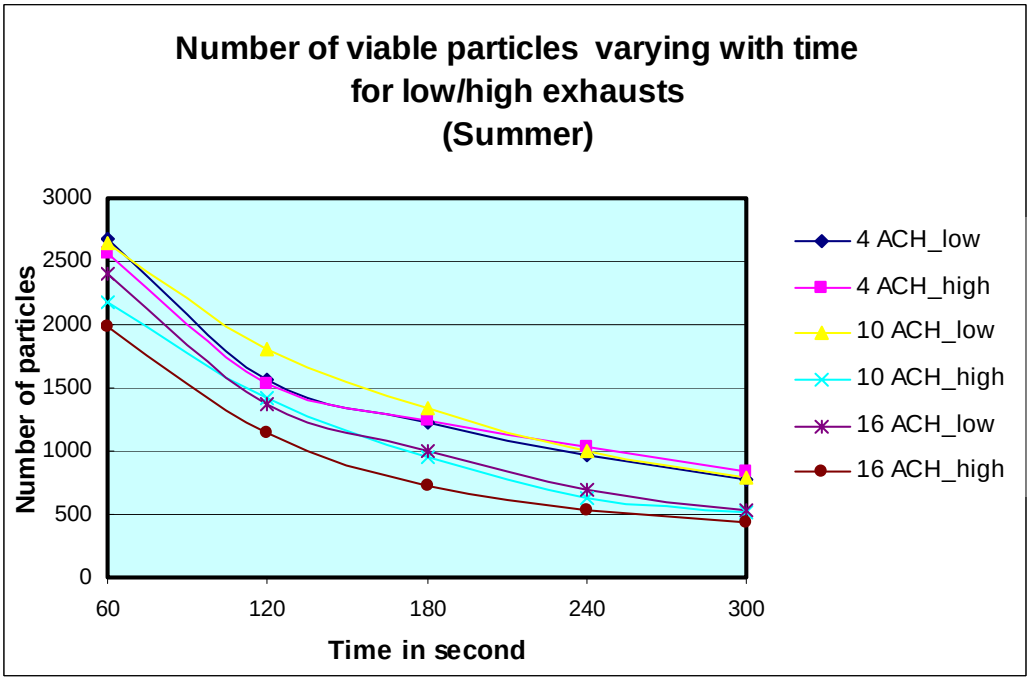

Figure 5.59. *Number of viable particles with exhaust location change (Summer).*

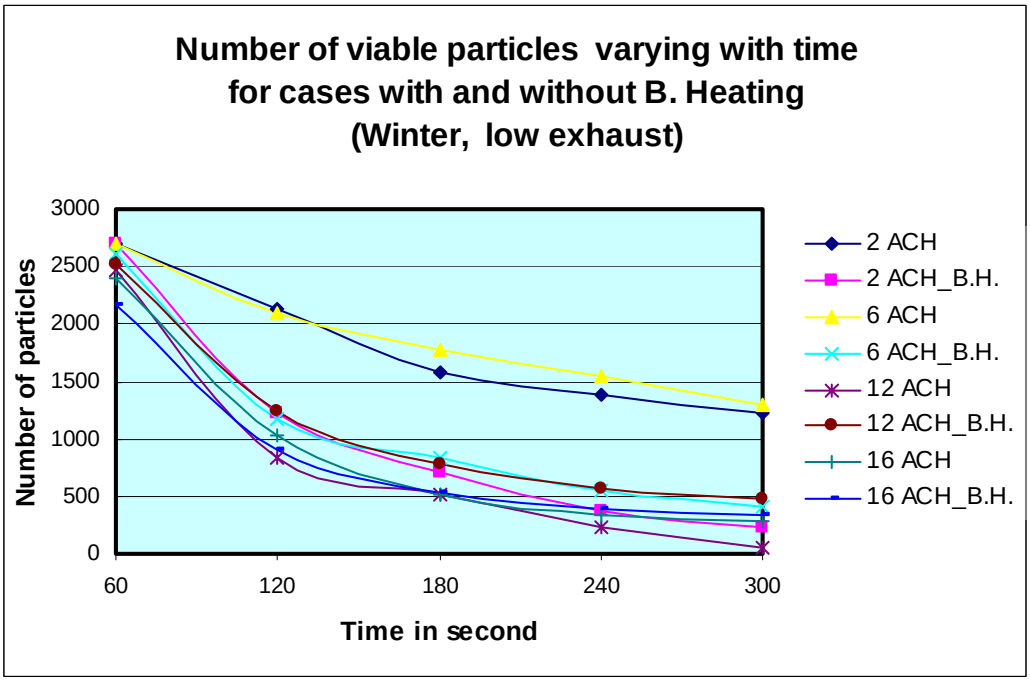

Figure 5.60. *Number of viable particles for cases with/ without Baseboard Heating.*

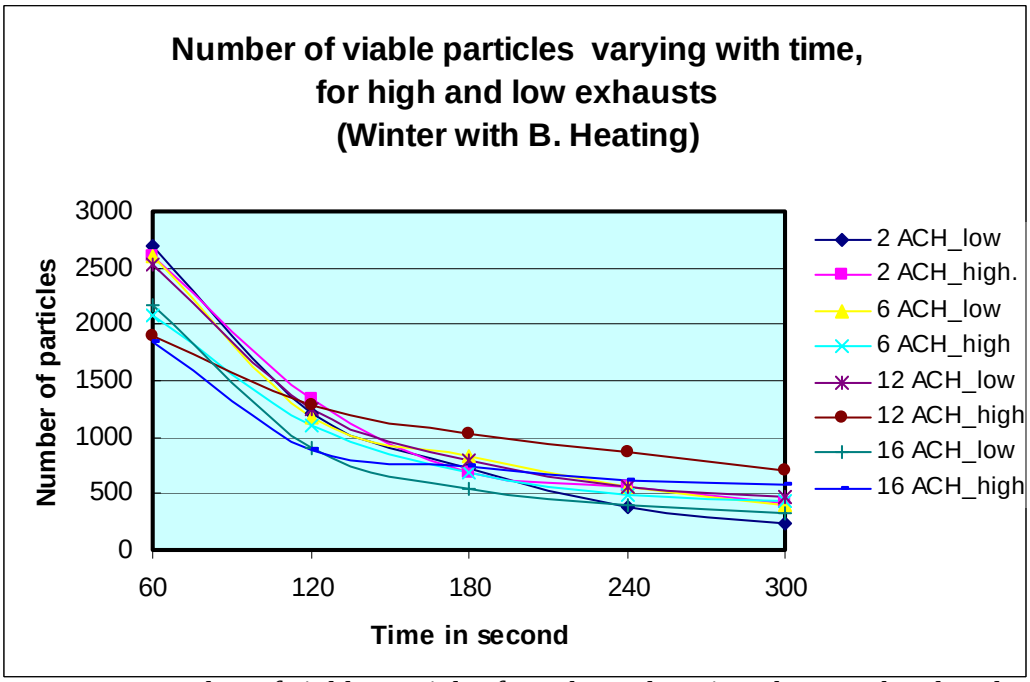

Figure 5.61. *Number of viable particles for exhaust location change when baseboard heating is applied*

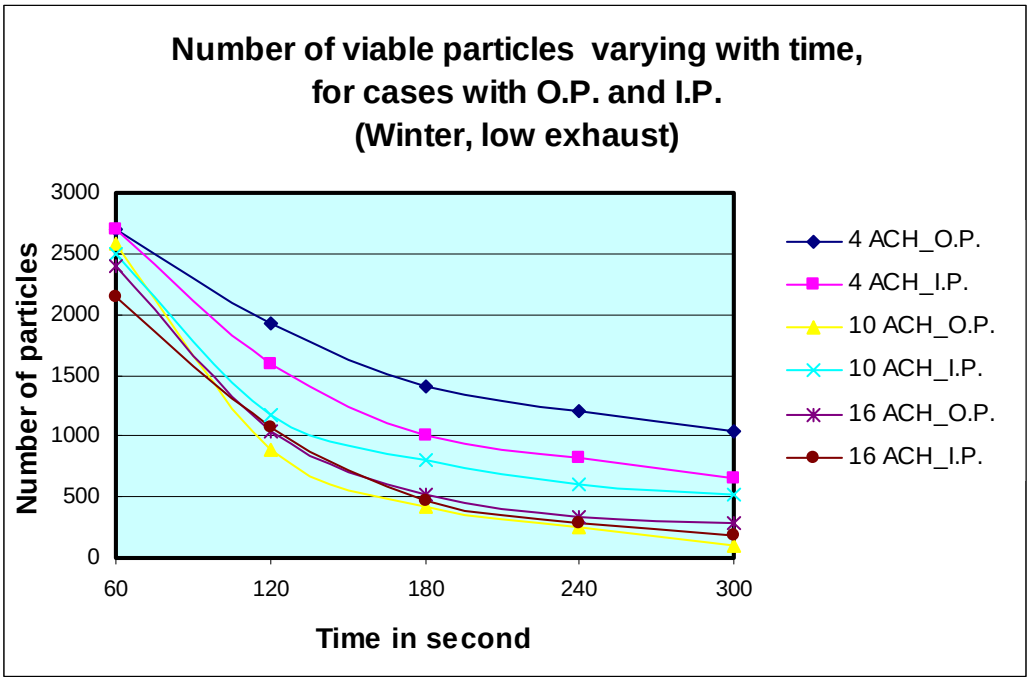

Figure 5.62. *Number of viable particles for cases with original/ increased pressurization (Winter)*

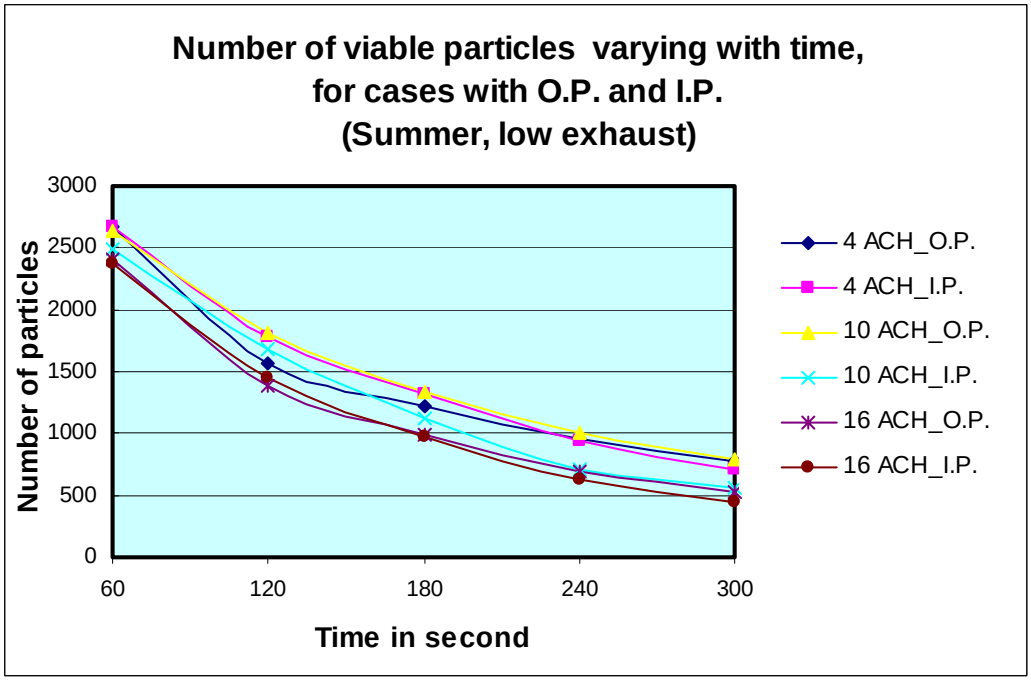

Figure 5.63. *Number of viable particles for cases with original/ increased pressurization (Summer)*

5.3.8 Number of Viable Particles – Individual Counting - Varying with Time (UV2)

UV2: UVGI output powe20W, located on the near bed wall, 7.5’ from the floor.

The conclusions drawn in 5.3.7 can be generally applied to this section. However with the increase of UV power output, the viable number of particles calculated from individual counting method generally becomes higher than that from group counting method. The non-uniformity of UV field is more severe. This does not affect the number of killed particles in group counting method, but significantly reduces that number when individual counting method is employed.

Figure 5.64 shows the winter cases with different ventilation flow rate. The viable number is reduced with the increase of ventilation flow rate. For summer cases, the viable number is less sensitive to the ventilation flow rate, especially for peak Q condition, as seen in Figure 5.66.

Figure 5.67 indicates that for winter cases, when the flow rate is low, the viable particle number becomes lower with high exhausts. For summer cases, the high exhausts give slightly lower number of viable particles for all range of flow rate as seen in Figure 5.68.

Figure 5.69 indicates that baseboard heating results in lower number of viable particles when the exhausts are low. When the flow rate increases, the numbers of viable particles for the cases with and without baseboard heating become close. Figure 5.70 compares the high and low exhausts with baseboard heating used, which does not show remarkable different between the two exhaust locations in terms of the number of viable particles.

Figures 5.71 and 5.72 show that there is little effect of increased pressurization on the number of viable particles.

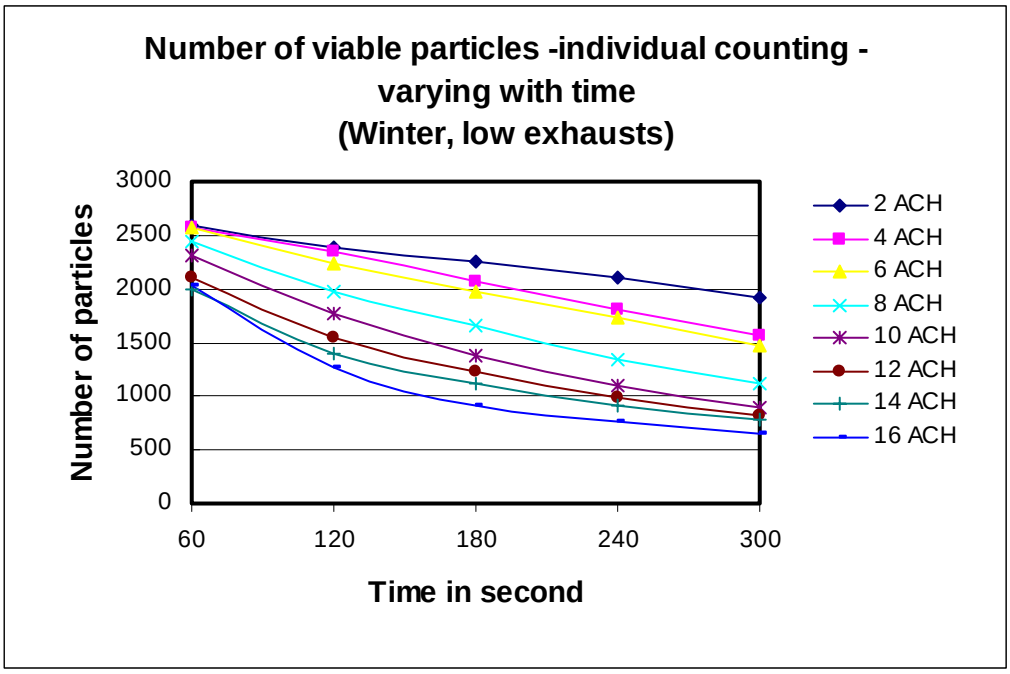

Figure 5.64. *Number of viable particles with ACH change (Winter)*

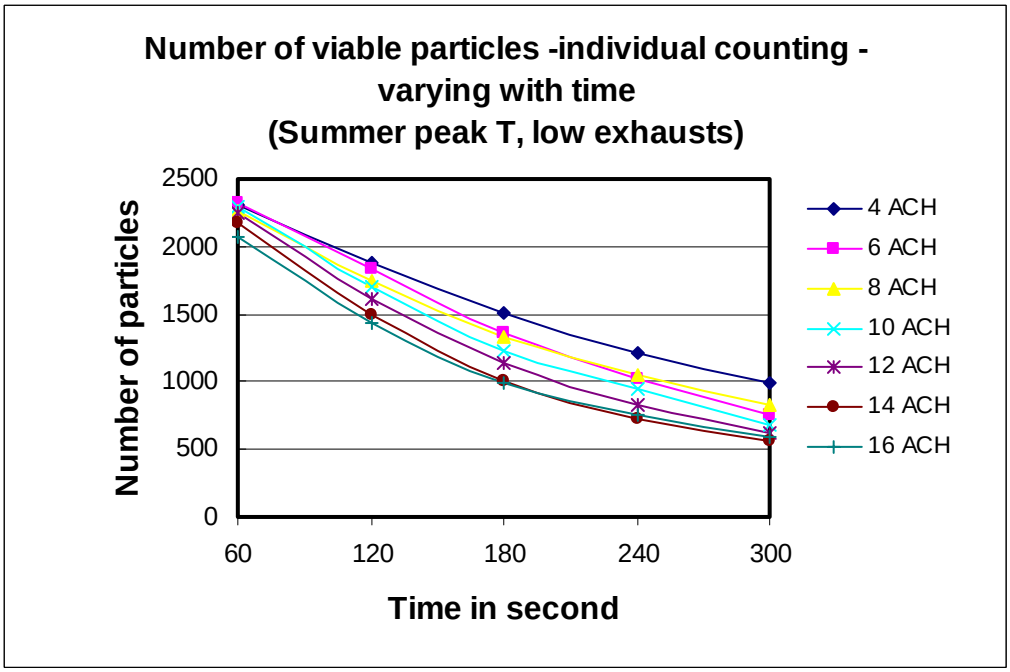

Figure 5.65. *Number of viable particles with ACH change (Summer).*

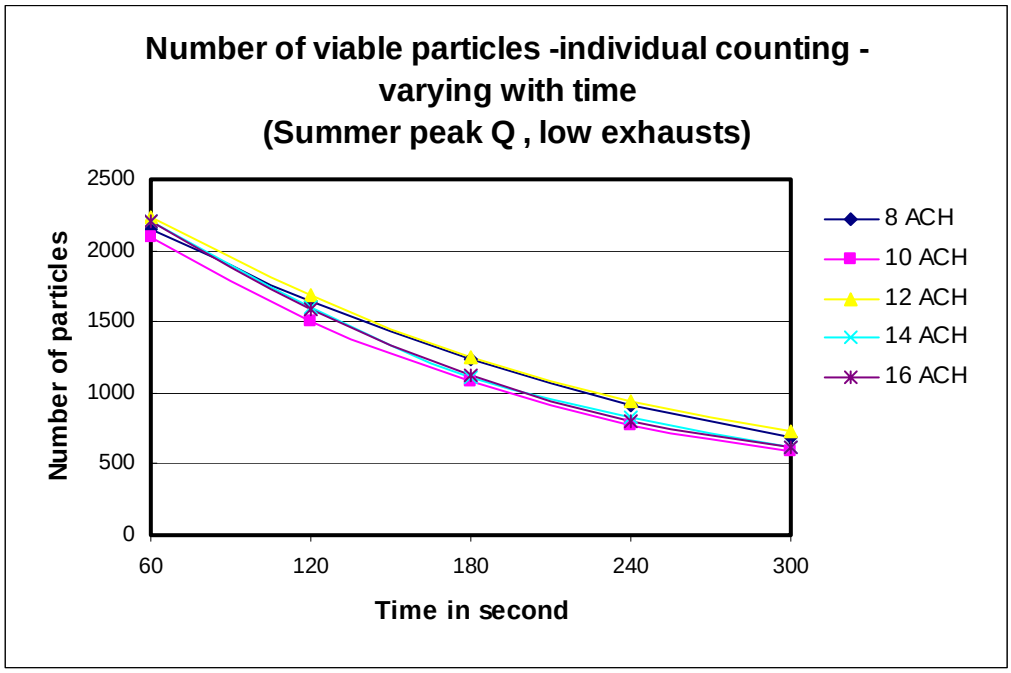

Figure 5.66. *Number of viable particles with ACH change (Summer peak Q).*

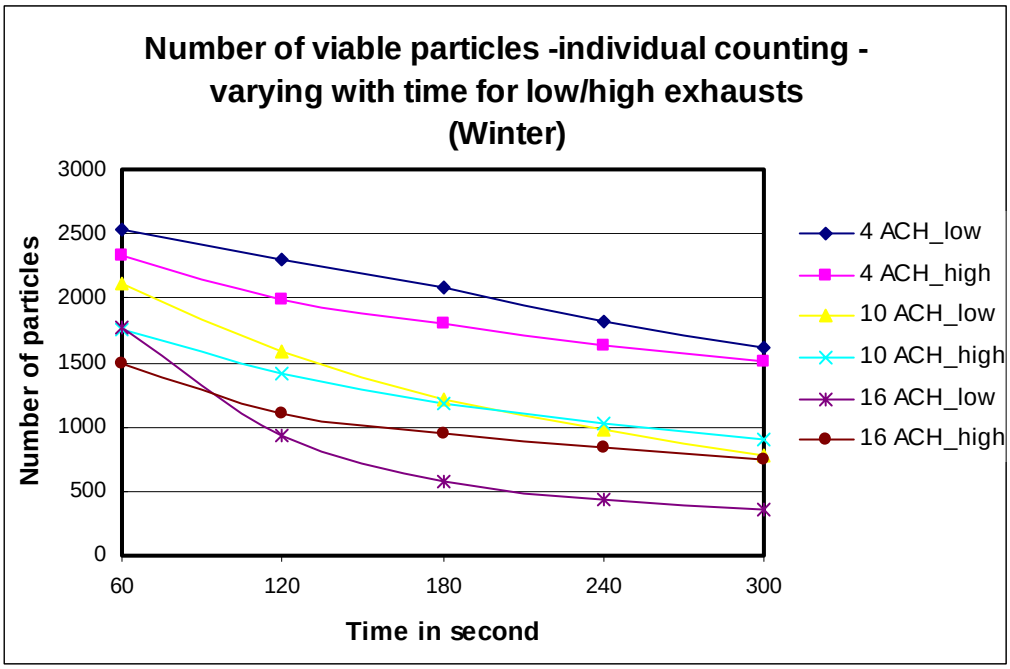

Figure 5.67. *Number of viable particles with exhaust location change (Winter).*

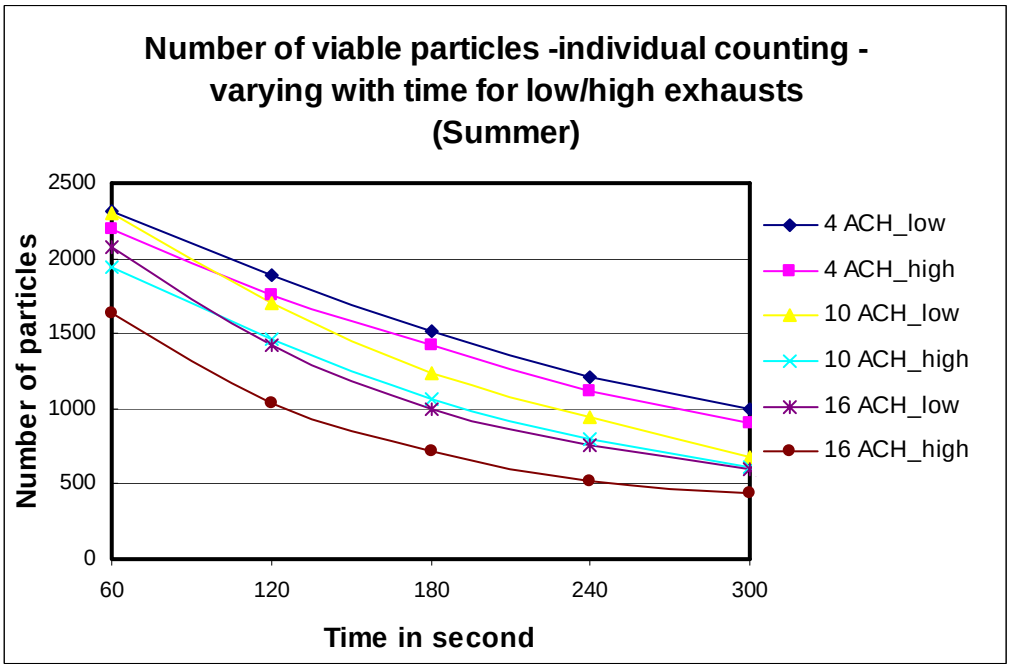

Figure 5.68. *Number of viable particles with exhaust location change (Summer).*

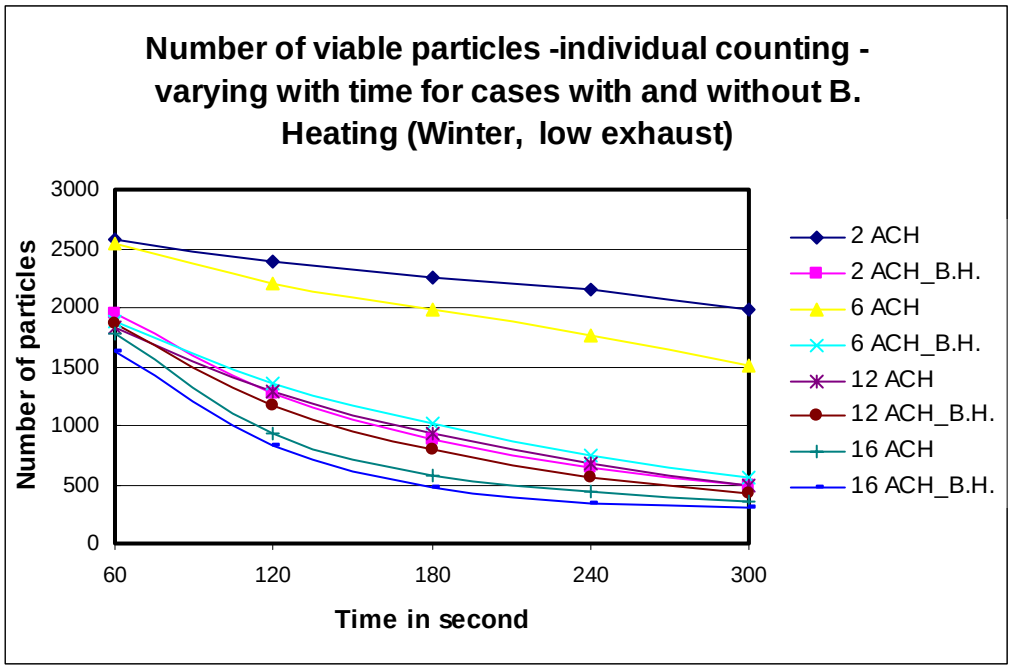

Figure 5.69. *Number of viable particles for cases with/ without Baseboard Heating.*

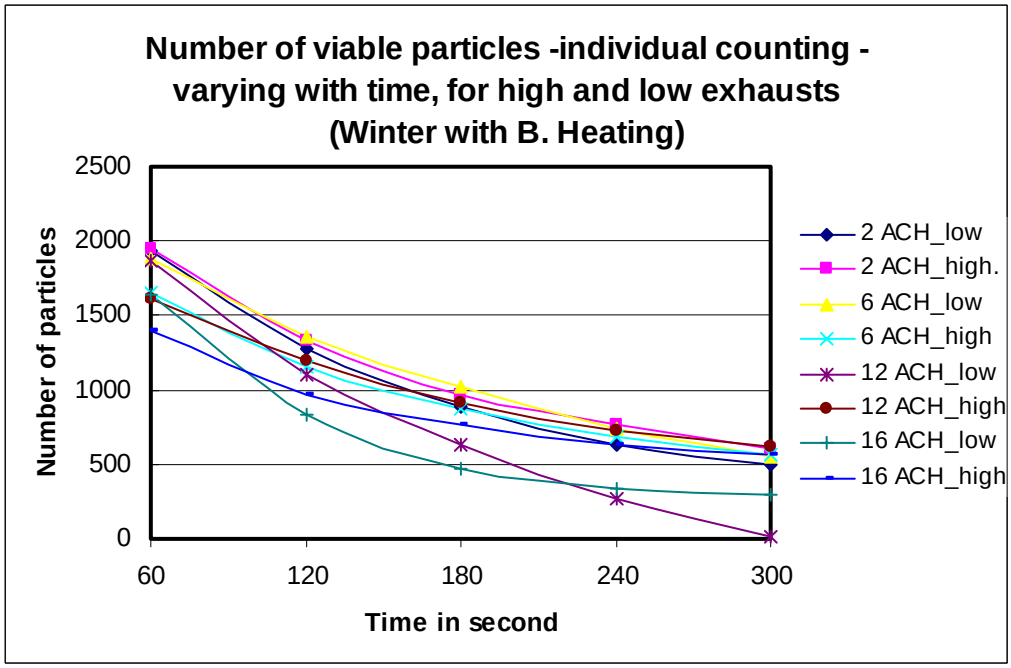

Figure 5.70. *Number of viable particles for exhaust location change when baseboard heating is applied*

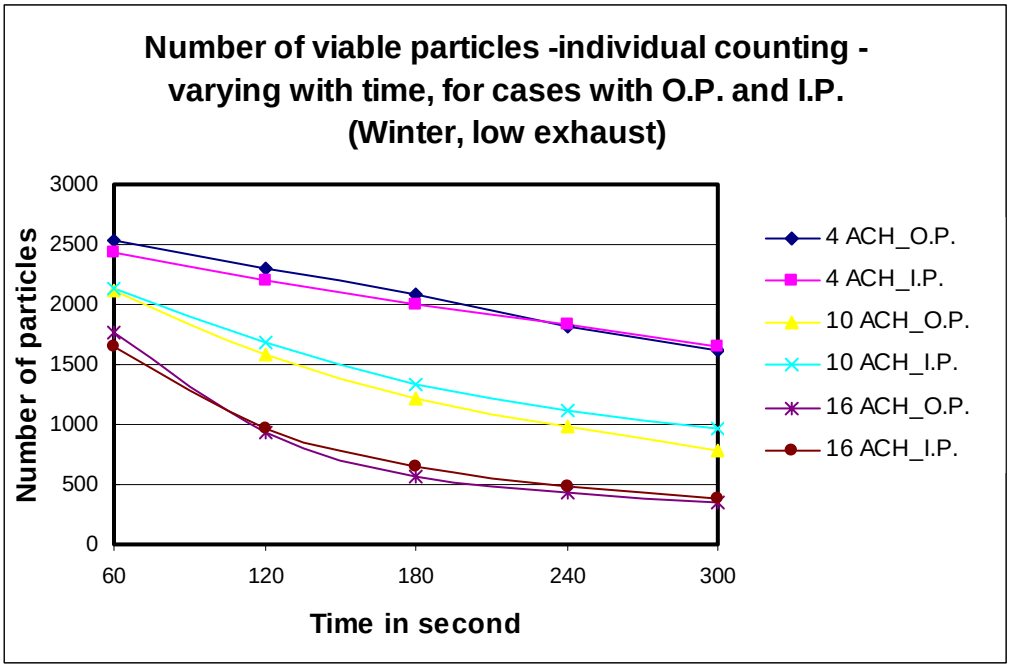

Figure 5.71. *Number of viable particles for cases with original/ increased pressurization (Winter)*

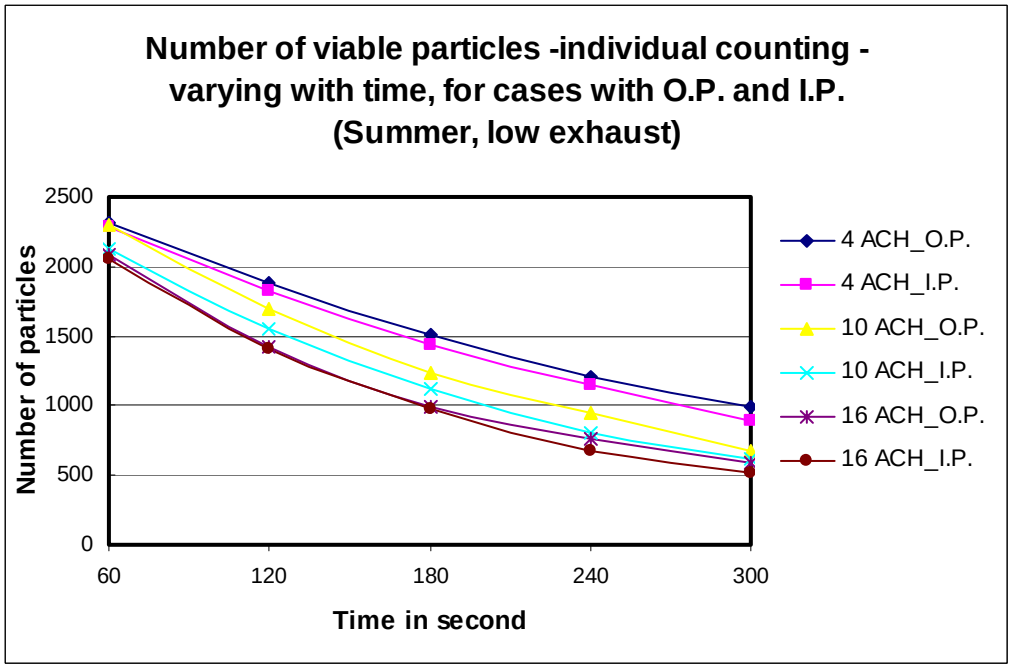

Figure 5.72. *Number of viable particles for cases with original/ increased pressurization (Summer)*

5.3.9 Number of Killed Particles - Group Counting - Varying with Time (UV2)

UV2: UVGI output power 20W, located on the near bed wall, 7.5' from the floor.

Figure 5.73 shows that 10 ACH gives highest number of killed particles. Further increase of the ventilation does not necessary result in higher number of particles killing. In summer cases, the number of killed particles decreases when flow rate increases as indicated in Figures 5.74 and 5.75.

Figure 5.76 indicates for higher flow rate, the low exhaust location does better in particle killing. For summer condition, the low exhausts seem to be better results in particle killing as seen in Figure 5.77.

As seen in 5.3.4, the baseboard heating significantly increases the number of killed particles when the UVGI is located on the partition wall with output of 10W. However, it is not applied to the situation when UVGI is moved to the wall near the bed with increased output of 20W. Figure 5.78 shows, with baseboard heating, the number of killed particles is actually reduced when the flow rate is higher than 10 ACH. Figure 5.79 compares the high and low exhausts with baseboard heating used, which shows that low exhausts result in higher number of killed particles by UVGI.

From Figure 5.80, it seems that the effect of increased pressurization of the room in winter condition on the number of killed particles varies from case to case. No obvious tendency is observed. For summer cases, pressurizing the room further gives slightly higher number of killed particles as shown in Figure 5.81.

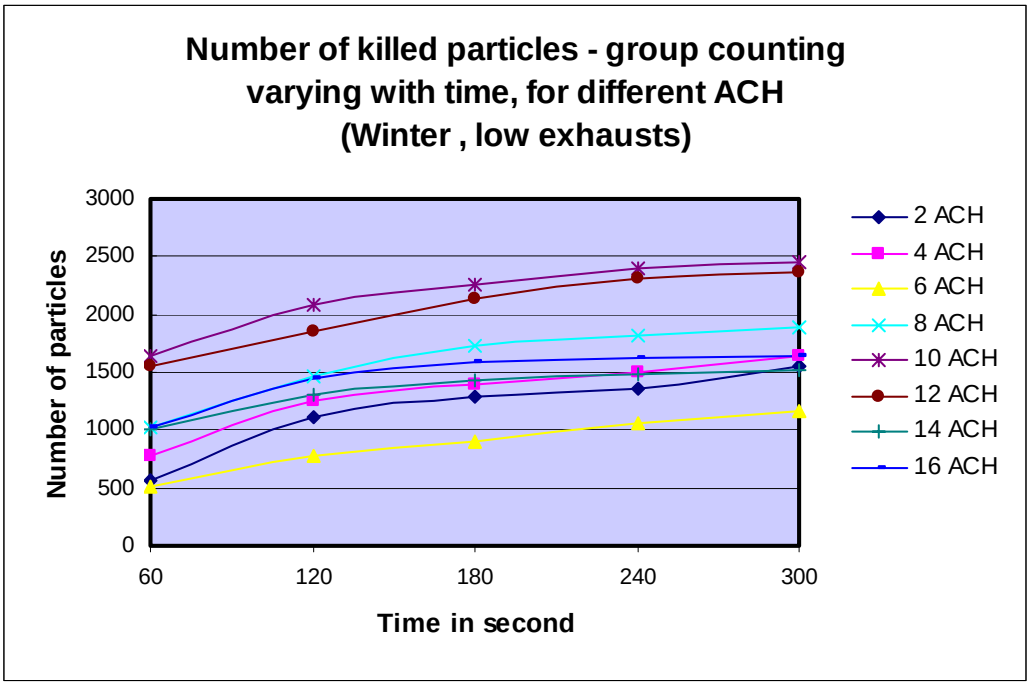

Figure 5.73. *Number of killed particles with ACH change (Winter)*

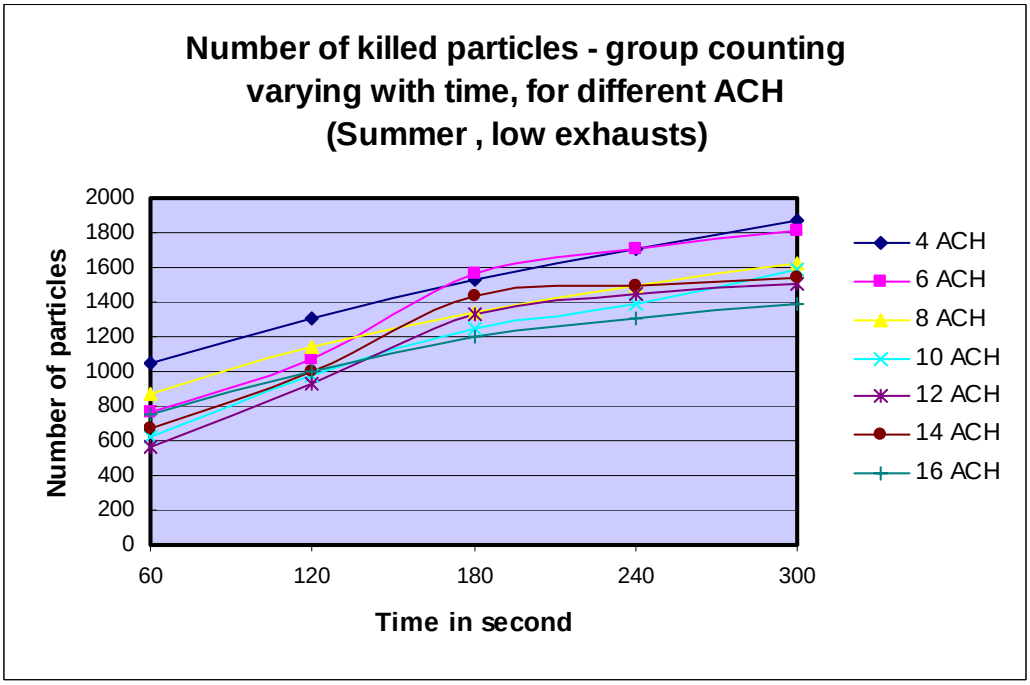

Figure 5.74. *Number of killed particles with ACH change (Summer)*

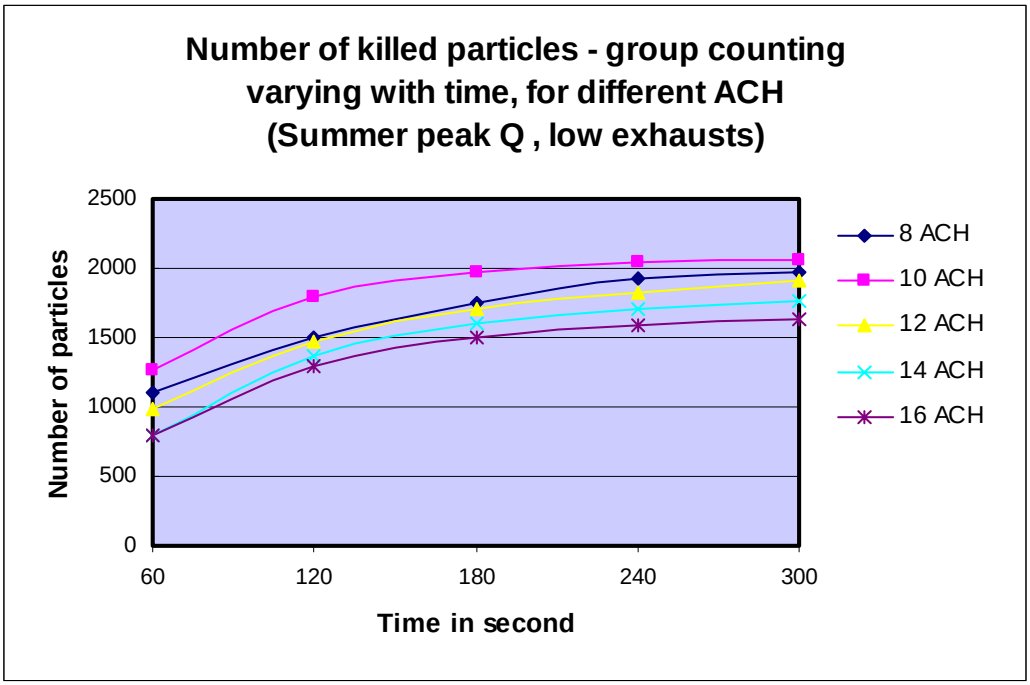

Figure 5.75. *Number of killed particles with ACH change (Summer peak Q)*

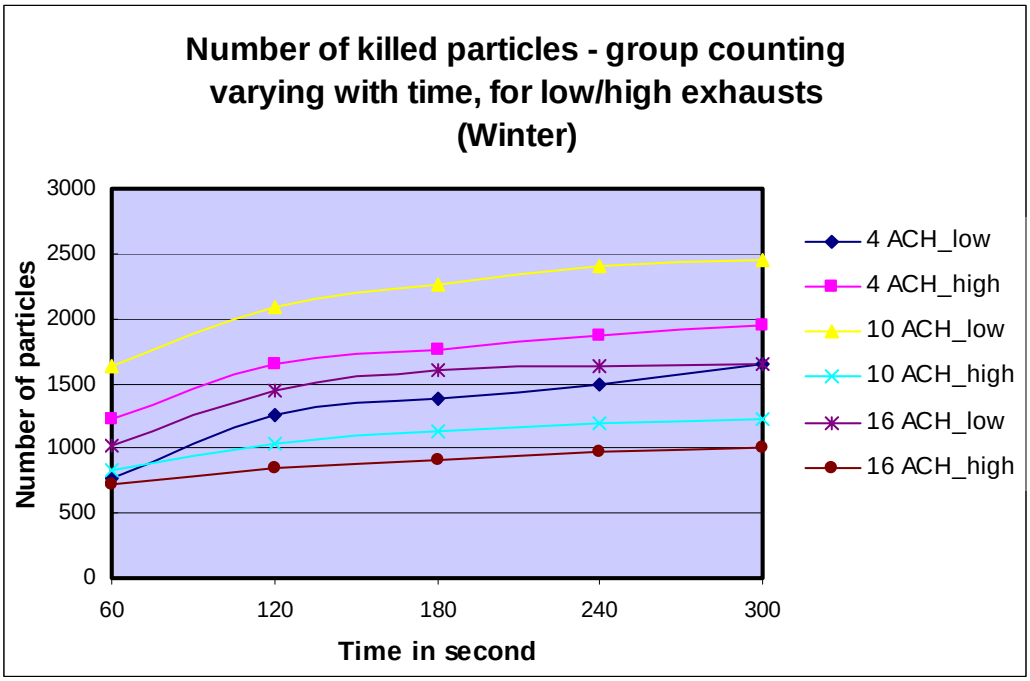

Figure 5.76. *Number of killed particles with exhaust location change (Winter)*

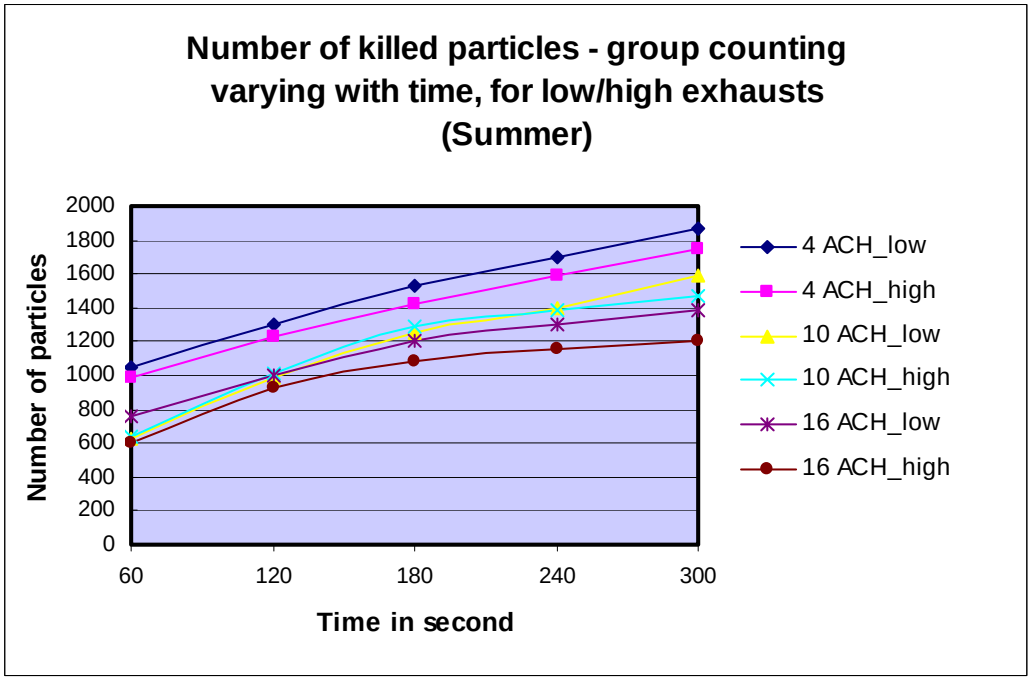

Figure 5.77. *Number of killed particles with exhaust location change (Summer)*

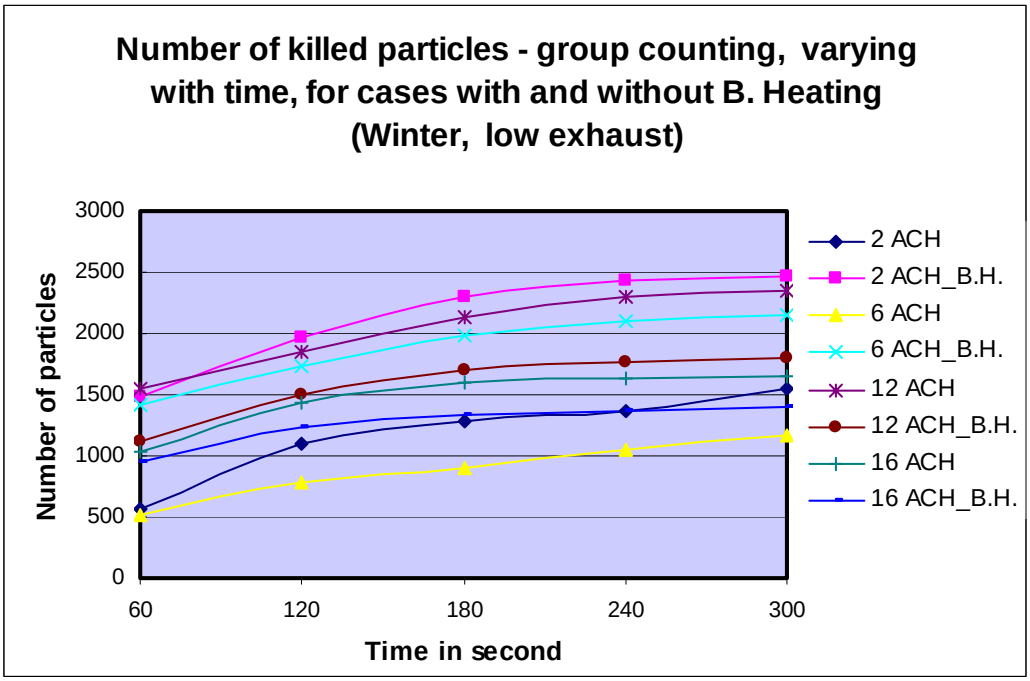

Figure 5.78. *Number of killed particles for cases with/without Baseboard Heating*

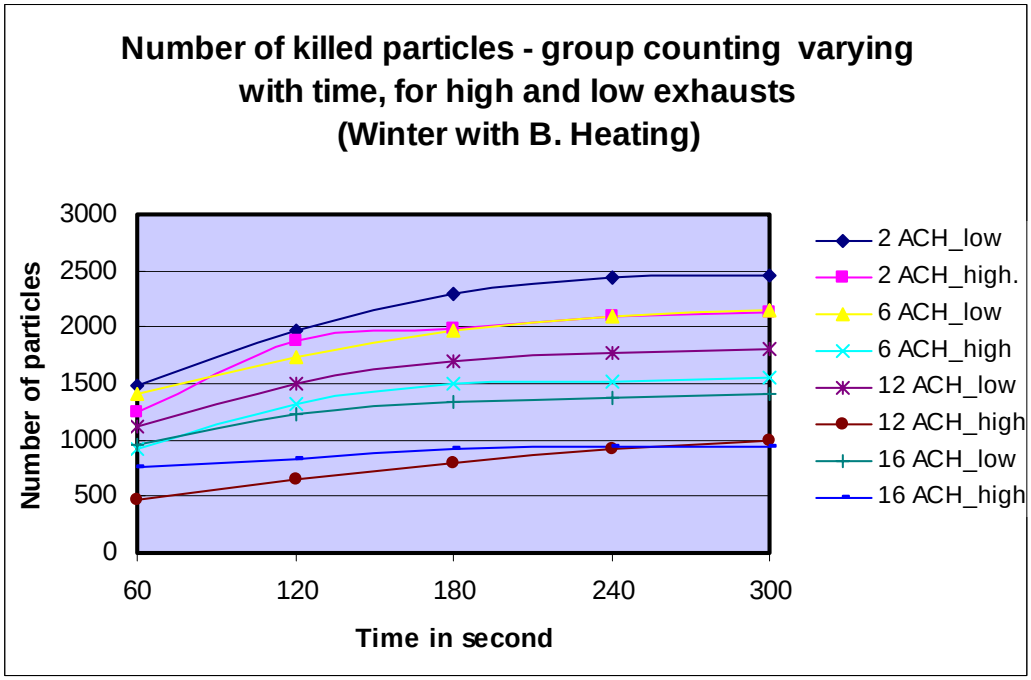

Figure 5.79. *Number of killed particles for exhaust location change when baseboard heating is applied*

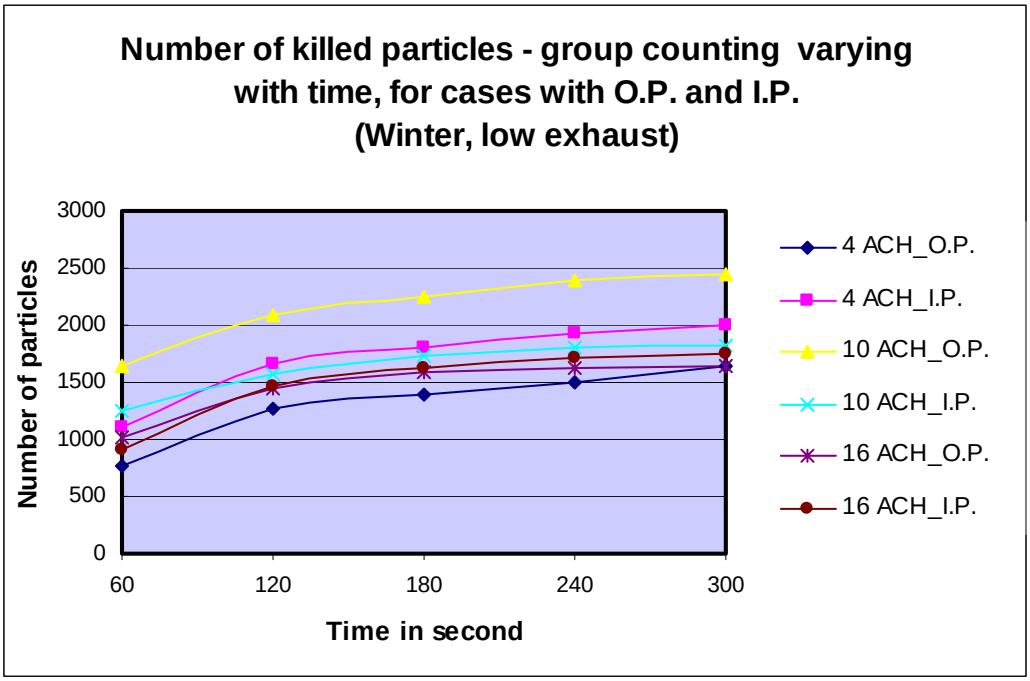

Figure 5.80. *Number of killed particles for cases with original/ increased pressurization (Winter)*

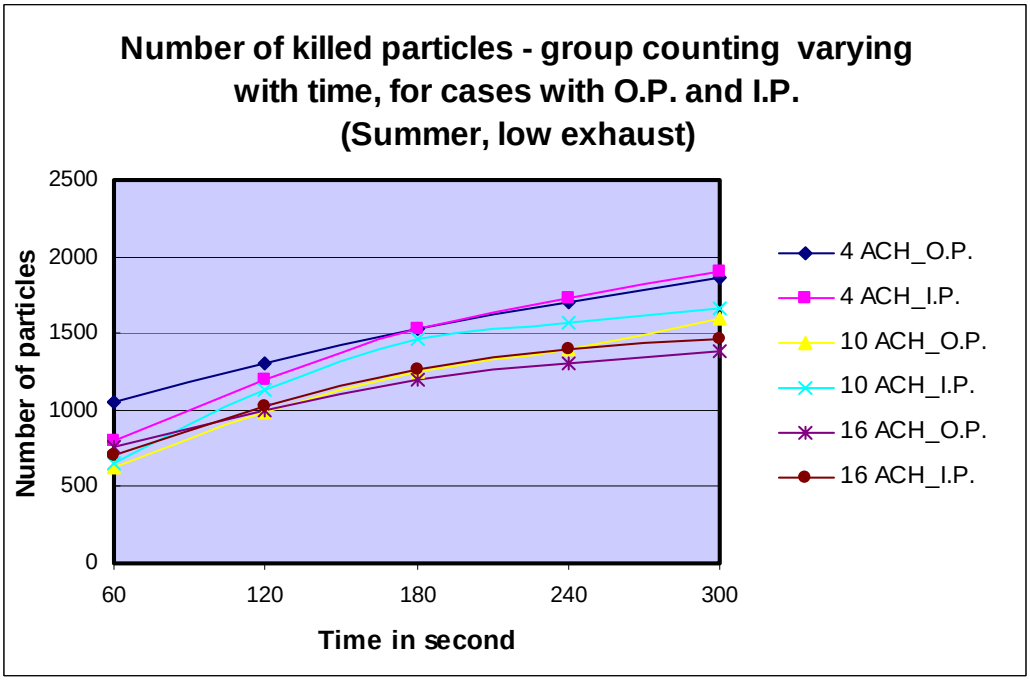

Figure 5.81. *Number of killed particles for cases with original/ increased pressurization (Summer)*

5.3.10 Number of Killed Particles - Individual Counting - Varying with Time (UV2)

UV2: UVGI output power 20W, located on the near bed wall, 7.5’ from the floor.

Figure 5.82 shows that 10 ACH and 12 ACH give the highest number of killed particles. Further increase of the ventilation does not necessary result in higher number of particles killing. For summer condition, the number of killed particles is not as sensitive to the flow rate as in winter cases. The best ventilation flow rate falls between 6-10 ACH (See Figures 5.83 and 5.84).

Figures 5.85 and 5.86 show no obvious tendency as to which exhaust location does better in UV killing

Figure 5.87 indicates that baseboard heating significantly increases the number of killed particles when the flow rate is low. Figure 5.88 compares the high and low exhausts with baseboard heating used, and shows that low exhausts greatly increase the number of killed particles by UVGI.

From Figure 5.89, it seems that the effect of increased pressurization of the room in winter condition on the number of killed particles varies from case to case. No obvious tendency is observed. For summer cases, pressurizing the room further gives slightly higher number of killed particles as shown in Figure 5.90.

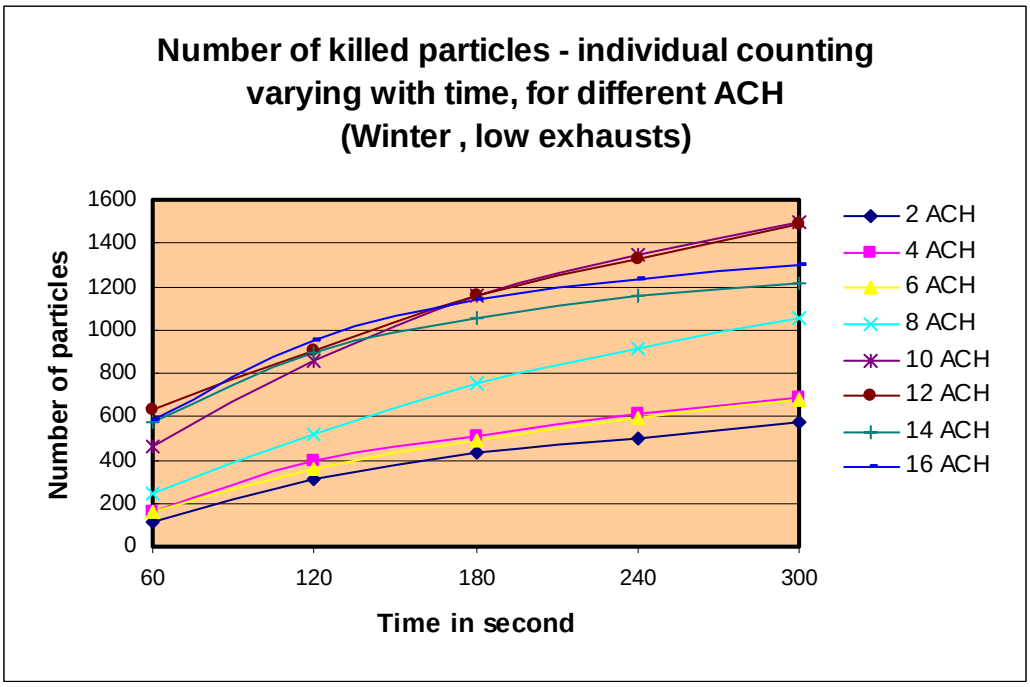

Figure 5.82. *Number of killed particles - individual counting - with ACH change (Winter)*

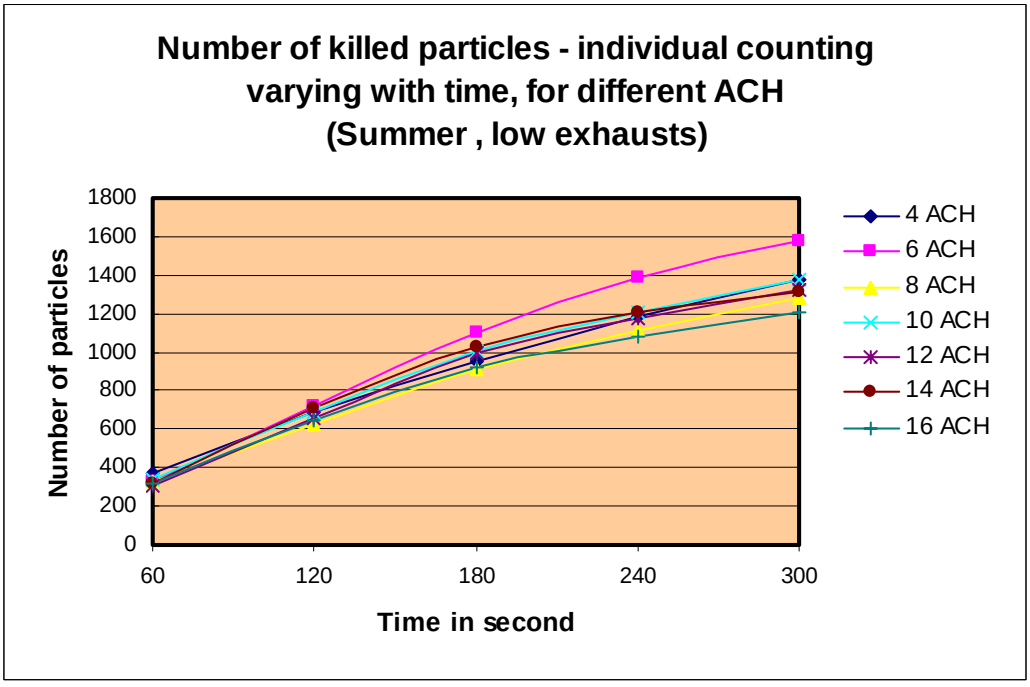

Figure5.83. *Number of killed particles - individual counting - with ACH change (Summer)*

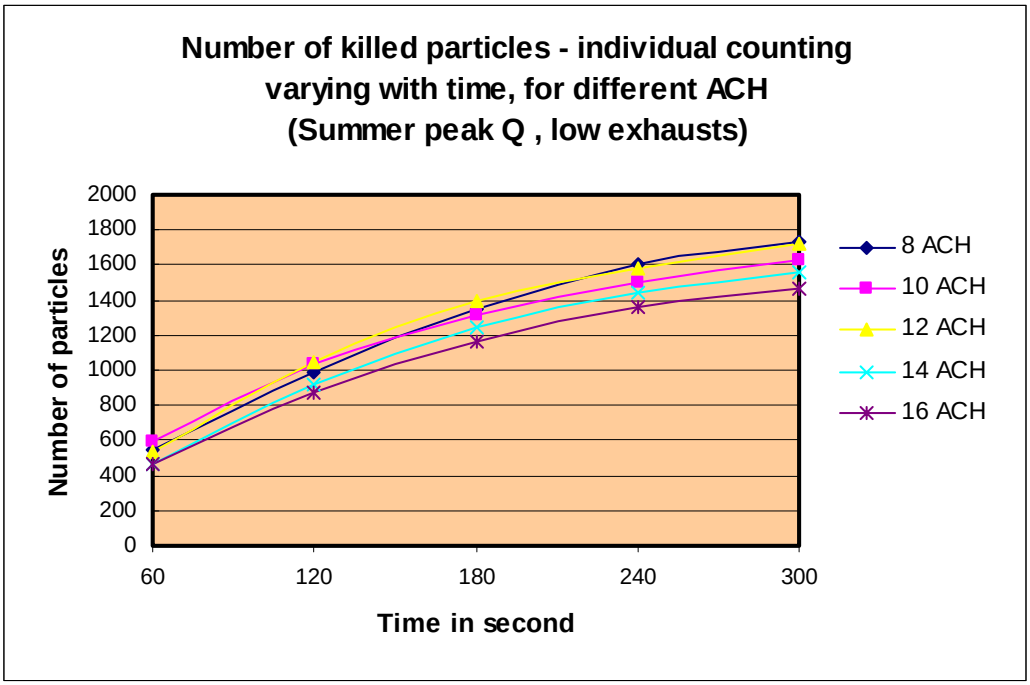

Figure 5.84. *Number of killed particles - individual counting- with ACH change (Summer peak Q)*

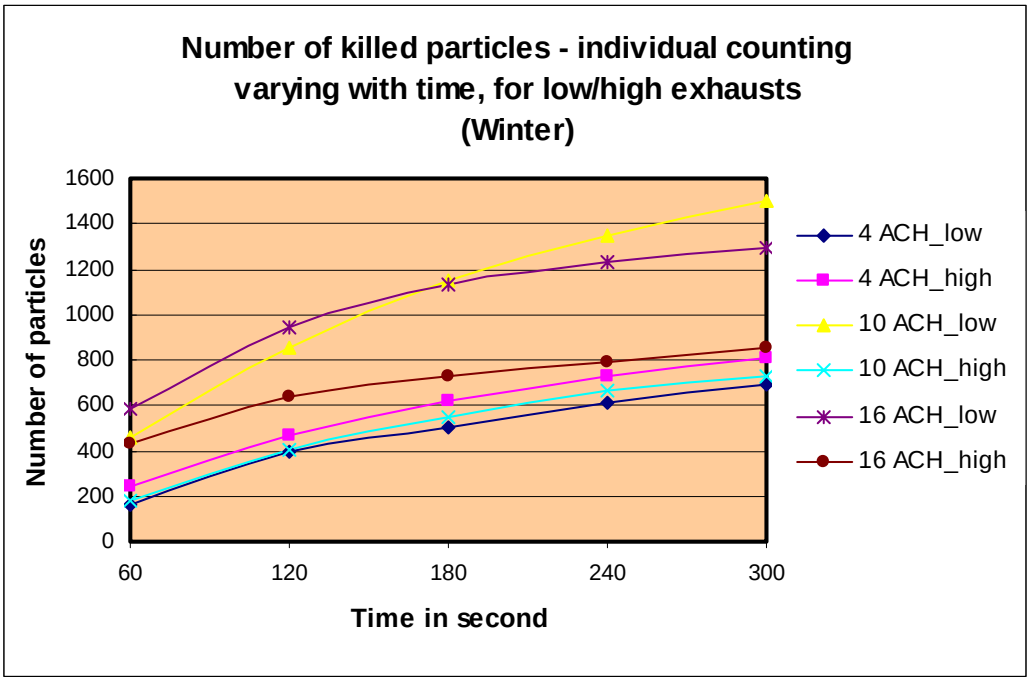

Figure 5.85. *Number of killed particles - individual counting - with exhaust location change (Winter)*

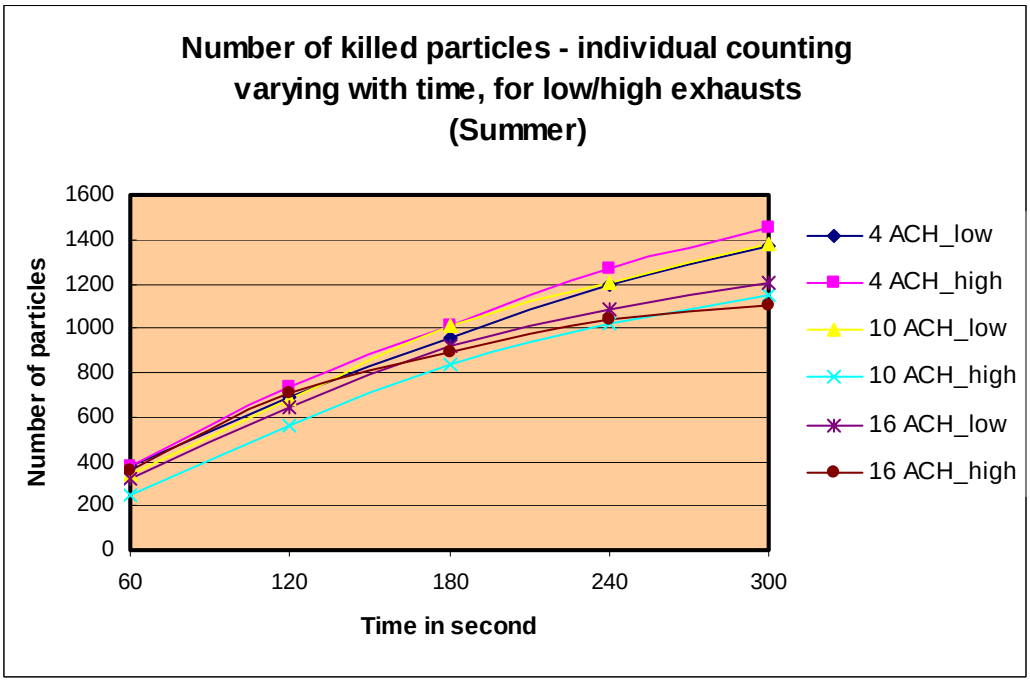

Figure 5.86. *Number of killed particles - individual counting - with exhaust location change (Summer)*

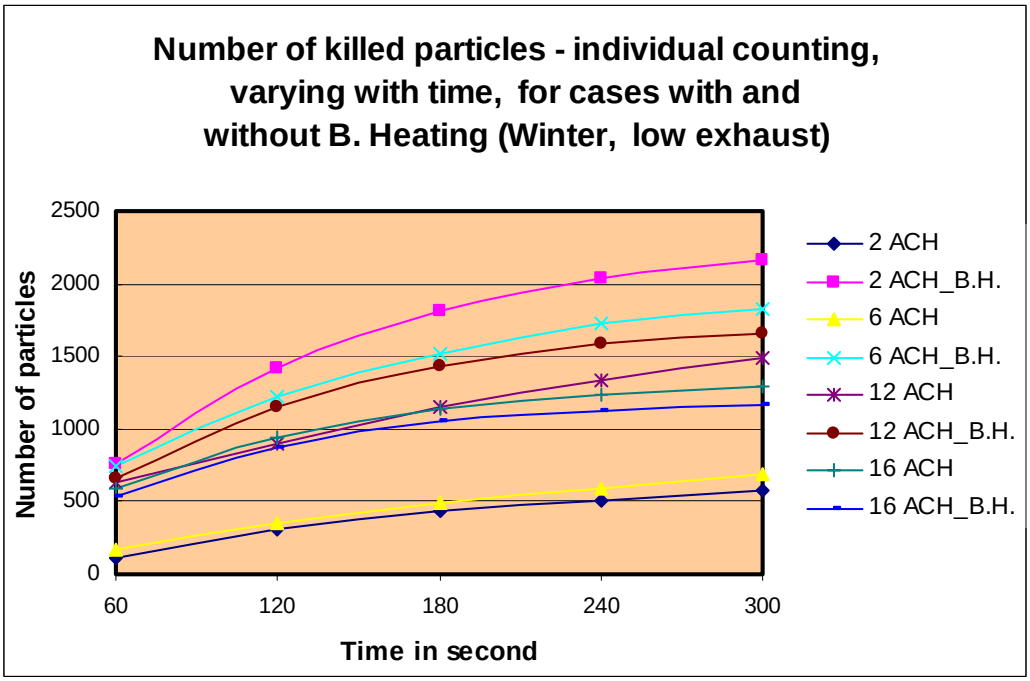

Figure 5.87. *Number of killed particles - individual counting - for cases with/without baseboard Heating*

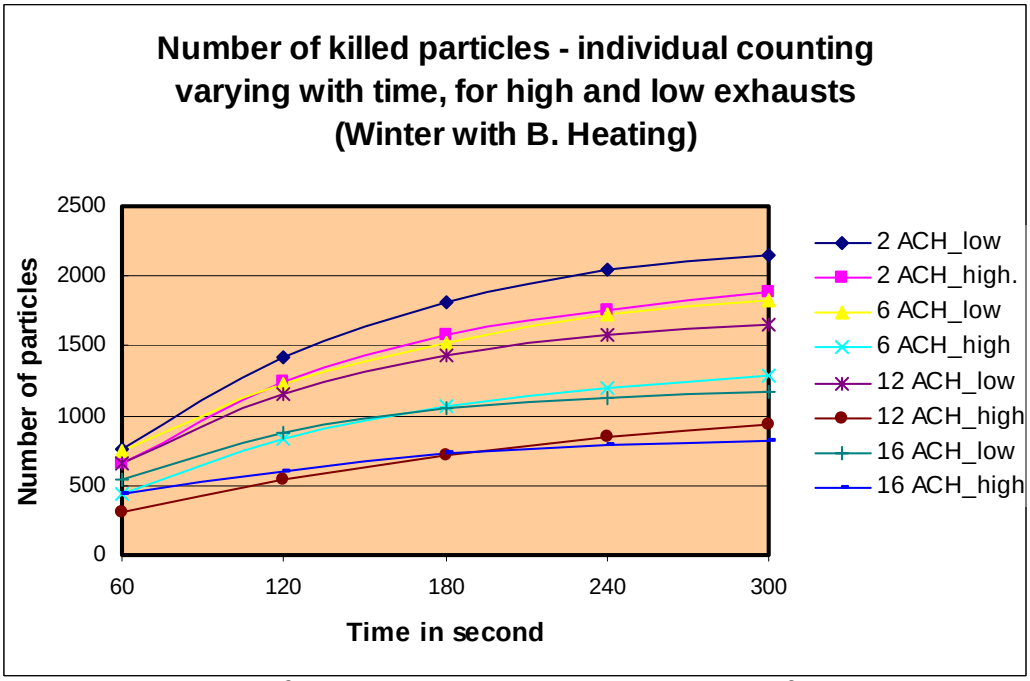

Figure 5.88. *Number of killed particles - individual counting -for exhaust location change when baseboard heating is applied*

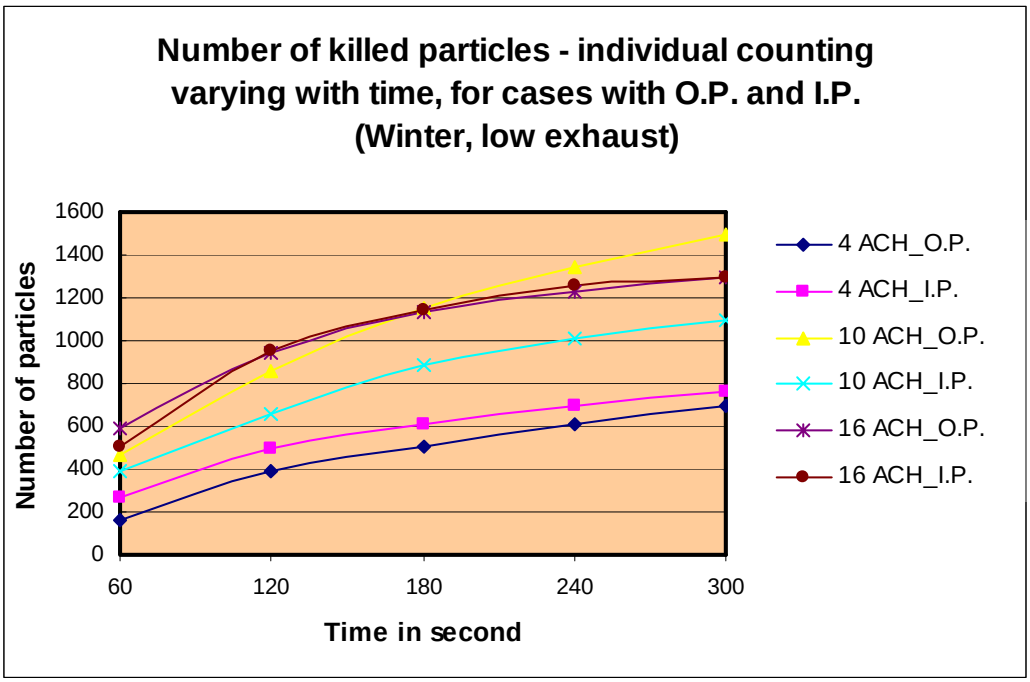

Figure 5.89. *Number of killed particles - individual counting - for cases with original/ increased pressurization (Winter)*

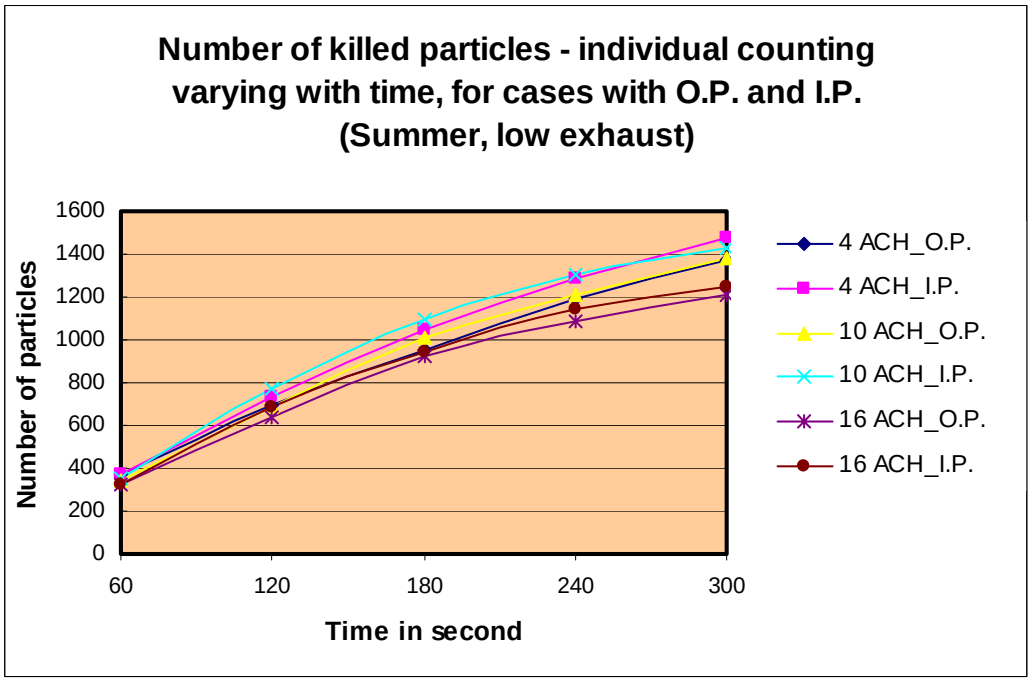

Figure 5.90. *Number of killed particles - individual counting - for cases with original/ increased pressurization (Summer)*

5.3.11 The Survival Fraction of Particles – Group Counting - Varying with Time (UV2)

UV2: UVGI output power 20W, located on the near bed wall, 7.5’ from the floor.

For winter cases, the surviving fraction with 12 ACH falls below 10% at the end of 300S. The surviving fractions with most of flow rates are between 85-95% (Figure 5.91). For summer cases, surviving fractions are around 80-90% as shown in Figures 5.92 and 5.93.

For high and low exhausts, with winter condition, no conclusion can be draw as to which location gives higher surviving fractions (Figure 5.94). For summer condition, the low exhaust location has lower surviving fraction as seen in Figure 5.95.

As shown in Figure 5.96, the baseboard heating seems to give significant impact to the surviving fractions only at flow rate of 12 ACH. This may be due to the way the group counting method accounts for the dosage.

Figure 5.97 compares the high and low exhausts with baseboard heating used. The effects of increased pressurization of the room on surviving fraction for winter and summer conditions are presented in Figures 5.98 and 5.99, respectively. Nothing remarkable is observed.

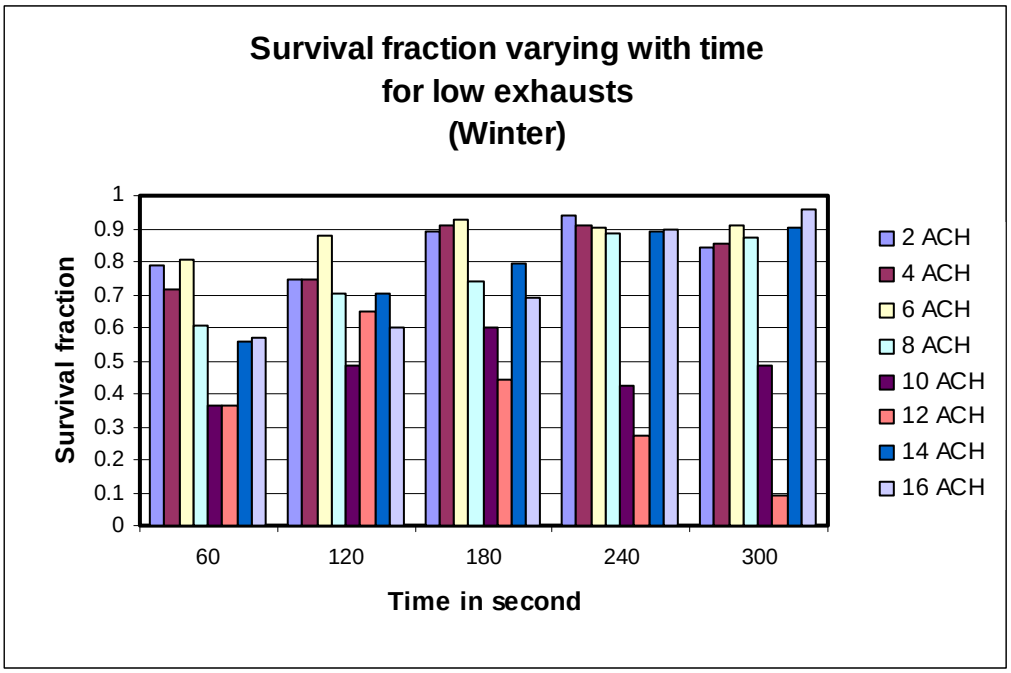

Figure 5.91. *Survival fraction with ACH change (Winter)*

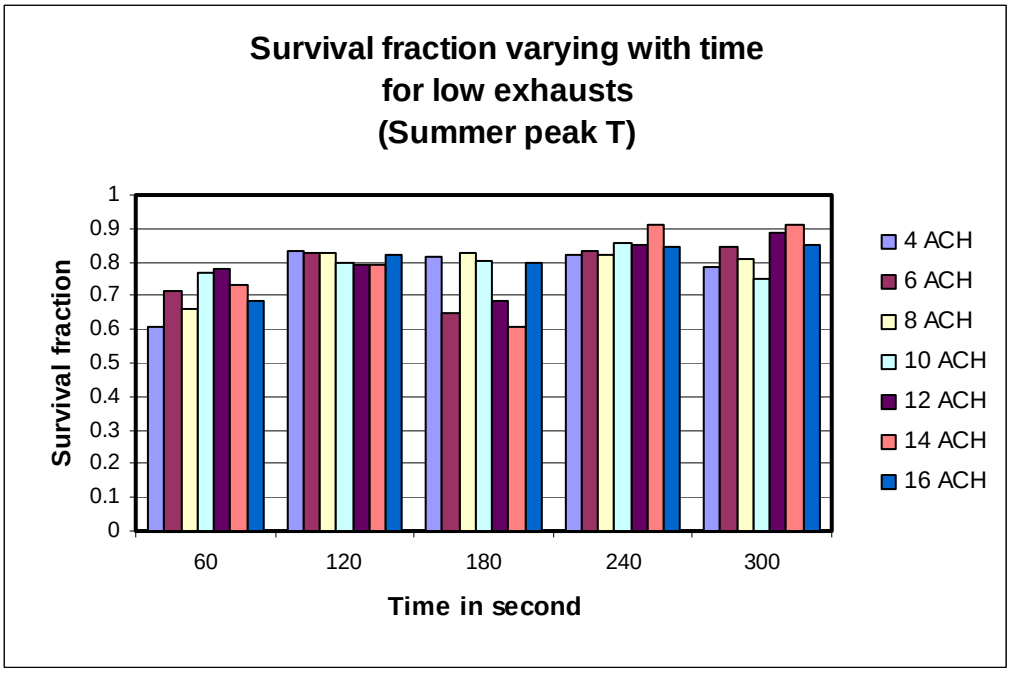

Figure 5.92. *Survival fraction with ACH change (Summer)*

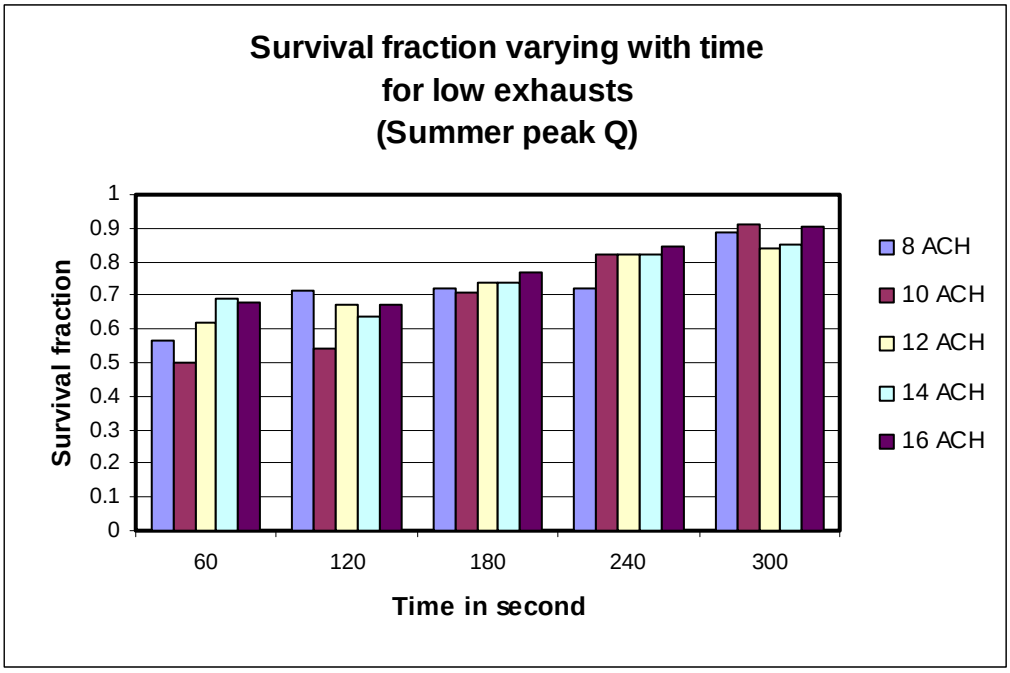

Figure 5.93. *Survival fraction with ACH change (Summer peak Q)*

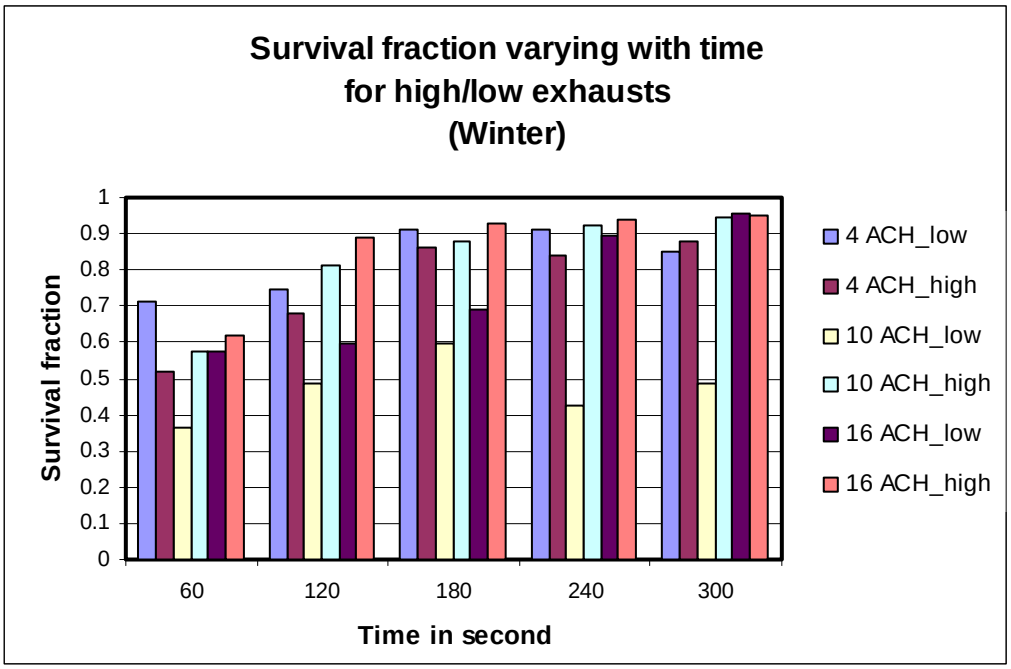

Figure 5.94. *Survival fraction with exhaust location change (Winter)*

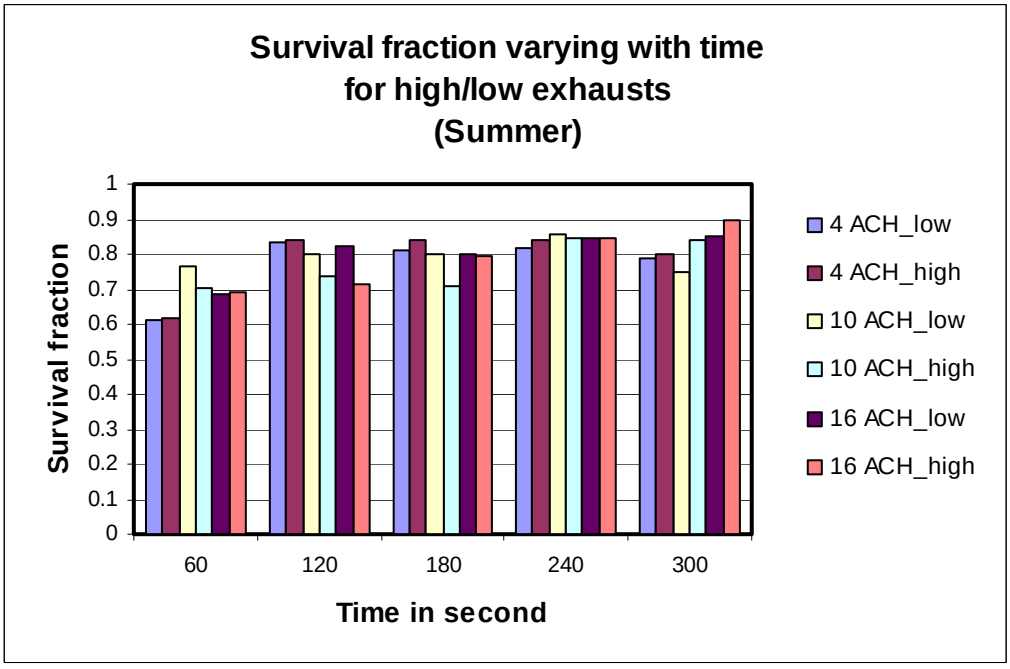

Figure 5.95. *Survival fraction with exhaust location change (Summer)*

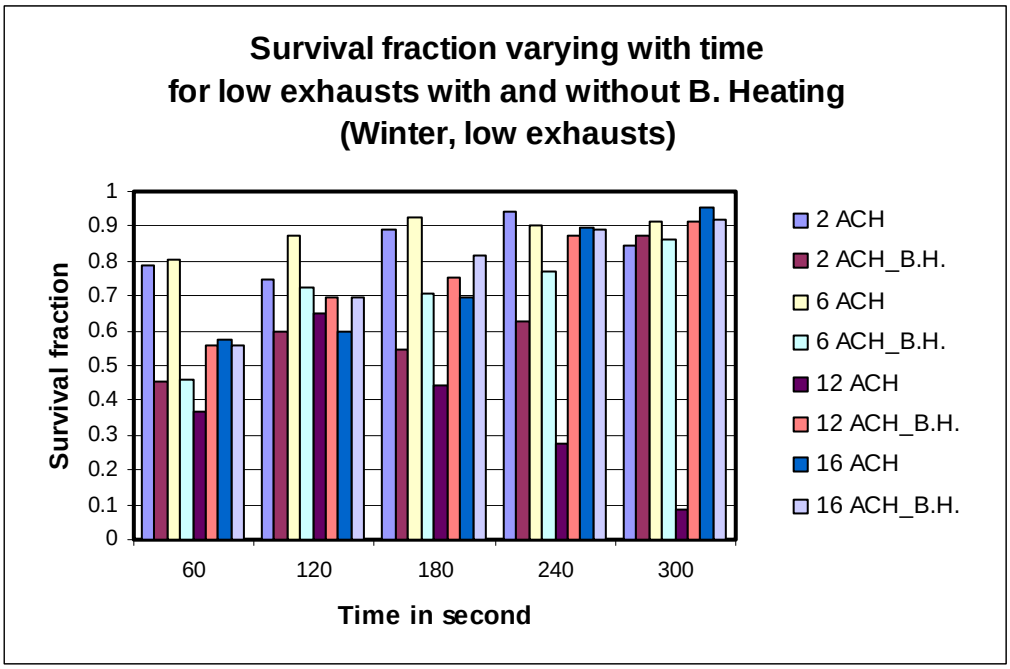

Figure 5.96. *Survival fraction for cases with /without Baseboard Heating*

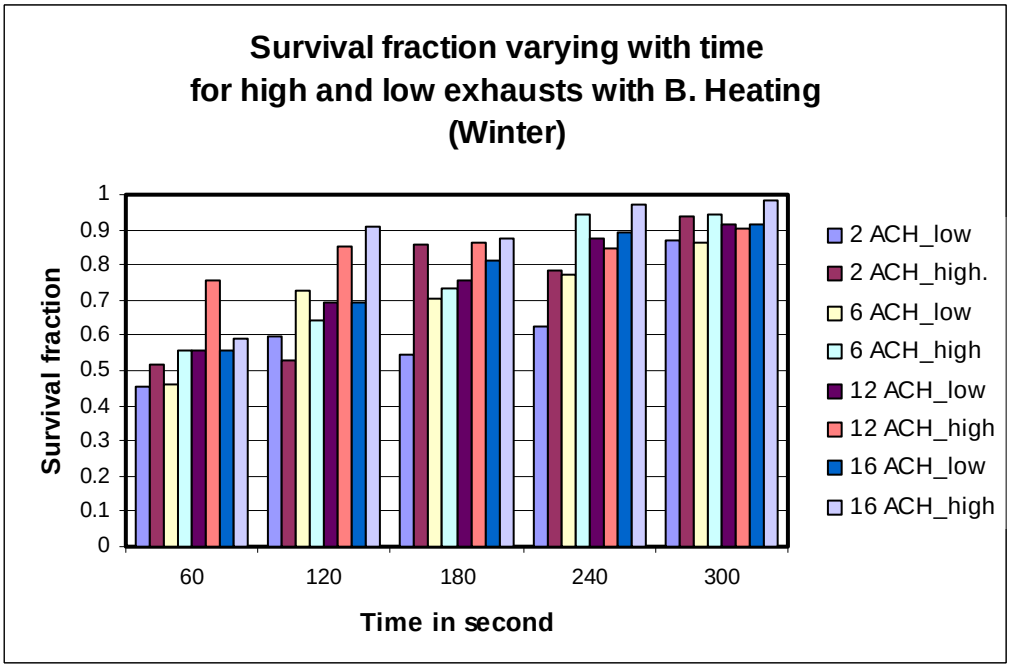

Figure 5.97. *Survival fraction for exhaust location change when baseboard heating is applied*

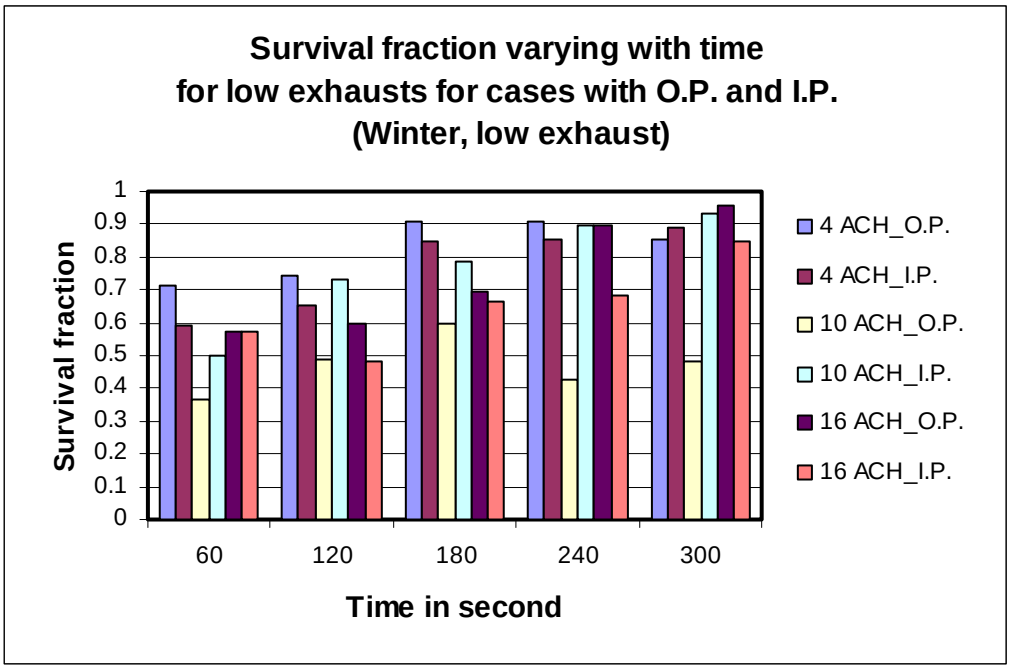

Figure 5.98. *Survival fraction for cases with original/ increased pressurization (Winter)*

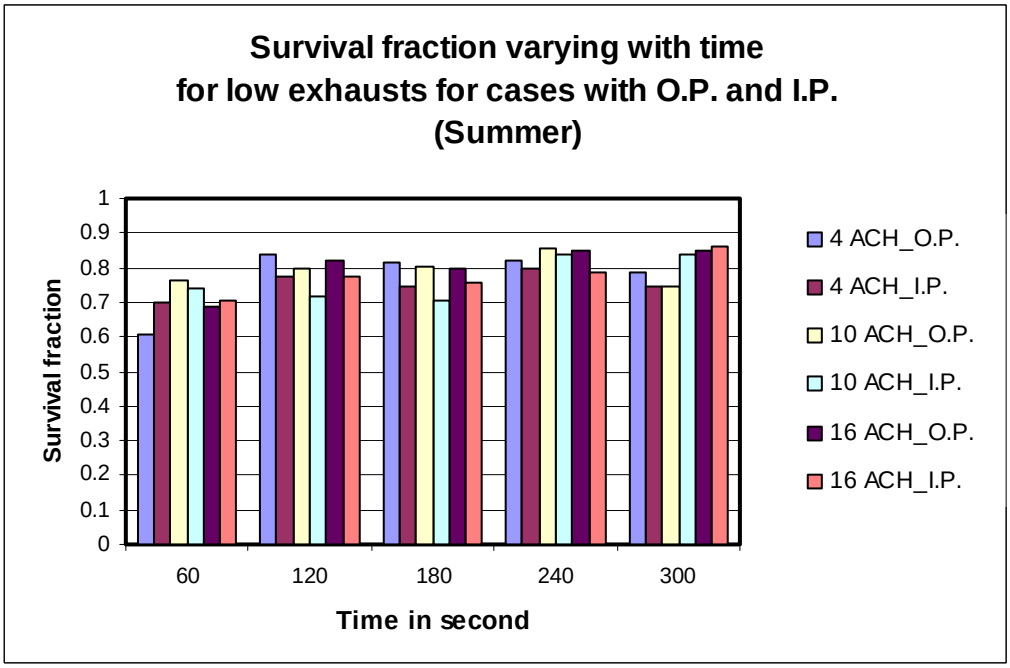

Figure 5.99. *Survival fraction for cases with original/ increased pressurization (Summer)*