CLAIMS

1. A control system for controlling air volume to maintain a desired concentration of airborne contamination in a cleanroom supplied by a HVAC system being operative to supply treated air to the cleanroom which comprises one or more zones or rooms, each of the zones or rooms having a respective desired concentration of airborne contamination, and wherein the HVAC system comprises at least one HVAC air handling unit supplying treated air through a ducting system, and one or more constant air volume devices and/or one or more variable air volume devices positioned in the ducting and generally associated with each respective zone or room of the cleanroom, the system comprising:

sensing means for sensing a concentration of non-viable particles and/or viable particles in real time or near real time; and

processing means for comparing the sensed concentration of non-viable particles and/or viable particles against the desired concentration of airborne contamination and outputting at least one control signal to the HVAC system based on the comparison, wherein the processing means comprises a model predictive controller which comprises a model component that receives a HVAC system operating condition from extrinsic data analysis and which models HVAC system behaviour; and means for receiving the modelled HVAC system behaviour and outputting the at least one control signal to the HVAC system based on the modelled HVAC system behaviour and a cost minimizing function.

2. The control system as claimed in claim 1, wherein the desired concentration of airborne contamination is specified by the number of non-viable particles per cubic meter having a particle size of equal to or greater than 0.1 μm, 0.2 μm, 0.3 μm, 0.5μm, 1 μm and 5μm in diameter.

3. The control system as claimed in any of claims 1 or 2, wherein the cleanroom being classified by particle size concentration as defined in ISO 14644-1 or any classification standard related to particle size concentration as determined by the cleanroom user.

4. The control system as claimed in any of the preceding claims, wherein the air treatment is selected from the group consisting, but not limited to, any one of the following: filtration, ventilation, heating, cooling, humidification, pressurisation, occupancy, and combinations thereof.

5. The control system as claimed in any of the preceding claims, wherein the sensing means comprises one or more ISO 14644-1 calibrated laser particle counters and/or viable particulate air monitoring sensors positioned in the cleanroom or the ducting of the HVAC system.

6. The control system as claimed in any of the preceding claims, further comprising one or more secondary sensing means for sensing an environmental condition and/or process condition and/or HVAC system condition in real time or near real time.

7. The control system as claimed in claim 6, wherein the secondary sensing means further comprises one or more sensors selected from the group consisting, but not limited to, any one of the following: temperature sensor, humidity sensor, pressure sensor, differential pressure sensor, airborne molecular contamination sensor, contaminant deposition sensor, air flow sensor, proximity sensor, and combinations thereof.

8. The control system as claimed in any of the preceding claims, wherein the processing means receiving energy price data and/or usage data.

9. The control system as claimed in claim 8, wherein the processing means receiving the sensed environmental condition and/or process condition and/or HVAC system condition and/or energy price data and/or usage data and outputting one or more secondary control signals to the HVAC system.

10. The control system as claimed in claim 9, wherein the one or more secondary control signals are outputted without causing the sensed concentration of particles to depart from the desired concentration of airborne contamination.

11. The control system as claimed in any of claims 6 to 10, wherein the desired concentration of airborne contamination and/or energy price data and/or usage data being initially user configurable.

12. The control system as claimed in any of the preceding claims, wherein the at least one control signal to the HVAC system controlling the air volume supplied to the cleanroom.

13. The control system as claimed in any of claims 6 to 11, wherein the one or more secondary control signals controlling the filtration, ventilation, heating, cooling, humidification, pressurisation, occupancy, and combinations thereof supplied to the cleanroom.

14. The control system as claimed in any of the preceding claims, wherein the processing means implements a model predictive control (MPC) algorithm.

15. The control system as claimed in claim 14, wherein the model predictive control algorithm being able to self-adapt.

16. The control system as claimed in claim 1,

wherein the means for receiving the modelled HVAC system behaviour and outputting the at least one control signal to the HVAC system based based on the modelled HVAC system behaviour and the cost minimizing function and constraints.

17. The control system as claimed in any of the preceding claims, wherein the control system is implemented in a programmable logic controller (PLC).

18. The control system as claimed in any of the preceding claims, further comprising display means.

19. The control system as claimed in any of the preceding claims, further comprising means for enabling communication and/or integration and/or interoperability with third party building management systems (BMSs).

20. The control system as claimed in any of the preceding claims, further comprising means for monitoring the energy performance of the cleanroom and/or particle contamination concentration within the cleanroom.

21. A method of controlling air volume to maintain a desired concentration of airborne contamination in a cleanroom supplied by a HVAC system being operative to supply treated air to the cleanroom which comprises one or more zones or rooms, each of the zones or rooms having a respective desired concentration of airborne contamination, and wherein the HVAC system comprises at least one HVAC air handling unit supplying treated air through a ducting system, and one or more constant air volume devices and/or one or more variable air volume devices positioned in the ducting and generally associated with each respective zone or room of the cleanroom, the method comprising the steps of:

sensing a concentration of non-viable particles and/or viable particles in real time or near real time;

comparing the sensed concentration of non-viable particles and/or viable particles against the desired concentration of airborne contamination; and

outputting at least one control signal to the HVAC system based on the comparison,

wherein the outputting step comprises a model predictive controller which comprises a model component that receives a HVAC system operating condition from extrinsic data analysis and which models HVAC system behaviour; and means for receiving the modelled HVAC system behaviour and outputting the at least one control signal to the HVAC system based on the modelled HVAC system behaviour and a cost minimizing function.

22. A computer program product for controlling air volume to maintain a desired concentration of airborne contamination in a cleanroom supplied by a HVAC system being operative to supply treated air to the cleanroom which comprises one or more zones or rooms, each of the zones or rooms having a respective desired concentration of airborne contamination, and wherein the HVAC system comprises at least one HVAC air handling unit supplying treated air through a ducting system, and one or more constant air volume devices and/or one or more variable air volume devices positioned in the

ducting and generally associated with each respective zone or room of the cleanroom, the computer program product comprising:

computer program means for sensing a concentration of non-viable particles and/or viable particles in real time or near real time;

computer program means for comparing the sensed concentration of non-viable particles and/or viable particles against the desired concentration of airborne contamination; and

computer program means for outputting at least one control signal to the HVAC system based on the comparison,

wherein computer program means for outputting comprises a model predictive controller which comprises a model component that receives a HVAC system operating condition from extrinsic data analysis and which models HVAC system behaviour; and means for receiving the modelled HVAC system behaviour and outputting the at least one control signal to the HVAC system based on the modelled HVAC system behaviour and a cost minimizing function.