Introduction

The Tokamak fusion reactor is a research facility being designed and built by the ITER Consortium to prove the viability of fusion as an energy source. The facility will operate with Tritium plasma, a radioactive isotope of hydrogen. Therefore, the facility will require an atmosphere detritiation system to contain and safely process tritiated gas streams from within three of the facility buildings; the Tokamak Building, the Tritium Plant Building and the Hot Cell Facility.

There will be two sub-systems within the Tokamak Building and Hot Cell Facility - the Glovebox Detritiation System and the Vent Detritiation System. Each will be an extensive network of pipes and equipment, including fans/blowers and control valves.

The Glovebox Detritiation System is intended to operate constantly so that the gloveboxes are maintained with pressures lower than the atmospheric condition. The Vent Detritiation System will operate under incident or accident conditions to depressurise the rooms or volumes where an incident has occurred, containing any potential contamination.

Computational Models

MMI has constructed computational system models using the software tool Flowmaster. These models represent typical configurations of the sub-systems process volumes, with associated Heating, Ventilation, and Air Conditioning (HVAC) systems (including pipes, fire dampers, isolation valves, pressure regulation valves and flow control valves).

The Flowmaster model (Figure 3) of the fluid system was straightforward; comprising of volumes, pipes and valves. However, the control scenario required the creation of custom scripts to facilitate sequenced, valve actuations, triggered on target system pressures and customised Proportional and Integral (PI) feedback controllers.

Results for the Unit Tests

Analyses were performed on these unit tests to assess system behaviour for several emergency conditions. These studies recommended optimum proportional and integral valve controller settings and valve actuation times to minimise pressure variation from the requirements. The analyses also confirmed that the proposed control would not result in any unsafe pressures or flow leading to increased contamination risks

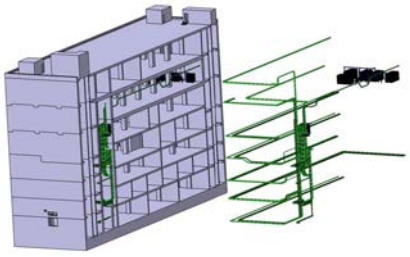

Figure 1: Possible configuration of the Tritium Plant building with the detritiation system pipe work extracted for clarity

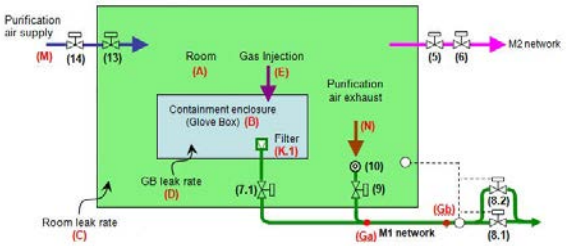

Figure 2: Unit test schematic

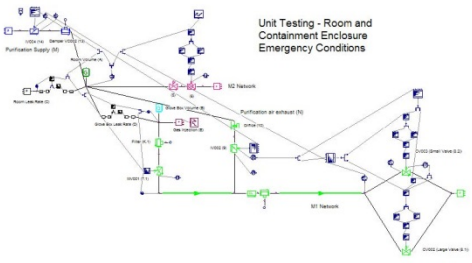

Figure 3: Flowmaster model of unit test, including implementation of control philosophy