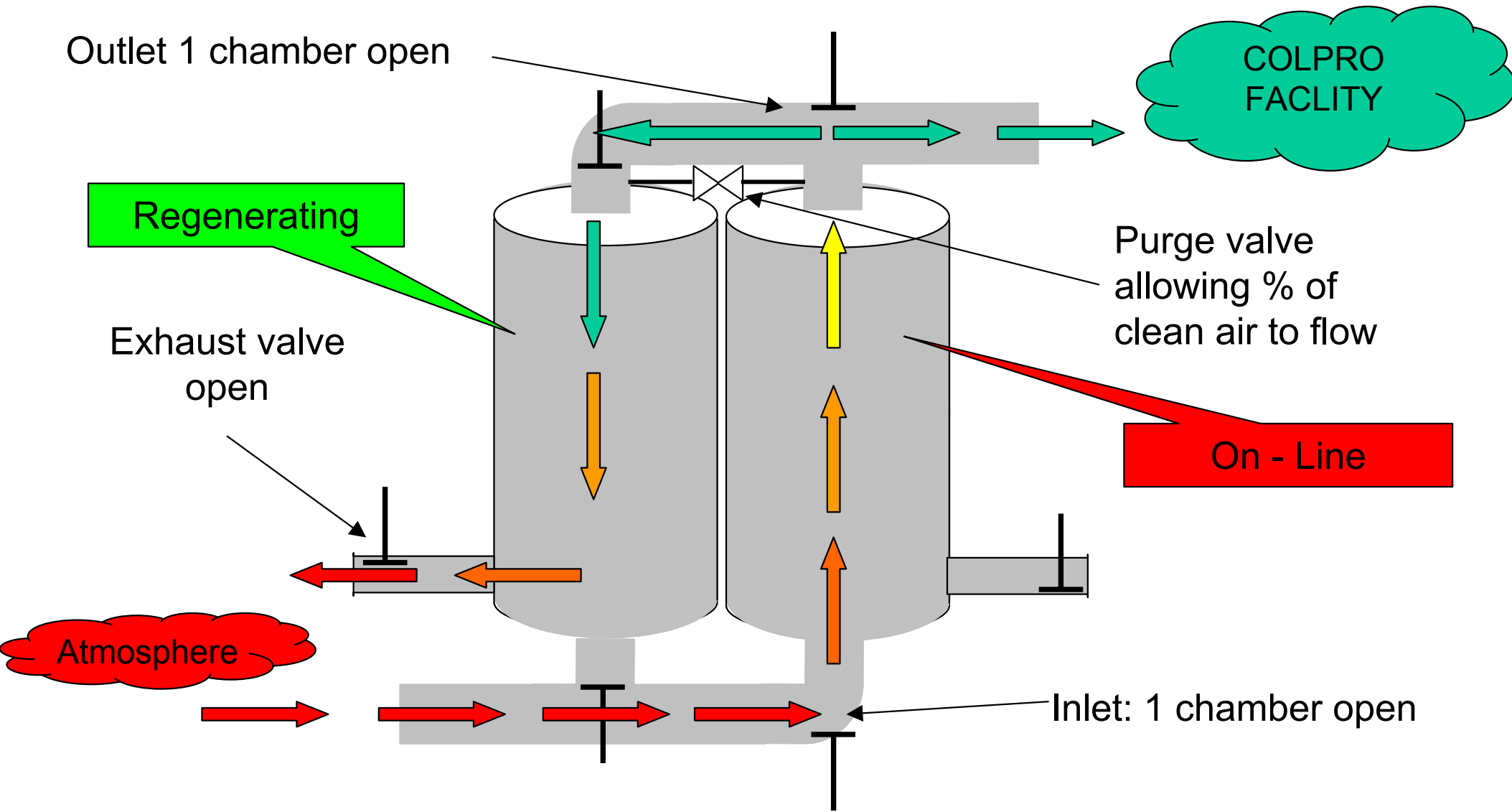


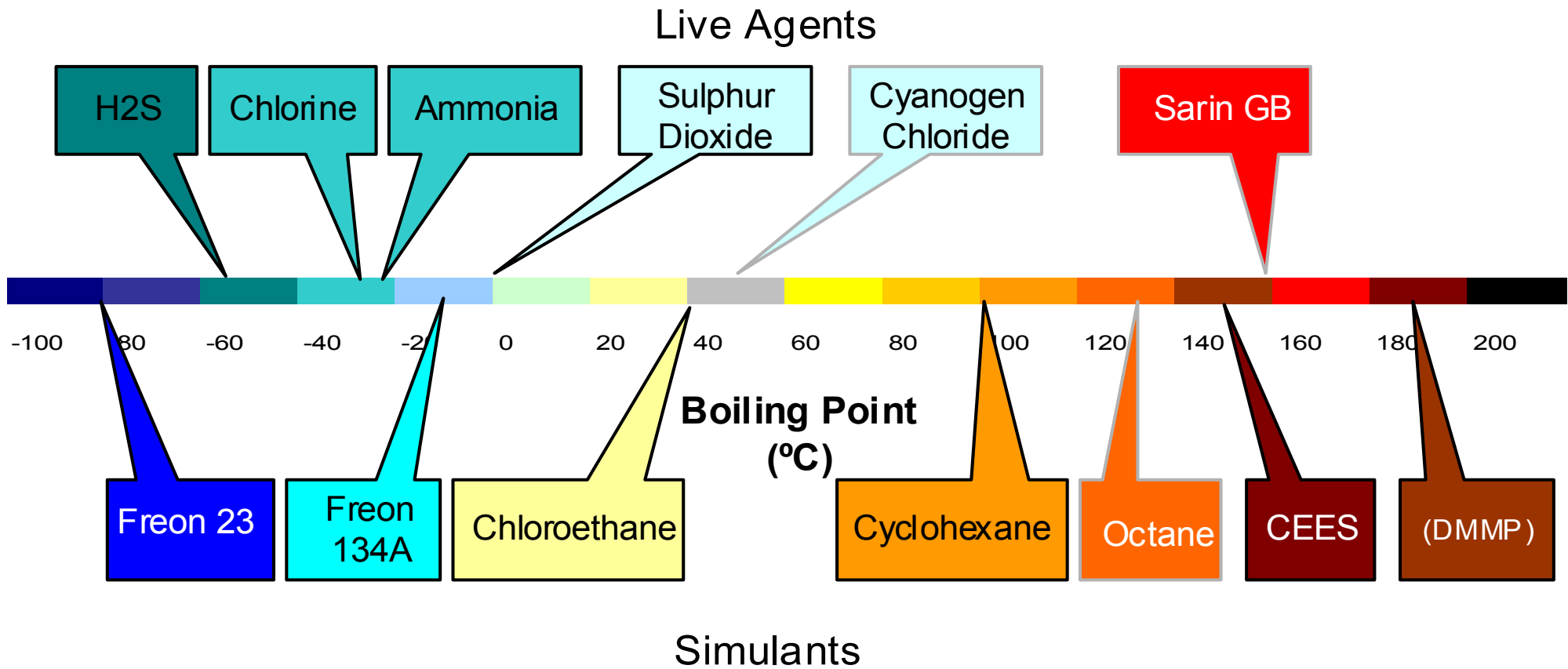
Regenerative Filtration - the new defense against NBC attack.

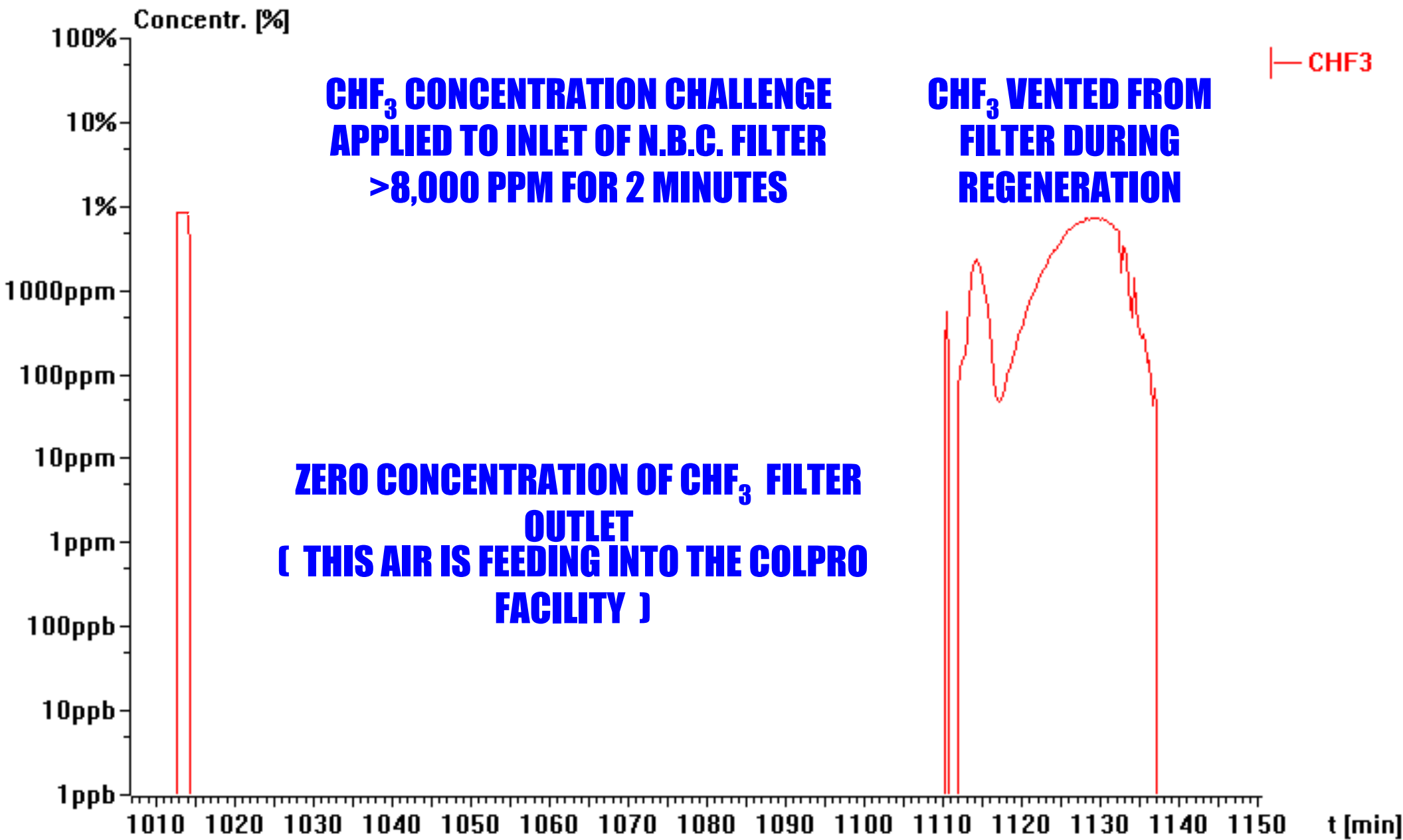
Prof. Robert M Fielding
Director of Technology
domnick hunter Inc.

REGENERATIVE NBC FILTER

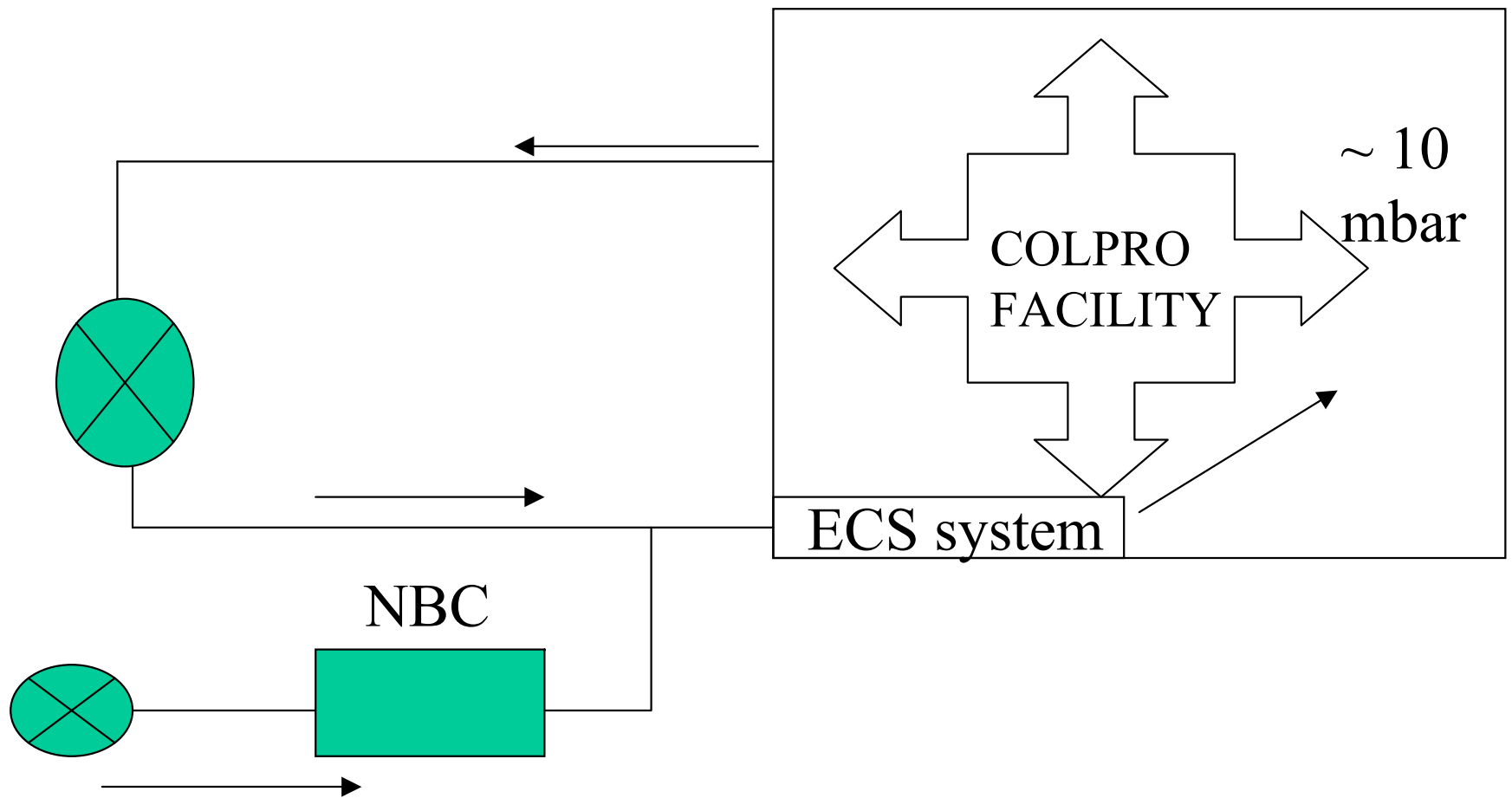








Re-circulation of air to the colpro



Re-circulation

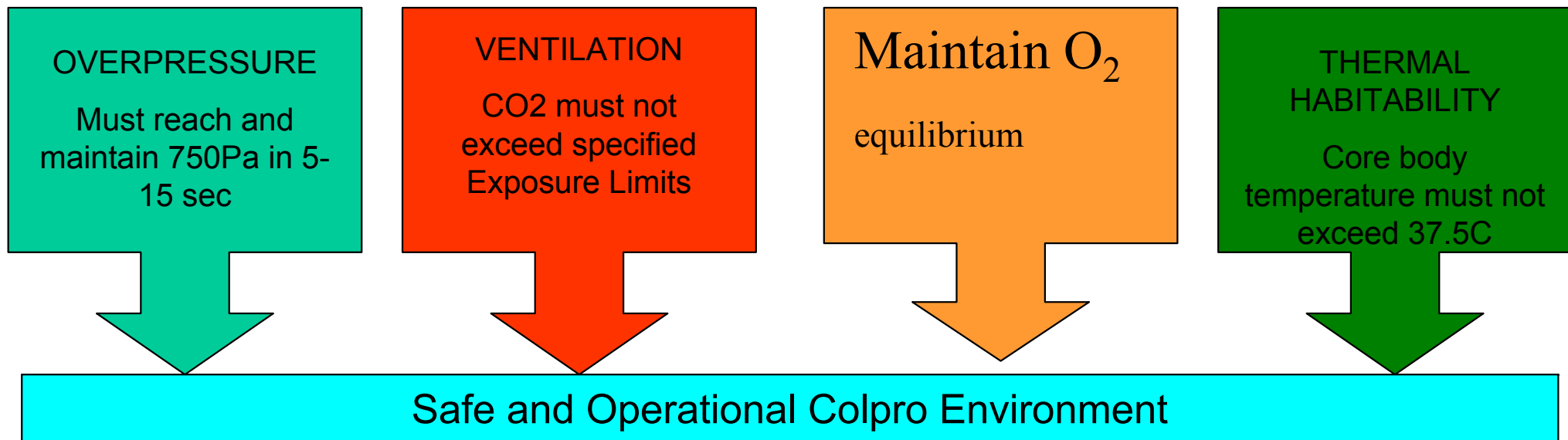
- More efficient use of filtered air
- Significantly reduced energy budget for Environmental Control System
- Ability for secondary HEPA filtration to crew air within enclosure
- Lower running costs

Physiological.....

- Modelling and testing have shown that the volume of air needed to maintain life is $<3 \text{ Nm}^3/\text{hr.}$ / per person - moderate exertion i.e. maintain oxygen balance within Colpro.
- Modelling has shown that maintaining the O_2 level above 19.5%, significant flow reductions are possible, whilst keeping the CO_2 levels within allowable levels.

COLPRO NBC System Airflow Requirements

- Reach and maintain colpro overpressure
- Provide sufficient Oxygen for the inhabitants and Carbon Dioxide removal
- Ensure thermal habitability satisfactory



Breathing Air Requirements

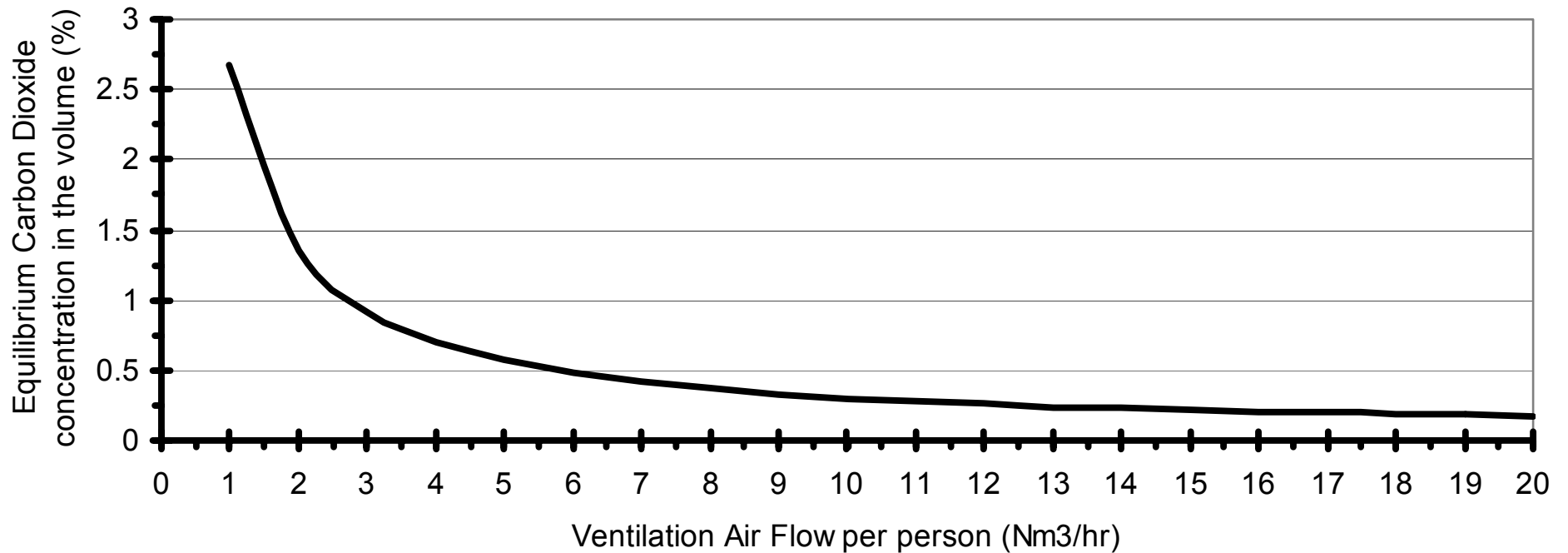
BS 4275 : 1997 Respiratory Protective Devices				Colpro	
Work rate	Examples	Peak inhalation rate		Def Stan 00-25	NATO Triptych (FRES)
		(l/min)	(m ³ /hr)		
Low	Sitting at ease Light manual work (writing, typing) Arm & leg work Driving in normal conditions Standing Drilling, milling Walking at < 3.5 km/hr level ground	100	6	51m ³ /hr per person, 66% of which (34m ³ /hr) from outside atmosphere	17m ³ /hr per working person, 8.5m ³ /hr per resting person
Moderate	Sustained hand & arm work Off road driving, hammering in nails Arm & trunk work Pneumatic hammer, weeding Walking at < 5.5 km/hr level	150	9		
High	Intense hand & arm work Carrying heavy items, shovelling Pushing heavy barrow Walking at 5.5 to 7 km/hr level ground	200	12		
Very High	Very intense activity at fast to max pace Working with axe, climbing stairs or ladder Walking at > 7 km/hr level ground	250	15		

Physiological Requirements

Occupational Exposure Standard for CO₂ is:

- 15,000 PPM (1.5%) for 15 minutes
- 5,000 PPM (0.5%) for 8 hour average in 24 hours

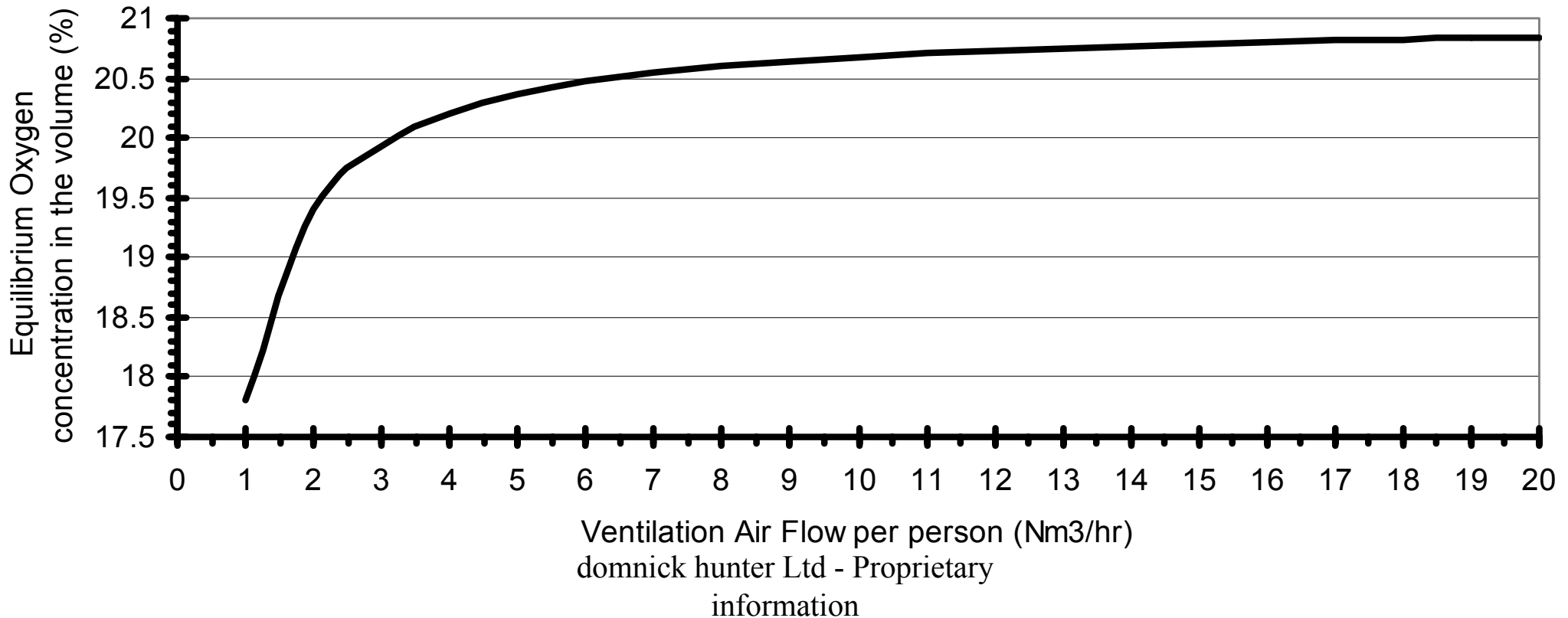
Personal ventilation air flow against equilibrium Carbon Dioxide concentration level for 3 personnel operating in a free air volume of 3.6 m³.



Physiological Requirements

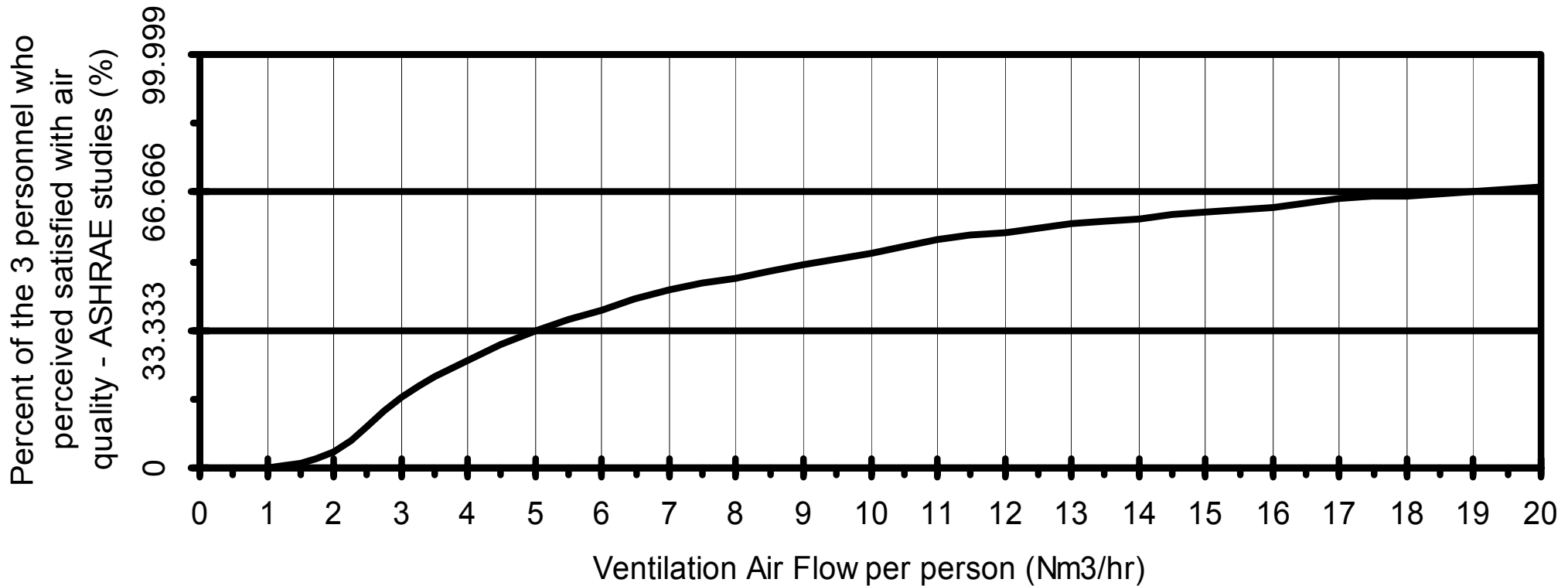
Lowest acceptable limit for Oxygen concentration in a submarine is 18%

Personal ventilation air flow against equilibrium Oxygen concentration level for 3 personnel operating in a free air volume of 3.6 m3



Psychological Requirements

Personal ventilation air flow rate against percent satisfaction for 3 persons operating in a free air volume of 3.6m³



Integration issues....

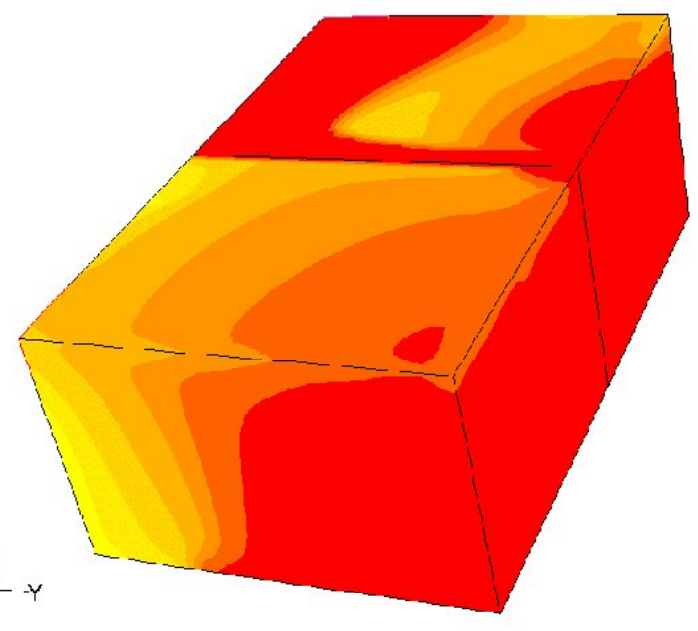
- Technology supported world wide.
- Modular design allows system growth as requirements increase.
- Operation in parallel with air conditioning distribution
- Smallest footprint in its class.
- Equipped with Building Management protocols and telemetry interrogation.
- Operation linked to alarm sensor array.



50% FILTER EFFICIENCY

Concentration Expressed as Life Expectancy for 50% of Population

- 1 min 5.38e-05
- 4 min 1.41e-05
- 17 min 3.70e-06
- 1 hour 9.72e-07
- 3.8 hour 2.55e-07
- 14.5 hour 6.69e-08
- 2.3 days 1.76e-08
- 4.61e-09
- 1.21e-09
- 3.17e-10
- safe working level 8.33e-11



Contours of Mass fraction of sarin (Time=1.5100e+01) Feb 20, 2002
 FLUENT 5.5 (3d, segregated, spe2, ke, unsteady)

Time from First Introduction of Sarin

Switch view

Efficiencies

90%

99%

99.999%

Outside concentration 1000 mg/m³

LCT₅₀ taken as 70 mg min/m³ from MSDS containing results from ECBC tests. LCT₅₀/concentration relationship assumed to be linear for life expectancy timescale shown. Safe working level is an 8 hour time weighted average permissible airborne exposure concentration for GB for an 8-hour workday of a 40-hour work week

This is an idealised, simplified model and is intended to demonstrate relative performance of different filter efficiencies and is not validated by testing.



Analysis by RCID tel 0044 (0)191 2225897

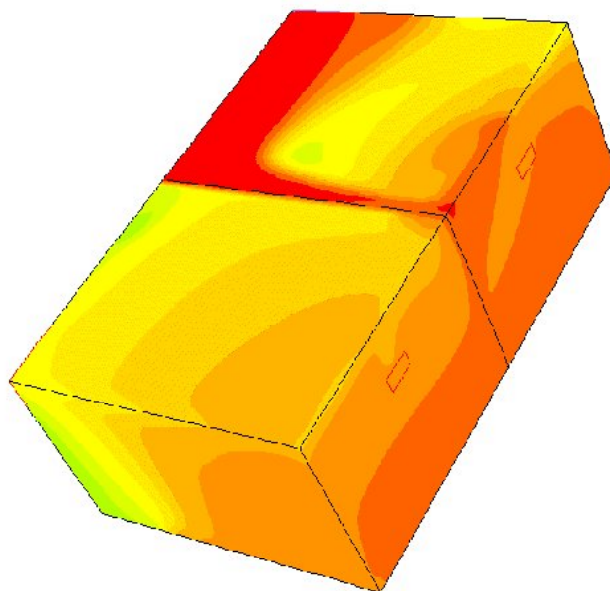
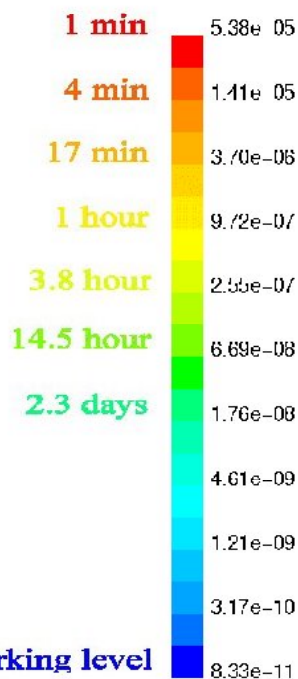
email: info@rcid.co.uk



domnick hunter

90% FILTER EFFICIENCY

Concentration Expressed as Life Expectancy for 50% of Population



Contours of Mass fraction of sarin (Time=1.5100e+01)

Feb 22, 2002

FLUENT 5.5 (3d, segregated, spe2, ke, unsteady)

Time from First Introduction of Sarin

Switch view

Efficiencies

50%

99%

99.999%

Outside concentration 1000 mg/m³

LCT₅₀ taken as 70 mg min/m³ from MSDS containing results from ECBC tests. LCT₅₀/concentration relationship assumed to be linear for life expectancy timescale shown. Safe working level is an 8 hour time weighted average permissible airborne exposure concentration for GB for an 8-hour workday of a 40-hour work week

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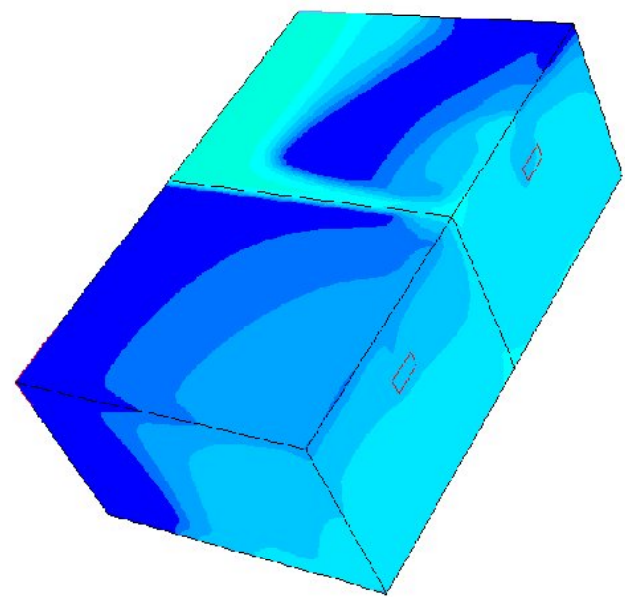
Analysis by RCID tel 0044 (0)191 2225897

email: info@rcid.ncl.ac.uk



99.999% FILTER EFFICIENCY

Concentration Expressed as Life Expectancy for 50% of Population



Contours of Mass fraction of sarin (Time=1.5100e+01) Feb 22, 2002
 FLUENT 5.5 (3d, segregated, spe2, ke, unsteady)

Time from First Introduction of Sarin

Switch view

Efficiencies

- 50%
- 90%
- 99%

Outside concentration 1000 mg/m³

LCT₅₀ taken as 70 mg min/m³ from MSDS containing results from ECBC tests. LCT₅₀/concentration relationship assumed to be linear for life expectancy timescale shown. Safe working level is an 8 hour time weighted average permissible airborne exposure concentration for GB for an 8-hour workday of a 40-hour work week

This is an idealised, simplified model and is intended to demonstrate relative performance of different filter efficiencies and is not validated by testing.



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Conclusions.....

- Latest Technological breakthrough in Collective Protection.
- Tested by ECBC Maryland & in 5 European countries.
- Fully effective against TIC's & TIM's
- Packaged Integrated Solution
- Mature and growing technology
- Logistic and Maintenance friendly
- 100% protection, 100% of the time

COLPRO NBC PROTECTION

in- situ regeneration



domnick hunter Ltd - Proprietary
information