Computer Models
For
Fire and Smoke

Model Name: BURNSIM

Version: 3.0

Date: 19 April 2007

Classification: Interactive burn injury/pain prediction model.

Very Short Description: BURNSIM allows the user to predict the time to pain and time to threshold blister as well as final burn depth in microns. For Convective heating is ha a limited number of fabrics that can be placed between the heat source and the skin.

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Lt Dena Bonetti (Armstrong Lab - Escape and Impact Branch – predecessor of AFRL/HEPA)
Steve Mosher, MS, General Dynamics AIS – support contractor to AFRL/HEPA.

User's Guide: Yes

Technical References:200 plus references, User Manuals and some papers/presentaions are included on the CD.

Validation References: Experimental work of: Moritz and Henriques (Harvard), Alice Stoll (US Navy), Knox etal (US Army Aeromedical Research Lab), University of Rochester Atomic Energy Project.

Availability: Version 3.0 is available professionals and student in the field.

Price: Free

Necessary Hardware: PC

Computer Language: C++ and Visual Basic (currently being changed to .NET)

Size: The cabinet file and setup together are about 5.5M but the executable is about 500KB.

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Detailed Description:

Introduction From the User's Guide

The work summarized is this guide was supported by the Joint Non-Lethal Weapons (JNLW) Program. It builds on previous work supported by many sources including the US Army, USAF, LSU School of Medicine, Defense Nuclear Agency, Live Fire Office and the Joint Strike Fighter (JSF) System Program Office. The current approach was to start with our computer model, BURNSIM v2.7, circa 2001, previously developed for JSF to model the effects of jet exhaust from the Short Take-Off and Vertical Landing (STOVL) version of the F-35. Maintainers who re-arm, re-fuel, and check out the F-35 after each mission can be exposed to hot exhaust gas, or contact with hot surfaces (touching the Aircraft). They depend on protective clothing to mitigate pain and burn injury and predictions from BURNSIN to define "safe zones" around the aircraft. To make it easier to use, Version 2.7 was reprogrammed from an earlier version in a Windows environment.

BURNSIM, v3.0, adds wavelength dependent in-depth energy absorption, more control over blood flow, tests of very short pulses and in general, a more detailed validation against several data sets. The goal was to develop and validate a version that could be

used to assess the effects of the thermal flash pulses associated with Non-lethal weapons known as Flash-Bangs. The model requires a description of the thermal environment (ambient temperatures, humidity and incident heat flux vs. time) and the clothing or personal protective equipment being worn in order to predict where the “safe” or non-injurious conditions are located in the particular data space.

The model itself uses the Crank-Nicholson six point implicit differencing method to simulate heat flow into and through the skin and uses a first order rate process to predict how deep the burn damage progresses into the skin. It also predicts time to burn (Threshold Blister) and time to pain (six levels) to facilitate consideration of the operational human factors related to how long one could work in that area or if the area near the flash-bang [or other thermal source] is safe.

This guide builds on two previous User Manuals (Knox et al, 1993 and 2001) and adds recent changes to the model. Appendix A describes the BURNSIM model in more detail. Appendix B contains an example run of convection with and without clothing to get the new user started. The HELP button on the first screen has additional information about various aspects of the model. A knowledgeable user should be able to run the model using this guide, but the authors are available to answer questions if needed.

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