maritimeEXODUS

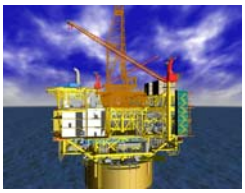
Fire Safety Engineering Group
The University of Greenwich
London SE10 9LS

maritimeEXODUS The Evacuation Model for the Marine Environment

maritimeEXODUS is more than simply an evacuation model, it is a computer based laboratory for evaluating the emergency and non-emergency movement and behaviour of passengers and crew.

Developed within the Fire Safety Engineering Group (FSEG) through pioneering research and development at the University of Greenwich, maritimeEXODUS simulates ***people-people, people-fire and people-structure*** interactions. The model tracks the path of each passenger as they gather at their assigned assembly point and await the order to abandon the vessel. If the passengers are subjected to the effects of fire hazards, maritimeEXODUS takes this into account and predicts whether passengers are likely to survive the effects of fire hazards such as heat, smoke and toxic gases. maritimeEXODUS also takes into account the impact of heel and trim on travel speeds and can simulate the abandonment phase. maritimeEXODUS can be applied to:

- ***Accident reconstruction***
- ***Tourist vessels***
- ***Ro-Ro Ferries***
- ***Cruise Ships***
- ***Naval Vessels***
- ***Off-Shore Facilities***
- ***HSC***
- ***FPSOs***



maritimeEXODUS applications

maritimeEXODUS has distinguished itself by winning some of the most prestigious awards that the maritime industry has to offer, such as the RINA/LR Award for Ship Safety in 2002 and the CITIS Award for Innovation in IT for Ship Operation 2002. maritimeEXODUS has also been endorsed by the UK MOD as, "the escape tool that most closely meets the needs of the MOD for the development of warship escape design guidance and assessment". As part of the EXODUS family, maritimeEXODUS has also been honoured through the award of the BCS prize 2001, The Queen's Anniversary Award 2002 and the European IST prize 2004.

REALISTIC DATA USED IN maritimeEXODUS

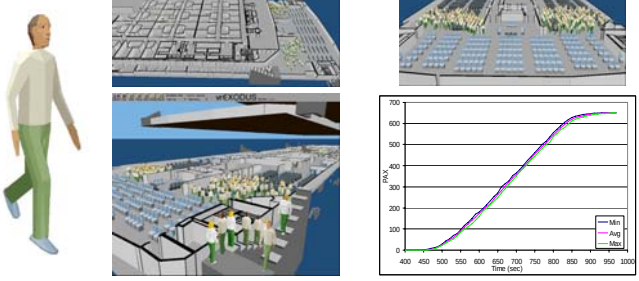
SHEBA data used in maritimeEXODUS e.g. crew attempts to open hatch and water tight door while at 20 degrees heel

THE EXODUS MODEL

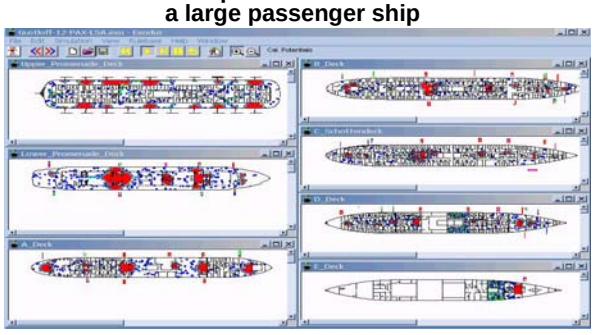
The software is written in C++ using Object Orientated techniques and utilises rule-based software technology to control the simulation. For additional flexibility these rules have been categorised into five interacting submodels known as the Passenger, Movement, Behaviour, Toxicity and Hazard models. These operate on a region of space defined by the geometry of the vessel. Internally, the geometry is covered in a mesh of nodes. The nodes are linked by a system of arcs. Each node represents a region of space typically occupied by a single person. maritimeEXODUS makes use of data generated from SHEBA.

maritimeEXODUS Features	Available now	Available soon
Full compliance with IMO MSC 1238 (muster simulation)	✓	
Impact of heel and trim on passenger travel speeds	✓	
Impact of wearing life jackets on passenger travel speeds	✓	
Life Jacket retrieval	✓	
Ability to include contra-flow	✓	
Ability to simulate abandonment phase	✓	
Ability to represent crew/pax procedures e.g. fire fighting	✓	
Ability to incorporate impact of fire, smoke, heat, toxic gas	✓	
Ability to simulate non-evacuation procedures e.g. boarding	✓	
Ability to interface with CAD drawings	✓	
Incorporate ladders, hatches, water tight doors and 60^0 stairs	✓	
Combining smoke with ship orientation	✓	
Direct coupling to CFD fire simulation software	✓	
Impact of heel and trim on passenger behaviour	✓	
Impact of irritant products upon the population	✓	
LSA selection according to the levels of congestion	✓	
Automatic identification of IMO critical congestion levels	✓	
Signage and Visibility Catchment Areas (VCA)	✓	
Impact of dynamic motion		✓
Semi-automatic evacuation and normal operations analysis		✓

maritimeEXODUS EXAMPLES.



maritimeEXODUS prediction of time to muster for a large passenger ship



maritimeEXODUS was used to reconstruct the sinking of the GUSTLOFF. In 1945 she took 3 torpedoes developing a 20^0 heel before sinking with the loss of over 10,000 lives

maritimeEXODUS can accurately represent crew/paxs performance on vertical ladders, 60^0 stairs and the operation of water tight doors and hatches. These are essential features for naval applications as shown for CVF

Contact: Prof Ed Galea
e.r.galea@gre.ac.uk
http://fseg.gre.ac.uk
Phone: + 44 (0)208 331 8730

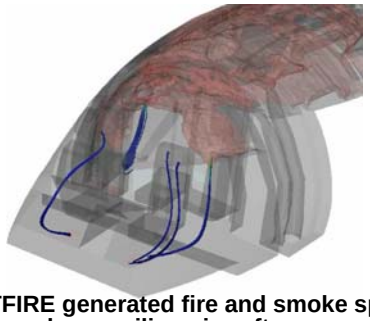
Fire Safety Engineering Group

The University of Greenwich
London SE10 9LS

A WORLD LEADER IN COMPUTATIONAL FIRE ENGINEERING

The Fire Safety Engineering Group (FSEG) of the University of Greenwich was founded by Prof Galea in 1986. The research and consultancy interests of the 30 strong team are focused on the development and application of Computational Fire Engineering (CFE) tools for the simulation of evacuation, non-emergency circulation of people, combustion, fire/smoke spread, structural response to fire and fire suppression. High profile applications of FSEG skills and technology in the built environment, aerospace, marine and rail sectors include:

- ***9/11 WTC*** – evacuation analysis
- ***Airbus A380 super jumbo*** - evacuation analysis
- ***SwissAir MD11 disaster inquiry*** – fire analysis
- ***New Royal Navy aircraft carrier (CVF)*** – evacuation analysis
- ***Ladbroke Grove rail disaster inquiry*** – fire/evacuation analysis
- ***Sydney Olympic Stadium*** – evacuation analysis

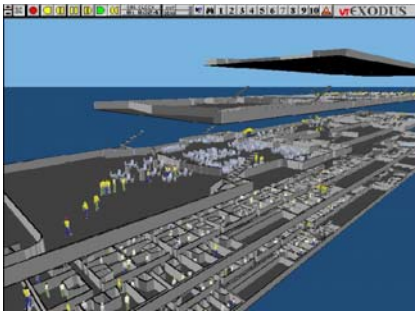


SMARTFIRE generated fire and smoke spread in above ceiling aircraft space

INTERNATIONAL RESEARCH AND CONSULTANCY

FSEG is one of Europe's leading centres of excellence in CFE. It is also one of the largest university-based groups dedicated to the modelling of fire and related phenomena in the world. FSEG has published over 200 academic and professional publications on fire and related topics. Since 1991 FSEG has generated over £6 million worth of research and consultancy funding and its research and consultancy activities have been supported by a client base including:

EADS, BAe Systems, BA, Buro Happold, BMT, Canary Wharf Management Ltd., EPSRC, EU, European Space Agency, Mitsubishi, LPC, MCA, NHS, Arup, RINA, Borealis, Rockwool, Thales, The Engineering Link, MOD, Lloyds Register, CAA, FAA, FRA, Boeing, NTSB, Bombardier, Canadian Dept of Trans, US Dept of Trans, Canadian Transportation Safety Board.



maritimeEXODUS: Simulation of mustering on a large passenger ship

Examples of FSEG research and consultancy projects include:

- Analysis of naval/passenger ship design for evacuation
- Fire/smoke analysis for underground stations
- Evacuation analysis of high-rise buildings
- Fire/evacuation design and certification analyses for aircraft
- Circulation/evacuation analysis for airports and subways
- Analysis of evacuation provision for hospitals
- Prediction of toxic gas generation resulting from cable fires
- Full-scale and experimental scale evacuation trials in aircraft, buildings, ship and rail environments.

AWARD-WINNING SOFTWARE

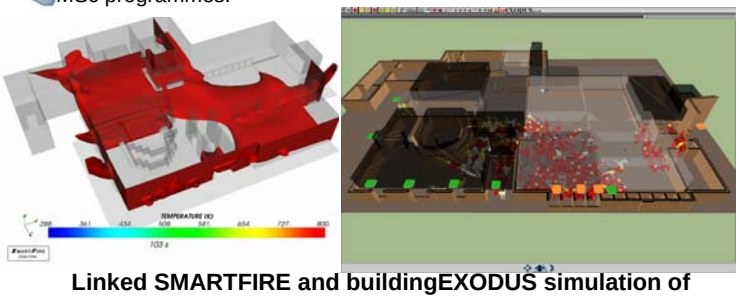
Research undertaken by FSEG has lead to the development of the CFE software: SMARTFIRE, buildingEXODUS, airEXODUS and maritimeEXODUS. These products are distributed world-wide by FSEG to customers in 30 countries. FSEG's innovation has been recognised through a number of prestigious awards:

- ***SFPE Bono Award 2008***
- ***Royal Aeronautical Society's Gold Award and George Taylor Prize 2006,***
- ***IST prize 2004 awarded by the EU and the European Council of Applied Sciences, Technology and Engineering***
- ***Queen's Anniversary Prize 2002***
- ***British Computer Society IT Award, 2001***
- ***Royal Institution of Naval Architecture/Lloyds Register Safer Ship Award 2001***
- ***Communications & IT in Shipping Award for Innovation in IT for Ship Operation 2002***

buildingEXODUS: Occupant interaction with fire, smoke and toxic gases

KNOWLEDGE TRANSFER

Members of FSEG are actively involved in the supervision of doctoral and masters level research students concerned with fire safety and the development and delivery of fire safety engineering courses, including, short courses for industry, MSc by Research and Taught MSc programmes.



Linked SMARTFIRE and buildingEXODUS simulation of Rhode Island disco fire incorporating smoke, heat, toxic and irritant gases.

HELPING SET INTERNATIONAL STANDARDS

FSEG expertise is sought by standards bodies such as the BSI, ISO, IMO and SFPE and is used to set standards in life safety, fire safety engineering and the use and validation of CFE tools.

Evacuation Trials: FSEG conduct evacuation trials in a range of environments including hospitals, ships, rail carriages and smoke filled aircraft cabins in order to collect human performance data

Contact: Prof Ed Galea
e.r.galea@gre.ac.uk
http://fseg.gre.ac.uk
Phone: + 44 (0)208 331 8730