SOFTWARE REQUIREMENTS DESCRIPTION FOR THE COMPUTER CODE DRIFTVNT VERSION 1.0

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ABSTRACT

This Software Requirements Description is intended to document the requirements for the computer code DRIFTVNT V1.0. DRIFTVNT is a set of subroutines that are invoked by another software package. Initially, DRIFTVNT will be integrated into MULTIFLO; however, it may be integrated into other software packages as well. For this reason, DRIFTVNT is maintained separately from MULTIFLO. DRIFTVNT is used to model the thermal radiation across an open emplacement drift as well as the effects of forced or natural ventilation in an emplacement drift. It is intended to function with a user-definable grid geometry.

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QUALITY OF DATA, ANALYSES, AND CODE DEVELOPMENT

DATA AND ANALYSES: Neither data nor analyses are reported in this document. This document describes the requirements for DRIFTVNT.

CODE DEVELOPMENT: Codes will be developed in accordance with the procedures described in the CNWRA Technical Operating Procedure, TOP-018, which implements the guidance contained in the CNWRA Quality Assurance Manual.

1 INTRODUCTION

This Software Requirements Description document identifies the software requirements for implementing the In-Drift Thermal Radiation and Forced Ventilation Model (Painter, et al., 2001). It includes descriptions for the source code module level breakdown, control flow, and configuration. This software could be used in the high-level waste repository license application review process for Yucca Mountain, Nevada.

DRIFTVNT is a set of subroutines that are invoked by another software package. Initially, DRIFTVNT will be callable from the MULTIFLO software; however, it may also be used standalone for future scoping calculations. For this reason, DRIFTVNT is maintained separately from MULTIFLO. DRIFTVNT is used to model the thermal radiation across an open emplacement drift as well as the effects of forced or natural ventilation in an emplacement drift.

2 SOFTWARE REQUIREMENTS FOR DRIFTVNT, VERSION 1.0

This Software Requirement Description identifies the interface and functionality that is required to implement the In-Drift Thermal Radiation and Forced Ventilation Model. The technical basis for this model has already been described (Painter, et al., 2001) and is included as Appendix A.

2.1 Software Function

DRIFTVNT implements the model of thermal radiation and forced ventilation within the emplacement drift. This code accounts for the thermal radiation from the waste package to the drift wall, forced air ventilation, cooling of the waste package and the drift wall due to convective heat transport from the waste package and drift wall to the ventilation air, and drying of the drift wall by the ventilation air.

Model parameters are user configurable. The user specifies the number of slices through the emplacement drift and the number of boundary cells per slice for one-half of the drift wall. It is assumed that all slices have the same number of boundary cells at the drift wall, that the temperature at the drift wall is constant throughout the slice for a given time step, and the slice is symmetric about the vertical axis with respect to geometry and environmental conditions. In addition, it is assumed that a slice through the emplacement drift can be modeled as an unstructured grid.

2.2 Computational Approach

This section covers the interface requirements, software and hardware requirements, and module layout/data flow. This software does not require a user interface, has no graphics requirements, and does not require pre- or post-processing.

2.2.1 Interface Requirements

DRIFTVNT interfaces to the calling software through an interface module, IDRIFT. IDRIFT receives an array of cells in which each cell has an associated volume, temperature, pressure, and initial heat source flux. For DRIFTVNT, only the cells at the drift wall (boundary cells) are relevant. Therefore, IDRIFT, processes the information from received cells and extracts the

required information from those at the wall of the emplacement drift. IDRIFT creates a volume-averaged set of data for each slice and passes this information to module DRIFT. DRIFT then process all the slices in the emplacement drift and returns heat and moisture flux from each of these slices. IDRIFT then takes this returned heat and moisture flux, transforms it into a heat and moisture flux for each of the boundary cells, and passes these fluxes back to the caller.

The interface module, IDRIFT, determines which cells are boundary cells through the use of a data file, driftvnt.dat, and through the use of input parameters from the caller. The data file specifies the number of slices and the number of boundary cells per slice, N, for one-half of the drift wall. In addition, IDRIFT receives an array of heat source locations from the caller. The code is structured such that the first N heat source locations map to slice 1, the next N heat source locations map to slice 2, and so on.

2.2.2 Data Flow and Module Layout

The module layout is shown in Figure 2-1. DRIFTVNT has three components: (1) an associated module DRIFT, (2) an interface IDRIFT, and (3) a data input file driftvnt.dat. The caller, which may for example be MULTIFLO, passes cell specific information (e.g. cell volume, cell temperature, and cell pressure) to the interface and receives cell specific information back from the interface (e.g., heat and moisture flux). The interface transforms the cell by cell information from the caller into slice by slice information for module DRIFT. Module DRIFT processes and returns heat and moisture flux. The heat and moisture flux is then transformed by the interface into cell by cell information and returned to the caller.

In order to accomplish this cell to slice conversion, the interface makes use of a data file. This data file, driftvnt.dat, provides configuration parameters to the interface specific to the emplacement drift geometry. For example, the data file contains the number of slices and the number of cells per slice. In addition, this file contains, initialization parameters such as tunnel radius, initial power from a waste package, and heat and moisture transfer coefficients. These initialization parameters are passed to module DRIFT for use in its heat and moisture transfer calculations.

2.2.3 Hardware and Software Requirements

The target platforms are a Windows PC based system running Windows NT 4.0 and a SUN Solaris 5.8 machine. The programming language is FORTRAN 77.

2.2.4 Software Validation

This software will be released as version 1.0. Version 1.0 will be validated in accordance with the Software Validation Test Plan for the Computer Code DRIFTVNT, Version 1.0 by December 13, 2002.

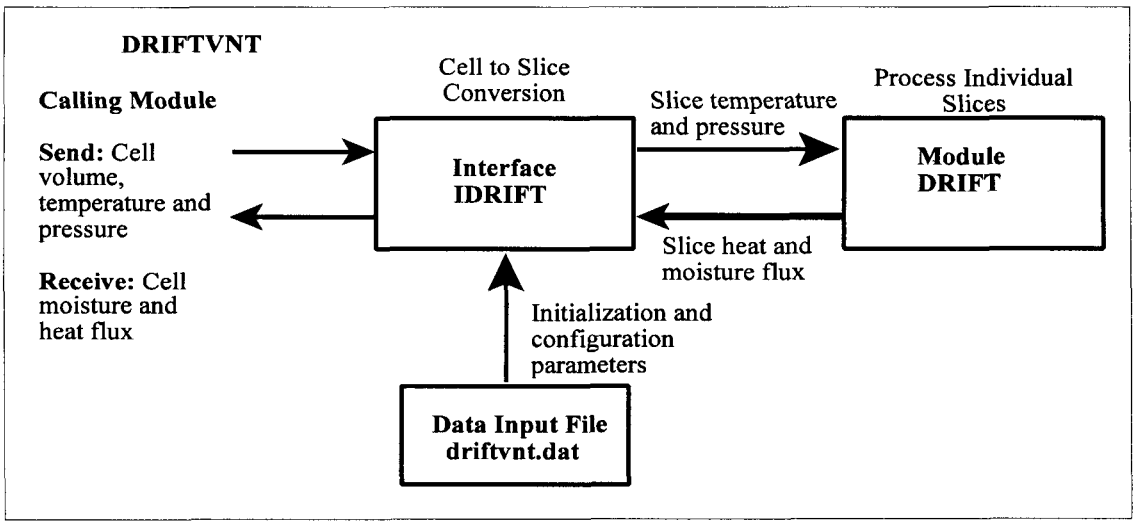

Figure 2-1. Data Flow Module Layout

3 REFERENCES

Painter, S., C. Manepally, and D.L. Hughson. "Evaluation of U.S. Department of Energy Thermohydrologic Data and Modeling Status Report." San Antonio, Texas: CNWRA. September 2001. (Included in Appendix A)