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Verification Test Report for CFAST 3.1.6 (U)

March 2002

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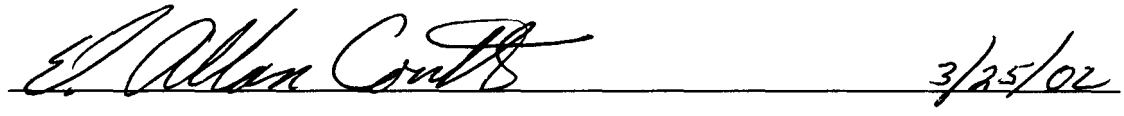
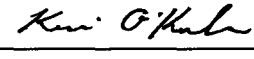


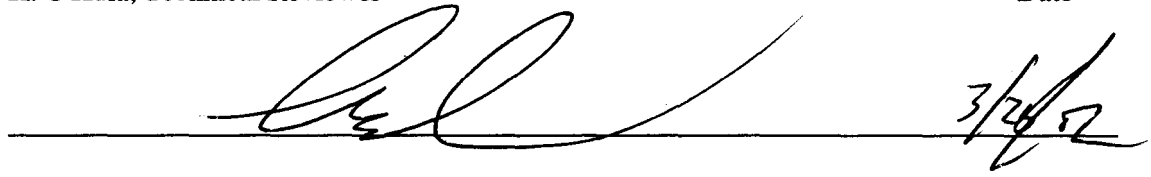
D. A. Coutts, Member — Date

A. R. Martin, Member — Date

Approvals:



K. O'Kula, Technical Reviewer — Date



F. R. McCoy, Principal — Date

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ABSTRACT

Fire is a significant hazard in most facilities that handle radioactive materials. The severity of fire varies with room arrangement, combustible loading, ventilation and protective system response. The complexity of even simple situations can be unwieldy to solve by hand calculations. Thus, computer simulation of the fire severity has become an important tool in characterizing fire risk. The Savannah River Site (SRS), a Department of Energy facility, has been using the Consolidated Model of Fire Growth and Smoke Transport (CFAST) software to complete such deterministic evaluations to better characterize the nuclear facility fire severity.

To fully utilize CFAST at SRS it is necessary to demonstrate that CFAST produces valid analytic solutions over its range of use. This report describes the primary verification exercise that is required to establish that CFAST, and its user interface program FAST, produce valid analytic solutions. This verification exercise may be used to check the functionality of FAST and as a training tool to familiarize users with the software. In addition, the report consolidates the lessons learned by the SRS staff in using FAST and CFAST as fire modeling tools.

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INTRODUCTION

An uncontrolled fire in a nuclear facility can be a very energetic event. Severe smoke, excessive temperatures, and large thermal gradients are common. Such fires can readily breach containment barriers (glove box, ventilation ductwork and the building envelope) and, because of the significant thermal gradients, readily disperse radioactive material. Thus, uncontrolled fire can be a dominant risk in many nuclear facilities. This report presents the results of a software verification effort that was conducted for Consolidated Model of Fire Growth and Smoke Transport (CFAST) Version 3.1.6 [1] and its companion user interface program FAST [2].

The report accomplishes the following objectives:

- Documents an initial verification problem
- Consolidates user information to support SRS fire modeling work
- Establishes a consistent approach that can be used for verifying most fire models in use at SRS.

The report is separated into four major topics: Sample Problem Description, Input File, Output files and Analysis. A synopsis of the individual report sections is presented below.

Introduction. An overview of the information to be presented in the report.

Sample Problem Description. A general discussion of the sample problem that was selected for the verification effort.

Input File. A detailed description of the input file (i.e., input deck) that was constructed to execute the sample problem in FAST.

Output Files. An explanation of what results can be obtained from FAST by discussion of the sample problem output files.

Analysis. A comparison between a known solution for the verification problem and the solution as conducted by WSMS personnel.

Results. A discussion of the findings from the comparison.

Conclusions. A summary of the overall report.

Works Cited. A list of references cited in the report.

Appendix 1 - Benchmark Exercise

Appendix 2 - Input Data File (CTFIBASE.DAT) As Provided By Dr. Dey, NIST/NRC

Appendix 3 - Input Data File (BASECASE.DAT) as Recreated for Verification Effort

Appendix 4 - Results (CTFIBASE.CSV) as Provided by Dr. Dey

Appendix 5 - Results from Verification Effort

Appendix 6 - LITE.LST Report for Verification Effort

Appendix 7 - Comparison of Results

Appendix 8 - Comparison of Parameters with Significant Differences

CFAST and FAST documentation consists of various reports that address multiple aspects of the code primarily in the form of NIST technical reports. Documentation includes:

- NIST Technical Note 1299, "CFAST, the Consolidated Model of Fire Growth and Smoke Transport" [1].
- NIST Special Publication 921, "A User's Guide for FAST: Engineering Tools for Estimating Fire Growth and Smoke Transport" [2].
- NIST Technical Note 1431, "A Technical Reference for CFAST: An Engineering Tool for Estimating Fire and Smoke Transport"[3].
- NISTIR 5486-1, "Technical Reference Guide for FPEtool Version 3.2" [4].
- NBSIR 85-3223, "Data Sources for Parameters Used in Predictive Modeling of Fire Growth and Smoke Spread" [5].

These documents are available from the NIST web site http://fast.nist.gov.

Quality Assurance

To fully utilize CFAST at SRS it is necessary to prepare software quality assurance documentation as described in Westinghouse Savannah River Company (WSRC) Procedure Manual 1Q, *Quality Assurance Manual*, QAP 20-1, "Software Quality Assurance"[6] and Westinghouse Safety Management Solutions (WSMS) Procedure Manual 1Q, *WSMS Quality Assurance Manual*, Procedure 4-4, Revision 1, "Software Quality Assurance" [7]. This report describes the development of a verification problem and the demonstration that CFAST software produces verifiable results. This is considered to fulfil the verification effort for the software features listed in Table 1 below as established by the software development plan described in WSRC-RP-2000-00802 [8]. The version selected for this effort is CFAST 3.1.6 which is available from the NIST web site http://fast.nist.gov. To ensure configuration control, as required by WSRC 1Q, *Quality Assurance Manual*, QAP 20-1 [6] and WSMS 1Q, *WSMS Quality Assurance Manual*, Procedure 4-4 [7], a version of the software is available from the WSMS

server. This version is maintained by the Emergency and Fire Technical Services group on \\exodus\wrkgroup\FIRE MODELS\Databases.

Sample Problem Selection

Most software verification efforts consist of running sample problems, which are provided by the software author, to ensure that results are consistent with a known solution. While FAST is provided with sample input files, which can be used to demonstrate the program is functional, there are no documented results for these sample problems. Thus, there is nothing to allow the user to judge whether the software is producing valid results.

To overcome this impediment the first scenario from the recently completed benchmark exercise from the *International Collaborative Project to Evaluate Fire Models for Nuclear Power Plant Applications* [9] will be adopted as the "vendor supplied" sample problem. This problem provides a relatively simple baseline that can easily be replicated for verification of initial installation of the FAST code. Selection of this problem also provides a verifiable baseline that can be compared to other user results.

Limitations

The sample problem models a relatively small fire in a large room with a closed door. The target, which is evaluated as part of the problem, is a cable. The problem produces predictions of room temperature, ventilation through a narrow gap, oxygen consumption and target heat flux. The sample problem does not address oxygen limited fires or post-flashover fires. Such scenarios will require separate problems and could be accomplished by the complete development of the benchmark scenarios (both the natural and forced convection parts), which will address most of the top 10 desired features that need to be verified. These features are presented in Table 1 [10]. The sample problem chosen will address priorities 1, 2, 5, 7, 8 and 9. Items 6 and 10 are addressed in references 11 and 12, respectively. Items 3 and 4 are not addressed at this time.

Table 1 -- FAST Capabilities and priority for their evaluation

Parameter	Importance in reducing release estimate over-conservatisms	Priority for validation
Upper layer temperature	High	1
Horizontal opening ventilation	High	2
Fire curve database	High	3
Vertical opening ventilation	High	4
Lower layer temperature	High	5
Thermophysical data base	High	6
Oxygen content	High	7
Target temperature	Medium	8
Target heat flux	Medium	9
Fans (forced convection)	Medium	10

DESCRIPTION OF SAMPLE PROBLEM

This section provides an overview of the sample problem to be used in the verification effort. Items that are presented include the sample problem source and key problem details. All of the scenario specifics are described in Appendix 1.

The sample problem was taken from the *International Collaborative Project to Evaluate Fire Models for Nuclear Power Plant Applications* [9]. This project is a major non-proprietary fire modeling validation effort organized by the Nuclear Regulatory Commission (NRC) and the National Institute of Standards and Technology (NIST). This multi-national project is intended to share the knowledge and resources of various participating organizations to evaluate and improve the state of the art of fire models for use in nuclear power plant fire safety and fire hazard analyses. The group has completed one benchmark exercise.

The scenario described as Part I - Base Case in Appendix 1 is used as the sample problem. This scenario evaluates the effect of a trash fire on an isolated electric cable serving as a target. The scenario is limited to a single room, which is 15.2 m deep by 9.1 m wide and 4.6 m high. The room is provided with a closed door leading outside. The target is a single power cable with a diameter of 50 mm located at the bottom left corner of a cable tray. The cable tray is 0.6 m wide. The left edge of the cable is located 7.6 m from the left corner of the room and runs the entire depth of the room at a height of 2.275 m above the floor. The distance between the midpoints of the trash bag and the tray is 2.2 m.

The input parameters, which are presented in the Benchmark Exercise included as Appendix 1, were provided as a FAST input file (CTFIBASE.DAT) by Dr. Monideep Dey, NIST/NRC. This FAST input file is included as Appendix 2. The input data file is reconstructed for this verification effort (BASECASE.DAT) and is included as Appendix 3. The details of the input file are discussed in the next section.

INPUT FILE

This section describes the details of the input files in Appendix 2and Appendix 3. Appendix 2 contains the sample input file as provided by NIST/NRC, which is maintained for comparison to the input files from this verification effort. Appendix 3 contains the input file as prepared for this verification effort. In addition to discussing the details of the input files, this section presents a summary of how FAST forms the input file and how the input file can be modified by the user.

FAST Setup

When installing FAST on a WSRC or WSMS computer, the files should be taken from the Fire Model folder located on \\exodus\wrkgroup\FIRE MODELS\Databases. This path is commonly referred to as the W-drive. The files should be written into a folder on the computer hard drive. Because the path will need to be typed repeatedly when input information is provided for files, it is recommended that the folder be contained in the "C" directory, rather than a subdirectory. For this effort, the files were copied to "C:\A". In addition to copying the file "setupf.exe" to this folder, the user should copy the most recent of the following files: WSMSTHxx.DF, and WSMSTHxx.NDX (currently WSMSTH03.DF, and WSMSTH03.NDX). These latter two files provide the verified material properties. They are intended to be used instead of the default thermal data base files provided with the FAST download (THERMAL.DF and THERMAL.NDX). See THERMF keyword under Options below.

After the three files are installed in the "FAST" folder, the file "setupf.exe" should be run from the "start" button on the bottom left of the computer screen. If necessary use the browse option under the run command. Follow the instructions on the screen as the program installs.

To run a FAST simulation, open FAST by running the executable file installed in the "FAST" folder. This file is titled "fast.exe". In building an input file, using the FAST interface will automatically generate the input deck (*.DAT file). For the sample problem presented, the user will need to provide the following:

- Simulation time and spreadsheet output
- Ambient conditions
- Compartment geometry
- Connections for horizontal flow
- Main fire specifications

The discussion below provides details on specifying the parameters for the sample problem by presenting a line-by-line explanation of the input file included as Appendix 3. Reference 2, Section 2, provides additional detailed instruction for creating input data for FAST and provides a visual representation of the fire scenario overview window as it appears in FAST. Some variations were identified between the FAST software and the documentation for the software (i.e., Reference 2). The relevant variations identified in the development of this report are noted in the discussion below.

Note: As an alternative to building the input file using the FAST user interface, input files can be built or edited using WordPad. For multiple scenarios with minimal variation between the scenarios, editing in WordPad is the preferable approach. When editing the data file using WordPad, save it as a text file (*.DAT).

Options

A new installation of the FAST software displays measurements in standard SI units. Users can customize the display measurement units by selecting *Options* from the desktop menu then selecting *User Specified Units*. For this effort, the user specified units are left in SI units.

The THRMF keyword in the input file (Appendix 3) gives the location and name of the thermal database. The thermal database specifies the thermophysical properties of the enclosing surfaces and targets by specifying the thermal conductivity, specific heat, emissivity, density, and thickness of specific materials that are then identified as enclosing surfaces or targets in the structure settings.

```
THRMF C:\A\WSMSTH02.DF
```

The default thermal database file as provided by NIST is initially THERMAL.DF (not THERMAL.TPF or THERMAL.DAT as identified in reference 2, Section A.6). An alternate thermal database file can be entered in the configuration file, used for the current application only or the default thermal database file can be changed if desired. See Section 6.1 of Reference 2 for details. Materials can also be added to the thermal database file (THERMAL.DF) or an alternate database can be created. See Sections 2.4.3 and 2.4.4 of Reference 2 for details. For this effort and subsequent WSMS work, an alternate thermal database has been created, WSMSTH02.DF [11]. This approach was used to ensure that the physical property information in the database was traceable to a source document. To specify an alternate thermal database, select the filename icon in the environment section of the overview window. Then specify the path and filename for the database.

Environment Settings

VERSN specifies the version of the CFAST model for which the input data file is prepared and an optional user defined title for the file. When using the FAST interface, the version number is automatically assigned for the corresponding CFAST version.

```
VERSN    3PART 1 - BASE CASE
```

TIMES, in units of seconds, are the simulation time, print interval, history interval and display interval followed by the copy count.

```
TIMES    600     10     10     10      0
```

The simulation time is a required input that has a maximum value of 86400 seconds. The print interval is the time interval between each printing of the output values. If omitted or less than or equal to zero, no printing of the output values will occur. The history interval is the time interval between each writing of the output to the history file. Documentation (reference 2, Section A.3) states that this value must be zero if no history file is to be used; however, non-specification of this parameter leads to no spreadsheet file output (i.e., even if no history output file is to be generated, the history file is still "used" to generate the spreadsheet output file). The display interval and copy count pertain to graphical display.

DUMPR gives the location and name of the history file output.

```
DUMPR C:\A\BASECASE.HI
```

History file is an optional input. If omitted, the file will not be generated. Note that, in order to obtain a history file, this parameter must be specified and the history interval must be set to a non-zero number. NOTE: As FAST is a DOS based program, the DOS naming convention applies.

ADUMP (or ADUMPF as identified in the documentation, Reference 2, Section A.3) gives the location and name of the spreadsheet (output) file and a specification of the type of output written to the spreadsheet file (N = Normal, F = Flow Field, W = Targets and Walls, S = Species, P = Wall Temperatures Profiles).

```
ADUMP C:\A\BASECASE.TXT NFS
```

Spreadsheet file is an optional input. If omitted, the file will not be generated. Note that in order to obtain a spreadsheet file, this parameter must be specified and the history interval must be set to a non-zero number. Normal output is the default setting for type of output. It appears that the settings are usually not loaded from this line, thus whenever a new file is loaded the output is set to Normal. If it is desired to produce additional outputs they must be manually specified for each execution of the file. This is accomplished within FAST by selecting the filename icon in the environment section of the overview window. Next, select the *Spreadsheet* text button and then check the radio button(s) for the desired output. Click "OK", then specify the path and filename for the spreadsheet output file. Specifying a *.CSV or *.TXT. file creates a comma delimited file that can then be opened with a spreadsheet program (e.g., Excel). NOTE: As FAST is a DOS based program, the DOS naming convention applies.

TAMB and EAMB give first the internal and then the external ambient temperature (K), ambient pressure (Pa) and station elevation (m) of the point at which the ambient temperature and pressure are measured.

```
TAMB  300.000         101300. 0.000000
EAMB  300.000         101300. 0.000000
```

Documentation (Reference 2, Section A.4) identifies the default ambient pressure as 101300 Pa and the default ambient temperature as 300 K. However, it appears that the default ambient temperature is 293.15 K.

Structure Settings

The size and location of every compartment in the structure MUST be described. The maximum number of compartments is 30 as indicated by the acceptable input range for this parameter

within FAST (not 15 as specified in the documentation, Reference 2, Section A.5). In a structure with *n* compartments, *n+1* denotes outside. Present SRS models have been limited to 3 compartments.

HI/F is the absolute height of the floor of the compartment with respect to the station elevation and is specified when defining each compartment. A structure with *n* compartments will have *n* data entries for this parameter.

```
HI/F  0.000000
```

HI/F is a required input. The default setting is zero. The acceptable input range for this parameter is 0 to 500 m.

WIDTH, DEPTH and HEIGH give the width (from left wall to right wall [y]), depth (from rear wall forward [x])and height [z] (in meters) of each compartment. See Illustration 1 below. A structure with *n* compartments will have *n* data entries for each of these parameters.

```
WIDTH  9.10000
DEPTH  15.2000
HEIGH  4.60000
```

WIDTH, DEPTH and HEIGH are required input. The default settings are 3.66, 2.44 and 2.44 m, respectively. The acceptable input range for each of these dimensions is 0 to 500 m.

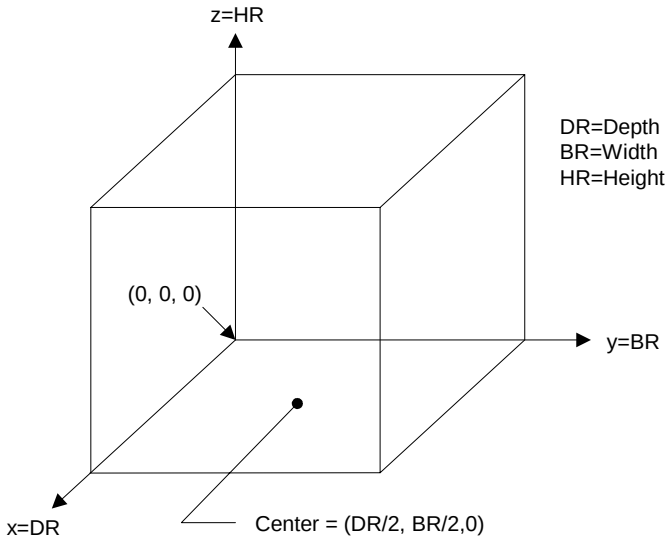

Illustration 1 - Orientation

CEILI, WALLS and FLOOR give the name of the material accessed from the thermal database file for the ceiling, walls and floor of each compartment. A structure with *n* compartments will have *n* data entries for each of these parameters.

```
CEILI CONC003
WALLS CONC003
FLOOR CONC003
```

The default settings are gypsum for CEILI and WALLS and plywood for FLOOR. If the default thermal database file has been changed, these settings will need to be altered if the default materials are not listed in the default thermal database. Conduction in these surfaces can be turned on/off.

HVENT specifies natural flow horizontal vents. The first set of numbers are From Compartment, To Compartment, and the vent number (i.e., from Compartment 1 to Compartment 2 - Vent number 1 in the example). The next set of numbers define the opening width, soffit height and sill height (m) of the vent followed by three optional parameters; the wind coefficient, the first compartment position and finally the second compartment position. See Reference 2, Section A.7 for additional information on these parameters.

```
HVENT  1  2  1  2.40000 0.00500000 0.000000 0.000000 0.000000
0.000000
```

It is possible to define a total of four (4) horizontal flow connections between any pair of compartments. Location of the connection (i.e., sill height, soffit height) is given with respect to the floor of the "from" compartment.

CVENT is the opening/closing parameter for the natural flow horizontal vents. The first set of numbers are From Compartment, To Compartment, and the vent number (i.e., from Compartment 1 to Compartment 2 - Vent number 1 in the example). The next set of numbers are the opening/closing parameters corresponding to each point on the specified fire timeline. The default value of one corresponds to an open vent and a fractional value represents the ratio of the opening (i.e., 0.5 would specify a vent which is halfway open). The time increments corresponding to these opening/closing factors are specified in FTIME below.

```
CVENT  1  2  1       1.00000       1.00000       1.00000
1.00000       1.00000       1.00000       1.00000
1.00000       1.00000       1.00000       1.00000
```

Main Fire Specifications

CHEMI gives parameters for kinetics as follows: the molar weight (molecular weight of the fuel vapor used for conversion to ppm), relative humidity (%), lower oxygen limit (%), heat of combustion (J/kg), initial fuel temperature (K), gaseous ignition temperature (K), and radiative fraction.

```
CHEMI  16.0000  50.0000  12.0000 2.41000E+007  300.000
493.150 0.300000
```

The molar weight by default is 16.0. Relative humidity is specified within the environment settings and by default is 50%. The lower oxygen limit is applicable only to Type 2 fires (see LFBT below) and by default is 10%. The default heat of combustion, based on wood, is 1.95E+07 J/kg (not 5.0E+07 as indicated in Reference 2, Section A.10). The defaults for initial fuel temperature, gaseous ignition temperature and radiative fraction are 293.15 K, 493.15 K and 0.3 respectively. Section 2.2.8 of Reference 2 states that if the gaseous ignition temperature is omitted, the default is arbitrarily set to the initial fuel temperature plus 200 °C; however, it appears that it is set to the default initial fuel temperature (293.15 K) plus 200 °C.

LFBO is the compartment of fire origin (i.e., Compartment 1).

```
LFBO 1
```

LFBT is the type of fire (0 = Off, 1 = Unconstrained, 2 = Constrained/Constrained with Flashover)

```
LFBT 2
```

CJET indicates for which surfaces convective heating will be determined. Setting selections are *OFF*, *CEILING*, *WALLS* and *ALL*.

```
CJET ALL
```

FPOS defines the position of the fire (X, Y, Z). Note: -1.0 indicates position is centered on that axis.

```
FPOS -1.00000  5.70000 0.000000
```

For the fire position (see Illustration 1 on page 8 for orientation):

X Position is the position of the fire as a distance from the rear wall of the compartment
Y Position is the position of the fire as a distance from the left wall of the compartment
Z Position is the height of the fire above the floor.

FTIME (s) gives the times for a defined heat release curve. Note that FTIME does not list the beginning time of 0.0.

```
FTIME       60.0000       120.000       180.000       240.000
300.000       360.000       420.000       480.000
540.000       600.000
```

Initial entry of this curve specifies the mass loss rate, heat release rate, and if applicable the heat of combustion curve (see discussion below on over specifying fire curves). It also specifies the time step for various other parameters (CVENT, HCR, HCN, etc.). Note that after initial entry, any adjustment to this curve will affect all the time specified curves.

FMASS (kg/s) gives the mass loss rate corresponding to each point of the specified fire. Note that FMASS begins at 0.0, which corresponds to a time of 0.0.

```
FMASS      0.000000    0.00829876     0.0145228     0.0141079
0.00829876    0.00622407    0.00414938    0.00414938
0.00331950    0.00311203    0.00414938
```

FQDOT (W) gives the heat release rate corresponding to each point of the specified fire. Note that FQDOT begins at 0.0, which corresponds to a time of 0.0.

```
FQDOT      0.000000       200000.       350000.       340000.
200000.       150000.       100000.       100000.
80000.0       75000.0       100000.
```

Over specifying Fire Curves: *Since the heat of combustion, heat release rate, and pyrolysis rate [mass loss rate] are related properties, the fire curve can be over specified. If each of the three parameters, heat of combustion from the fire specification window, heat release rate curve, and pyrolysis rate have been specified, the fire is over specified. The input editor accounts for this by using the two most recently entered to calculate the third parameter. This allows for two typical scenarios depending on whether the user desires to use a constant value heat of combustion or a heat of combustion curve. If the user desires to use a constant value heat of combustion, this value should first be entered in the fire specification window. Either the pyrolysis rate or heat release rate curve is then entered. If the pyrolysis rate curve is entered, the heat release rate is automatically calculated by multiplying each entry in the pyrolysis rate curve by the constant value heat of combustion. If the heat release rate is entered, the pyrolysis rate curve is calculated by dividing each entry of the heat release rate curve by the constant value heat of combustion. For the user desiring a heat of combustion curve rather than a constant value, the user should enter the heat release rate and pyrolysis rate curves separately. The model will calculate the appropriate heat of combustion curve prior to execution. One caution regarding this approach. If a user desiring a constant value heat of combustion saves the input file and returns later, the input editor views the heat release rate and pyrolysis rate curves as the last two properties entered. If the user then makes modifications to entries in one of the curves, the other curve will not be automatically calculated. The user must make a change to the heat of combustion in order to get the second curve recalculated. [2]*

HCR is the hydrogen to carbon ratio (kg/kg) corresponding to each point of the specified fire timeline including the point corresponding to time equals zero in FTIME.

```
HCR         0.160000      0.160000      0.160000      0.160000
0.160000      0.160000      0.160000      0.160000
0.160000      0.160000      0.160000
```

The default value for this ratio is 0.08.

Target Specifications

The CFAST model can track and report calculations of the heat flux striking and the temperature of arbitrarily positioned and oriented targets. In order to specify targets, a compartment must be selected from the structure graphics list on the fire scenario overview window.

The TARGET is identified by specification of the compartment in which the target is located followed by the target position (X, Y, Z) (m), the normal (direction) vector (X, Y, Z), and the target material accessed from the thermal database file. Optional advanced settings include the solution method (STEADY = Steady State, XPLICIT = Explicit, MPLICIT = Implicit) and equation type (PDE or ODE). Note: -1.0 indicates position is centered on that axis.

```
TARGET  1  7.60000  7.60000  2.27500 0.000000 0.000000 -
1.00000     CABLE EXPLICIT PDE
```

For the target position (see Illustration 1 on page 8 for orientation):

X Position is the position of the target as a distance from the rear wall of the compartment
Y Position is the position of the target as a distance from the left wall of the compartment

Z Position is the height of the target above the floor.

For the normal (direction) vector:

X, Y and Z components of the unit normal vector pointing away from the target center. Provides description of the orientation of the target with respect to the back, left corner of the compartment. This should be a unit vector ($X^2 + Y^2 + Z^2 = 1$).

Targets in the same compartment are mutually exclusive. They are independently calculated and do not shield or cover each other. In the output files, targets are grouped by compartment number. Note: The program generates a floor target for each compartment. These floor targets will always be numbered after the manually added targets.

Runtime Graphics

The remaining entries pertain to runtime graphics and are not considered pertinent to the task at hand. See Reference 2, Section A.17 for more information on these parameters.

```
SELECT 1 0 0
#GRAPHICS ON
DEVICE 1
WINDOW    0.    0. -100. 1280. 1024. 1100.
LABEL  1  970.  960.    0. 1231. 1005.   10. 15 00:00:00 0.00
0.00
GRAPH  1  100.   50.    0.  600.  475.   10. 3 TIME HEIGHT
GRAPH  2  100.  550.    0.  600.  940.   10. 3 TIME CELSIUS
GRAPH  3  720.   50.    0. 1250.  475.   10. 3 TIME
FIRE_SIZE(kW)
GRAPH  4  720.  550.    0. 1250.  940.   10. 3 TIME O|D2|O()
HEAT   0 0 0 0 3   1 U
TEMPE  0 0 0 0 2   1 U
INTER  0 0 0 0 1   1 U
O2     0 0 0 0 4   1 U
```

OUTPUT FILES

Results from execution of the sample problem were obtained from Dr. Dey, NIST/NRC. A spreadsheet output file and graphs of these results are included as Appendix 4. The spreadsheet output file and graphs of the results from execution of the sample problem for the verification effort are included as Appendix 5. A summary of the description and corresponding units for the output parameters are included in Table 2. These outputs were generated by choosing spreadsheet output selections of Normal, Flow Field and Species as described in the Environment Settings of the Input section of this report.

Table 2 -- Output descriptions

Output Parameter	Spreadsheet Output Selection	Unit of Measure (Ref. 1)	Description
Upper Layer Temperature (1)	Normal	K	Upper layer temperature
Lower Layer Temperature (1)	Normal	K	Lower layer temperature
Layer Height (1)	Normal	m	Height above floor to bottom of upper layer
Upper Layer Volume (1)	Normal	m^3	Upper layer volume
Pressure (1)	Normal	Pa	Gauge pressure
Ambient Target (1)	Normal	W/m^2	Undefined
Floor Target (1)	Normal	W/m^2	Undefined
Main Plume Flow	Normal	kg/s	Plume mass flow rate for main fire
Main Pyrolysis Rate	Normal	kg/s	Fuel mass loss rate for main fire
Main Fire Size	Normal	W	Heat release rate (HRR)
Main Flame Height	Normal	m	Undefined
Main Convection Size	Normal	W	Undefined
Target Temperature (1)	Normal	K	Target surface temperature
Target Flux (1)	Normal	W/m^2	Incoming flux on target
Target Fire Radiation (1)	Normal	of Target Flux (1)	Target Fire Radiation (1)
Target Surface Radiation (1)	Normal	of Target Flux (1)	Target Surface Radiation (1)
Target Gas Radiation (1)	Normal	of Target Flux (1)	Target Gas Radiation (1)
Target Convection (1)	Normal	of Target Flux (1)	Target Convection (1)
Target Temperature (2)	Normal	K	Undefined
Target Flux (2)	Normal	W/m^2	Undefined
Target Fire Radiation (2)	Normal	of Target Flux (2)	Undefined
Target Surface Radiation (2)	Normal	of Target Flux (2)	Undefined
Target Gas Radiation (2)	Normal	of Target Flux (2)	Undefined
Target Convection (2)	Normal	of Target Flux (2)	Undefined
Upper N_2 (1)	Species	%	mass concentration of nitrogen in upper layer
Upper O_2 (1)	Species	%	mass concentration of oxygen in upper layer

Output Parameter	Spreadsheet Output Selection	Unit of Measure (Ref. 1)	Description
Upper CO_2 (1)	Species	%	mass concentration of carbon dioxide in upper layer
Upper CO (1)	Species	ppm	mass concentration of carbon monoxide in upper layer
Upper HCN (1)	Species	ppm	mass concentration of hydrogen cyanide in upper layer
Upper HCL (1)	Species	ppm	mass concentration of hydrogen chloride in upper layer
Upper TUHC (1)	Species	%	mass concentration of total unburned hydrocarbons in upper layer
Upper H_2O (1)	Species	%	mass concentration of water in upper layer
Upper OD (1)	Species	m^{-1}	mass concentration of soot in upper layer
HCl c (1)[1]	Species	mg/m^2	Undefined
HCl uw (1)[1]	Species	mg/m^2	Undefined
HCl lw (1)[1]	Species	mg/m^2	Undefined
HCl f (1)[1]	Species	mg/m^2	Undefined
Lower N_2 (1)	Species	%	mass concentration of nitrogen in lower layer
Lower O_2 (1)	Species	%	mass concentration of oxygen in lower layer
Lower CO_2 (1)	Species	%	mass concentration of carbon dioxide in lower layer
Lower CO (1)	Species	ppm	mass concentration of carbon monoxide in lower layer
Lower HCN (1)	Species	ppm	mass concentration of hydrogen cyanide in lower layer
Lower HCl (1)	Species	ppm	mass concentration of hydrogen chloride in lower layer
Lower TUHC (1)	Species	%	mass concentration of total unburned hydrocarbons in lower layer
Lower H_2O (1)	Species	%	mass concentration of water in lower layer
Lower OD (1)	Species	m^{-1}	mass concentration of soot in lower layer
HCl c (1)[2]	Species	mg/m^2	Undefined
HCl uw (1)[2]	Species	mg/m^2	Undefined
HCl lw (1)[2]	Species	mg/m^2	Undefined
HCl f (1)[2]	Species	mg/m^2	Undefined
Upper Inflow 1-Outside (1)	Flow Field	kg/s	mass flow rate into upper layer
Upper Outflow 1-Outside (1)	Flow Field	kg/s	mass flow rate out of upper layer
Lower Inflow 1-Outside (1)	Flow Field	kg/s	mass flow rate into lower layer
Lower Outflow 1-Outside (1)	Flow Field	kg/s	mass flow rate out of lower layer

With the exception of Targets, (1) denotes compartment number 1, (2) compartment number 2, etc.
For Targets, (1) denotes last target defined, etc. See Target Specifications for numbering convention of targets.

The outputs for targets; target fire radiation, target surface radiation, target gas radiation and target convection are given as a percentage of the (total) target flux for both Target (1) and Target (2). Target (1) is the cable and Target (2) is a preset target that is a point on the floor in the center of the room. Target (2) is not evaluated in this verification effort. Likewise, the output for Ambient Target (1) and Floor Target (1) are not evaluated at this time due to ambiguity regarding these specifications.

Additional output reports are available from FAST. One such report is automatically generated each time the data file is executed. This file is Lite.lst and is stored in the same file as the source code. The report contains an overview of the input parameters and settings as well as selected

data for each time step specified in the history interval. The file should be renamed and saved if the information is to be retained as the program writes to the Lite.lst file each time a run is performed. The LITE.LST report generated for the verification effort is included as Appendix 6. Output reports can also be ran from DOS. "Report" requires a history file as input. At the DOS prompt enter:

C:\fast\report [location and name of history file (*.HI)]/r:nnn [desired location and name of output file (*.TXT)]

where nnn is

w	=>	temperature profiles in the walls
i	=>	building configuration
n	=>	normal temperature/interface history
f	=>	flow fields
s	=>	species
t	=>	tenability estimates for each compartment
p	=>	wall temperature profiles

ANALYSIS

A comparison of the Appendix 4 output (CTFIBASE.CSV) and the output from the verification effort (BASECASE.XLS) is performed using Excel. This comparison is a relative difference computation and is included as Appendix 7. Exact matches are identified as "OK". A value in a cell indicates a non-match. The relative difference calculated is the ratio of the difference between the output of each of the two efforts to the Appendix 4 output, rounded to four digits.

Comparison values that are less than 0.01% are considered acceptable. These differences are considered insignificant and can probably be attributed to differences in machine precision, round-off, settings within spreadsheet programs and uncertainty within the model due to incompletely understood physics and necessary numerical simplifications. For output parameters of interest, any comparison values greater than 0.01% are examined. Parameters that are addressed by this effort are identified in Table 3 below. Significant parameters, as presented in Table 1, not addressed by this effort are the fire curve database, vertical opening ventilation and fans (forced convection).

Table 3 -- Comparison results

Output Parameter	Unit of Measure (Ref. 2)	Difference >0.01%	Results
Upper Layer Temperature (1)	K	No	Acceptable
Lower Layer Temperature (1)	K	No	Acceptable
Layer Height (1)	m	No	Acceptable
Upper Layer Volume (1)	m^3	No	Acceptable
Pressure (1)	Pa	Yes	Requires Evaluation
Ambient Target (1)	W/m^2	Yes	Not Verified
Floor Target (1)	W/m^2	Yes	Not Verified
Main Plume Flow	kg/s	No	Acceptable
Main Pyrolysis Rate	kg/s	No	Acceptable
Main Fire Size	W	No	Acceptable
Main Flame Height	m	No	Acceptable
Main Convection Size	W	No	Acceptable
Target Temperature (1)	K	No	Acceptable
Target Flux (1)	W/m^2	No	Acceptable
Target Fire Radiation (1)	% of Target Flux (1)	No	Acceptable
Target Surface Radiation (1)	% of Target Flux (1)	No	Acceptable
Target Gas Radiation (1)	% of Target Flux (1)	No	Acceptable
Target Convection (1)	% of Target Flux (1)	Yes	Requires Evaluation
Target Temperature (2)	K	No	Not Verified
Target Flux (2)	W/m^2	No	Not Verified
Target Fire Radiation (2)	% of Target Flux (2)	No	Not Verified

Output Parameter	Unit of Measure (Ref. 2)	Difference >0.01%	Results
Target Surface Radiation (2)	% of Target Flux (2)	No	Not Verified
Target Gas Radiation (2)	% of Target Flux (2)	No	Not Verified
Target Convection (2)	% of Target Flux (2)	Yes	Not Verified
Upper N_2 (1)	%	No	Not Verified
Upper O_2 (1)	%	No	Acceptable
Upper CO_2 (1)	%	No	Not Verified
Upper CO (1)	ppm	No	Not Verified
Upper HCN (1)	ppm	No	Not Verified
Upper HCL (1)	ppm	No	Not Verified
Upper TUHC (1)	%	No	Not Verified
Upper H_2O (1)	%	No	Not Verified
Upper OD (1)	m^{-1}	No	Not Verified
HCl c (1)[1]	mg/m^2	No	Not Verified
HCl uw (1)[1]	mg/m^2	No	Not Verified
HCl lw (1)[1]	mg/m^2	No	Not Verified
HCl f (1)[1]	mg/m^2	No	Not Verified
Lower N_2 (1)	%	No	Not Verified
Lower O_2 (1)	%	No	Acceptable
Lower CO_2 (1)	%	No	Not Verified
Lower CO (1)	ppm	No	Not Verified
Lower HCN (1)	ppm	No	Not Verified
Lower HCl (1)	ppm	No	Not Verified
Lower TUHC (1)	%	No	Not Verified
Lower H_2O (1)	%	No	Not Verified
Lower OD (1)	m^{-1}	No	Not Verified
HCl c (1)[2]	mg/m^2	No	Not Verified
HCl uw (1)[2]	mg/m^2	No	Not Verified
HCl lw (1)[2]	mg/m^2	No	Not Verified
HCl f (1)[2]	mg/m^2	No	Not Verified
Upper Inflow 1-Outside (1)	kg/s	No	Acceptable
Upper Outflow 1-Outside (1)	kg/s	No	Acceptable
Lower Inflow 1-Outside (1)	kg/s	Yes	Requires Evaluation
Lower Outflow 1-Outside (1)	kg/s	Yes	Requires Evaluation

[1]Upper Layer Species [2]
[2]Lower Layer Species [2]

Those parameters identified as requiring evaluation in Table 3 were examined in more detail. Significant relative differences (> 0.01%) exist for Pressure (1), Target Convection (1), Lower Inflow 1-Outside (1), Lower Outflow 1-Outside (1). Each parameter was graphed as a function of time and a comparison between the output of the two efforts was performed. These graphs are included as Appendix 8. A graph of the deltas at each time-step for each parameter is also included in Appendix 8.

In addition to the comparison with the Appendix 4 output, an alternate analysis was conducted with a second WSMS computer. No variation was observed when compared with output from this effort. For the verified parameters, selected check points for output values consisting of minimum and maximum values with the corresponding time of occurrence, intercept times (where applicable) and output values at 150 seconds are listed below in Table 4.

Table 4 -- Check points

	Output	Maximum Value	Minimum Value	t_{max} (s)	t_{min} (s)	t_{int} (s)	t = 150 s
	Normal Output						
A	TIME	590	0				150
B	Upper Layer Temp (1)	356.842	300	240	0		345.248
C	Lower Layer Temp (1)	301.967	300	150	0		301.967
D	Layer Height (1)	4.59954	0.384782	0	590		1.55532
E	Upper Layer Volume (1)	583.049	0.063627	590	0		421.14
F	Pressure (1)	2056.85	-37.3101	150	370	305	2056.85
I	Main Plume Flow	4.64977		20			1.2837
J	Main Pyrolysis Rate	0.0145228		120			0.014315
K	Main Fire Size	349975		120			344971
L	Main Flame Height	2.00934		120			1.99389
M	Main Convec. Size	244983		120			241480
N	Target Temperature (1)	322.202	300	420	0		315.647
O	Target Flux (1)	1256.28		180			1240.22
P	Target Fire Rad. (1)	54.9308		90			35.5719
Q	Target Surface Rad. (1)	83.0962		10			17.2399
R	Target Gas Rad. (1)	72.5473		540			35.3368
S	Target Convec. (1)	16.3427	-1.85068	240	90	92	11.8514
	Species Output						
AA	Upper O2 (1)	20.538	19.2299	0	590		19.9373
AN	Lower O2 (1)	20.538	20.4718	0 & 20	310		20.5245
	Flow Field Output						
AZ	Upper Inflow 1-Outside (1)						0
BA	Upper Outflow 1-Outside (1)						0
BB	Lower Inflow 1-Outside (1)	0.0784142	0	370	0-300		0
BC	Lower Outflow 1-Outside (1)	0.586178	0	150	310-590		0.586178

RESULTS

From the comparison between the Appendix 4 output (CTFIBASE.CSV) and the output from this verification effort (BASECASE.XLS), most of the parameters evaluated have a relative difference of less than 0.01 percent, which is considered acceptable. As discussed previously, the parameters Ambient Target (1), Floor Target (1) and Target (2) are not verified due to ambiguity regarding these specifications. Furthermore, the parameters for N_2, CO_2, CO, HCN, HCl, TUHC, and OD are not verified as the production of these species are held to zero and thus not considered in the simulation. Some variation does exist for the following parameters discussed individually below.

Pressure (1)

The pressure output is the gage pressure and is calculated in CFAST as the difference between absolute pressure and atmospheric pressure. As CFAST is calculating this value based on an atmospheric pressure of 101300 Pa and output values are considerably smaller than this value, variation can be attributed to differences due to round-off.

A graph comparing the pressure output of each effort does not reveal any significant difference between the two (See Appendix 8, Figure 1). The relative difference as calculated for the comparison in Appendix 7 shows that a significant relative difference (>0.01%) begins to occur at 230 seconds and essentially stays above this level for the remainder of the simulation. As indicated by a graph of the delta for the two output files (Appendix 8, Figure 2), the largest differences occur during the period between 120 and 250 seconds. For most of this time period, the pressure is relatively large (around 1000 Pa) hence the delta is insignificant. However, as the pressure begins to drop and becomes relatively small (220 Pa at 250 s), the delta becomes more significant.

Target Convection (1)

Target convection output is calculated with CFAST as a percentage of the total target flux. A graph comparing the target convection output of each effort does not reveal any significant difference between the two (See Appendix 8, Figure 3). The relative difference as calculated for the comparison in Appendix 7 shows that a significant relative difference (>0.01%) occurs at 490 seconds and 570 seconds. This difference is only about 0.02%. As indicated by a graph of the delta for the two output files, the largest difference is 2.5E-03 (See Appendix 8, Figure 4). As the target convection is calculated as a percentage of the total target flux, and the target convection at these times is relatively small (about ten percent of the total flux), this difference becomes proportionally large. Hence the significant difference for target convection can probably be attributed to rounding effects in calculating the percentage within CFAST.

Lower Inflow 1-Outside (1)

Lower Inflow 1-Outside (1) is the airflow (kg/s) from outside into the room lower layer. A graph comparing the lower inflow results of each effort does not reveal any significant difference between the two (See Appendix 8, Figure 5). The relative difference as calculated for the comparison in Appendix 7 shows that a significant relative difference (>0.01%) begins to occur at 310 seconds when the airflow changes from outflow to inflow because the fire is no longer large enough to pressurize the room. Prior to this point, the inflow is zero as outflow occurs. The largest difference was 4.83E-05 (See Appendix 8, Figure 6 for a graph of the delta for the two output files). The values calculated are very small (on the order of 10^{-2} to 10^{-3}), thus small differences can produce high percentage errors because of division by a value close to zero.

Lower Outflow 1-Outside (1)

Lower Outflow 1-Outside (1) is the airflow (kg/s) from the room lower layer to outside. A graph comparing the lower outflow results of each effort does not reveal any significant difference between the two (See Appendix 8, Figure 7). The relative difference as calculated for the comparison in Appendix 7 shows that a significant relative difference (>0.01%) occurs only at 290 and 300 seconds when the airflow changes from outflow to inflow because the fire is no longer large enough to pressurize the room. The largest difference is 2.9E-05 (See Appendix 8, Figure 8 for a graph of the delta for the two output files). As with the inflow, the values calculated are small and the relative difference becomes more significant due to division by a near zero number.

CONCLUSIONS

The parameters listed in Table 5 are verified for a specific sample problem involving a fire that did not approach flashover conditions. In most cases, the normalized (percentage) difference between the test case and the base case is below 0.01 percent. The largest difference was 1.56 percent, which was for the room gage pressure. This large normalized error, and most of the other large normalized errors, is due to the fact that the calculated parameter was so small (i.e., division by a value close to zero). In terms of the applications for which the FAST model will be used, such errors are considered negligible.

In addition to the verification effort an installation check routine is recommended. This routine should be used whenever FAST is initially installed on a computer and prior to any significant analytical efforts. See Table 4 for check point values.

Table 5 -- Status of verification

Verified Parameters	Unverified Parameters
Upper Layer Temperature (1)	Ambient Target (1)
Lower Layer Temperature (1)	Floor Target (1)
Layer Height (1)	Target Temperature (2)
Upper Layer Volume (1)	Target Flux (2)
Pressure (1)	Target Fire Radiation (2)
Main Plume Flow	Target Surface Radiation (2)
Main Pyrolysis Rate	Target Gas Radiation (2)
Main Fire Size	Target Convection (2)
Main Flame Height	Upper & Lower N_2 (1)
Main Convection Size	Upper & Lower CO_2 (1)
Target Temperature (1)	Upper & Lower CO (1)
Target Flux (1)	Upper & Lower HCN (1)
Target Fire Radiation (1)	Upper & Lower HCL (1)
Target Surface Radiation (1)	Upper & Lower TUHC (1)
Target Gas Radiation (1)	Upper & Lower H_2O (1)
Target Convection (1)	Upper & Lower OD (1)
Upper O_2 (1)	Upper & Lower HCl c (1)[1]
Lower O_2 (1)	Upper & Lower HCl uw (1)[1]
Upper Inflow 1-Outside (1)	Upper & Lower HCl lw (1)[1]
Upper Outflow 1-Outside (1)	Upper & Lower HCl f (1)[1]
Lower Inflow 1-Outside (1)	
Lower Outflow 1-Outside (1)	

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Appendix 1 - Benchmark Exercise

International Collaborative Project to Evaluate Fire Models for Nuclear Power Plant Applications

Benchmark Exercise # 1

Cable Tray Fires of Redundant Safety Trains

(Revised September 11, 2000)

Definition of Scenario

(Revised September 11, 2000)

The project plan describes the background and choice of scenarios relating to cable tray fires of redundant safe-shutdown systems as the first benchmark exercise to be conducted in this project. The project plan also describes this task in general terms in Section 5.1.4 and 9.2.1.

Background

The objective of the fire modeling analyses in a probabilistic risk analysis (PRA) is to estimate the conditional probability of safe-shutdown equipment damage given a fire. Fire modeling results are necessary in order to make this estimate. The main fire protection features that affect the development of a fire are:

1. Automatic fire detection (detection by operators is also important)

2. Automatic isolation of the fire rooms with gaseous suppression systems by the closure of fire doors and dampers, and manual isolation of rooms with non-gaseous suppression systems.

3. Fire suppression (automatic and manual)

The target damage time is compared with the duration of a specific sequence identified in an event tree formulated to model the possible combinations of the above events. The conditional probability of the safe shutdown equipment damage is the probability of that sequence, if the damage time is less than the sequence duration.

Given the state of the art of fire modeling, the adequacy of fire detection and suppression is normally not included in fire modeling analyses to support a PRA. Therefore, this benchmark exercise does not include the evaluation of these systems or events.

Discussion

The benchmark exercise is intended to be for a *simple* scenario defined in sufficient detail to allow evaluation of the physics modeled in the fire computer codes. This approach will be similar to that adopted by the CIB W14 effort for code assessment. An assessment of appropriate input parameters and assumptions, interpretation of results, and determining the adequacy of the physical models in the codes for specific scenarios will establish useful technical information regarding the capabilities and limitations of the codes. This valuable information will be documented in a technical reference manual for fire model users. Generic insights regarding the capabilities of the models will also be developed in this process and documented.

The comparisons between codes can be used to understand the modeling of the physics in them, i.e. if all the codes produce similar results over a range of scenarios then the physics modeled in the codes is probably adequate for this scenario. However, the compounding effects of different phenomena will also need to be evaluated. Some variations in the results may be acceptable depending on how the results will be used. Uncertainties in the predictions based on validations of each code will be discussed and provide a basis for the confidence on the set of results developed in the exercise.

Procedure

1. Analysts should discuss and agree on the input data for the various codes that will be used in the benchmark exercise. The goal is for participants to analyze the same problem and minimize the variation of results due to differing input data. User effects will be examined at a later stage.

2. The form of the results to be compared should be agreed upon by participants prior to the commencement of the exercise.

3. Developers of the fire codes, and those not involved in the development of the codes, can conduct the code analyses for the benchmark exercise.

4. Blind simulations should be conducted, i.e. each analyst will conduct his or her analyses independently, and simultaneously share results with others when analyses by all the participants have been completed and results are available. The results could be simultaneously posted on the web site prior to a meeting of the participants to allow some questions or discussion on the web before the semi-annual meeting.

5. If desired, the same code (e.g. CFAST) can be used by different organizations since this will provide useful information on whether the results vary with different users. However, the same version of the code should be used (for CFAST, use Version 3.1.6).

6. A series of benchmark exercises will be defined and conducted in this project. This will allow the evaluation of the full spectrum of fire model features and applications, and facilitate formulation of a comprehensive technical reference for users on the capabilities and limitations of the current state-of-the-art models.

Fire Codes to be Used

The following fire codes will be used in this benchmark exercise by the organizations listed that are participating in the exercise.

	Organization	Codes
1.	IPSN	FLAMME-S (zone)
2.	NRC/NIST	CFAST (zone), FDS[1] (CFD)
3.	GRS	COCOSYS (lumped parameter), CFX (CFD) [may be]
4.	VTT	CFAST
5.	EDF	MAGIC (zone)
6.	BRE/NII	CFAST, JASMINE (CFD)
7.	WPI (may be)	WPIFIRE (zone)

[1] Exploratory and preliminary analysis will be conducted with the FDS code.

Definition

Room Size and Geometry

A representative PWR emergency switchgear room is selected for this benchmark exercise. The room is 15.2 m (50 ft) deep x 9.1 m (30 ft) wide and 4.6 m (15 ft) high. The room contains the power and instrumentation cables for the pumps and valves associated with redundant safe-shutdown equipment. The power and instrument cable trays associated with the redundant safe-shutdown equipment run the entire depth of the room, and are arranged in separate divisions and separated horizontally by a distance, D. The value of D, the safe separation distance, is varied and examined in this problem. The cable trays are 0.6 m (~24 in.) wide and 0.08 m (~3 in.) deep.

A simplified schematic of the room, illustrating critical cable tray locations, is shown in the attached figure. The postulated fire scenario is the initial ignition of the cable tray labeled as "A", located at 0.9 m (~3 ft) from the right wall of the room at an elevation of 2.3 m (7.5 ft) above the floor, by a trash bag fire on the floor. Cables for the redundant train are contained in another tray, labeled "B," the target. A horizontal distance, D, as shown in the attached figure separates tray B from tray A. The room has a door, 2.4 m x 2.4 m (8 ft x 8 ft), located at the midpoint of the front wall, assumed to lead to the outside. The room has a mechanical ventilation system with a flowrate of 5 volume changes per hour in and out of the room. Assume a constant flowrate in the mechanical ventilation system. The midpoint of the vertical vents for the supply and exhaust air are located at an elevation of 2.4 m and have area of 0.5 m^2 each. Assume vents are square and located at the center of the side walls (parallel to the cable trays). Assume air is supplied from the outside through the right wall, and exhausted to the outside from the left wall.

The effects of the fire door being open or closed, and the mechanical ventilation on and off will be examined.

It is assumed that:

- Other cable trays (C1 and C2) containing critical and non-critical cables are located directly above tray A.
- No combustible material intervenes between trays A and B.

Analyses

There are two parts to the analyses.

The objective of Part I is to determine the maximum horizontal distance between a specified transient fire and tray A that results in the ignition of tray A. This information is of use in a fire PRA to calculate the area reduction factor for the transient source fire frequency, which are derived to be applicable to the total area of the rooms. Analyses of this part of the problem will also provide insights regarding the capabilities of the models to predict simpler fire scenarios for risk analyses than those associated with fires of redundant cable trays.

Part II will determine the damage time of the target cable tray B for several heat release rates of the cable tray stack (A, C2, and C1), and horizontal distance, D. The effects of target elevation and ventilation will also be examined.

Thermophysical Data for Walls, Floor, and Ceiling (Concrete)

Specific Heat	1000 J/KgK
Conductivity	1.75 W/mK
Density	2200 Kg/m3
Emissivity	0.94

Assume the walls, floor and ceiling are 152 mm thick.

Thermophysical Data for Cables

Heat of combustion of insulation	16 MJ/kg
Fraction of flame heat released as radiation	0.48
Density	1710 kg/m3
Specific Heat	1040 J/kgK
Thermal Conductivity	0.092 W/mK
Emissivity	0.8

Chemical Properties of Cables[2]

Assume cable insulation is PVC – polyvinyl chloride. Chemical formula is C_2H_3Cl. The oxygen-fuel mass ratio = 1.408. The yields (mass of species/mass of fuel) are listed in the following Table.

Yields for PVC

Species	Yield
CO_2	0.46
CO	0.063
HCl	0.5
Soot	0.172

Assume the Smoke Potential of PVC = 1.7 ob.m3/g, where the smoke potential is defined as the optical density (dB/m or ob) x Volume of the compartment (m3)/mass of the fuel pyrolyzed (g).

Ambient Conditions (Internal and External)

Temperature	300 K
Relative Humidity	50
Pressure	101300 Pa
Elevation	0
Wind Speed	0

Other Constants and Indices

Constriction coefficient for flow through door	0.68
Convective heat transfer coefficient (assume same for all surfaces)	15 $Wm^{-2}K^{-1}$
Lower Oxygen Limit	12 %[3]

[2] Tewarson, A, "Generation of Heat and Chemical Compounds in Fires," SFPE Handbook of Fire Protection Engineering, 2nd Edition, **3**-53 to **3**-124, 1995.

Construction and Properties of Fire Door[4]

The following are properties of the fire door for use in models that allow the incorporation of such features. Assume fire door is a metal-clad door with a wood core, and insulating panels between the wood core and the metal clad (on both sides of the wood core). Assume metal clad = 0.6 mm, wood core = 40 mm, and insulating panel = 3 mm.

Properties of Fire Door

	Conductivity (W/mC)	Density ($Kg/m^{3)}$	Specific Heat (kJ/KgC)
Metal Clad - Carbon Steel	43	7801	0.473
Wood Core - Yellow Pine	0.147	640	2.8
Fiber, insulating panel	0.048	240	

Input Data for Part I

Heat Release Rates

Assume heat release rate for a trash fire[5] as characterized in the following Table (assume linear growth between points).

32 Gallon Trash Bag Fire

Time (minutes)	Heat Release Rate (kW)
1	200
2	350
3	340
4	200
5	150
6	100
7	100
8	80
9	75
10	100

The trash bag consists of: (1) straw and grass cuttings = 1.55 kg; (2) eucalyptus duff = 2.47 kg; and (3) polyethylene bag = 0.04 kg. Contents were thoroughly mixed, and then placed in the bag in a loose manner. Approximate the trash bag as a cylinder with a diameter = 0.49 m and height

---

[3] The fire source should pyrolyze at a rate corresponding to the specified heat release rate in Part II if oxygen depletion terminates combustion, i.e., the mass release rate of the fuel is fixed rather than the "true" heat release rate associated with the oxidation process.

[4] Derived from information in NFPA 80 and SFPE Handbook.

[5] Lee, B. T., "Heat Release Rate Characteristics of Some Combustible Fuel Sources in Nuclear Power Plants," NBSIR 85-3195, National Bureau of Standards, 1985; and
Van Volkinburg, D. R. et al, "Toward a Standard Ignition Source," Paper No. 78-64, Lawrence Berkeley Laboratory, University of California, Berkeley, California, 1978.

= 0.62 m. Assume the fraction of heat released as radiation is 0.3, and the heat of combustion of the trash bag material = 24.1 MJ/Kg.

Assume the trash bag and the target (representing tray A) are at the center of the cable tray lengths. In order to conduct a simplified and conservative analysis, assume the target is a single power cable with a diameter = 50 mm at the bottom left corner of the cable tray A. For models in which targets are represented as a rectangular slab, assume the slab is oriented horizontally with a thickness of 50 mm. Assume the cable ignites when the centerline of the cable reaches 643 K.

Base case

Distance between the midpoints of the trash bag and tray A = 2.2 m (~7 ft), the door is closed, and mechanical ventilation system is off.

Variation of Parameters

A. To facilitate comparisons of code results, simulations for horizontal distances between the trash bag and tray A of 0.3, 0.9, and 1.5 (~1, ~ 3, and ~ 5 ft) should be conducted (Cases 1–3)

B. Simulations should also be conducted with (a) the door open and mechanical system off; and (b) mechanical ventilation system on and door closed (Cases 4-5).

Summary of Cases for Part I

	Distance from Fire	Door	Ventilation System
Base Case	2.2 m	Closed*	Off
Case 1	0.3+		
Case 2	0.9		
Case 3	1.5		
Case 4		Open	
Case 5			On

* For simulations with the door closed, assume a crack (2.4 m x 0.005 m) at the bottom of the doorway.
+ A value in a cell indicates the parameter is varied from the base case.

The maximum horizontal distance between the trash bag and tray A, that results in the ignition of tray A, should be determined by extrapolation of results for the simulations with the door closed and mechanical ventilation system off (Base case to Case 3).

The resulting centerline temperature of the cable should be presented for these simulations. In addition, the following parameters should be reported:

- Upper layer temperature
- Lower layer temperature
- Depth of the hot gas layer
- Heat release rate
- Oxygen content[6] (upper and lower layer)

[6] Neglect any oxygen present in the fuel in the calculation of the oxygen concentration in the compartment.

- Flow rates through door and vents
- Radiation flux on the target
- Target surface temperature
- Total heat loss to boundaries

For CFD and lumped-parameter models, the profile at the midpoint of the room should be presented.

All results should be presented in SI units.

Input Data for Part II

Heat Release Rates

The modeling of and predicting the heat release rate of a burning cable tray stack is extremely complex, and current models are not capable of realistically predicting such phenomena. Therefore, the heat release rates of the burning cable tray stack is defined as input in the problem. The consecutive ignition and burning of all 3 cable trays (trays A, C2, and C1) will be modeled as one fire. Conduct analyses assuming peak heat release rate for the whole cable tray stack between 1 – 3 MW[7]. Assume t-squared growth with t_0 = 10 min., and Q_0 = 1 MW[8].

$$Q=Q_0 (t/t_0)^2$$

Assume a fire duration of 60 minutes at peak heat release rate, and then a t-squared decay with similar constants as for growth.

Geometry

For point source calculations, assume the heat source (trays A, C2, and C1) is at the center of the cable tray length and width and at the elevation of the bottom of tray C2. For 3-D calculations, assume the fire source is the entire length of tray C2 (15.2 m), width (0.6 m), and height of 0.24 m (0.08 x 3). Assume the target (representing tray B) is at the center of the cable tray length. In order to conduct a simplified and conservative analysis, assume the target is a single power or instrumentation cable with no electrical conductor inside the cable, and with a diameter of 50 mm or 15 mm respectively at the bottom right corner of cable tray B. For models in which targets are represented as a rectangular slab, assume the slab is oriented horizontally with a thickness of 50 mm or 15 mm. Assume the cable is damaged when the centerline of the cable reaches 200 C.

[7] The 1 – 3 MW range was chosen as bounding values for a stack of 3 cable trays. Considering a heat of combustion of 25 MJ/Kg and a surface controlled specific mass loss rate of about 3 g/m^2-sec for cables that pass the IEEE tests, a cable tray 15 m long and 0.6 m wide will have an effective heat release rate of 0.9 MW. An earlier study (NUREG/CR-4230), and fire tests reported in EPRI NP-2660 and EPRI NP-2751 also concluded that the peak heat release rate for a cable tray is limited from 0.8 to 2 MW for a well ventilated room.

[8] EdF CNPP tests (1997)

Base Case

Heat Release Rate for cable tray stack = 1 MW (reaching peak heat-release rate and decaying as specified above) at a horizontal distance, D = 6.1 m (20 ft). Door is closed and ventilation system is off. Target is a power cable 1.1 m (3.5 ft) above tray A.

Variation of Parameters

A. Vary D = 3.1, 4.6 m (~10, ~15 ft.) – Cases 1-2
B. Vary peak heat release rate for cable tray stack = 2 MW, and 3 MW (reaching peak heat-release rate and decaying as specified above) at a horizontal distance, D = 3.1, 4.6, 6.1 m (Cases 3-8).
C. Door closed and ventilation system operational initially; and door opened, and ventilation system shut after 15 minutes (Case 9).
D. Door and ventilation system open throughout the simulation (Case 10).
E. Two elevations for tray B should be analyzed to examine the possible effects of the ceiling jet sub-layer and the elevation of the target:

- 2.0 m (6.5 ft) above tray A, (i.e., 0.3 m (1 ft) below the ceiling) – Case 11
- Same elevation as tray A – Case 12

F. Instrumentation cable with diameter = 15 mm (Case 13)

The resulting centerline temperature of the target, and time to damage of target, should be presented for these analyses. In addition, the following parameters should be reported:

- Upper layer temperature
- Lower layer temperature
- Depth of the hot gas layer
- Heat release rate
- Oxygen content (upper and lower layer)
- Flow rates through door and vents
- Radiation flux on the target
- Target surface temperature
- Total heat loss to boundaries
- Chemical species (CO, HCl, soot) in upper layer
- Optical density of smoke (optional)

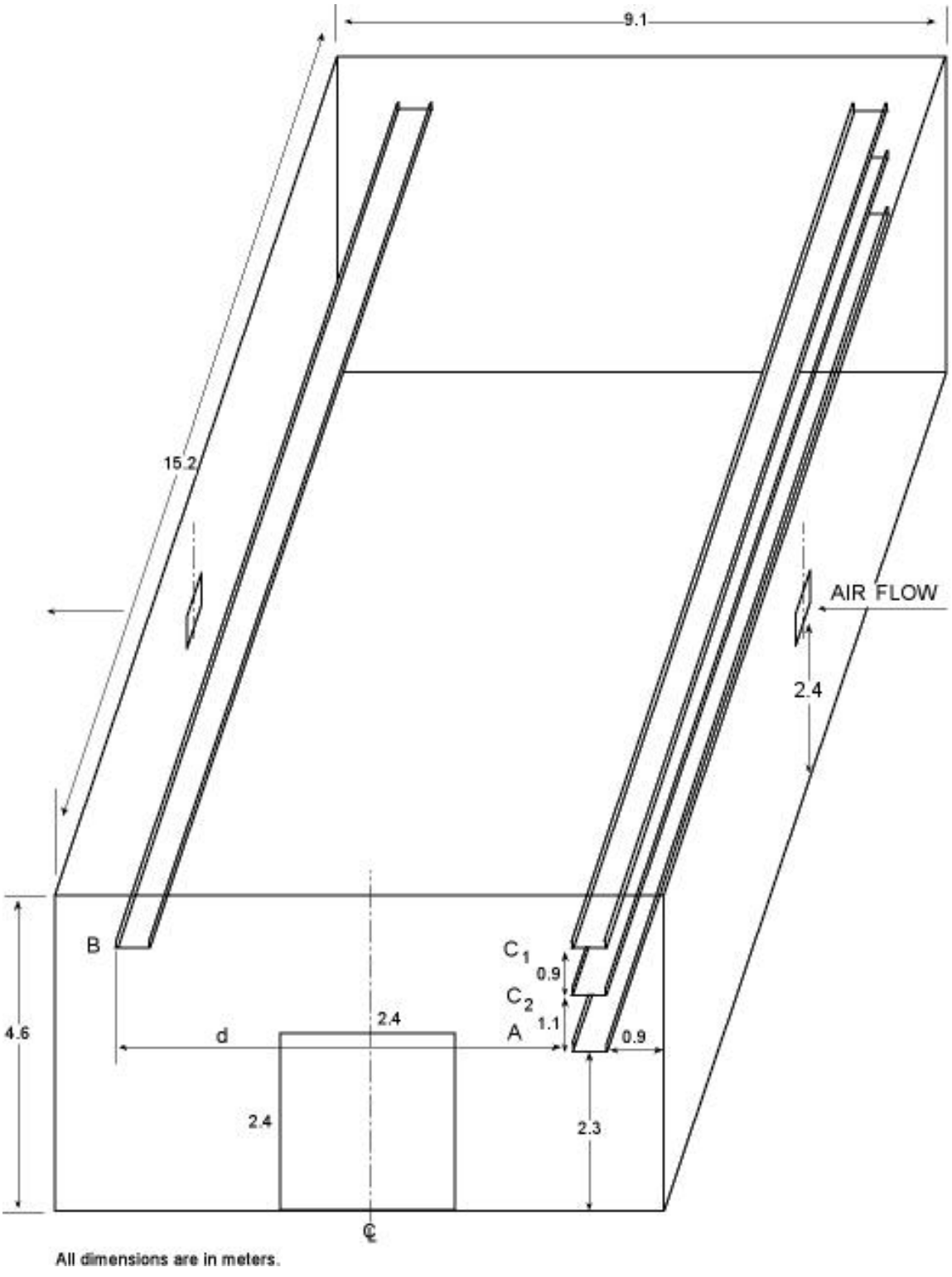
For CFD and lumped-parameter models, the profile at the midpoint of the room should be presented.

All results should be presented in SI units.

Summary of Cases for Part II

	HRR (MW)	D (m)	Door	Vent. Sys.	Target	Elev. (m)
Base Case	1 MW	6.1	Closed*	Off	Power	1.1
Case 1		3.1+				
Case 2		4.6				
Case 3	2	3.1				
Case 4	2	4.6				
Case 5	2	6.1				
Case 6	3	3.1				
Case 7	3	4.6				
Case 8	3	6.1				
Case 9			Open>15 min	Off>15 min		
Case 10			Open	On		
Case 11						2.0
Case 12						Same
Case 13					Instrument	

* For simulations with the door closed, assume a crack (2.4 m x 0.005 m) at the bottom of the doorway.
+A value in a cell indicates the parameter is varied from the base case.



Representative PWR Emergency Switchgear Room

Attachment

Comments on Proposed Definition of Benchmark Exercise and Disposition of Issues

The following comments were discussed and resolutions developed at the meeting on June 19-20, 2000 at IPSN in Fontenay-aux-Roses, France.

1. Issue: Should user effects be addressed?

   Disposition: Minimize user effects now, and address issue later

2. Issue: Mechanical ventilation rate
   2-5 vol./hr is more realistic
   zone models not valid for high ventilation rates

   Disposition: Use 5 vol./hr

3. Issue: Location of doors and vents for use in CFD and lumped parameter models

   Disposition: Assume door is located at the center of the front wall, and the vents at the center of the side walls.

4. Issue: Specify content and dimensions (including floor area) of trash bag fire source

   Disposition:Contents: (1) straw and grass cuttings = 1.55 kg; (2) eucalyptus duff = 2.47 kg; and (3) polyethylene bag = 0.04 kg. Contents were thoroughly mixed, and then placed in the bag in a loose manner.

   Dimensions: Assume cylindrical geometry with diameter = 0.492 m and height = 0.615 m

5. Issue: The curve for the HRR of the trash bag fire should be specified

   Disposition: Assume a linear fit between points. Specifying the best curve to go through the data points from the experiments may introduce more error than assuming a linear interpolation between the points.

6. Issue: The heat release rate curves of cable tray fires should be based on experiments. Experiments have shown that peak heat release rates for cable fires generally do not last more than 60 minutes.

   Disposition: A t-squared growth is appropriate for modeling cable tray fires. The HRR curves will be chosen based on experiments conducted by EdF. Assume t-squared growth with t_0 = 10 min., and Q_0 = 1 MW.

$$Q=Q_0 (t/t_0)^2$$

Assume a fire duration of 60 minutes at peak heat release rate, and then a t-squared decay with similar constants as for growth.

7. Issue: The type and dimensions of the cables need to be specified in more detail to allow more detailed modeling of heat transfer to the cables.

   Disposition: Power cables = 50 mm diam., and instrument cables = 15 mm diam. For models in which targets are represented as rectangular slabs, assume slabs are oriented horizontally with a thickness of 50 mm and 15 mm correspondingly.

   Open Issue (raised by Remy Bertrand): Are the slab dimensions too thick and have an inertia greater than reality? In principle, the integral protective overjacket is 1 to 2 mm thick.

8. Issue: Some codes require the specification of a large leakage opening (when doors and vents are closed) for successful code execution (e.g., HAVARD 6)

   Disposition: Maintain leakage value specified in draft problem definition. Users of codes with limitation should adjust value as needed, and document value used.

9. Issue: Should corner/wall effects be examined? In practice, cable trays are installed nearer than 0.9 m from walls. Should transient combustibles in the corner or along walls be considered?

   Disposition: In order to minimize the number of cases for the benchmark exercise, corner/wall effects will not be examined now but at a later stage. However, model users may run additional cases to examine issue, and present results to other participants.

10. Issue: What temperature in the cable should be used to establish the criteria for cable damage temperature? The outside cable surface temperature is not indicative of effects on cable functionality. IPSN experiments indicate that the temperature at the inside surface of the insulation is about 200 C when malfunction occurs.

    Disposition: Use the centerline temperature, and criteria for damage = 200 C

11. Issue: What value should be used for the constriction coefficient?

    Disposition: Set value at 0.68

12. Issue: What value should be used for the convective heat transfer coefficient?

    Disposition: Set value at 15 $Wm^{-2}K^{-1}$

13. Issue: What value should be used for the Lower Oxygen Limit?

    Disposition: Use value of 12 %.

    Open Issue (raised by Moni Dey): At the meeting we decided to use a value of 0 for the base case, and run one case at 12 % if model allows this value to be varied. However, if the LOL is set at 0 %, the cases which were developed to examine the effects of ventilation will be not be useful to run. Therefore, it is suggested the LOL be set at 12 % in order to examine these effects.

14. Issue: Should the structures securing cable trays be evaluated as targets in the problem?

Disposition: In order to limit the scope of the current benchmark exercise, the modeling of cable tray structures will not be included in the analyses. However, model users may include this analysis and share the results with the other participants.

15. Issue: Should the door be open to ambient conditions outside, or to another compartment. In NPPs, doors in most compartments would open to another compartment.

    Disposition: In order to simplify and make feasible the evaluation of model effects, multi-compartment analysis will not be included at this stage since that would include additional considerations and effects on the results. However, modelers may evaluate the effect of this assumption on the results and share the information with other participants.

16. Issue: Intermediate results to cable temperature should be presented to allow a full evaluation of results, and for generating statistics of results.

    Disposition: In addition to the cable centerline temperature, the following parameters should be reported:

- Upper layer temperature
- Lower layer temperature
- Depth of the hot gas layer
- Heat release rate
- Oxygen content (upper and lower layer)
- Flow rates through door and vents
- Radiation flux on the target
- Target surface temperature
- Total heat loss to boundaries
- Chemical species (CO, HCl, soot (C)) in upper layer

For CFD and lumped-parameter models, the profile at the midpoint of the room should be presented.

17. Issue: The physical properties (heat conductivity, density, and specific heat) and thickness of the fire door are needed.

    Disposition: Assume fire door is a metal-clad door with a wood core and insulating panels between wood core and metal clad (on both sides of wood core). Assume metal clad = 0.6 mm, wood core = 40 mm, and insulating panel = 3 mm.

Properties of Fire Door

	Conductivity (W/m °C)	Density ($Kg/m^{3)}$	Specific Heat (kJ/Kg °C)
Carbon Steel	43	7801	0.473
Yellow Pine	0.147	640	2.8
Fiber, insulating panel	0.048	240	

18. Issue: The chemical properties of the cables (C, CL, O, H amounts), the necessary amounts of oxygen and the yields of CO, CO_2, H_2O vapor and soot should be given.

    Disposition: Assume cable insulation is PVC – polyvinyl chloride. Chemical formula is C_2H_3Cl. The oxygen-fuel mass ratio = 1.408. Yields (mass of species/mass of fuel) are CO_2 = 0.46, CO = 0.063, HCl = 0.5, soot = 0.172.

The following are comments received on the revised definition of the problem for the benchmark exercise issued to participants on August 4, 2000 (which incorporated the disposition of the issues above).

1. Issue: The definition of the trash bag fire in Part I is too complicated. If the concentration of O2, CO2, CO, and other species in the room is to be calculated, the chemical yields of the trash bag fire needs to be known. A more simple initial fire with well known chemical yields should be used.

   Disposition: As indicated in the description of the problem, the intent of Part I is to exercise fire models to evaluate their capability to provide information for a fire risk assessment, namely, to determine the distance between fire source and the target cable tray that will result in the ignition of the target. This information can then be used to adjust the fire source frequency in the compartment being analyzed. Since the chemical behavior of the fuel in the combustion process does not have a significant effect on the specific desired result, the calculation of the concentrations of the chemical species in the fire scenarios for Part I should be omitted. Neglect any oxygen present in the fuel in the calculation of the oxygen concentration in the compartment for determining if the fire will be constrained as a result of lack of oxygen. Assume the heat of combustion of the trash bag material = 24.1 MJ/Kg.

2. Issue: The volume of the fire source for Part II has not been specified.

   Disposition: Assume the fire source is the entire length of tray C2 (15.2 m), width (0.6 m), and height of 0.24 m (0.08 x 3).

3. Issue: The definition of heat release rate, and the LOL concept should be clarified.

   Disposition: The fire source should pyrolyze at a rate corresponding to the specified heat release rate in Part II if oxygen depletion terminates combustion, i.e., the mass release rate of the fuel is fixed rather than the "true" heat release rate associated with the oxidation process.

4. Issue: The emphasis in both parts of the problem seems to be toward the "closed door" case. Considering this scenario may cause some difficulties with some models, a few more open door cases should be specified.

   Disposition. The cases for the benchmark exercise were chosen to be representative of fire scenarios in nuclear power plants where the doors to most compartments would be closed, at least during the initial phase of the fire scenario. Issues related to the modeling of compartments in such configurations should be identified. Participants may analyze a broader spectrum of cases with open doors and share the results and insights generated with others.

5. Issue: Cable trays located high in the room will probably be extinguished rapidly by oxygen depletion. Cases in Part II in which the cable trays are located at lower levels would be of interest. It would be more conservative to locate the fire source in Part II for the 3 cable trays at level A, than C2.

   Disposition: Participants may conduct analyses of additional cases to examine the effect of cable trays being located at lower levels, and also for locating the fire source in Part II at level A, and share the results of these analyses with others.

6. Issue: The smoke opacity is not given for Part II.

   Disposition: Participants that wish to calculate and report the optical density of the smoke should use a value for the Smoke Potential of PVC = 1.7 ob.m^3/g, where the smoke potential is defined as the optical density (dB/m or ob) x Volume of the compartment (m^3)/mass of the fuel pyrolyzed (g).

[7]The fire source should pyrolyze at a rate corresponding to the specified heat release rate in Part II if oxygen depletion terminates combustion, i.e., the mass release rate of the fuel is fixed rather than the "true" heat release rate associated with the oxidation process.

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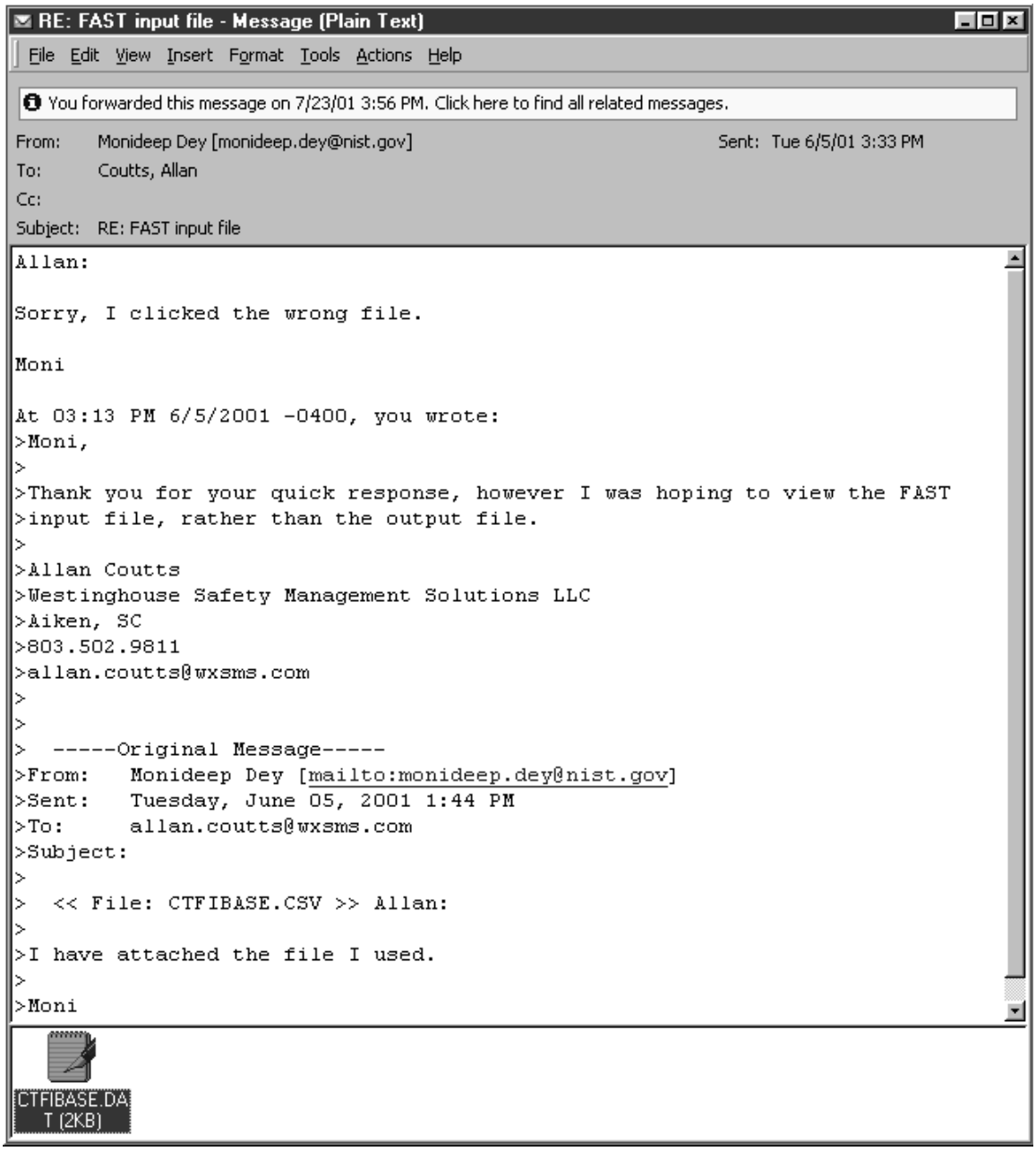
Appendix 2 - Input Data File (CTFIBASE.DAT) As Provided By Dr. Dey, NIST/NRC



RE: FAST input file - Message (Plain Text)

File Edit View Insert Format Tools Actions Help

You forwarded this message on 7/23/01 3:56 PM. Click here to find all related messages.

From: Monideep Dey [monideep.dey@nist.gov] Sent: Tue 6/5/01 3:33 PM
To: Coutts, Allan
Cc:
Subject: RE: FAST input file

Allan:

Sorry, I clicked the wrong file.

Moni

At 03:13 PM 6/5/2001 -0400, you wrote:
>Moni,
>
>Thank you for your quick response, however I was hoping to view the FAST
>input file, rather than the output file.
>
>Allan Coutts
>Westinghouse Safety Management Solutions LLC
>Aiken, SC
>803.502.9811
>allan.coutts@wxsms.com
>
>
> -----Original Message-----
>From: Monideep Dey [mailto:monideep.dey@nist.gov]
>Sent: Tuesday, June 05, 2001 1:44 PM
>To: allan.coutts@wxsms.com
>Subject:
>
> << File: CTFIBASE.CSV >> Allan:
>
>I have attached the file I used.
>
>Moni

CTFIBASE.DAT (2KB)

```
VERSN    3CABLE TRAY FIRE - PART I BASE CASE
#VERSN 3 CABLE TRAY FIRE - PART I BASE CASE
TIMES    600     10     10     10      0
DUMPR C:\WINDOWS\DESKTOP\FAST316\CTFIBASE.HI
ADUMP C:\WINDOWS\DESKTOP\FAST316\CTFIBASE.CSV N
TAMB  300.000        101300. 0.000000
EAMB  300.000        101300. 0.000000
HI/F  0.000000
WIDTH  9.10000
DEPTH  15.2000
HEIGH  4.60000
CEILI CONCRETE
WALLS CONCRETE
FLOOR CONCRETE
#CEILI CONCRETE
#WALLS CONCRETE
#FLOOR CONCRETE
HVENT  1  2  1  2.40000 0.00500000 0.000000 0.000000 0.000000 0.000000
CVENT  1  2  1       1.00000       1.00000       1.00000       1.00000       1.00000       1.00000
1.00000       1.00000       1.00000       1.00000       1.00000
CHEMI  16.0000  50.0000  12.0000 2.41000E+007  300.000  493.150 0.300000
LFBO 1
LFBT 2
CJET ALL
FPOS -1.00000  5.70000 0.000000
FTIME       60.0000       120.000       180.000       240.000       300.000       360.000       420.000
480.000       540.000       600.000
FMASS      0.000000    0.00829876     0.0145228     0.0141079    0.00829876    0.00622407    0.00414938
0.00414938    0.00331950    0.00311203    0.00414938
FQDOT      0.000000       200000.       350000.       340000.       200000.       150000.       100000.
100000.       80000.0       75000.0       100000.
HCR        0.160000      0.160000      0.160000      0.160000      0.160000      0.160000      0.160000
0.160000      0.160000      0.160000      0.160000
TARGET  1  7.60000  7.60000  2.27500 0.000000 0.000000 -1.00000     CABLE EXPLICIT PDE
SELECT 1 0 0
#GRAPHICS ON
DEVICE 1
WINDOW    0.    0. -100. 1280. 1024. 1100.
LABEL  1  970.  960.    0. 1231. 1005.   10. 15 00:00:00 0.00  0.00
GRAPH  1  100.   50.    0.  600.  475.   10. 3 TIME HEIGHT
GRAPH  2  100.  550.    0.  600.  940.   10. 3 TIME CELSIUS
GRAPH  3  720.   50.    0. 1250.  475.   10. 3 TIME FIRE_SIZE(kW)
GRAPH  4  720.  550.    0. 1250.  940.   10. 3 TIME O|D2|O()
HEAT   0 0 0 0 3   1 U
TEMPE  0 0 0 0 2   1 U
INTER  0 0 0 0 1   1 U
O2     0 0 0 0 4   1 U
```

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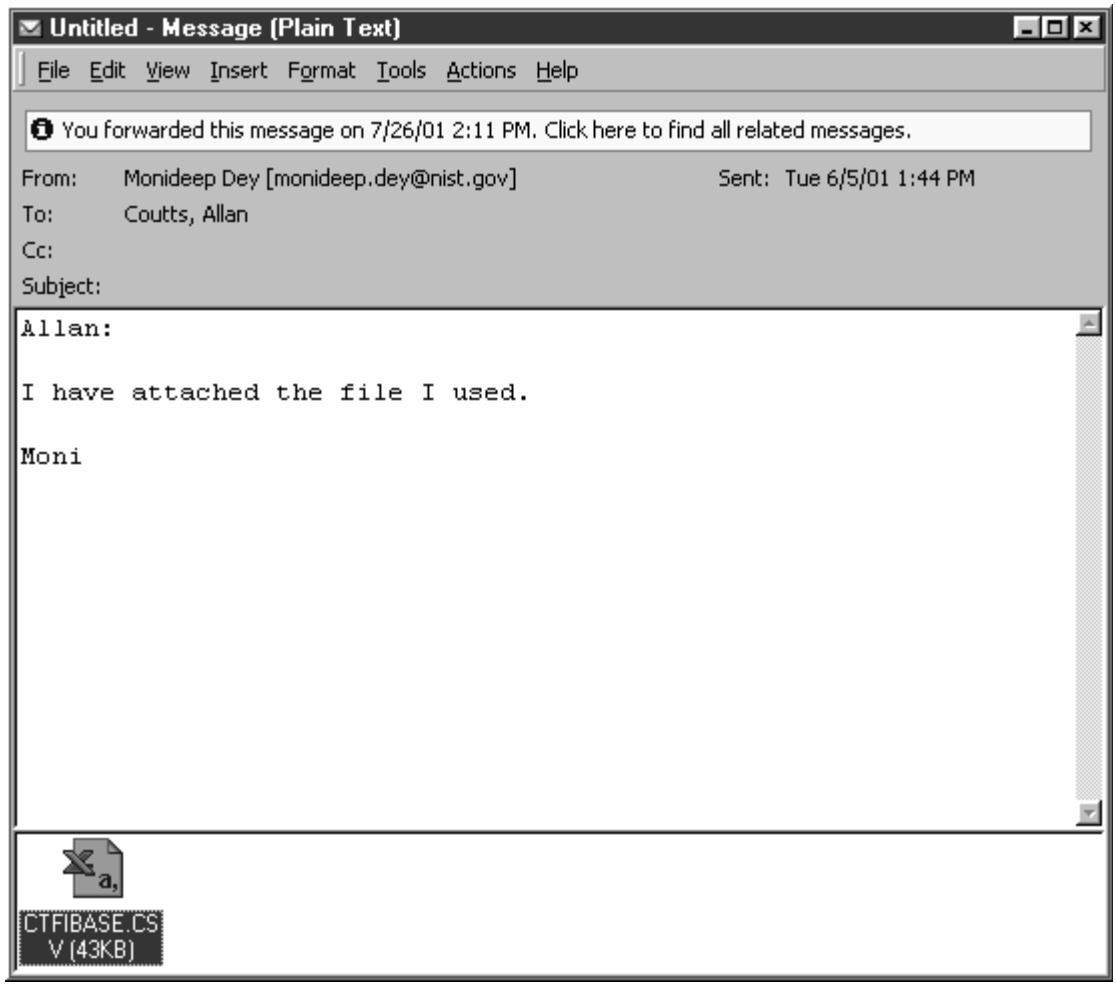
Appendix 3 - Input Data File (BASECASE.DAT) as Recreated for Verification Effort

```
VERSN    3PART 1 - BASE CASE
#VERSN 3 PART 1 - BASE CASE
TIMES    600     10     10     10      0
DUMPR C:\A\BASECASE.HI
ADUMP C:\A\BASECASE.TXT NFS
TAMB  300.000        101300. 0.000000
EAMB  300.000        101300. 0.000000
THRMF C:\A\WSMSTH02.DF
HI/F  0.000000
WIDTH  9.10000
DEPTH  15.2000
HEIGH  4.60000
CEILI CONC003
WALLS CONC003
FLOOR CONC003
#CEILI CONC003
#WALLS CONC003
#FLOOR CONC003
HVENT  1  2  1  2.40000 0.00500000 0.000000 0.000000 0.000000 0.000000
CVENT  1  2  1       1.00000       1.00000       1.00000       1.00000       1.00000       1.00000
1.00000       1.00000       1.00000       1.00000       1.00000
CHEMI  16.0000  50.0000  12.0000 2.41000E+007  300.000  493.150 0.300000
LFBO 1
LFBT 2
CJET ALL
FPOS -1.00000  5.70000 0.000000
FTIME       60.0000       120.000       180.000       240.000       300.000       360.000       420.000
480.000       540.000       600.000
FMASS      0.000000    0.00829876     0.0145228     0.0141079    0.00829876    0.00622407    0.00414938
0.00414938    0.00331950    0.00311203    0.00414938
FQDOT      0.000000       200000.       350000.       340000.       200000.       150000.       100000.
100000.       80000.0       75000.0       100000.
HCR        0.160000      0.160000      0.160000      0.160000      0.160000      0.160000      0.160000
0.160000      0.160000      0.160000      0.160000
TARGET  1  7.60000  7.60000  2.27500 0.000000 0.000000 -1.00000     CABLE EXPLICIT PDE
SELECT 1 0 0
#GRAPHICS ON
DEVICE 1
WINDOW    0.    0. -100. 1280. 1024. 1100.
LABEL  1  970.  960.    0. 1231. 1005.   10. 15 00:00:00 0.00  0.00
GRAPH  1  100.   50.    0.  600.  475.   10. 3 TIME HEIGHT
GRAPH  2  100.  550.    0.  600.  940.   10. 3 TIME CELSIUS
GRAPH  3  720.   50.    0. 1250.  475.   10. 3 TIME FIRE_SIZE(kW)
GRAPH  4  720.  550.    0. 1250.  940.   10. 3 TIME O|D2|O()
HEAT   0 0 0 0 3   1 U
TEMPE  0 0 0 0 2   1 U
INTER  0 0 0 0 1   1 U
O2     0 0 0 0 4   1 U
```

Appendix 4 - Results (CTFIBASE.CSV) as Provided by Dr. Dey, NIST/NRC


Untitled - Message (Plain Text)
File Edit View Insert Format Tools Actions Help
You forwarded this message on 7/26/01 2:11 PM. Click here to find all related messages.
From: Monideep Dey [monideep.dey@nist.gov] Sent: Tue 6/5/01 1:44 PM
To: Coutts, Allan
Cc:
Subject:
Allan:
I have attached the file I used.
Moni
CTFIBASE.CSV (43KB)

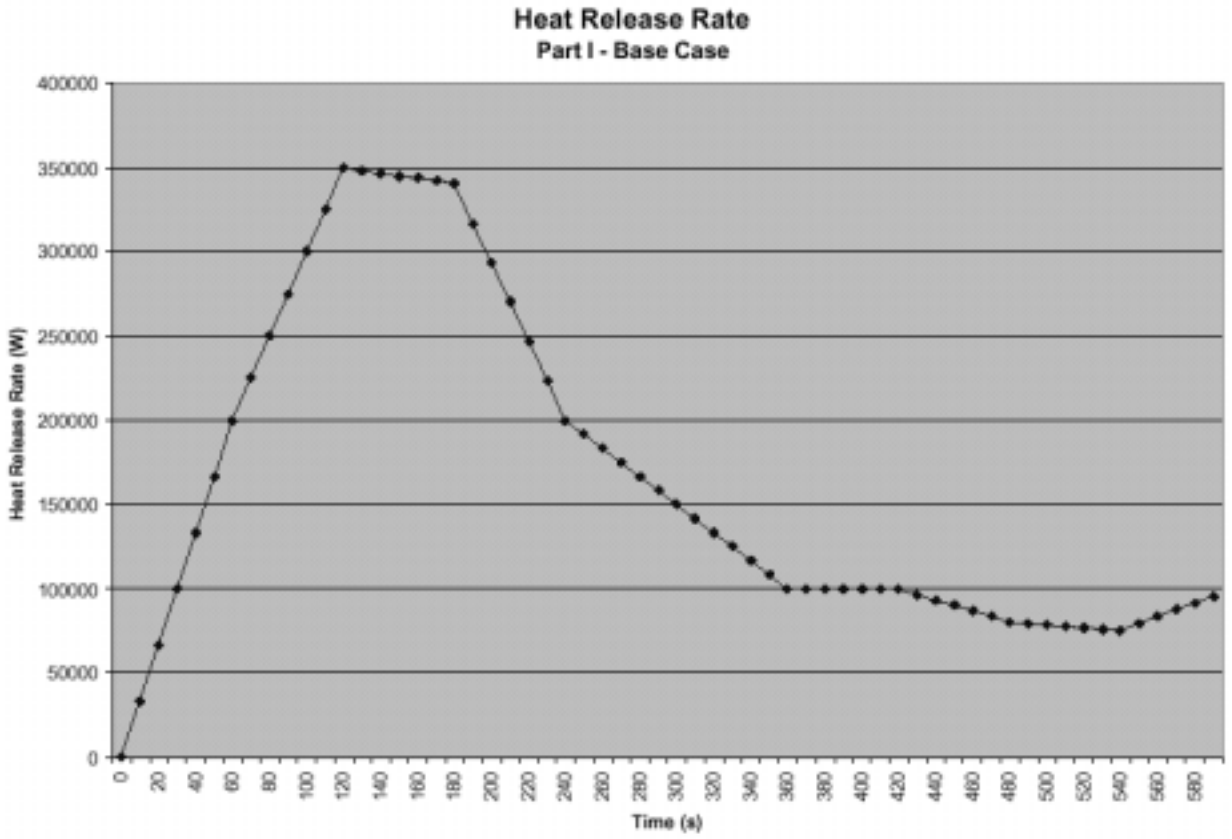
TIME	Upper Layer Temp (1)	Lower Layer Temp (1)	Layer Height (1)	Upper Layer Volume (1)	Pressure (1)	Ambient Target (1)	Floor Target (1)	Main Plume Flow	Main Pyrolysis Rate	Main Fire Size	Main Flame Height
0.00E+00	3.00E+02	3.00E+02	4.60E+00	6.36E-02	-1.48E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.00E+01	3.03E+02	3.00E+02	4.37E+00	3.18E+01	1.85E+01	2.10E+00	1.72E+00	4.48E+00	1.38E-03	3.33E+04	6.04E-01
2.00E+01	3.05E+02	3.00E+02	4.08E+00	7.23E+01	7.41E+01	5.57E+00	4.50E+00	4.65E+00	2.77E-03	6.67E+04	8.95E-01
3.00E+01	3.08E+02	3.00E+02	3.78E+00	1.13E+02	1.65E+02	1.04E+01	8.48E+00	4.45E+00	4.15E-03	1.00E+05	1.11E+00
4.00E+01	3.10E+02	3.00E+02	3.50E+00	1.52E+02	2.88E+02	1.68E+01	1.38E+01	4.13E+00	5.53E-03	1.33E+05	1.28E+00
5.00E+01	3.13E+02	3.00E+02	3.24E+00	1.88E+02	4.42E+02	2.47E+01	2.06E+01	3.76E+00	6.92E-03	1.67E+05	1.42E+00
6.00E+01	3.16E+02	3.01E+02	3.00E+00	2.21E+02	6.25E+02	3.43E+01	2.89E+01	3.39E+00	8.30E-03	2.00E+05	1.55E+00
7.00E+01	3.19E+02	3.01E+02	2.78E+00	2.52E+02	8.17E+02	4.51E+01	3.84E+01	3.02E+00	9.34E-03	2.25E+05	1.64E+00
8.00E+01	3.22E+02	3.01E+02	2.58E+00	2.80E+02	1.01E+03	5.72E+01	4.93E+01	2.68E+00	1.04E-02	2.50E+05	1.72E+00
9.00E+01	3.25E+02	3.01E+02	2.39E+00	3.05E+02	1.20E+03	7.07E+01	6.16E+01	2.39E+00	1.14E-02	2.75E+05	1.80E+00
1.00E+02	3.29E+02	3.01E+02	2.22E+00	3.29E+02	1.40E+03	8.58E+01	7.53E+01	2.12E+00	1.24E-02	3.00E+05	1.87E+00
1.10E+02	3.32E+02	3.01E+02	2.07E+00	3.50E+02	1.61E+03	1.02E+02	9.05E+01	1.88E+00	1.35E-02	3.25E+05	1.94E+00
1.20E+02	3.36E+02	3.02E+02	1.92E+00	3.70E+02	1.82E+03	1.21E+02	1.07E+02	1.67E+00	1.45E-02	3.50E+05	2.01E+00
1.30E+02	3.39E+02	3.02E+02	1.79E+00	3.88E+02	1.97E+03	1.39E+02	1.24E+02	1.47E+00	1.45E-02	3.48E+05	2.00E+00
1.40E+02	3.42E+02	3.02E+02	1.67E+00	4.05E+02	2.05E+03	1.56E+02	1.41E+02	1.37E+00	1.44E-02	3.47E+05	2.00E+00
1.50E+02	3.45E+02	3.02E+02	1.56E+00	4.21E+02	2.06E+03	1.73E+02	1.57E+02	1.28E+00	1.43E-02	3.45E+05	1.99E+00
1.60E+02	3.48E+02	3.02E+02	1.45E+00	4.36E+02	2.03E+03	1.90E+02	1.73E+02	1.20E+00	1.42E-02	3.43E+05	1.99E+00
1.70E+02	3.50E+02	3.02E+02	1.34E+00	4.51E+02	1.96E+03	2.06E+02	1.88E+02	1.11E+00	1.42E-02	3.42E+05	1.99E+00
1.80E+02	3.52E+02	3.02E+02	1.24E+00	4.64E+02	1.88E+03	2.22E+02	2.03E+02	1.04E+00	1.41E-02	3.40E+05	1.98E+00
1.90E+02	3.54E+02	3.02E+02	1.15E+00	4.77E+02	1.74E+03	2.35E+02	2.17E+02	9.24E-01	1.31E-02	3.17E+05	1.92E+00
2.00E+02	3.55E+02	3.02E+02	1.07E+00	4.89E+02	1.52E+03	2.46E+02	2.28E+02	8.23E-01	1.22E-02	2.93E+05	1.85E+00
2.10E+02	3.56E+02	3.01E+02	9.94E-01	4.99E+02	1.25E+03	2.55E+02	2.36E+02	7.31E-01	1.12E-02	2.70E+05	1.79E+00
2.20E+02	3.57E+02	3.01E+02	9.28E-01	5.08E+02	9.68E+02	2.62E+02	2.43E+02	6.48E-01	1.02E-02	2.47E+05	1.71E+00
2.30E+02	3.57E+02	3.01E+02	8.70E-01	5.16E+02	6.82E+02	2.66E+02	2.47E+02	5.74E-01	9.27E-03	2.23E+05	1.64E+00
2.40E+02	3.57E+02	3.01E+02	8.20E-01	5.23E+02	4.17E+02	2.69E+02	2.50E+02	5.07E-01	8.30E-03	2.00E+05	1.56E+00
2.50E+02	3.57E+02	3.01E+02	7.78E-01	5.29E+02	2.21E+02	2.71E+02	2.52E+02	4.70E-01	7.95E-03	1.92E+05	1.53E+00
2.60E+02	3.57E+02	3.01E+02	7.41E-01	5.34E+02	1.09E+02	2.72E+02	2.54E+02	4.38E-01	7.61E-03	1.83E+05	1.49E+00
2.70E+02	3.57E+02	3.01E+02	7.09E-01	5.38E+02	5.17E+01	2.74E+02	2.56E+02	4.08E-01	7.26E-03	1.75E+05	1.46E+00
2.80E+02	3.56E+02	3.01E+02	6.80E-01	5.42E+02	2.38E+01	2.75E+02	2.57E+02	3.81E-01	6.92E-03	1.67E+05	1.43E+00
2.90E+02	3.56E+02	3.01E+02	6.55E-01	5.46E+02	9.16E+00	2.75E+02	2.57E+02	3.56E-01	6.57E-03	1.58E+05	1.39E+00
3.00E+02	3.56E+02	3.01E+02	6.32E-01	5.49E+02	1.81E+00	2.75E+02	2.57E+02	3.33E-01	6.22E-03	1.50E+05	1.36E+00
3.10E+02	3.56E+02	3.01E+02	6.12E-01	5.52E+02	-3.77E-02	2.74E+02	2.57E+02	3.12E-01	5.88E-03	1.42E+05	1.32E+00
3.20E+02	3.55E+02	3.01E+02	5.95E-01	5.54E+02	-1.98E+00	2.73E+02	2.56E+02	2.93E-01	5.53E-03	1.33E+05	1.28E+00
3.30E+02	3.55E+02	3.01E+02	5.79E-01	5.56E+02	-6.68E+00	2.71E+02	2.54E+02	2.74E-01	5.19E-03	1.25E+05	1.24E+00
3.40E+02	3.54E+02	3.01E+02	5.66E-01	5.58E+02	-1.39E+01	2.69E+02	2.52E+02	2.57E-01	4.84E-03	1.17E+05	1.20E+00
3.50E+02	3.54E+02	3.01E+02	5.54E-01	5.60E+02	-2.33E+01	2.66E+02	2.49E+02	2.40E-01	4.50E-03	1.08E+05	1.15E+00
3.60E+02	3.53E+02	3.01E+02	5.44E-01	5.61E+02	-3.48E+01	2.63E+02	2.45E+02	2.25E-01	4.15E-03	1.00E+05	1.11E+00
3.70E+02	3.52E+02	3.01E+02	5.35E-01	5.62E+02	-3.73E+01	2.59E+02	2.42E+02	2.21E-01	4.15E-03	1.00E+05	1.11E+00
3.80E+02	3.52E+02	3.01E+02	5.27E-01	5.63E+02	-3.37E+01	2.56E+02	2.39E+02	2.18E-01	4.15E-03	1.00E+05	1.11E+00
3.90E+02	3.51E+02	3.01E+02	5.18E-01	5.65E+02	-2.97E+01	2.53E+02	2.36E+02	2.15E-01	4.15E-03	1.00E+05	1.11E+00
4.00E+02	3.51E+02	3.01E+02	5.09E-01	5.66E+02	-2.60E+01	2.51E+02	2.33E+02	2.12E-01	4.15E-03	1.00E+05	1.11E+00
4.10E+02	3.50E+02	3.01E+02	5.01E-01	5.67E+02	-2.27E+01	2.48E+02	2.31E+02	2.08E-01	4.15E-03	1.00E+05	1.11E+00
4.20E+02	3.49E+02	3.01E+02	4.92E-01	5.68E+02	-1.99E+01	2.46E+02	2.28E+02	2.05E-01	4.15E-03	1.00E+05	1.11E+00
4.30E+02	3.49E+02	3.01E+02	4.83E-01	5.69E+02	-2.09E+01	2.43E+02	2.26E+02	1.97E-01	4.01E-03	9.67E+04	1.09E+00
4.40E+02	3.48E+02	3.01E+02	4.75E-01	5.71E+02	-2.36E+01	2.41E+02	2.23E+02	1.90E-01	3.87E-03	9.33E+04	1.07E+00
4.50E+02	3.48E+02	3.02E+02	4.68E-01	5.72E+02	-2.66E+01	2.38E+02	2.21E+02	1.83E-01	3.73E-03	9.00E+04	1.05E+00
4.60E+02	3.47E+02	3.02E+02	4.61E-01	5.73E+02	-2.98E+01	2.35E+02	2.18E+02	1.76E-01	3.60E-03	8.67E+04	1.03E+00
4.70E+02	3.47E+02	3.02E+02	4.55E-01	5.73E+02	-3.30E+01	2.33E+02	2.15E+02	1.70E-01	3.46E-03	8.33E+04	1.01E+00
4.80E+02	3.46E+02	3.02E+02	4.50E-01	5.74E+02	-3.63E+01	2.30E+02	2.12E+02	1.64E-01	3.32E-03	8.00E+04	9.86E-01
4.90E+02	3.46E+02	3.02E+02	4.45E-01	5.75E+02	-3.65E+01	2.27E+02	2.09E+02	1.61E-01	3.28E-03	7.92E+04	9.81E-01
5.00E+02	3.45E+02	3.02E+02	4.40E-01	5.75E+02	-3.48E+01	2.24E+02	2.07E+02	1.58E-01	3.25E-03	7.83E+04	9.75E-01
5.10E+02	3.45E+02	3.02E+02	4.35E-01	5.76E+02	-3.30E+01	2.21E+02	2.04E+02	1.56E-01	3.22E-03	7.75E+04	9.70E-01
5.20E+02	3.44E+02	3.02E+02	4.30E-01	5.77E+02	-3.13E+01	2.19E+02	2.01E+02	1.53E-01	3.18E-03	7.67E+04	9.64E-01
5.30E+02	3.44E+02	3.02E+02	4.25E-01	5.77E+02	-2.98E+01	2.16E+02	1.99E+02	1.51E-01	3.15E-03	7.58E+04	9.59E-01
5.40E+02	3.43E+02	3.02E+02	4.20E-01	5.78E+02	-2.84E+01	2.14E+02	1.97E+02	1.48E-01	3.11E-03	7.50E+04	9.53E-01
5.50E+02	3.43E+02	3.02E+02	4.15E-01	5.79E+02	-2.14E+01	2.12E+02	1.94E+02	1.51E-01	3.28E-03	7.92E+04	9.81E-01
5.60E+02	3.42E+02	3.02E+02	4.09E-01	5.80E+02	-1.28E+01	2.10E+02	1.93E+02	1.54E-01	3.46E-03	8.33E+04	1.01E+00
5.70E+02	3.42E+02	3.02E+02	4.02E-01	5.81E+02	-6.47E+00	2.09E+02	1.91E+02	1.58E-01	3.63E-03	8.75E+04	1.03E+00
5.80E+02	3.42E+02	3.02E+02	3.94E-01	5.82E+02	-2.39E+00	2.08E+02	1.90E+02	1.62E-01	3.80E-03	9.17E+04	1.06E+00
5.90E+02	3.42E+02	3.02E+02	3.85E-01	5.83E+02	-3.53E-01	2.07E+02	1.89E+02	1.66E-01	3.98E-03	9.58E+04	1.08E+00
MAX =	3.57E+02	3.02E+02	4.60E+00	5.83E+02	2.06E+03	2.75E+02	2.57E+02	4.65E+00	1.45E-02	3.50E+05	2.01E+00

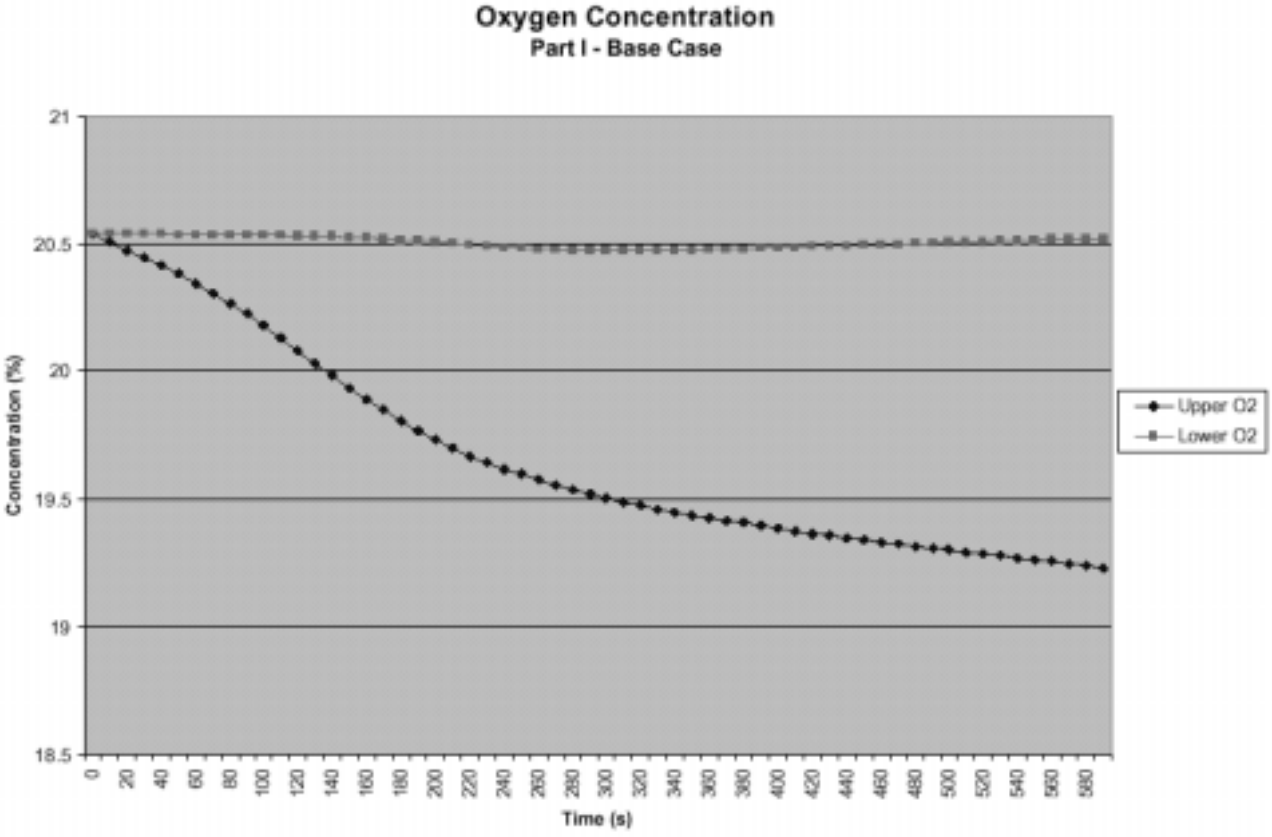
TIME	Main Convec. Size	Target Temperature (1)	Target Flux (1)	Target Fire Rad. (1)	Target Surface Rad. (1)	Target Gas Rad. (1)	Target Convec. (1)	Target Temperature (2)	Target Flux (2)	Target Fire Rad. (2)	Target Surface Rad. (2)
0.00E+00	0.00E+00	3.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+02	4.59E+02	0.00E+00	9.61E+01
1.00E+01	2.33E+04	3.00E+02	5.28E+02	1.28E+01	8.31E+01	4.29E+00	-1.79E-01	3.00E+02	4.61E+02	0.00E+00	9.30E+01
2.00E+01	4.67E+04	3.01E+02	5.95E+02	2.27E+01	7.40E+01	3.78E+00	-4.30E-01	3.00E+02	4.65E+02	0.00E+00	8.88E+01
3.00E+01	7.00E+04	3.02E+02	6.63E+02	3.06E+01	6.67E+01	3.38E+00	-6.60E-01	3.00E+02	4.69E+02	0.00E+00	8.44E+01
4.00E+01	9.33E+04	3.03E+02	7.30E+02	3.70E+01	6.08E+01	3.05E+00	-8.69E-01	3.00E+02	4.75E+02	0.00E+00	7.99E+01
5.00E+01	1.17E+05	3.04E+02	7.98E+02	4.23E+01	5.60E+01	2.79E+00	-1.06E+00	3.00E+02	4.83E+02	0.00E+00	7.54E+01
6.00E+01	1.40E+05	3.05E+02	8.65E+02	4.68E+01	5.18E+01	2.56E+00	-1.23E+00	3.01E+02	4.92E+02	0.00E+00	7.11E+01
7.00E+01	1.57E+05	3.06E+02	9.15E+02	4.98E+01	4.92E+01	2.41E+00	-1.39E+00	3.01E+02	5.02E+02	0.00E+00	6.69E+01
8.00E+01	1.75E+05	3.07E+02	9.64E+02	5.25E+01	4.69E+01	2.28E+00	-1.62E+00	3.01E+02	5.14E+02	0.00E+00	6.30E+01
9.00E+01	1.92E+05	3.08E+02	1.01E+03	5.49E+01	4.48E+01	2.16E+00	-1.85E+00	3.01E+02	5.27E+02	0.00E+00	5.92E+01
1.00E+02	2.10E+05	3.10E+02	1.16E+03	5.05E+01	3.62E+01	6.02E+00	7.31E+00	3.01E+02	5.42E+02	0.00E+00	5.57E+01
1.10E+02	2.27E+05	3.11E+02	1.20E+03	4.80E+01	2.86E+01	1.54E+01	7.98E+00	3.01E+02	5.58E+02	0.00E+00	5.24E+01
1.20E+02	2.45E+05	3.13E+02	1.24E+03	4.57E+01	2.38E+01	2.16E+01	8.77E+00	3.02E+02	5.76E+02	0.00E+00	4.93E+01
1.30E+02	2.44E+05	3.14E+02	1.24E+03	4.19E+01	2.11E+01	2.70E+01	9.94E+00	3.02E+02	5.94E+02	0.00E+00	4.64E+01
1.40E+02	2.43E+05	3.15E+02	1.24E+03	3.86E+01	1.90E+01	3.15E+01	1.10E+01	3.02E+02	6.11E+02	0.00E+00	4.38E+01
1.50E+02	2.41E+05	3.16E+02	1.24E+03	3.56E+01	1.72E+01	3.53E+01	1.19E+01	3.02E+02	6.28E+02	0.00E+00	4.14E+01
1.60E+02	2.40E+05	3.16E+02	1.24E+03	3.29E+01	1.58E+01	3.87E+01	1.26E+01	3.02E+02	6.44E+02	0.00E+00	3.92E+01
1.70E+02	2.39E+05	3.17E+02	1.25E+03	3.05E+01	1.45E+01	4.17E+01	1.33E+01	3.02E+02	6.60E+02	0.00E+00	3.73E+01
1.80E+02	2.38E+05	3.18E+02	1.26E+03	2.83E+01	1.35E+01	4.43E+01	1.38E+01	3.02E+02	6.75E+02	0.00E+00	3.55E+01
1.90E+02	2.22E+05	3.19E+02	1.24E+03	2.52E+01	1.28E+01	4.74E+01	1.46E+01	3.02E+02	6.89E+02	0.00E+00	3.39E+01
2.00E+02	2.05E+05	3.19E+02	1.22E+03	2.25E+01	1.22E+01	5.02E+01	1.51E+01	3.02E+02	7.00E+02	0.00E+00	3.25E+01
2.10E+02	1.89E+05	3.20E+02	1.21E+03	2.00E+01	1.17E+01	5.27E+01	1.56E+01	3.02E+02	7.09E+02	0.00E+00	3.14E+01
2.20E+02	1.73E+05	3.20E+02	1.19E+03	1.78E+01	1.14E+01	5.49E+01	1.59E+01	3.02E+02	7.15E+02	0.00E+00	3.05E+01
2.30E+02	1.56E+05	3.20E+02	1.17E+03	1.58E+01	1.11E+01	5.69E+01	1.62E+01	3.02E+02	7.20E+02	0.00E+00	2.97E+01
2.40E+02	1.40E+05	3.21E+02	1.15E+03	1.40E+01	1.09E+01	5.88E+01	1.63E+01	3.02E+02	7.22E+02	0.00E+00	2.91E+01
2.50E+02	1.34E+05	3.21E+02	1.14E+03	1.31E+01	1.07E+01	5.99E+01	1.63E+01	3.02E+02	7.24E+02	0.00E+00	2.86E+01
2.60E+02	1.28E+05	3.21E+02	1.13E+03	1.24E+01	1.05E+01	6.09E+01	1.62E+01	3.02E+02	7.26E+02	0.00E+00	2.82E+01
2.70E+02	1.22E+05	3.21E+02	1.12E+03	1.17E+01	1.04E+01	6.18E+01	1.62E+01	3.02E+02	7.28E+02	0.00E+00	2.79E+01
2.80E+02	1.17E+05	3.21E+02	1.11E+03	1.10E+01	1.03E+01	6.26E+01	1.61E+01	3.02E+02	7.29E+02	0.00E+00	2.76E+01
2.90E+02	1.11E+05	3.22E+02	1.10E+03	1.04E+01	1.02E+01	6.34E+01	1.60E+01	3.02E+02	7.29E+02	0.00E+00	2.73E+01
3.00E+02	1.05E+05	3.22E+02	1.09E+03	9.79E+00	1.01E+01	6.41E+01	1.59E+01	3.02E+02	7.29E+02	0.00E+00	2.71E+01
3.10E+02	9.92E+04	3.22E+02	1.08E+03	9.23E+00	1.01E+01	6.49E+01	1.58E+01	3.02E+02	7.28E+02	0.00E+00	2.70E+01
3.20E+02	9.33E+04	3.22E+02	1.06E+03	8.68E+00	1.01E+01	6.55E+01	1.57E+01	3.02E+02	7.27E+02	0.00E+00	2.69E+01
3.30E+02	8.75E+04	3.22E+02	1.05E+03	8.16E+00	1.01E+01	6.62E+01	1.55E+01	3.02E+02	7.25E+02	0.00E+00	2.68E+01
3.40E+02	8.17E+04	3.22E+02	1.04E+03	7.65E+00	1.02E+01	6.68E+01	1.54E+01	3.02E+02	7.23E+02	0.00E+00	2.68E+01
3.50E+02	7.58E+04	3.22E+02	1.02E+03	7.15E+00	1.02E+01	6.75E+01	1.52E+01	3.02E+02	7.20E+02	0.00E+00	2.68E+01
3.60E+02	7.00E+04	3.22E+02	1.01E+03	6.65E+00	1.03E+01	6.81E+01	1.50E+01	3.02E+02	7.17E+02	0.00E+00	2.68E+01
3.70E+02	7.00E+04	3.22E+02	9.99E+02	6.68E+00	1.03E+01	6.83E+01	1.47E+01	3.02E+02	7.13E+02	0.00E+00	2.68E+01
3.80E+02	7.00E+04	3.22E+02	9.90E+02	6.70E+00	1.04E+01	6.85E+01	1.44E+01	3.02E+02	7.10E+02	0.00E+00	2.69E+01
3.90E+02	7.00E+04	3.22E+02	9.82E+02	6.71E+00	1.04E+01	6.87E+01	1.42E+01	3.02E+02	7.07E+02	0.00E+00	2.69E+01
4.00E+02	7.00E+04	3.22E+02	9.75E+02	6.73E+00	1.04E+01	6.90E+01	1.39E+01	3.02E+02	7.05E+02	0.00E+00	2.69E+01
4.10E+02	7.00E+04	3.22E+02	9.67E+02	6.74E+00	1.04E+01	6.92E+01	1.37E+01	3.02E+02	7.02E+02	0.00E+00	2.70E+01
4.20E+02	7.00E+04	3.22E+02	9.61E+02	6.75E+00	1.04E+01	6.94E+01	1.34E+01	3.02E+02	7.00E+02	0.00E+00	2.70E+01
4.30E+02	6.77E+04	3.22E+02	9.52E+02	6.55E+00	1.05E+01	6.97E+01	1.33E+01	3.02E+02	6.97E+02	0.00E+00	2.70E+01
4.40E+02	6.53E+04	3.22E+02	9.43E+02	6.35E+00	1.05E+01	7.01E+01	1.31E+01	3.02E+02	6.95E+02	0.00E+00	2.70E+01
4.50E+02	6.30E+04	3.22E+02	9.34E+02	6.15E+00	1.06E+01	7.04E+01	1.29E+01	3.02E+02	6.92E+02	0.00E+00	2.71E+01
4.60E+02	6.07E+04	3.22E+02	9.25E+02	5.96E+00	1.06E+01	7.08E+01	1.27E+01	3.02E+02	6.89E+02	0.00E+00	2.71E+01
4.70E+02	5.83E+04	3.22E+02	9.16E+02	5.76E+00	1.07E+01	7.11E+01	1.25E+01	3.02E+02	6.87E+02	0.00E+00	2.72E+01
4.80E+02	5.60E+04	3.22E+02	9.07E+02	5.57E+00	1.07E+01	7.14E+01	1.23E+01	3.02E+02	6.84E+02	0.00E+00	2.72E+01
4.90E+02	5.54E+04	3.22E+02	9.00E+02	5.54E+00	1.08E+01	7.16E+01	1.21E+01	3.02E+02	6.81E+02	0.00E+00	2.73E+01
5.00E+02	5.48E+04	3.22E+02	8.93E+02	5.50E+00	1.08E+01	7.18E+01	1.19E+01	3.02E+02	6.78E+02	0.00E+00	2.74E+01
5.10E+02	5.42E+04	3.22E+02	8.86E+02	5.47E+00	1.09E+01	7.20E+01	1.16E+01	3.02E+02	6.75E+02	0.00E+00	2.74E+01
5.20E+02	5.37E+04	3.22E+02	8.79E+02	5.44E+00	1.09E+01	7.22E+01	1.14E+01	3.02E+02	6.73E+02	0.00E+00	2.75E+01
5.30E+02	5.31E+04	3.22E+02	8.73E+02	5.40E+00	1.10E+01	7.24E+01	1.13E+01	3.02E+02	6.70E+02	0.00E+00	2.75E+01
5.40E+02	5.25E+04	3.22E+02	8.67E+02	5.36E+00	1.10E+01	7.25E+01	1.11E+01	3.02E+02	6.68E+02	0.00E+00	2.76E+01
5.50E+02	5.54E+04	3.22E+02	8.64E+02	5.66E+00	1.10E+01	7.25E+01	1.08E+01	3.02E+02	6.66E+02	0.00E+00	2.76E+01
5.60E+02	5.83E+04	3.22E+02	8.62E+02	5.95E+00	1.10E+01	7.24E+01	1.06E+01	3.02E+02	6.64E+02	0.00E+00	2.77E+01
5.70E+02	6.12E+04	3.22E+02	8.61E+02	6.22E+00	1.10E+01	7.23E+01	1.05E+01	3.02E+02	6.63E+02	0.00E+00	2.77E+01
5.80E+02	6.42E+04	3.22E+02	8.61E+02	6.49E+00	1.09E+01	7.23E+01	1.03E+01	3.02E+02	6.62E+02	0.00E+00	2.77E+01
5.90E+02	6.71E+04	3.22E+02	8.61E+02	6.74E+00	1.09E+01	7.22E+01	1.02E+01	3.02E+02	6.61E+02	0.00E+00	2.76E+01
MAX =	2.45E+05	3.22E+02	1.26E+03	5.49E+01	8.31E+01	7.25E+01	1.63E+01	3.02E+02	7.29E+02	0.00E+00	9.61E+01

TIME	Target Gas Rad. (2)	Target Convec. (2)	Upper N2 (1)	Upper O2 (1)	Upper CO2 (1)	Upper CO (1)	Upper HCN (1)	Upper HCL (1)	Upper TUHC (1)	Upper H2O (1)	Upper OD (1)
0.00E+00	3.92E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E+00	0.00E+00
1.00E+01	7.01E+00	-1.55E-02	7.77E+01	2.05E+01	1.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E+00	0.00E+00
2.00E+01	1.12E+01	-3.10E-02	7.77E+01	2.05E+01	3.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E+00	0.00E+00
3.00E+01	1.57E+01	-4.01E-02	7.77E+01	2.04E+01	4.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E+00	0.00E+00
4.00E+01	2.02E+01	-4.11E-02	7.77E+01	2.04E+01	6.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.87E+00	0.00E+00
5.00E+01	2.46E+01	-3.37E-02	7.76E+01	2.04E+01	8.30E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E+00	0.00E+00
6.00E+01	2.89E+01	-1.84E-02	7.76E+01	2.03E+01	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E+00	0.00E+00
7.00E+01	3.31E+01	2.10E-03	7.76E+01	2.03E+01	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.98E+00	0.00E+00
8.00E+01	3.70E+01	2.14E-02	7.76E+01	2.03E+01	1.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E+00	0.00E+00
9.00E+01	4.07E+01	4.02E-02	7.75E+01	2.02E+01	1.67E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.06E+00	0.00E+00
1.00E+02	4.42E+01	5.86E-02	7.75E+01	2.02E+01	1.91E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E+00	0.00E+00
1.10E+02	4.75E+01	7.61E-02	7.75E+01	2.01E+01	2.16E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.15E+00	0.00E+00
1.20E+02	5.06E+01	9.23E-02	7.75E+01	2.01E+01	2.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.21E+00	0.00E+00
1.30E+02	5.35E+01	1.02E-01	7.74E+01	2.00E+01	2.70E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E+00	0.00E+00
1.40E+02	5.62E+01	8.89E-02	7.74E+01	2.00E+01	2.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E+00	0.00E+00
1.50E+02	5.86E+01	6.09E-02	7.74E+01	1.99E+01	3.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E+00	0.00E+00
1.60E+02	6.08E+01	2.34E-02	7.74E+01	1.99E+01	3.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E+00	0.00E+00
1.70E+02	6.28E+01	-1.95E-02	7.73E+01	1.98E+01	3.68E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E+00	0.00E+00
1.80E+02	6.46E+01	-6.46E-02	7.73E+01	1.98E+01	3.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E+00	0.00E+00
1.90E+02	6.63E+01	-1.14E-01	7.73E+01	1.98E+01	4.12E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.52E+00	0.00E+00
2.00E+02	6.77E+01	-1.77E-01	7.73E+01	1.97E+01	4.31E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.56E+00	0.00E+00
2.10E+02	6.89E+01	-2.46E-01	7.73E+01	1.97E+01	4.48E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E+00	0.00E+00
2.20E+02	6.99E+01	-3.16E-01	7.72E+01	1.97E+01	4.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E+00	0.00E+00
2.30E+02	7.07E+01	-3.79E-01	7.72E+01	1.96E+01	4.78E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E+00	0.00E+00
2.40E+02	7.13E+01	-4.30E-01	7.72E+01	1.96E+01	4.91E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.68E+00	0.00E+00
2.50E+02	7.18E+01	-4.62E-01	7.72E+01	1.96E+01	5.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E+00	0.00E+00
2.60E+02	7.22E+01	-4.67E-01	7.72E+01	1.96E+01	5.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.72E+00	0.00E+00
2.70E+02	7.26E+01	-4.55E-01	7.72E+01	1.96E+01	5.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E+00	0.00E+00
2.80E+02	7.28E+01	-4.34E-01	7.72E+01	1.95E+01	5.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E+00	0.00E+00
2.90E+02	7.31E+01	-4.10E-01	7.72E+01	1.95E+01	5.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.77E+00	0.00E+00
3.00E+02	7.32E+01	-3.86E-01	7.72E+01	1.95E+01	5.52E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E+00	0.00E+00
3.10E+02	7.34E+01	-3.60E-01	7.71E+01	1.95E+01	5.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E+00	0.00E+00
3.20E+02	7.35E+01	-3.36E-01	7.71E+01	1.95E+01	5.67E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E+00	0.00E+00
3.30E+02	7.35E+01	-3.14E-01	7.71E+01	1.95E+01	5.75E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.83E+00	0.00E+00
3.40E+02	7.35E+01	-2.94E-01	7.71E+01	1.94E+01	5.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.85E+00	0.00E+00
3.50E+02	7.35E+01	-2.77E-01	7.71E+01	1.94E+01	5.87E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E+00	0.00E+00
3.60E+02	7.35E+01	-2.61E-01	7.71E+01	1.94E+01	5.93E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.87E+00	0.00E+00
3.70E+02	7.34E+01	-2.48E-01	7.71E+01	1.94E+01	5.98E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.88E+00	0.00E+00
3.80E+02	7.34E+01	-2.35E-01	7.71E+01	1.94E+01	6.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E+00	0.00E+00
3.90E+02	7.33E+01	-2.24E-01	7.71E+01	1.94E+01	6.08E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.90E+00	0.00E+00
4.00E+02	7.33E+01	-2.15E-01	7.71E+01	1.94E+01	6.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.91E+00	0.00E+00
4.10E+02	7.32E+01	-2.06E-01	7.71E+01	1.94E+01	6.19E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.92E+00	0.00E+00
4.20E+02	7.32E+01	-1.98E-01	7.71E+01	1.94E+01	6.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.93E+00	0.00E+00
4.30E+02	7.32E+01	-1.90E-01	7.71E+01	1.94E+01	6.29E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.93E+00	0.00E+00
4.40E+02	7.32E+01	-1.83E-01	7.71E+01	1.93E+01	6.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+00	0.00E+00
4.50E+02	7.31E+01	-1.76E-01	7.71E+01	1.93E+01	6.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E+00	0.00E+00
4.60E+02	7.31E+01	-1.69E-01	7.71E+01	1.93E+01	6.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.96E+00	0.00E+00
4.70E+02	7.30E+01	-1.63E-01	7.71E+01	1.93E+01	6.48E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.97E+00	0.00E+00
4.80E+02	7.29E+01	-1.57E-01	7.71E+01	1.93E+01	6.52E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E+00	0.00E+00
4.90E+02	7.29E+01	-1.51E-01	7.71E+01	1.93E+01	6.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E+00	0.00E+00
5.00E+02	7.28E+01	-1.46E-01	7.71E+01	1.93E+01	6.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.99E+00	0.00E+00
5.10E+02	7.27E+01	-1.42E-01	7.70E+01	1.93E+01	6.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+00	0.00E+00
5.20E+02	7.27E+01	-1.37E-01	7.70E+01	1.93E+01	6.68E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+00	0.00E+00
5.30E+02	7.26E+01	-1.34E-01	7.70E+01	1.93E+01	6.72E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E+00	0.00E+00
5.40E+02	7.25E+01	-1.30E-01	7.70E+01	1.93E+01	6.75E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E+00	0.00E+00
5.50E+02	7.25E+01	-1.27E-01	7.70E+01	1.93E+01	6.79E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E+00	0.00E+00
5.60E+02	7.24E+01	-1.24E-01	7.70E+01	1.93E+01	6.83E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.03E+00	0.00E+00
5.70E+02	7.24E+01	-1.22E-01	7.70E+01	1.92E+01	6.88E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E+00	0.00E+00
5.80E+02	7.25E+01	-1.20E-01	7.70E+01	1.92E+01	6.92E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E+00	0.00E+00
5.90E+02	7.25E+01	-1.18E-01	7.70E+01	1.92E+01	6.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E+00	0.00E+00
MAX =	7.35E+01	1.02E-01	7.77E+01	2.05E+01	6.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E+00	0.00E+00

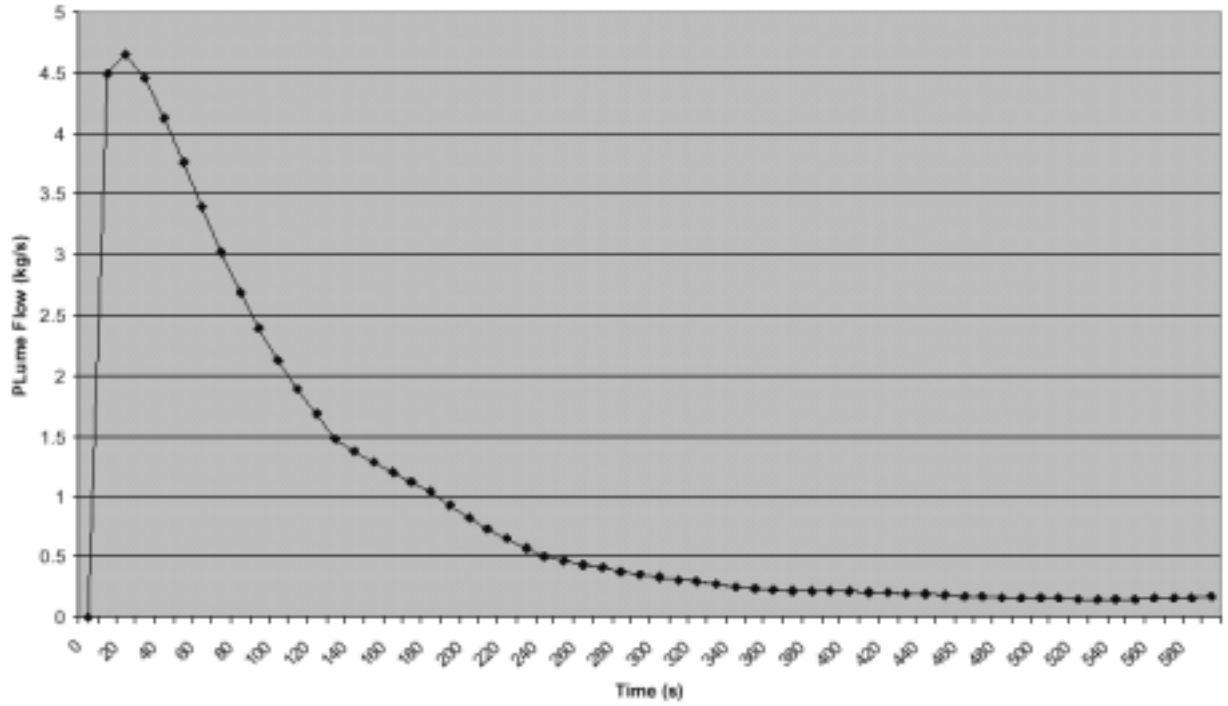
TIME	HCl c (1)	HCl uw (1)	HCl lw (1)	HCl f (1)	Lower N2 (1)	Lower O2 (1)	Lower CO2 (1)	Lower CO (1)	Lower HCN (1)	Lower HCL (1)	Lower TUHC (1)
0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MAX =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TIME	Lower H2O (1)	Lower OD (1)	HCl c (1)	HCl uw (1)	HCl lw (1)	HCl f (1)	Upper Inflow 1-Outside (1)	Upper Outflow 1-Outside (1)	Lower Inflow 1-Outside (1)	Lower Outflow 1-Outside (1)
0.00E+00	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.00E-18	0.00E+00
1.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.52E-02
2.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-01
3.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E-01
4.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E-01
5.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E-01
6.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-01
7.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.68E-01
8.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-01
9.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.47E-01
1.00E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.83E-01
1.10E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.17E-01
1.20E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.50E-01
1.30E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.74E-01
1.40E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.84E-01
1.50E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.86E-01
1.60E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.82E-01
1.70E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.72E-01
1.80E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-01
1.90E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.38E-01
2.00E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.03E-01
2.10E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.56E-01
2.20E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.00E-01
2.30E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.36E-01
2.40E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E-01
2.50E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-01
2.60E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-01
2.70E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.22E-02
2.80E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.25E-02
2.90E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-02
3.00E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.73E-02
3.10E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.49E-03	0.00E+00
3.20E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-02	0.00E+00
3.30E+02	1.74E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.32E-02	0.00E+00
3.40E+02	1.73E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.78E-02	0.00E+00
3.50E+02	1.72E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-02	0.00E+00
3.60E+02	1.71E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-02	0.00E+00
3.70E+02	1.70E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.84E-02	0.00E+00
3.80E+02	1.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.45E-02	0.00E+00
3.90E+02	1.67E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.99E-02	0.00E+00
4.00E+02	1.65E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.54E-02	0.00E+00
4.10E+02	1.64E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.12E-02	0.00E+00
4.20E+02	1.63E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.72E-02	0.00E+00
4.30E+02	1.62E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.86E-02	0.00E+00
4.40E+02	1.61E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.24E-02	0.00E+00
4.50E+02	1.59E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.63E-02	0.00E+00
4.60E+02	1.58E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.00E-02	0.00E+00
4.70E+02	1.56E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.37E-02	0.00E+00
4.80E+02	1.55E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.73E-02	0.00E+00
4.90E+02	1.53E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.76E-02	0.00E+00
5.00E+02	1.52E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-02	0.00E+00
5.10E+02	1.50E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.38E-02	0.00E+00
5.20E+02	1.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.19E-02	0.00E+00
5.30E+02	1.47E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.01E-02	0.00E+00
5.40E+02	1.46E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.84E-02	0.00E+00
5.50E+02	1.44E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.94E-02	0.00E+00
5.60E+02	1.43E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.60E-02	0.00E+00
5.70E+02	1.42E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.26E-02	0.00E+00
5.80E+02	1.42E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-02	0.00E+00
5.90E+02	1.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.63E-03	0.00E+00
MAX =	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.84E-02	5.86E-01

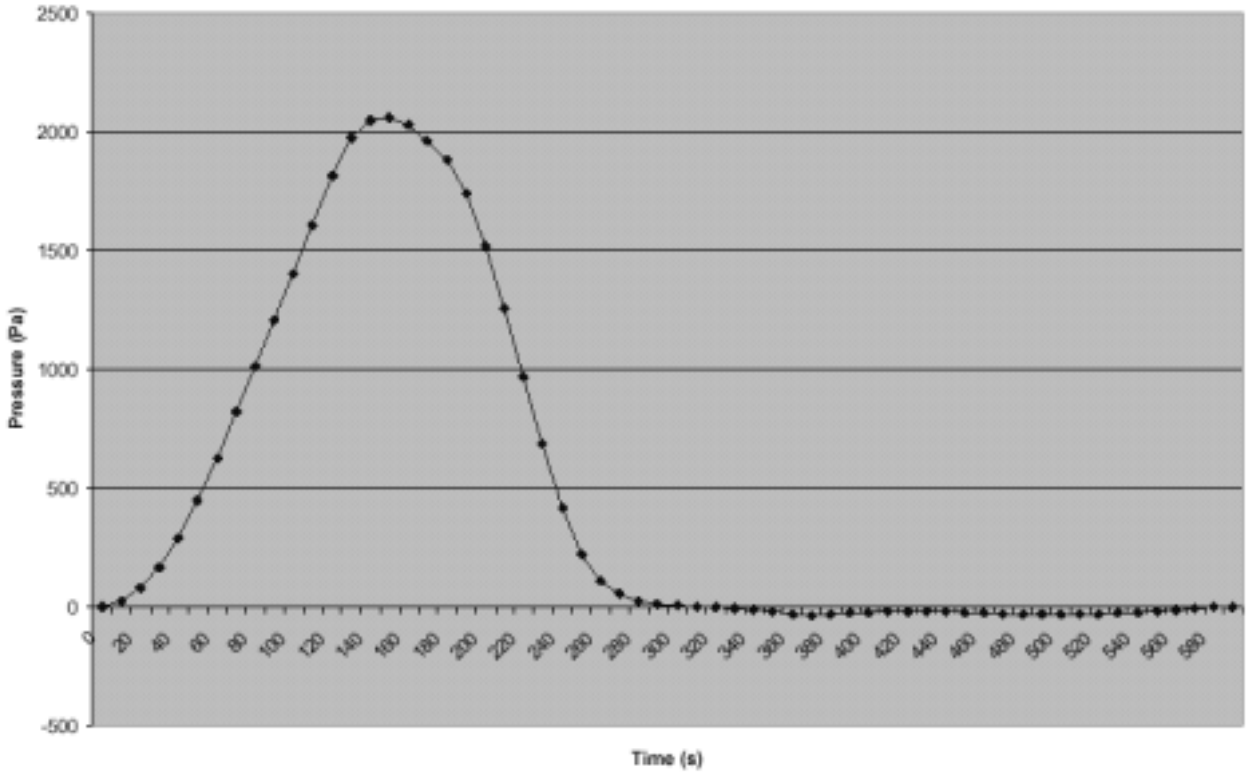

Heat Release Rate
Part I - Base Case
Heat Release Rate (W)
400000
350000
300000
250000
200000
150000
100000
50000
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580
Time (s)

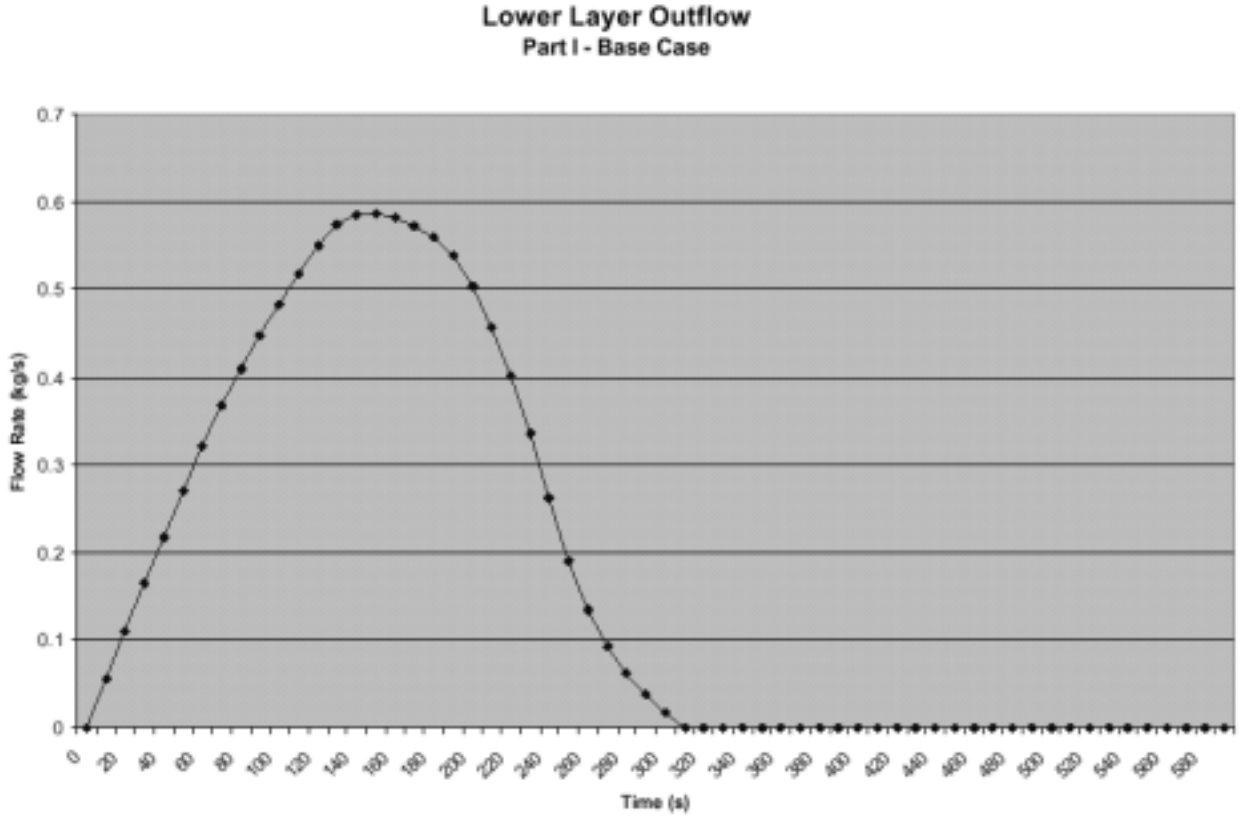

Oxygen Concentration
Part I - Base Case
Concentration (%)
21
20.5
20
19.5
19
18.5
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580
Time (s)
Upper O2
Lower O2

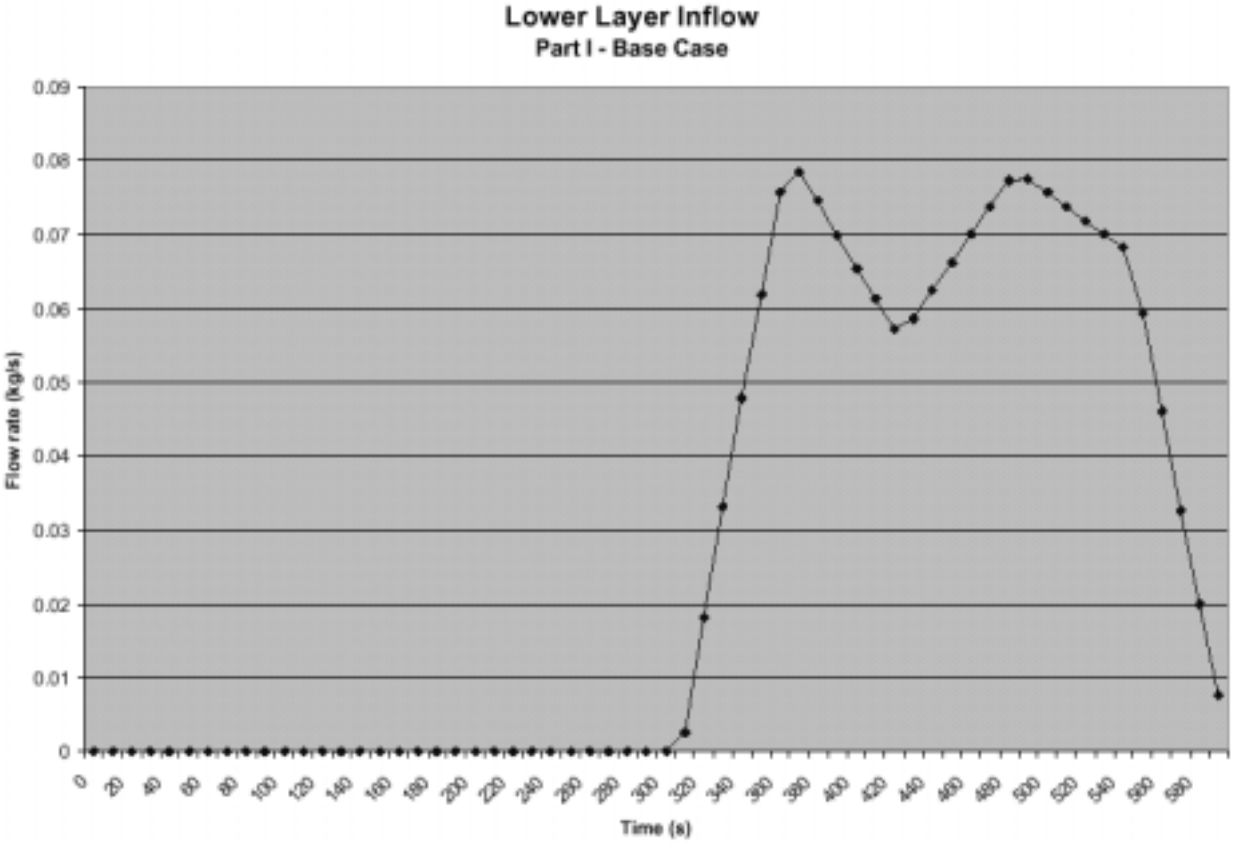
Plume Flow
Part I - Base Case

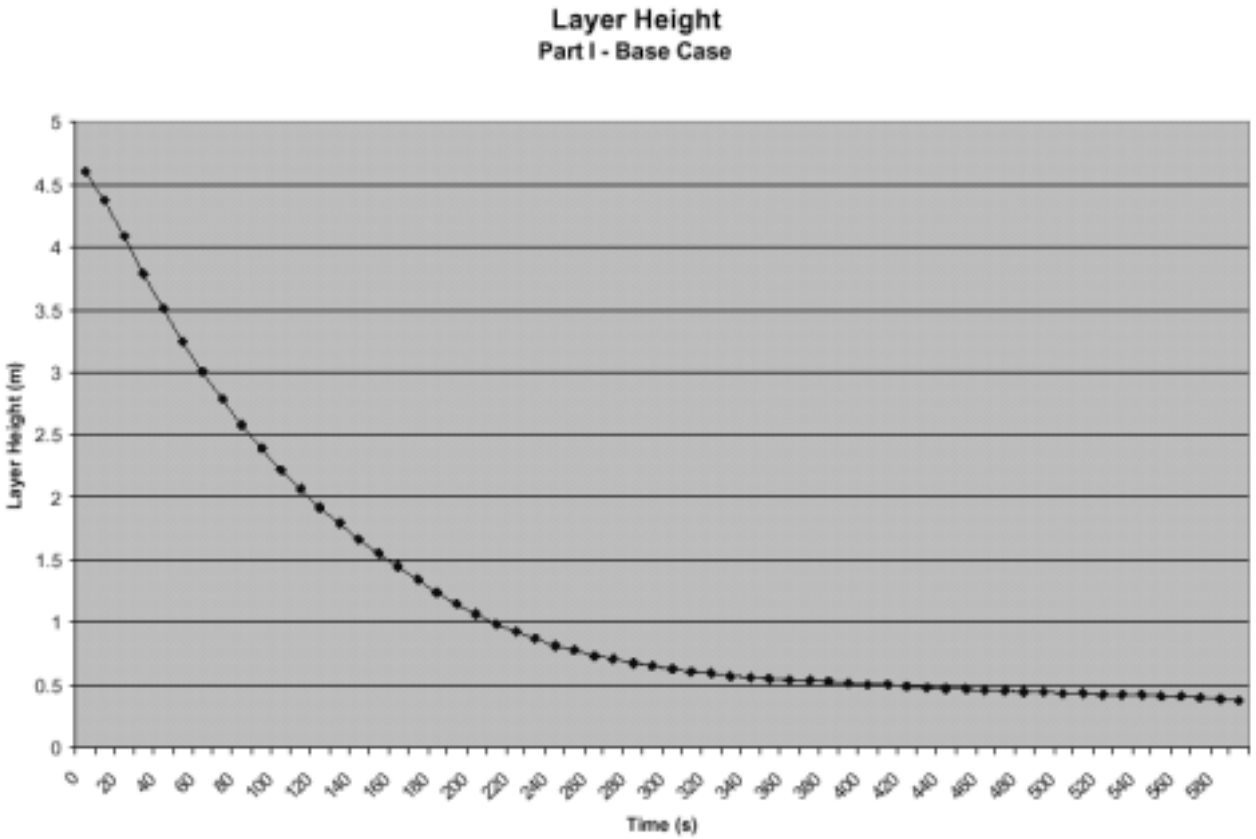


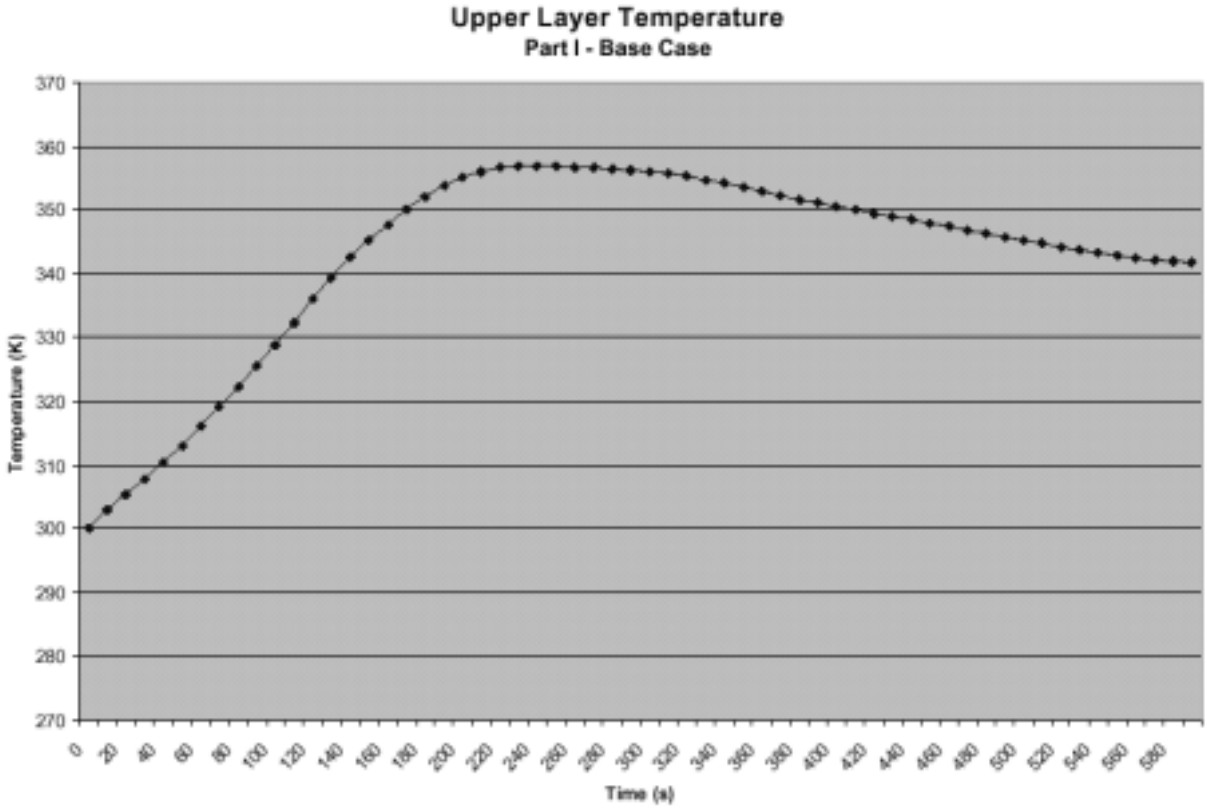
Pressure
Part I - Base Case

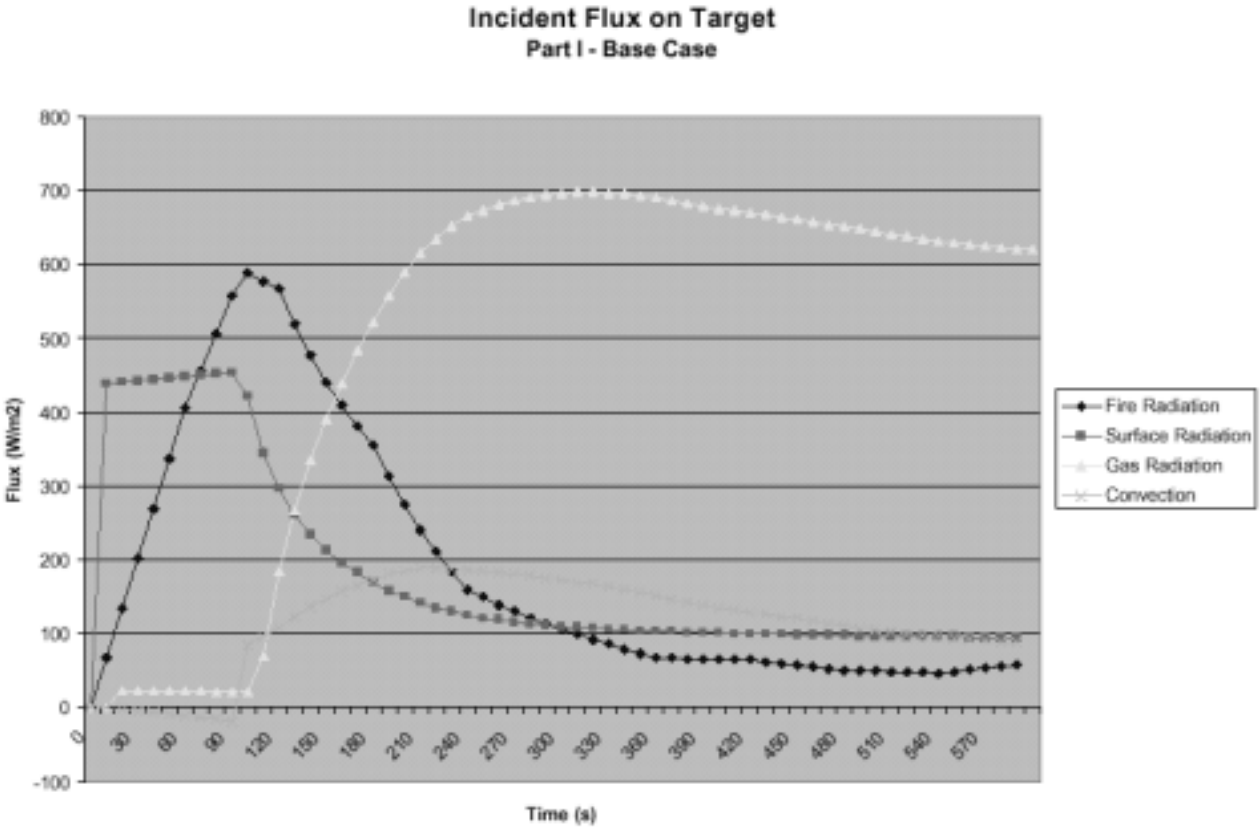


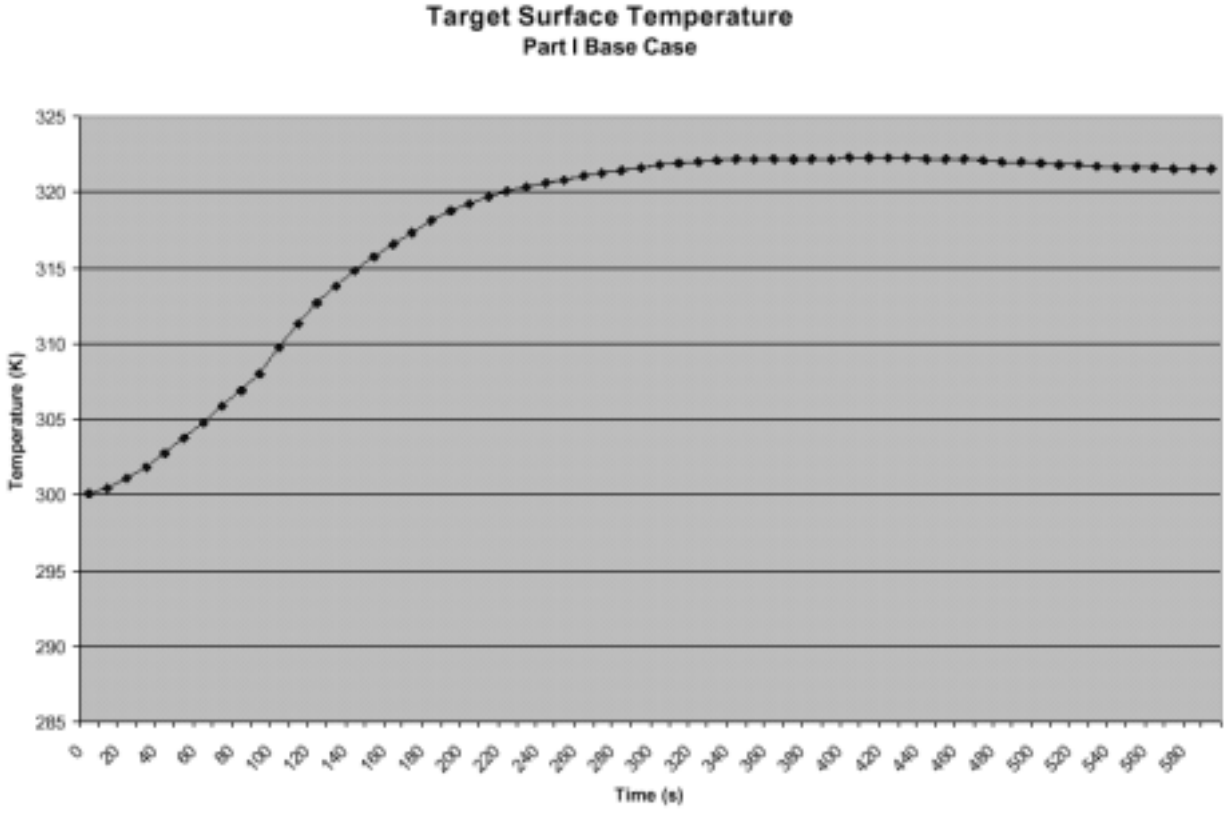

Lower Layer Outflow
Part I - Base Case
Flow Rate (kg/s)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580
Time (s)


Lower Layer Inflow
Part I - Base Case
Flow rate (kg/s)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580
Time (s)


Layer Height
Part I - Base Case
Layer Height (m)
Time (s)


Upper Layer Temperature
Part I - Base Case
Temperature (K)
Time (s)


Incident Flux on Target
Part I - Base Case
Flux (W/m2)
Time (s)
Fire Radiation
Surface Radiation
Gas Radiation
Convection


Target Surface Temperature
Part I Base Case
Temperature (K)
Time (s)

Appendix 5 - Results from Verification Effort

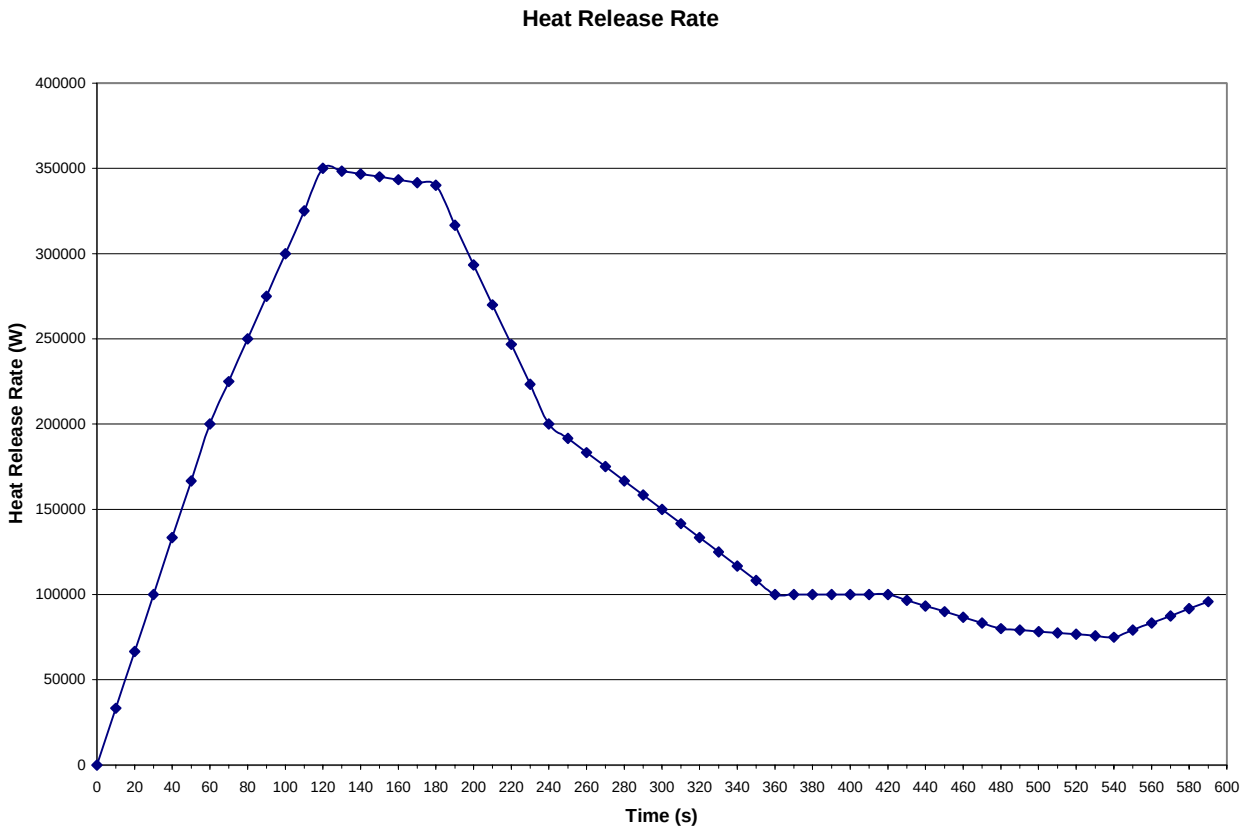
TIME	Upper Layer Temp (1)	Lower Layer Temp (1)	Layer Height (1)	Upper Layer Volume (1)	Pressure (1)	Ambient Target (1)	Floor Target (1)	Main Plume Flow	Main Pyrolysis Rate	Main Fire Size	Main Flame Height
0.00E+00	3.00E+02	3.00E+02	4.60E+00	6.36E-02	-1.48E-18	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.00E+01	3.03E+02	3.00E+02	4.37E+00	3.18E+01	1.85E+01	2.10E+00	1.72E+00	4.48E+00	1.38E-03	3.33E+04	6.04E-01
2.00E+01	3.05E+02	3.00E+02	4.08E+00	7.23E+01	7.41E+01	5.57E+00	4.50E+00	4.65E+00	2.77E-03	6.67E+04	8.95E-01
3.00E+01	3.08E+02	3.00E+02	3.78E+00	1.13E+02	1.65E+02	1.04E+01	8.48E+00	4.45E+00	4.15E-03	1.00E+05	1.11E+00
4.00E+01	3.10E+02	3.00E+02	3.50E+00	1.52E+02	2.88E+02	1.68E+01	1.38E+01	4.13E+00	5.53E-03	1.33E+05	1.28E+00
5.00E+01	3.13E+02	3.00E+02	3.24E+00	1.88E+02	4.42E+02	2.47E+01	2.06E+01	3.76E+00	6.92E-03	1.67E+05	1.42E+00
6.00E+01	3.16E+02	3.01E+02	3.00E+00	2.21E+02	6.25E+02	3.43E+01	2.89E+01	3.39E+00	8.30E-03	2.00E+05	1.55E+00
7.00E+01	3.19E+02	3.01E+02	2.78E+00	2.52E+02	8.17E+02	4.51E+01	3.84E+01	3.02E+00	9.34E-03	2.25E+05	1.64E+00
8.00E+01	3.22E+02	3.01E+02	2.58E+00	2.80E+02	1.01E+03	5.72E+01	4.93E+01	2.68E+00	1.04E-02	2.50E+05	1.72E+00
9.00E+01	3.25E+02	3.01E+02	2.39E+00	3.05E+02	1.20E+03	7.08E+01	6.15E+01	2.39E+00	1.14E-02	2.75E+05	1.80E+00
1.00E+02	3.29E+02	3.01E+02	2.22E+00	3.29E+02	1.40E+03	8.58E+01	7.52E+01	2.12E+00	1.24E-02	3.00E+05	1.87E+00
1.10E+02	3.32E+02	3.01E+02	2.07E+00	3.50E+02	1.61E+03	1.02E+02	9.05E+01	1.88E+00	1.35E-02	3.25E+05	1.94E+00
1.20E+02	3.36E+02	3.02E+02	1.92E+00	3.70E+02	1.82E+03	1.21E+02	1.07E+02	1.67E+00	1.45E-02	3.50E+05	2.01E+00
1.30E+02	3.39E+02	3.02E+02	1.79E+00	3.88E+02	1.97E+03	1.39E+02	1.24E+02	1.47E+00	1.45E-02	3.48E+05	2.00E+00
1.40E+02	3.42E+02	3.02E+02	1.67E+00	4.05E+02	2.05E+03	1.56E+02	1.41E+02	1.37E+00	1.44E-02	3.47E+05	2.00E+00
1.50E+02	3.45E+02	3.02E+02	1.56E+00	4.21E+02	2.06E+03	1.73E+02	1.57E+02	1.28E+00	1.43E-02	3.45E+05	1.99E+00
1.60E+02	3.48E+02	3.02E+02	1.45E+00	4.36E+02	2.03E+03	1.90E+02	1.73E+02	1.20E+00	1.42E-02	3.43E+05	1.99E+00
1.70E+02	3.50E+02	3.02E+02	1.34E+00	4.51E+02	1.96E+03	2.06E+02	1.88E+02	1.11E+00	1.42E-02	3.42E+05	1.99E+00
1.80E+02	3.52E+02	3.02E+02	1.24E+00	4.64E+02	1.88E+03	2.22E+02	2.03E+02	1.04E+00	1.41E-02	3.40E+05	1.98E+00
1.90E+02	3.54E+02	3.02E+02	1.15E+00	4.77E+02	1.74E+03	2.35E+02	2.17E+02	9.24E-01	1.31E-02	3.17E+05	1.92E+00
2.00E+02	3.55E+02	3.02E+02	1.07E+00	4.89E+02	1.52E+03	2.46E+02	2.28E+02	8.23E-01	1.22E-02	2.93E+05	1.85E+00
2.10E+02	3.56E+02	3.01E+02	9.94E-01	4.99E+02	1.25E+03	2.55E+02	2.36E+02	7.31E-01	1.12E-02	2.70E+05	1.79E+00
2.20E+02	3.57E+02	3.01E+02	9.28E-01	5.08E+02	9.68E+02	2.62E+02	2.43E+02	6.48E-01	1.02E-02	2.47E+05	1.71E+00
2.30E+02	3.57E+02	3.01E+02	8.70E-01	5.16E+02	6.82E+02	2.66E+02	2.47E+02	5.74E-01	9.27E-03	2.23E+05	1.64E+00
2.40E+02	3.57E+02	3.01E+02	8.20E-01	5.23E+02	4.17E+02	2.69E+02	2.50E+02	5.07E-01	8.30E-03	2.00E+05	1.56E+00
2.50E+02	3.57E+02	3.01E+02	7.78E-01	5.29E+02	2.21E+02	2.71E+02	2.52E+02	4.70E-01	7.95E-03	1.92E+05	1.53E+00
2.60E+02	3.57E+02	3.01E+02	7.41E-01	5.34E+02	1.09E+02	2.72E+02	2.54E+02	4.38E-01	7.61E-03	1.83E+05	1.49E+00
2.70E+02	3.57E+02	3.01E+02	7.09E-01	5.38E+02	5.17E+01	2.74E+02	2.56E+02	4.08E-01	7.26E-03	1.75E+05	1.46E+00
2.80E+02	3.56E+02	3.01E+02	6.80E-01	5.42E+02	2.38E+01	2.75E+02	2.57E+02	3.81E-01	6.92E-03	1.67E+05	1.43E+00
2.90E+02	3.56E+02	3.01E+02	6.55E-01	5.46E+02	9.16E+00	2.75E+02	2.57E+02	3.56E-01	6.57E-03	1.58E+05	1.39E+00
3.00E+02	3.56E+02	3.01E+02	6.32E-01	5.49E+02	1.81E+00	2.75E+02	2.57E+02	3.33E-01	6.22E-03	1.50E+05	1.36E+00
3.10E+02	3.56E+02	3.01E+02	6.12E-01	5.52E+02	-3.83E-02	2.74E+02	2.57E+02	3.12E-01	5.88E-03	1.42E+05	1.32E+00
3.20E+02	3.55E+02	3.01E+02	5.95E-01	5.54E+02	-1.99E+00	2.73E+02	2.56E+02	2.93E-01	5.53E-03	1.33E+05	1.28E+00
3.30E+02	3.55E+02	3.01E+02	5.79E-01	5.56E+02	-6.69E+00	2.71E+02	2.54E+02	2.74E-01	5.19E-03	1.25E+05	1.24E+00
3.40E+02	3.54E+02	3.01E+02	5.66E-01	5.58E+02	-1.39E+01	2.69E+02	2.52E+02	2.57E-01	4.84E-03	1.17E+05	1.20E+00
3.50E+02	3.54E+02	3.01E+02	5.54E-01	5.60E+02	-2.33E+01	2.66E+02	2.49E+02	2.40E-01	4.50E-03	1.08E+05	1.15E+00
3.60E+02	3.53E+02	3.01E+02	5.44E-01	5.61E+02	-3.48E+01	2.63E+02	2.45E+02	2.25E-01	4.15E-03	1.00E+05	1.11E+00
3.70E+02	3.52E+02	3.01E+02	5.35E-01	5.62E+02	-3.73E+01	2.59E+02	2.42E+02	2.21E-01	4.15E-03	1.00E+05	1.11E+00
3.80E+02	3.52E+02	3.01E+02	5.27E-01	5.63E+02	-3.37E+01	2.56E+02	2.39E+02	2.18E-01	4.15E-03	1.00E+05	1.11E+00
3.90E+02	3.51E+02	3.01E+02	5.18E-01	5.65E+02	-2.97E+01	2.53E+02	2.36E+02	2.15E-01	4.15E-03	1.00E+05	1.11E+00
4.00E+02	3.51E+02	3.01E+02	5.09E-01	5.66E+02	-2.60E+01	2.51E+02	2.33E+02	2.12E-01	4.15E-03	1.00E+05	1.11E+00
4.10E+02	3.50E+02	3.01E+02	5.01E-01	5.67E+02	-2.28E+01	2.48E+02	2.31E+02	2.08E-01	4.15E-03	1.00E+05	1.11E+00
4.20E+02	3.49E+02	3.01E+02	4.92E-01	5.68E+02	-1.99E+01	2.46E+02	2.28E+02	2.05E-01	4.15E-03	1.00E+05	1.11E+00
4.30E+02	3.49E+02	3.01E+02	4.83E-01	5.69E+02	-2.09E+01	2.43E+02	2.26E+02	1.97E-01	4.01E-03	9.67E+04	1.09E+00
4.40E+02	3.48E+02	3.01E+02	4.75E-01	5.71E+02	-2.37E+01	2.41E+02	2.23E+02	1.90E-01	3.87E-03	9.33E+04	1.07E+00
4.50E+02	3.48E+02	3.02E+02	4.68E-01	5.72E+02	-2.67E+01	2.38E+02	2.21E+02	1.83E-01	3.73E-03	9.00E+04	1.05E+00
4.60E+02	3.47E+02	3.02E+02	4.61E-01	5.72E+02	-2.98E+01	2.35E+02	2.18E+02	1.76E-01	3.60E-03	8.67E+04	1.03E+00
4.70E+02	3.47E+02	3.02E+02	4.55E-01	5.73E+02	-3.30E+01	2.32E+02	2.15E+02	1.70E-01	3.46E-03	8.33E+04	1.01E+00
4.80E+02	3.46E+02	3.02E+02	4.50E-01	5.74E+02	-3.63E+01	2.30E+02	2.12E+02	1.64E-01	3.32E-03	8.00E+04	9.86E-01
4.90E+02	3.46E+02	3.02E+02	4.45E-01	5.75E+02	-3.66E+01	2.27E+02	2.10E+02	1.61E-01	3.28E-03	7.92E+04	9.81E-01
5.00E+02	3.45E+02	3.02E+02	4.40E-01	5.75E+02	-3.49E+01	2.24E+02	2.07E+02	1.58E-01	3.25E-03	7.83E+04	9.75E-01
5.10E+02	3.45E+02	3.02E+02	4.35E-01	5.76E+02	-3.31E+01	2.21E+02	2.04E+02	1.56E-01	3.22E-03	7.75E+04	9.70E-01
5.20E+02	3.44E+02	3.02E+02	4.30E-01	5.77E+02	-3.14E+01	2.19E+02	2.02E+02	1.53E-01	3.18E-03	7.67E+04	9.64E-01
5.30E+02	3.44E+02	3.02E+02	4.25E-01	5.77E+02	-2.98E+01	2.16E+02	1.99E+02	1.51E-01	3.15E-03	7.58E+04	9.59E-01
5.40E+02	3.43E+02	3.02E+02	4.20E-01	5.78E+02	-2.84E+01	2.14E+02	1.97E+02	1.48E-01	3.11E-03	7.50E+04	9.53E-01
5.50E+02	3.43E+02	3.02E+02	4.15E-01	5.79E+02	-2.15E+01	2.12E+02	1.94E+02	1.51E-01	3.28E-03	7.92E+04	9.81E-01
5.60E+02	3.42E+02	3.02E+02	4.09E-01	5.80E+02	-1.29E+01	2.10E+02	1.93E+02	1.54E-01	3.46E-03	8.33E+04	1.01E+00
5.70E+02	3.42E+02	3.02E+02	4.02E-01	5.81E+02	-6.49E+00	2.09E+02	1.91E+02	1.58E-01	3.63E-03	8.75E+04	1.03E+00
5.80E+02	3.42E+02	3.02E+02	3.94E-01	5.82E+02	-2.40E+00	2.08E+02	1.90E+02	1.62E-01	3.80E-03	9.17E+04	1.06E+00
5.90E+02	3.42E+02	3.02E+02	3.85E-01	5.83E+02	-3.57E-01	2.07E+02	1.89E+02	1.66E-01	3.98E-03	9.58E+04	1.08E+00
MAX =	3.57E+02	3.02E+02	4.60E+00	5.83E+02	2.06E+03	2.75E+02	2.57E+02	4.65E+00	1.45E-02	3.50E+05	2.01E+00

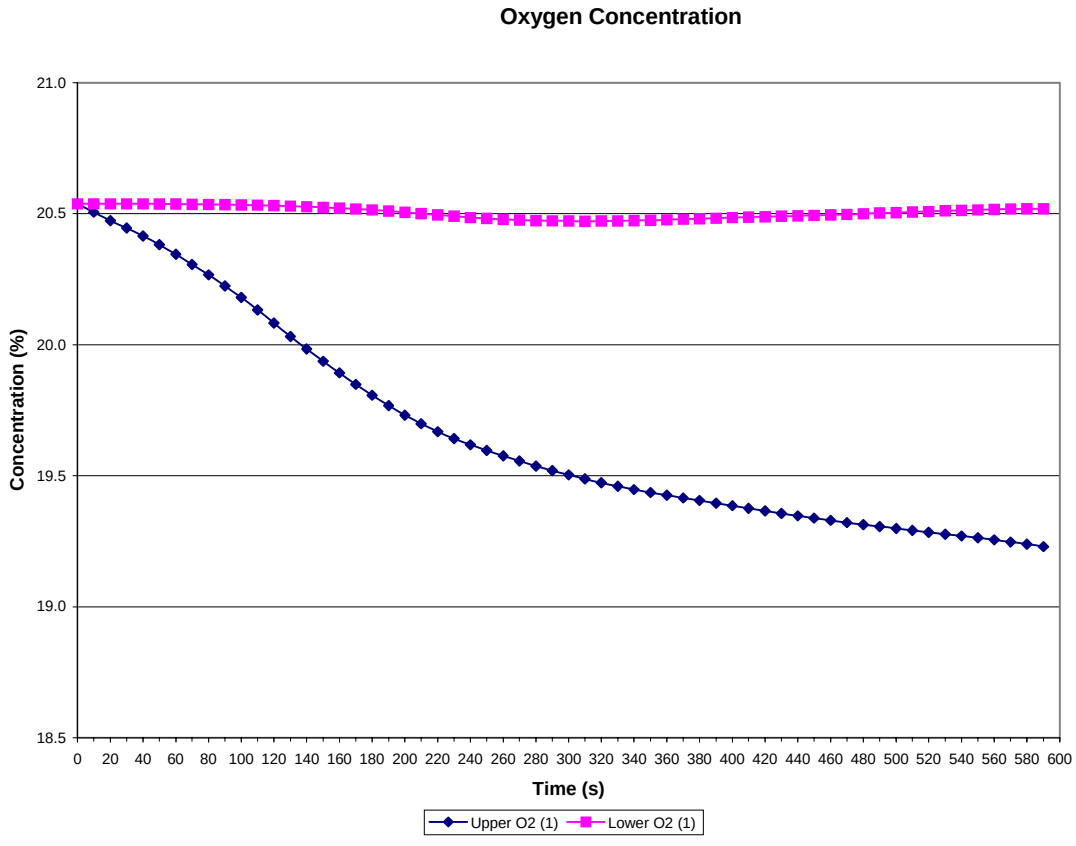
TIME	Main Convec. Size	Target Temperature (1)	Target Flux (1)	Target Fire Rad. (1)	Target Surface Rad. (1)	Target Gas Rad. (1)	Target Convec. (1)	Target Temperature (2)	Target Flux (2)	Target Fire Rad. (2)	Target Surface Rad. (2)
0.00E+00	0.00E+00	3.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+02	4.59E+02	0.00E+00	9.61E+01
1.00E+01	2.33E+04	3.00E+02	5.28E+02	1.28E+01	8.31E+01	4.29E+00	-1.79E-01	3.00E+02	4.61E+02	0.00E+00	9.30E+01
2.00E+01	4.67E+04	3.01E+02	5.95E+02	2.27E+01	7.40E+01	3.78E+00	-4.30E-01	3.00E+02	4.65E+02	0.00E+00	8.88E+01
3.00E+01	7.00E+04	3.02E+02	6.63E+02	3.06E+01	6.67E+01	3.38E+00	-6.60E-01	3.00E+02	4.69E+02	0.00E+00	8.44E+01
4.00E+01	9.33E+04	3.03E+02	7.30E+02	3.70E+01	6.08E+01	3.05E+00	-8.69E-01	3.00E+02	4.75E+02	0.00E+00	7.99E+01
5.00E+01	1.17E+05	3.04E+02	7.98E+02	4.23E+01	5.60E+01	2.79E+00	-1.06E+00	3.00E+02	4.83E+02	0.00E+00	7.54E+01
6.00E+01	1.40E+05	3.05E+02	8.65E+02	4.68E+01	5.18E+01	2.56E+00	-1.23E+00	3.01E+02	4.92E+02	0.00E+00	7.11E+01
7.00E+01	1.57E+05	3.06E+02	9.15E+02	4.98E+01	4.92E+01	2.41E+00	-1.39E+00	3.01E+02	5.02E+02	0.00E+00	6.69E+01
8.00E+01	1.75E+05	3.07E+02	9.64E+02	5.25E+01	4.69E+01	2.28E+00	-1.62E+00	3.01E+02	5.14E+02	0.00E+00	6.30E+01
9.00E+01	1.92E+05	3.08E+02	1.01E+03	5.49E+01	4.48E+01	2.16E+00	-1.85E+00	3.01E+02	5.27E+02	0.00E+00	5.93E+01
1.00E+02	2.10E+05	3.10E+02	1.16E+03	5.05E+01	3.62E+01	6.02E+00	7.31E+00	3.01E+02	5.42E+02	0.00E+00	5.57E+01
1.10E+02	2.27E+05	3.11E+02	1.20E+03	4.80E+01	2.86E+01	1.54E+01	7.98E+00	3.01E+02	5.58E+02	0.00E+00	5.24E+01
1.20E+02	2.45E+05	3.13E+02	1.24E+03	4.57E+01	2.38E+01	2.16E+01	8.77E+00	3.02E+02	5.76E+02	0.00E+00	4.93E+01
1.30E+02	2.44E+05	3.14E+02	1.24E+03	4.19E+01	2.11E+01	2.70E+01	9.94E+00	3.02E+02	5.94E+02	0.00E+00	4.64E+01
1.40E+02	2.43E+05	3.15E+02	1.24E+03	3.86E+01	1.90E+01	3.15E+01	1.10E+01	3.02E+02	6.11E+02	0.00E+00	4.38E+01
1.50E+02	2.41E+05	3.16E+02	1.24E+03	3.56E+01	1.72E+01	3.53E+01	1.19E+01	3.02E+02	6.28E+02	0.00E+00	4.14E+01
1.60E+02	2.40E+05	3.16E+02	1.24E+03	3.29E+01	1.58E+01	3.87E+01	1.26E+01	3.02E+02	6.44E+02	0.00E+00	3.92E+01
1.70E+02	2.39E+05	3.17E+02	1.25E+03	3.05E+01	1.45E+01	4.17E+01	1.33E+01	3.02E+02	6.60E+02	0.00E+00	3.73E+01
1.80E+02	2.38E+05	3.18E+02	1.26E+03	2.83E+01	1.35E+01	4.43E+01	1.38E+01	3.02E+02	6.75E+02	0.00E+00	3.55E+01
1.90E+02	2.22E+05	3.19E+02	1.24E+03	2.52E+01	1.28E+01	4.74E+01	1.46E+01	3.02E+02	6.89E+02	0.00E+00	3.39E+01
2.00E+02	2.05E+05	3.19E+02	1.22E+03	2.25E+01	1.22E+01	5.02E+01	1.51E+01	3.02E+02	7.00E+02	0.00E+00	3.25E+01
2.10E+02	1.89E+05	3.20E+02	1.21E+03	2.00E+01	1.17E+01	5.27E+01	1.56E+01	3.02E+02	7.09E+02	0.00E+00	3.14E+01
2.20E+02	1.73E+05	3.20E+02	1.19E+03	1.78E+01	1.14E+01	5.49E+01	1.59E+01	3.02E+02	7.15E+02	0.00E+00	3.05E+01
2.30E+02	1.56E+05	3.20E+02	1.17E+03	1.58E+01	1.11E+01	5.69E+01	1.62E+01	3.02E+02	7.20E+02	0.00E+00	2.97E+01
2.40E+02	1.40E+05	3.21E+02	1.15E+03	1.40E+01	1.09E+01	5.88E+01	1.63E+01	3.02E+02	7.22E+02	0.00E+00	2.91E+01
2.50E+02	1.34E+05	3.21E+02	1.14E+03	1.31E+01	1.07E+01	5.99E+01	1.63E+01	3.02E+02	7.24E+02	0.00E+00	2.86E+01
2.60E+02	1.28E+05	3.21E+02	1.13E+03	1.24E+01	1.05E+01	6.09E+01	1.62E+01	3.02E+02	7.26E+02	0.00E+00	2.82E+01
2.70E+02	1.22E+05	3.21E+02	1.12E+03	1.17E+01	1.04E+01	6.18E+01	1.62E+01	3.02E+02	7.28E+02	0.00E+00	2.79E+01
2.80E+02	1.17E+05	3.21E+02	1.11E+03	1.10E+01	1.03E+01	6.26E+01	1.61E+01	3.02E+02	7.29E+02	0.00E+00	2.76E+01
2.90E+02	1.11E+05	3.22E+02	1.10E+03	1.04E+01	1.02E+01	6.34E+01	1.60E+01	3.02E+02	7.29E+02	0.00E+00	2.73E+01
3.00E+02	1.05E+05	3.22E+02	1.09E+03	9.79E+00	1.01E+01	6.41E+01	1.59E+01	3.02E+02	7.29E+02	0.00E+00	2.71E+01
3.10E+02	9.92E+04	3.22E+02	1.08E+03	9.23E+00	1.01E+01	6.49E+01	1.58E+01	3.02E+02	7.28E+02	0.00E+00	2.70E+01
3.20E+02	9.33E+04	3.22E+02	1.06E+03	8.68E+00	1.01E+01	6.55E+01	1.57E+01	3.02E+02	7.27E+02	0.00E+00	2.69E+01
3.30E+02	8.75E+04	3.22E+02	1.05E+03	8.16E+00	1.01E+01	6.62E+01	1.55E+01	3.02E+02	7.25E+02	0.00E+00	2.68E+01
3.40E+02	8.17E+04	3.22E+02	1.04E+03	7.65E+00	1.02E+01	6.68E+01	1.54E+01	3.02E+02	7.23E+02	0.00E+00	2.68E+01
3.50E+02	7.58E+04	3.22E+02	1.02E+03	7.15E+00	1.02E+01	6.75E+01	1.52E+01	3.02E+02	7.20E+02	0.00E+00	2.67E+01
3.60E+02	7.00E+04	3.22E+02	1.01E+03	6.65E+00	1.03E+01	6.81E+01	1.50E+01	3.02E+02	7.17E+02	0.00E+00	2.68E+01
3.70E+02	7.00E+04	3.22E+02	9.99E+02	6.68E+00	1.03E+01	6.83E+01	1.47E+01	3.02E+02	7.13E+02	0.00E+00	2.68E+01
3.80E+02	7.00E+04	3.22E+02	9.90E+02	6.70E+00	1.04E+01	6.85E+01	1.44E+01	3.02E+02	7.10E+02	0.00E+00	2.69E+01
3.90E+02	7.00E+04	3.22E+02	9.82E+02	6.71E+00	1.04E+01	6.87E+01	1.42E+01	3.02E+02	7.07E+02	0.00E+00	2.69E+01
4.00E+02	7.00E+04	3.22E+02	9.75E+02	6.73E+00	1.04E+01	6.90E+01	1.39E+01	3.02E+02	7.05E+02	0.00E+00	2.69E+01
4.10E+02	7.00E+04	3.22E+02	9.67E+02	6.74E+00	1.04E+01	6.92E+01	1.37E+01	3.02E+02	7.02E+02	0.00E+00	2.70E+01
4.20E+02	7.00E+04	3.22E+02	9.61E+02	6.75E+00	1.04E+01	6.94E+01	1.34E+01	3.02E+02	7.00E+02	0.00E+00	2.70E+01
4.30E+02	6.77E+04	3.22E+02	9.52E+02	6.55E+00	1.05E+01	6.97E+01	1.33E+01	3.02E+02	6.97E+02	0.00E+00	2.70E+01
4.40E+02	6.53E+04	3.22E+02	9.43E+02	6.35E+00	1.05E+01	7.01E+01	1.31E+01	3.02E+02	6.95E+02	0.00E+00	2.70E+01
4.50E+02	6.30E+04	3.22E+02	9.34E+02	6.15E+00	1.06E+01	7.04E+01	1.29E+01	3.02E+02	6.92E+02	0.00E+00	2.71E+01
4.60E+02	6.07E+04	3.22E+02	9.25E+02	5.96E+00	1.06E+01	7.08E+01	1.27E+01	3.02E+02	6.89E+02	0.00E+00	2.71E+01
4.70E+02	5.83E+04	3.22E+02	9.16E+02	5.76E+00	1.07E+01	7.11E+01	1.25E+01	3.02E+02	6.87E+02	0.00E+00	2.72E+01
4.80E+02	5.60E+04	3.22E+02	9.07E+02	5.57E+00	1.07E+01	7.14E+01	1.23E+01	3.02E+02	6.84E+02	0.00E+00	2.72E+01
4.90E+02	5.54E+04	3.22E+02	9.00E+02	5.54E+00	1.08E+01	7.16E+01	1.21E+01	3.02E+02	6.81E+02	0.00E+00	2.73E+01
5.00E+02	5.48E+04	3.22E+02	8.93E+02	5.50E+00	1.08E+01	7.18E+01	1.19E+01	3.02E+02	6.78E+02	0.00E+00	2.74E+01
5.10E+02	5.42E+04	3.22E+02	8.86E+02	5.47E+00	1.09E+01	7.20E+01	1.16E+01	3.02E+02	6.75E+02	0.00E+00	2.74E+01
5.20E+02	5.37E+04	3.22E+02	8.79E+02	5.44E+00	1.09E+01	7.22E+01	1.14E+01	3.02E+02	6.73E+02	0.00E+00	2.75E+01
5.30E+02	5.31E+04	3.22E+02	8.73E+02	5.40E+00	1.10E+01	7.24E+01	1.12E+01	3.02E+02	6.70E+02	0.00E+00	2.75E+01
5.40E+02	5.25E+04	3.22E+02	8.67E+02	5.36E+00	1.10E+01	7.25E+01	1.11E+01	3.02E+02	6.68E+02	0.00E+00	2.76E+01
5.50E+02	5.54E+04	3.22E+02	8.64E+02	5.66E+00	1.10E+01	7.25E+01	1.08E+01	3.02E+02	6.66E+02	0.00E+00	2.76E+01
5.60E+02	5.83E+04	3.22E+02	8.62E+02	5.95E+00	1.10E+01	7.24E+01	1.06E+01	3.02E+02	6.64E+02	0.00E+00	2.77E+01
5.70E+02	6.12E+04	3.22E+02	8.61E+02	6.22E+00	1.10E+01	7.23E+01	1.05E+01	3.02E+02	6.63E+02	0.00E+00	2.77E+01
5.80E+02	6.42E+04	3.22E+02	8.61E+02	6.49E+00	1.09E+01	7.23E+01	1.03E+01	3.02E+02	6.62E+02	0.00E+00	2.77E+01
5.90E+02	6.71E+04	3.22E+02	8.61E+02	6.74E+00	1.09E+01	7.22E+01	1.02E+01	3.02E+02	6.61E+02	0.00E+00	2.76E+01
MAX =	2.45E+05	3.22E+02	1.26E+03	5.49E+01	8.31E+01	7.25E+01	1.63E+01	3.02E+02	7.29E+02	0.00E+00	9.61E+01

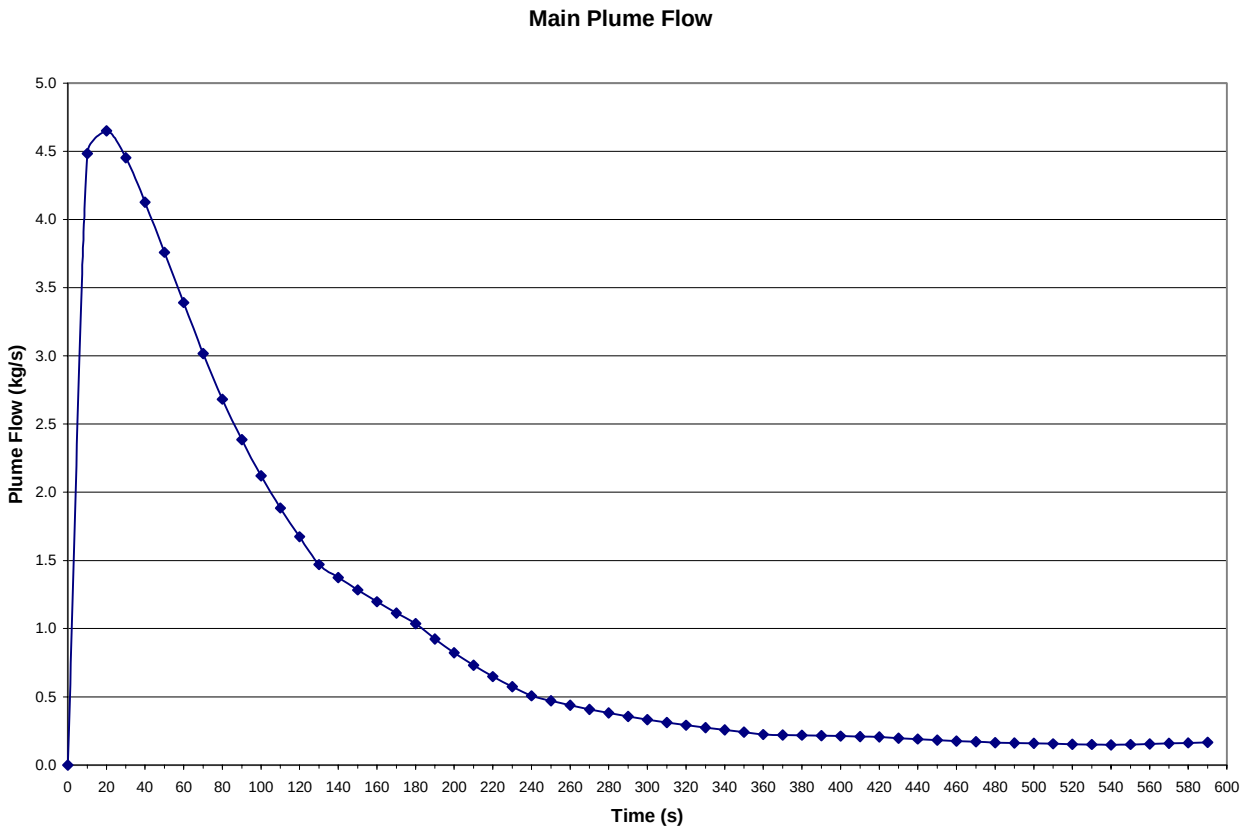
TIME	Target Gas Rad. (2)	Target Convec. (2)	Upper N2 (1)	Upper O2 (1)	Upper CO2 (1)	Upper CO (1)	Upper HCN (1)	Upper HCL (1)	Upper TUHC (1)	Upper H2O (1)	Upper OD (1)
0.00E+00	3.92E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E+00	0.00E+00
1.00E+01	7.01E+00	-1.55E-02	7.77E+01	2.05E+01	1.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.78E+00	0.00E+00
2.00E+01	1.12E+01	-3.10E-02	7.77E+01	2.05E+01	3.34E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E+00	0.00E+00
3.00E+01	1.57E+01	-4.01E-02	7.77E+01	2.04E+01	4.87E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.84E+00	0.00E+00
4.00E+01	2.02E+01	-4.12E-02	7.77E+01	2.04E+01	6.52E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.87E+00	0.00E+00
5.00E+01	2.46E+01	-3.40E-02	7.76E+01	2.04E+01	8.30E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E+00	0.00E+00
6.00E+01	2.89E+01	-1.88E-02	7.76E+01	2.03E+01	1.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.94E+00	0.00E+00
7.00E+01	3.31E+01	1.49E-03	7.76E+01	2.03E+01	1.23E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.98E+00	0.00E+00
8.00E+01	3.70E+01	2.06E-02	7.76E+01	2.03E+01	1.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.02E+00	0.00E+00
9.00E+01	4.07E+01	3.92E-02	7.75E+01	2.02E+01	1.67E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.06E+00	0.00E+00
1.00E+02	4.42E+01	5.74E-02	7.75E+01	2.02E+01	1.91E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.11E+00	0.00E+00
1.10E+02	4.75E+01	7.48E-02	7.75E+01	2.01E+01	2.16E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.15E+00	0.00E+00
1.20E+02	5.06E+01	9.08E-02	7.75E+01	2.01E+01	2.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.21E+00	0.00E+00
1.30E+02	5.35E+01	1.00E-01	7.74E+01	2.00E+01	2.70E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.26E+00	0.00E+00
1.40E+02	5.62E+01	8.73E-02	7.74E+01	2.00E+01	2.96E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.31E+00	0.00E+00
1.50E+02	5.86E+01	5.93E-02	7.74E+01	1.99E+01	3.21E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.35E+00	0.00E+00
1.60E+02	6.08E+01	2.19E-02	7.74E+01	1.99E+01	3.45E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.40E+00	0.00E+00
1.70E+02	6.28E+01	-2.10E-02	7.73E+01	1.98E+01	3.68E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.44E+00	0.00E+00
1.80E+02	6.46E+01	-6.61E-02	7.73E+01	1.98E+01	3.90E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.48E+00	0.00E+00
1.90E+02	6.63E+01	-1.15E-01	7.73E+01	1.98E+01	4.12E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.52E+00	0.00E+00
2.00E+02	6.77E+01	-1.78E-01	7.73E+01	1.97E+01	4.31E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.56E+00	0.00E+00
2.10E+02	6.89E+01	-2.47E-01	7.73E+01	1.97E+01	4.48E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.59E+00	0.00E+00
2.20E+02	6.99E+01	-3.16E-01	7.72E+01	1.97E+01	4.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E+00	0.00E+00
2.30E+02	7.07E+01	-3.79E-01	7.72E+01	1.96E+01	4.78E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.65E+00	0.00E+00
2.40E+02	7.13E+01	-4.30E-01	7.72E+01	1.96E+01	4.91E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.68E+00	0.00E+00
2.50E+02	7.18E+01	-4.61E-01	7.72E+01	1.96E+01	5.02E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E+00	0.00E+00
2.60E+02	7.22E+01	-4.66E-01	7.72E+01	1.96E+01	5.13E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.72E+00	0.00E+00
2.70E+02	7.26E+01	-4.54E-01	7.72E+01	1.96E+01	5.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.74E+00	0.00E+00
2.80E+02	7.28E+01	-4.33E-01	7.72E+01	1.95E+01	5.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.76E+00	0.00E+00
2.90E+02	7.31E+01	-4.09E-01	7.72E+01	1.95E+01	5.43E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.77E+00	0.00E+00
3.00E+02	7.32E+01	-3.84E-01	7.72E+01	1.95E+01	5.52E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.79E+00	0.00E+00
3.10E+02	7.34E+01	-3.58E-01	7.71E+01	1.95E+01	5.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.81E+00	0.00E+00
3.20E+02	7.35E+01	-3.34E-01	7.71E+01	1.95E+01	5.67E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.82E+00	0.00E+00
3.30E+02	7.35E+01	-3.12E-01	7.71E+01	1.95E+01	5.75E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.83E+00	0.00E+00
3.40E+02	7.35E+01	-2.93E-01	7.71E+01	1.94E+01	5.81E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.85E+00	0.00E+00
3.50E+02	7.35E+01	-2.75E-01	7.71E+01	1.94E+01	5.87E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.86E+00	0.00E+00
3.60E+02	7.35E+01	-2.59E-01	7.71E+01	1.94E+01	5.93E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.87E+00	0.00E+00
3.70E+02	7.34E+01	-2.46E-01	7.71E+01	1.94E+01	5.98E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.88E+00	0.00E+00
3.80E+02	7.34E+01	-2.33E-01	7.71E+01	1.94E+01	6.03E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.89E+00	0.00E+00
3.90E+02	7.33E+01	-2.22E-01	7.71E+01	1.94E+01	6.08E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.90E+00	0.00E+00
4.00E+02	7.33E+01	-2.13E-01	7.71E+01	1.94E+01	6.14E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.91E+00	0.00E+00
4.10E+02	7.32E+01	-2.04E-01	7.71E+01	1.94E+01	6.19E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.92E+00	0.00E+00
4.20E+02	7.32E+01	-1.96E-01	7.71E+01	1.94E+01	6.24E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.93E+00	0.00E+00
4.30E+02	7.32E+01	-1.89E-01	7.71E+01	1.94E+01	6.29E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.93E+00	0.00E+00
4.40E+02	7.32E+01	-1.81E-01	7.71E+01	1.93E+01	6.34E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.94E+00	0.00E+00
4.50E+02	7.31E+01	-1.74E-01	7.71E+01	1.93E+01	6.39E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E+00	0.00E+00
4.60E+02	7.31E+01	-1.68E-01	7.71E+01	1.93E+01	6.44E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.96E+00	0.00E+00
4.70E+02	7.30E+01	-1.61E-01	7.71E+01	1.93E+01	6.48E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.97E+00	0.00E+00
4.80E+02	7.29E+01	-1.55E-01	7.71E+01	1.93E+01	6.52E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E+00	0.00E+00
4.90E+02	7.29E+01	-1.50E-01	7.71E+01	1.93E+01	6.56E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.98E+00	0.00E+00
5.00E+02	7.28E+01	-1.45E-01	7.71E+01	1.93E+01	6.60E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.99E+00	0.00E+00
5.10E+02	7.27E+01	-1.40E-01	7.70E+01	1.93E+01	6.64E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+00	0.00E+00
5.20E+02	7.27E+01	-1.36E-01	7.70E+01	1.93E+01	6.68E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E+00	0.00E+00
5.30E+02	7.26E+01	-1.33E-01	7.70E+01	1.93E+01	6.72E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.01E+00	0.00E+00
5.40E+02	7.25E+01	-1.29E-01	7.70E+01	1.93E+01	6.75E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E+00	0.00E+00
5.50E+02	7.25E+01	-1.26E-01	7.70E+01	1.93E+01	6.79E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.02E+00	0.00E+00
5.60E+02	7.25E+01	-1.23E-01	7.70E+01	1.93E+01	6.83E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.03E+00	0.00E+00
5.70E+02	7.24E+01	-1.21E-01	7.70E+01	1.92E+01	6.88E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E+00	0.00E+00
5.80E+02	7.25E+01	-1.19E-01	7.70E+01	1.92E+01	6.92E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.04E+00	0.00E+00
5.90E+02	7.25E+01	-1.18E-01	7.70E+01	1.92E+01	6.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E+00	0.00E+00
MAX =	7.35E+01	1.00E-01	7.77E+01	2.05E+01	6.97E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.05E+00	0.00E+00

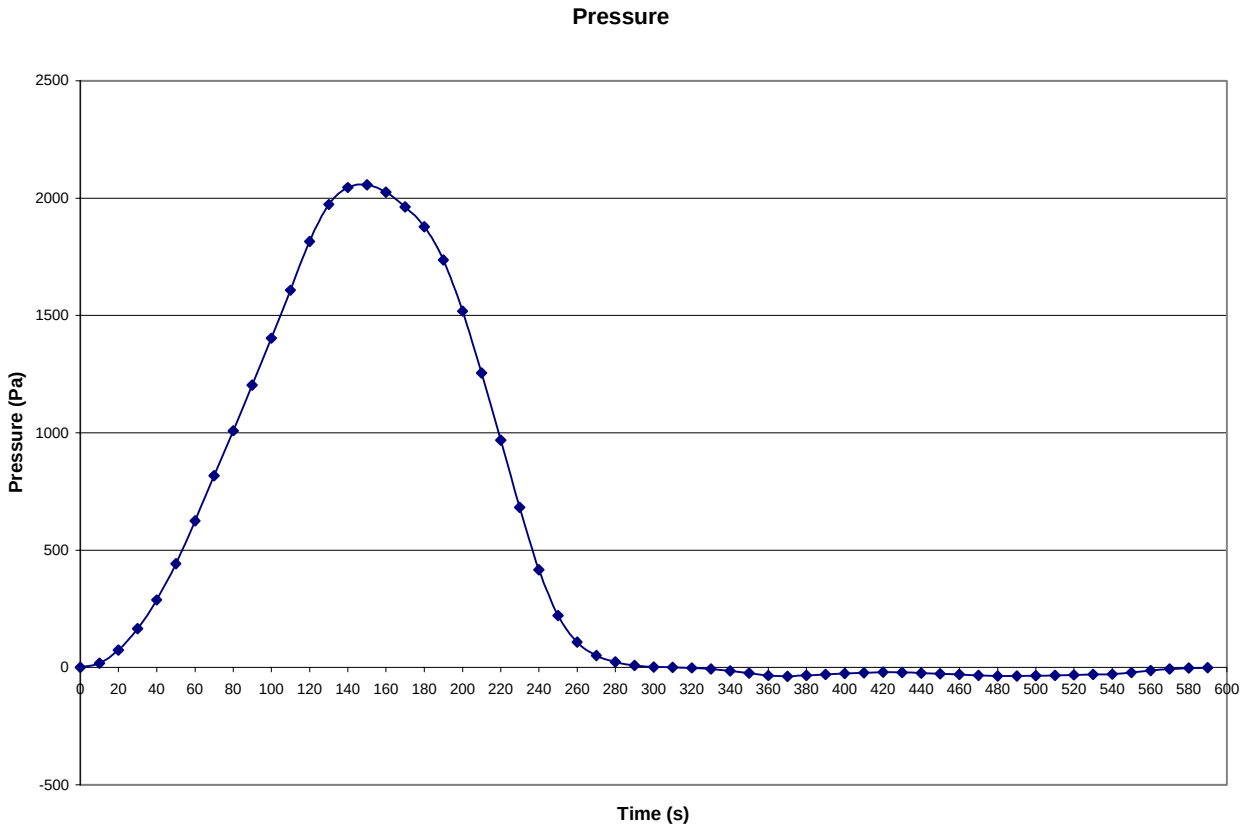
TIME	HCl c (1)	HCl uw (1)	HCl lw (1)	HCl f (1)	Lower N2 (1)	Lower O2 (1)	Lower CO2 (1)	Lower CO (1)	Lower HCN (1)	Lower HCL (1)	Lower TUHC (1)
0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
6.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
7.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
8.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
9.00E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
1.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.77E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.78E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
3.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.79E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.00E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.20E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.30E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.50E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.80E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.60E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.70E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.80E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
5.90E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
MAX =	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.81E+01	2.05E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TIME	Lower H2O (1)	Lower OD (1)	HCl c (1)	HCl uw (1)	HCl lw (1)	HCl f (1)	Upper Inflow 1-Outside (1)	Upper Outflow 1-Outside (1)	Lower Inflow 1-Outside (1)	Lower Outflow 1-Outside (1)
0.00E+00	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.00E-18	0.00E+00
1.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.52E-02
2.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.11E-01
3.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E-01
4.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.18E-01
5.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.70E-01
6.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.22E-01
7.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.68E-01
8.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.09E-01
9.00E+01	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.47E-01
1.00E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.83E-01
1.10E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.17E-01
1.20E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.50E-01
1.30E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.74E-01
1.40E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.85E-01
1.50E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.86E-01
1.60E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.82E-01
1.70E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.72E-01
1.80E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.60E-01
1.90E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.38E-01
2.00E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.03E-01
2.10E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.56E-01
2.20E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.00E-01
2.30E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.36E-01
2.40E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.62E-01
2.50E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.91E-01
2.60E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-01
2.70E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.22E-02
2.80E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.25E-02
2.90E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.88E-02
3.00E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.72E-02
3.10E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.51E-03	0.00E+00
3.20E+02	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E-02	0.00E+00
3.30E+02	1.74E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.32E-02	0.00E+00
3.40E+02	1.73E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.78E-02	0.00E+00
3.50E+02	1.72E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.20E-02	0.00E+00
3.60E+02	1.71E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.57E-02	0.00E+00
3.70E+02	1.70E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.85E-02	0.00E+00
3.80E+02	1.68E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.46E-02	0.00E+00
3.90E+02	1.67E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.00E-02	0.00E+00
4.00E+02	1.65E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.55E-02	0.00E+00
4.10E+02	1.64E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.13E-02	0.00E+00
4.20E+02	1.63E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.73E-02	0.00E+00
4.30E+02	1.62E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.87E-02	0.00E+00
4.40E+02	1.61E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.25E-02	0.00E+00
4.50E+02	1.59E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.63E-02	0.00E+00
4.60E+02	1.58E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.01E-02	0.00E+00
4.70E+02	1.56E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.38E-02	0.00E+00
4.80E+02	1.55E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.74E-02	0.00E+00
4.90E+02	1.53E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.76E-02	0.00E+00
5.00E+02	1.52E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.58E-02	0.00E+00
5.10E+02	1.50E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.38E-02	0.00E+00
5.20E+02	1.48E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.19E-02	0.00E+00
5.30E+02	1.47E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.01E-02	0.00E+00
5.40E+02	1.45E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.85E-02	0.00E+00
5.50E+02	1.44E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.95E-02	0.00E+00
5.60E+02	1.43E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.61E-02	0.00E+00
5.70E+02	1.42E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.27E-02	0.00E+00
5.80E+02	1.42E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.99E-02	0.00E+00
5.90E+02	1.41E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.67E-03	0.00E+00
MAX =	1.75E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.85E-02	5.86E-01

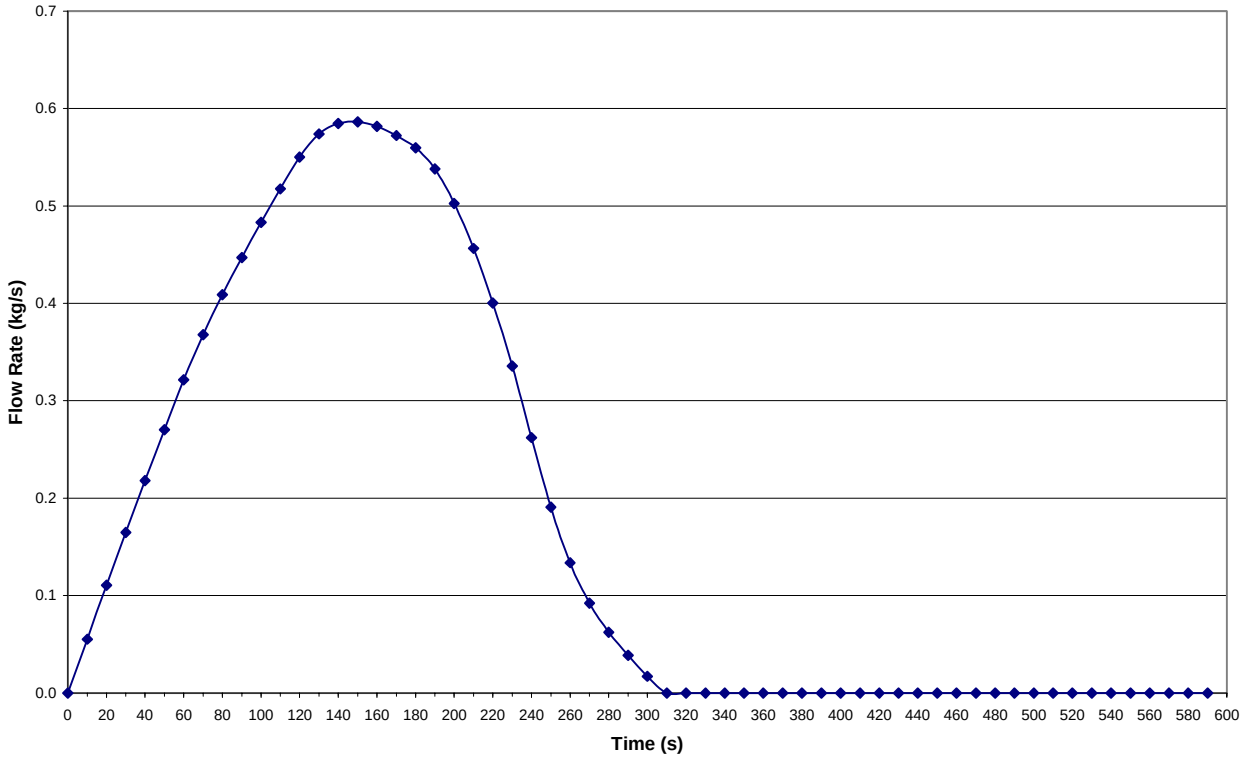

Heat Release Rate
Heat Release Rate (W)
400000
350000
300000
250000
200000
150000
100000
50000
0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
Time (s)


Oxygen Concentration
Concentration (%)
21.0
20.5
20.0
19.5
19.0
18.5
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
Time (s)
Upper O2 (1)
Lower O2 (1)

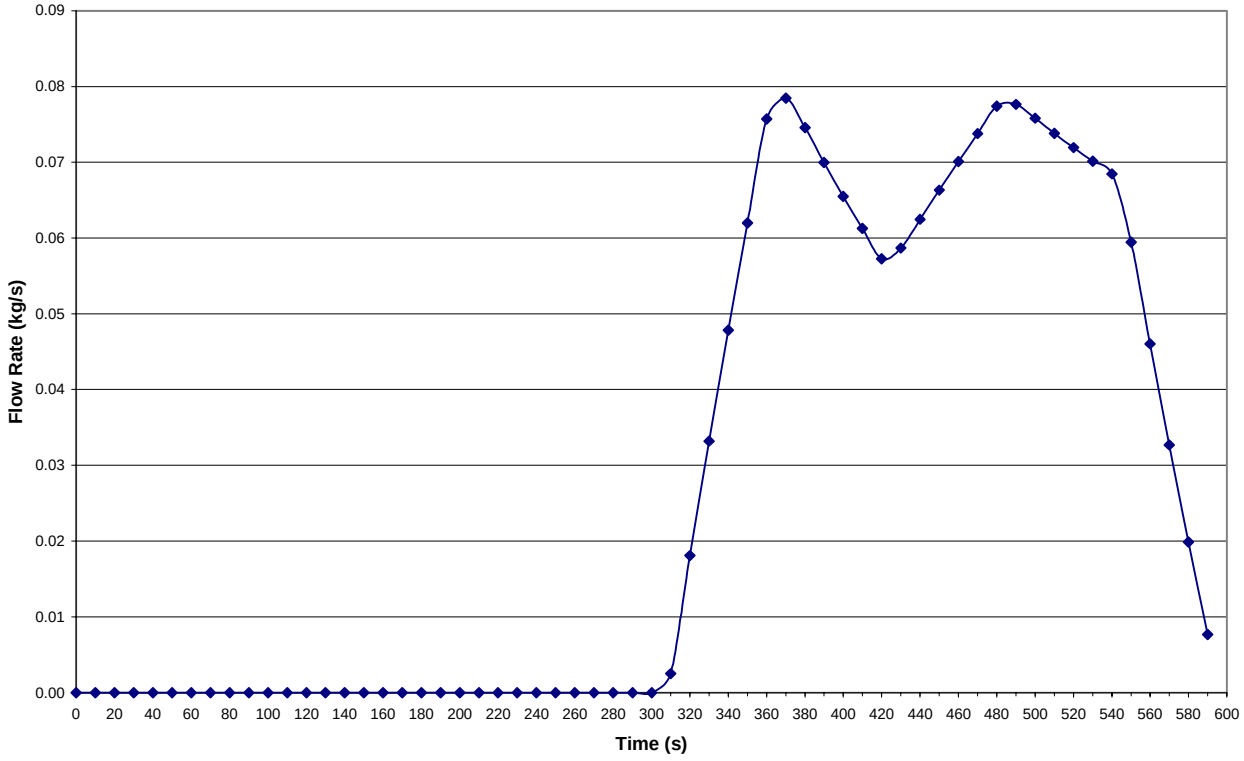

Main Plume Flow
Plume Flow (kg/s)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
Time (s)

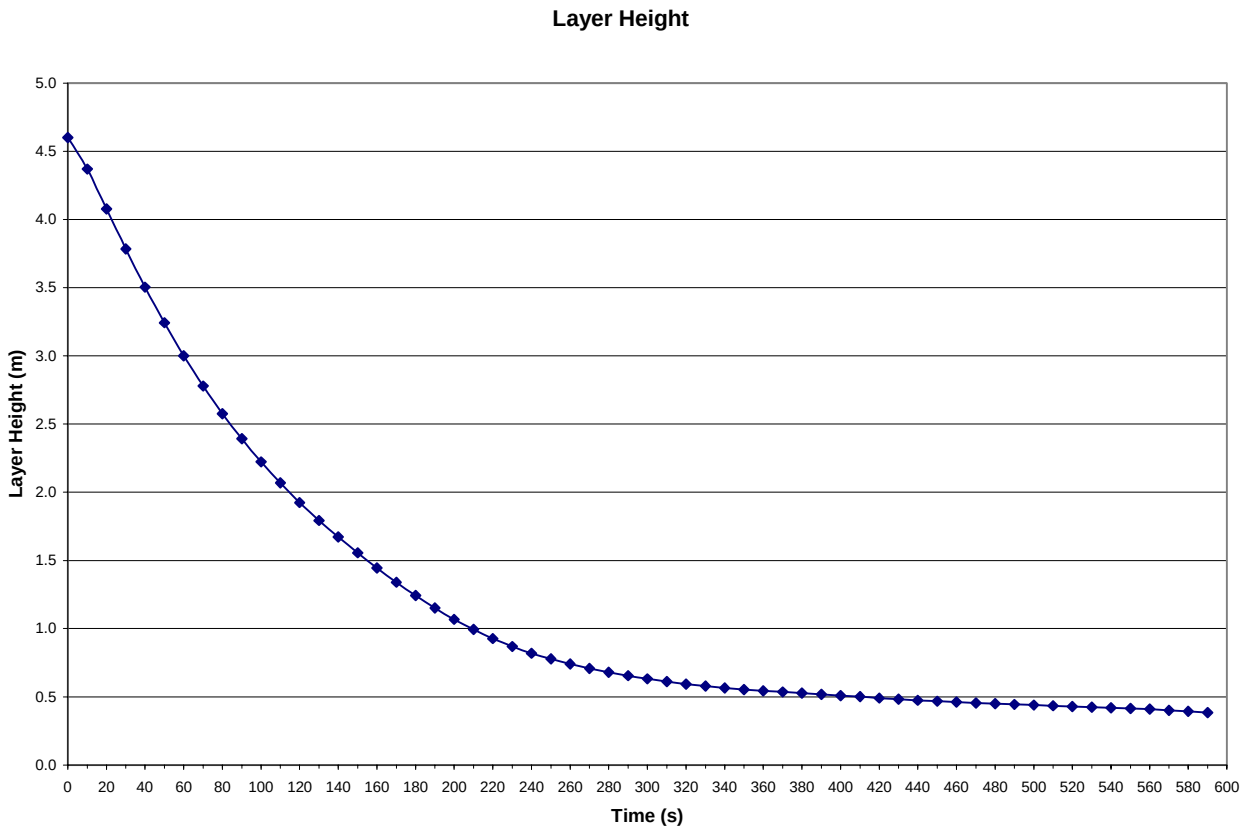

Pressure
Pressure (Pa)
2500
2000
1500
1000
500
0
-500
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
Time (s)

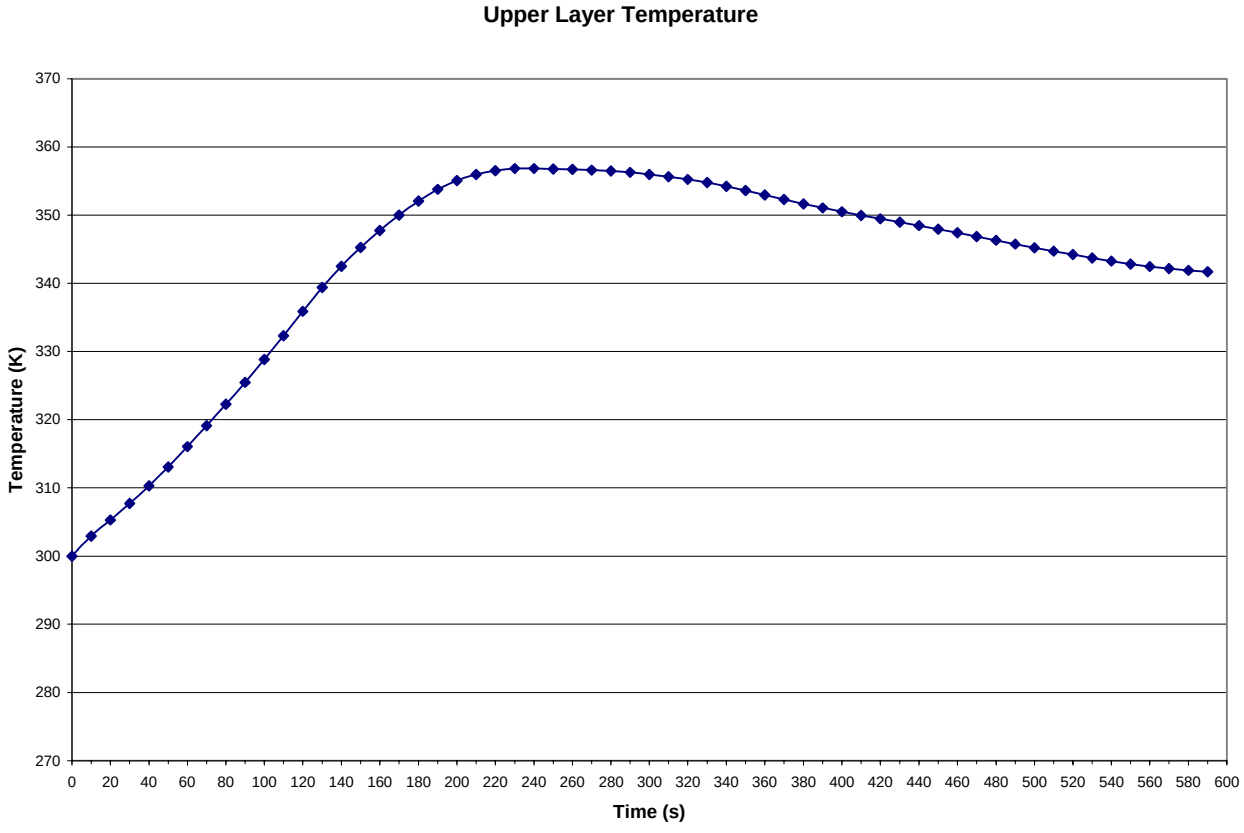
Lower Layer Outflow

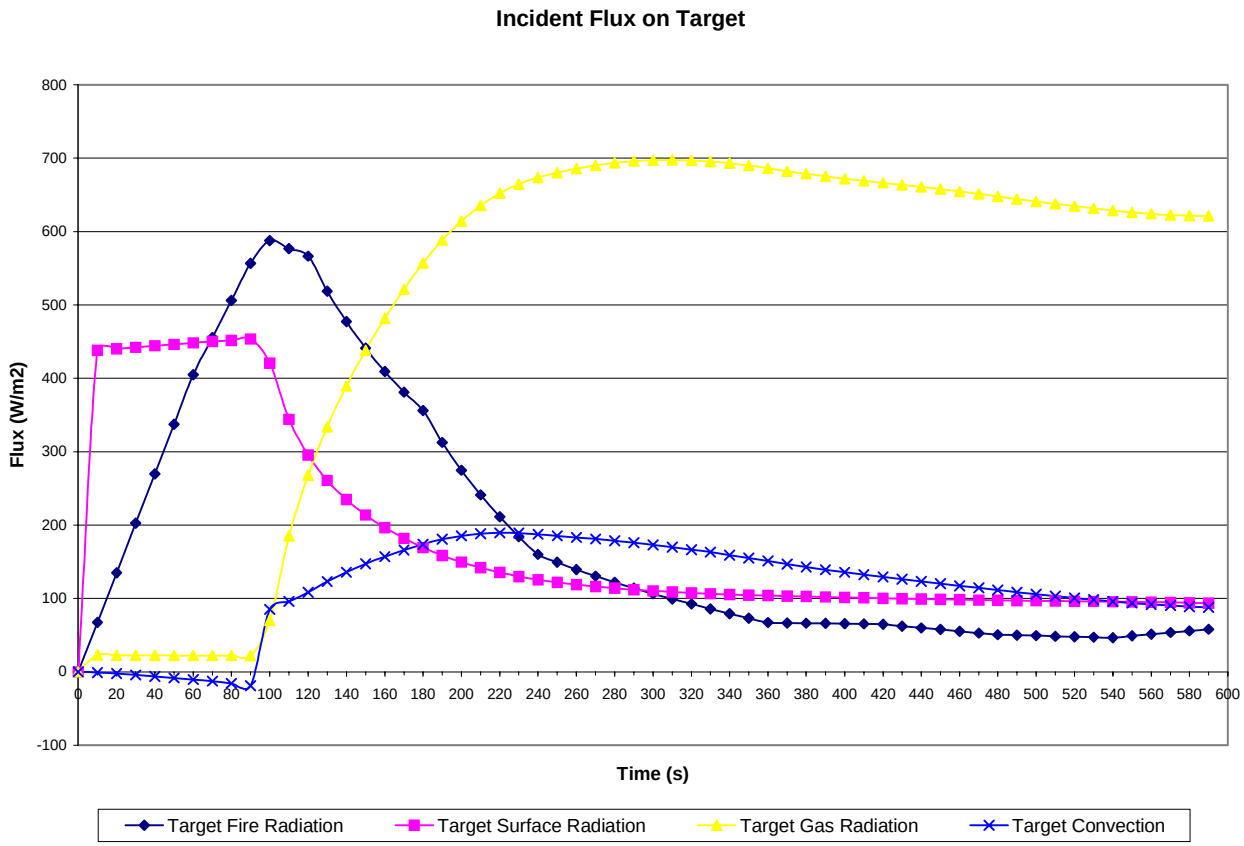


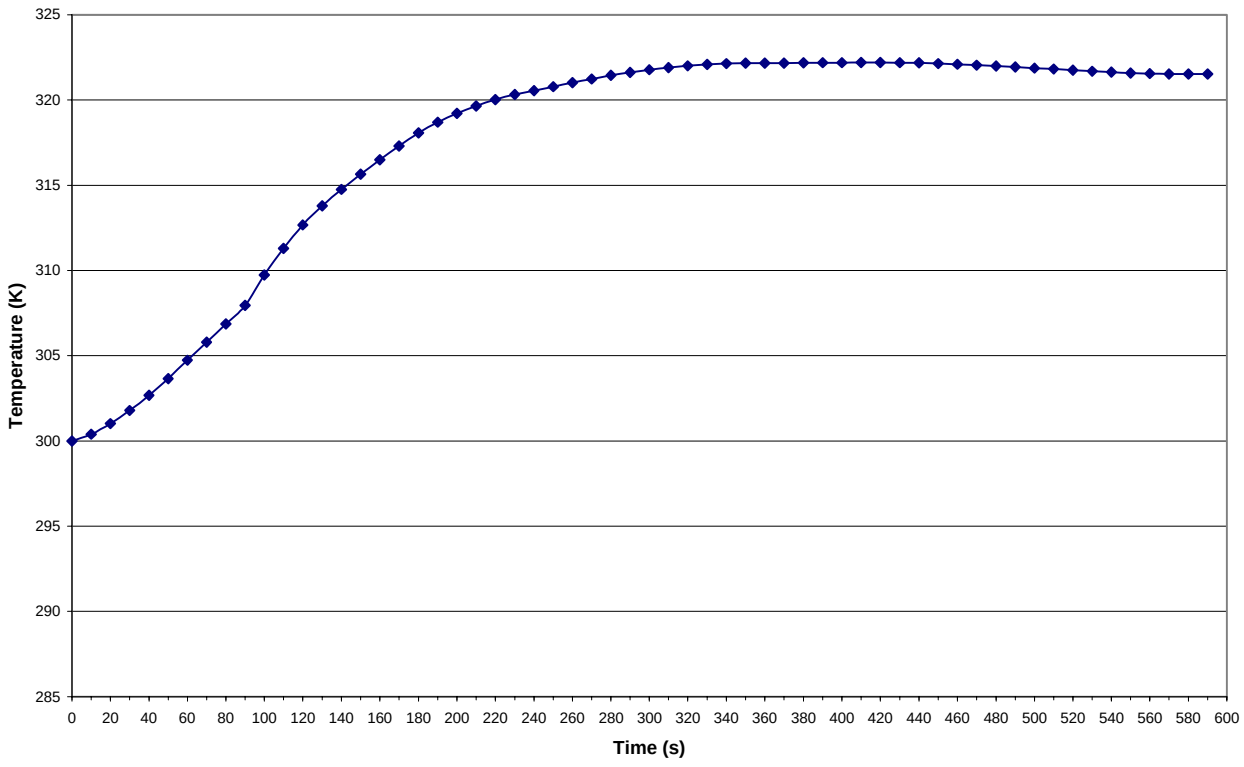
Lower Layer Inflow




Layer Height
Layer Height (m)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
Time (s)


Upper Layer Temperature
Temperature (K)
370
360
350
340
330
320
310
300
290
280
270
0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300 320 340 360 380 400 420 440 460 480 500 520 540 560 580 600
Time (s)


Incident Flux on Target
Flux (W/m2)
Time (s)
Target Fire Radiation
Target Surface Radiation
Target Gas Radiation
Target Convection


Target Surface Temperature
Temperature (K)
Time (s)

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Appendix 6 - LITE.LST Report for Verification Effort

CFAST Version 3.1.6 PART 1 - BASE CASE

Data file is BASECASE.DAT (Checksum 00000000)

OVERVIEW

Compartments	Doors, ...	Ceil. Vents, ...	MV Connects
1	1	0	0

Simulation Time (s)	Print Interval (s)	History Interval (s)	Restart Interval (s)
600	10	10	0

Ceiling jet is on for all
History file is C:\A\BASECASE.HI

AMBIENT CONDITIONS

Interior Temperature (K)	Interior Pressure (Pa)	Exterior Temperature (K)	Exterior Pressure (Pa)	Station Elevation (m)	Wind Speed (m/s)	Wind Ref. Height (m)	Wind Power
300.	101300.	300.	101300.	0.00	0.0	10.0	0.16

COMPARTMENTS

Compartment	Width (m)	Depth (m)	Height (m)	Area (m^2)	Volume (m^3)	Ceiling Height (m)	Floor Height (m)
1	9.10	15.20	4.60	138.32	636.27	4.60	0.00

VENT CONNECTIONS

Horizontal Natural Flow Connections (Doors, Windows, ...)

From Compartment	To Compartment	Vent Number	Width (m)	Sill Height (m)	Soffit Height (m)	Abs. Sill (m)	Abs. Soffit (m)	Area (m^2)
1	Outside	1	2.40	0.00	0.00	0.00	0.00	0.01

There are no vertical natural flow connections

There are no mechanical flow connections

THERMAL PROPERTIES

Compartment	Ceiling	Wall	Floor
1	CONC003	CONC003	CONC003

Thermal data base used: C:\A\WSMSTH02.DF

Name	Conductivity	Specific heat	Density	Thickness	Emissivity	HCL B's (1->5)				
CONC003	1.75	1.000E+03	2.200E+03	0.152	0.940	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CABLE	9.200E-02	1.040E+03	1.710E+03	5.000E-02	0.800	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

TARGETS

Target	Compartment	Position (x, y, z)			Direction (x, y, z)			Material	
1	1	7.60	7.60	2.28	0.00	0.00	-1.00	CABLE	
2	1	7.60	4.55	0.00	0.00	0.00	1.00	CONC003	Floor, compartment 1

FIRES

Name: Main Fire

Compartment	Fire Type	Position (x,y,z)	Relative Humidity	Lower O2 Limit	Pyrolysis Temperature
1	Constrained	7.60 5.70 0.00	50.0	12.00	300.

Time (s)	Fmass (kg/s)	Hcomb (J/kg)	Fqdot (W)	Fhigh (m)	C/CO2 (kg/kg)	CO/CO2 (kg/kg)	H/C (kg/kg)	O/C (kg/kg)	HCN (kg/kg)	HCL (kg/kg)
0.	0.00E+00	2.41E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
60.	8.30E-03	2.41E+07	2.00E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
120.	1.45E-02	2.41E+07	3.50E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
180.	1.41E-02	2.41E+07	3.40E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
240.	8.30E-03	2.41E+07	2.00E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
300.	6.22E-03	2.41E+07	1.50E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
360.	4.15E-03	2.41E+07	1.00E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
420.	4.15E-03	2.41E+07	1.00E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
480.	3.32E-03	2.41E+07	8.00E+04	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
540.	3.11E-03	2.41E+07	7.50E+04	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00
600.	4.15E-03	2.41E+07	1.00E+05	0.00E+00	0.00E+00	0.00E+00	0.16	0.00E+00	0.00E+00	0.00E+00

Time = 0.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	300.0	300.0	4.6	0.000E+00	0.000E+00	-1.477E-18	0.000E+00
Outside					0.000E+00		

Time = 10.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	303.0	300.0	4.4	1.383E-03	3.333E+04	18.5	2.10
Outside					0.000E+00		

Time = 20.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	305.3	300.1	4.1	2.766E-03	6.667E+04	74.1	5.57
Outside					0.000E+00		

Time = 30.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	307.7	300.2	3.8	4.149E-03	1.000E+05	165.	10.4
Outside					0.000E+00		

Time = 40.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	310.3	300.3	3.5	5.533E-03	1.333E+05	288.	16.8
Outside					0.000E+00		

Time = 50.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	313.1	300.4	3.2	6.916E-03	1.667E+05	442.	24.7
Outside					0.000E+00		

Time = 60.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	316.0	300.6	3.0	8.299E-03	2.000E+05	625.	34.3
Outside					0.000E+00		

Time = 70.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	319.1	300.8	2.8	9.336E-03	2.250E+05	817.	45.1
Outside					0.000E+00		

Time = 80.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	322.3	300.9	2.6	1.037E-02	2.500E+05	1.008E+03	57.2
Outside					0.000E+00		

Time = 90.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	325.5	301.1	2.4	1.141E-02	2.750E+05	1.203E+03	70.8
Outside					0.000E+00		

Time = 100.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	328.8	301.3	2.2	1.245E-02	3.000E+05	1.403E+03	85.8
Outside					0.000E+00		

Time = 110.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	332.3	301.5	2.1	1.349E-02	3.250E+05	1.607E+03	102.
Outside					0.000E+00		

Time = 120.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	335.9	301.7	1.9	1.452E-02	3.500E+05	1.815E+03	121.
Outside					0.000E+00		

Time = 130.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	339.4	301.8	1.8	1.445E-02	3.483E+05	1.973E+03	139.
Outside					0.000E+00		

Time = 140.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	342.5	301.9	1.7	1.438E-02	3.466E+05	2.045E+03	156.
Outside					0.000E+00		

Time = 150.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	345.2	302.0	1.6	1.432E-02	3.450E+05	2.057E+03	173.
Outside					0.000E+00		

Time = 160.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	347.7	302.0	1.4	1.425E-02	3.433E+05	2.025E+03	190.
Outside					0.000E+00		

Time = 170.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	350.0	301.9	1.3	1.418E-02	3.416E+05	1.962E+03	206.
Outside					0.000E+00		

Time = 180.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	352.1	301.9	1.2	1.411E-02	3.400E+05	1.878E+03	222.
Outside					0.000E+00		

Time = 190.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	353.8	301.8	1.2	1.314E-02	3.166E+05	1.737E+03	235.
Outside					0.000E+00		

Time = 200.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	355.1	301.7	1.1	1.217E-02	2.933E+05	1.519E+03	246.
Outside					0.000E+00		

Time = 210.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.0	301.5	0.99	1.120E-02	2.700E+05	1.254E+03	255.
Outside					0.000E+00		

Time = 220.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.5	301.3	0.93	1.024E-02	2.467E+05	968.	262.
Outside					0.000E+00		

Time = 230.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.8	301.1	0.87	9.267E-03	2.233E+05	682.	266.
Outside					0.000E+00		

Time = 240.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.8	301.0	0.82	8.299E-03	2.000E+05	417.	269.
Outside					0.000E+00		

Time = 250.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.8	300.8	0.78	7.953E-03	1.917E+05	221.	271.
Outside					0.000E+00		

Time = 260.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.7	300.8	0.74	7.607E-03	1.833E+05	109.	272.
Outside					0.000E+00		

Time = 270.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.6	300.8	0.71	7.261E-03	1.750E+05	51.7	274.
Outside					0.000E+00		

Time = 280.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.5	300.9	0.68	6.916E-03	1.667E+05	23.8	275.
Outside					0.000E+00		

Time = 290.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.3	300.9	0.65	6.570E-03	1.583E+05	9.16	275.
Outside					0.000E+00		

Time = 300.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	356.0	301.0	0.63	6.224E-03	1.500E+05	1.81	275.
Outside					0.000E+00		

Time = 310.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	355.6	301.0	0.61	5.878E-03	1.417E+05	-3.831E-02	274.
Outside					0.000E+00		

Time = 320.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	355.2	301.1	0.59	5.533E-03	1.333E+05	-1.99	273.
Outside					0.000E+00		

Time = 330.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	354.8	301.2	0.58	5.187E-03	1.250E+05	-6.69	271.
Outside					0.000E+00		

Time = 340.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	354.2	301.2	0.57	4.841E-03	1.167E+05	-13.9	269.
Outside					0.000E+00		

Time = 350.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	353.6	301.2	0.55	4.495E-03	1.083E+05	-23.3	266.
Outside					0.000E+00		

Time = 360.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	352.9	301.3	0.54	4.149E-03	9.999E+04	-34.8	263.
Outside					0.000E+00		

Time = 370.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	352.3	301.3	0.54	4.149E-03	9.999E+04	-37.3	259.
Outside					0.000E+00		

Time = 380.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	351.7	301.3	0.53	4.149E-03	9.999E+04	-33.7	256.
Outside					0.000E+00		

Time = 390.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	351.1	301.3	0.52	4.149E-03	9.999E+04	-29.7	253.
Outside					0.000E+00		

Time = 400.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	350.5	301.4	0.51	4.149E-03	9.999E+04	-26.0	251.
Outside					0.000E+00		

Time = 410.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	350.0	301.4	0.50	4.149E-03	9.999E+04	-22.8	248.
Outside					0.000E+00		

Time = 420.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	349.5	301.4	0.49	4.149E-03	9.999E+04	-19.9	246.
Outside					0.000E+00		

Time = 430.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	349.0	301.5	0.48	4.011E-03	9.666E+04	-20.9	243.
Outside					0.000E+00		

Time = 440.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	348.5	301.5	0.48	3.873E-03	9.333E+04	-23.7	241.
Outside					0.000E+00		

Time = 450.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	347.9	301.5	0.47	3.734E-03	8.999E+04	-26.7	238.
Outside					0.000E+00		

Time = 460.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	347.4	301.5	0.46	3.596E-03	8.666E+04	-29.8	235.
Outside					0.000E+00		

Time = 470.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	346.9	301.5	0.46	3.458E-03	8.333E+04	-33.0	232.
Outside					0.000E+00		

Time = 480.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	346.3	301.6	0.45	3.320E-03	7.999E+04	-36.3	230.
Outside					0.000E+00		

Time = 490.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	345.8	301.6	0.44	3.285E-03	7.916E+04	-36.6	227.
Outside					0.000E+00		

Time = 500.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	345.2	301.6	0.44	3.250E-03	7.833E+04	-34.9	224.
Outside					0.000E+00		

Time = 510.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	344.7	301.6	0.43	3.216E-03	7.749E+04	-33.1	221.
Outside					0.000E+00		

Time = 520.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	344.2	301.6	0.43	3.181E-03	7.666E+04	-31.4	219.
Outside					0.000E+00		

Time = 530.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	343.7	301.6	0.42	3.147E-03	7.583E+04	-29.8	216.
Outside					0.000E+00		

Time = 540.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	343.2	301.6	0.42	3.112E-03	7.499E+04	-28.4	214.
Outside					0.000E+00		

Time = 550.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	342.8	301.6	0.42	3.285E-03	7.916E+04	-21.5	212.
Outside					0.000E+00		

Time = 560.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	342.5	301.7	0.41	3.458E-03	8.333E+04	-12.9	210.
Outside					0.000E+00		

Time = 570.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	342.2	301.7	0.40	3.631E-03	8.749E+04	-6.49	209.
Outside					0.000E+00		

Time = 580.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	341.9	301.7	0.39	3.804E-03	9.166E+04	-2.40	208.
Outside					0.000E+00		

Time = 590.0 seconds.

Compartment	Upper Temp. (K)	Lower Temp. (K)	Inter. Height (m)	Pyrol Rate (kg/s)	Fire Size (W)	Pressure (Pa)	Ambient Target (W/m^2)
1	341.7	301.7	0.38	3.976E-03	9.583E+04	-0.357	207.
Outside					0.000E+00		

Appendix 7 - Comparison of Results

TIME	TIME	Upper Layer Temp (1)	Lower Layer Temp (1)	Layer Height (1)	Upper Layer Volume (1)	Pressure (1)	Ambient Target (1)	Floor Target (1)	Main Plume Flow	Main Pyrolysis Rate	Main Fire Size
0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
10	OK	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK
20	OK	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK
30	OK	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK
40	OK	OK	OK	OK	OK	OK	0.0000	0.0001	OK	OK	OK
50	OK	OK	OK	OK	OK	0.0000	-0.0001	0.0001	OK	OK	OK
60	OK	OK	OK	OK	OK	0.0000	-0.0001	0.0001	OK	OK	OK
70	OK	OK	OK	OK	OK	0.0000	-0.0001	0.0002	OK	OK	OK
80	OK	OK	OK	OK	OK	0.0000	-0.0001	0.0002	OK	OK	OK
90	OK	OK	OK	OK	OK	0.0000	-0.0001	0.0002	OK	OK	OK
100	OK	OK	OK	OK	OK	0.0000	-0.0001	0.0002	OK	OK	OK
110	OK	OK	OK	OK	0.0000	0.0000	-0.0001	0.0002	OK	OK	OK
120	OK	OK	OK	OK	OK	0.0000	-0.0001	0.0002	OK	OK	OK
130	OK	0.0000	OK	OK	OK	0.0000	-0.0001	0.0002	OK	OK	OK
140	OK	0.0000	OK	0.0000	OK	0.0000	-0.0001	0.0001	OK	OK	OK
150	OK	OK	OK	OK	0.0000	-0.0001	-0.0001	0.0001	OK	OK	OK
160	OK	0.0000	OK	0.0000	0.0000	-0.0001	-0.0001	0.0001	OK	OK	OK
170	OK	0.0000	0.0000	OK	OK	-0.0001	-0.0001	0.0001	OK	OK	OK
180	OK	0.0000	OK	0.0000	OK	-0.0001	-0.0001	0.0001	0.0000	OK	OK
190	OK	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	0.0001	0.0000	OK	OK
200	OK	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	0.0000	0.0000	OK	OK
210	OK	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	0.0000	0.0000	OK	OK
220	OK	0.0000	0.0000	0.0000	0.0000	-0.0001	-0.0001	0.0000	0.0000	OK	OK
230	OK	0.0000	0.0000	0.0000	0.0000	-0.0002	-0.0001	0.0000	0.0000	OK	OK
240	OK	0.0000	0.0000	0.0000	0.0000	-0.0002	-0.0001	0.0000	0.0000	OK	OK
250	OK	0.0000	0.0000	0.0000	0.0000	-0.0003	-0.0001	-0.0001	0.0000	OK	OK
260	OK	0.0000	0.0000	0.0000	0.0000	-0.0003	-0.0001	-0.0001	0.0000	OK	OK
270	OK	0.0000	OK	0.0000	0.0000	-0.0001	-0.0001	-0.0001	0.0000	OK	OK
280	OK	0.0000	OK	0.0000	0.0000	0.0001	-0.0001	-0.0001	0.0000	OK	0.0000
290	OK	0.0000	0.0000	0.0000	0.0000	0.0006	-0.0001	-0.0001	0.0000	OK	OK
300	OK	0.0000	OK	0.0000	0.0000	0.0022	0.0000	-0.0001	0.0000	OK	OK
310	OK	0.0000	0.0000	0.0000	0.0000	-0.0156	0.0000	-0.0002	0.0000	OK	OK
320	OK	0.0000	OK	0.0000	0.0000	-0.0025	0.0000	-0.0002	0.0000	OK	OK
330	OK	0.0000	OK	0.0000	0.0000	-0.0016	0.0000	-0.0002	0.0000	OK	OK
340	OK	0.0000	0.0000	0.0000	0.0000	-0.0012	0.0000	-0.0002	0.0000	OK	OK
350	OK	0.0000	OK	0.0000	0.0000	-0.0010	OK	-0.0002	0.0000	OK	OK
360	OK	0.0000	0.0000	0.0000	OK	-0.0009	0.0000	-0.0002	0.0000	OK	OK
370	OK	0.0000	0.0000	0.0000	OK	-0.0010	0.0000	-0.0002	OK	OK	OK
380	OK	0.0000	0.0000	OK	OK	-0.0011	0.0000	-0.0002	OK	OK	OK
390	OK	0.0000	0.0000	0.0000	OK	-0.0013	0.0000	-0.0002	0.0000	OK	OK
400	OK	0.0000	0.0000	0.0000	OK	-0.0014	0.0001	-0.0002	0.0000	OK	OK
410	OK	OK	0.0000	0.0000	0.0000	-0.0015	0.0001	-0.0002	0.0000	OK	OK
420	OK	OK	0.0000	0.0000	0.0000	-0.0017	0.0001	-0.0001	0.0000	OK	OK
430	OK	0.0000	0.0000	0.0000	0.0000	-0.0016	0.0001	-0.0001	0.0000	OK	OK
440	OK	0.0000	0.0000	0.0000	0.0000	-0.0015	0.0001	-0.0001	0.0000	OK	OK
450	OK	0.0000	0.0000	0.0000	0.0000	-0.0014	0.0001	-0.0001	0.0000	OK	OK
460	OK	0.0000	0.0000	0.0000	0.0000	-0.0013	0.0001	-0.0001	0.0000	OK	OK
470	OK	0.0000	0.0000	0.0000	0.0000	-0.0013	0.0001	-0.0001	0.0000	OK	OK
480	OK	0.0000	0.0000	-0.0001	0.0000	-0.0012	0.0001	-0.0001	0.0000	OK	OK
490	OK	0.0000	0.0000	-0.0001	0.0000	-0.0012	0.0002	-0.0001	-0.0001	OK	0.0000
500	OK	0.0000	0.0000	-0.0001	0.0000	-0.0012	0.0002	-0.0001	-0.0001	OK	OK
510	OK	0.0000	0.0000	-0.0001	0.0000	-0.0012	0.0002	-0.0001	-0.0001	OK	OK
520	OK	0.0000	0.0000	-0.0001	0.0000	-0.0013	0.0002	-0.0001	-0.0001	OK	OK
530	OK	0.0000	0.0000	-0.0001	0.0000	-0.0013	0.0002	-0.0001	-0.0001	OK	OK
540	OK	0.0000	0.0000	-0.0001	0.0000	-0.0013	0.0002	0.0000	-0.0001	OK	0.0000
550	OK	0.0000	0.0000	-0.0001	0.0000	-0.0015	0.0002	0.0000	-0.0001	OK	OK
560	OK	0.0000	0.0000	-0.0001	0.0000	-0.0020	0.0002	0.0000	-0.0001	OK	OK
570	OK	0.0000	0.0000	-0.0001	0.0000	-0.0027	0.0002	0.0000	-0.0001	OK	OK
580	OK	0.0000	0.0000	-0.0001	0.0000	-0.0042	0.0002	0.0000	-0.0001	OK	0.0000
590	OK	0.0000	0.0000	-0.0001	0.0000	-0.0105	0.0003	0.0000	-0.0001	OK	OK

TIME	Main Flame Height	Main Convec. Size	Target Temperature (1)	Target Flux (1)	Target Fire Rad. (1)	Target Surface Rad. (1)	Target Gas Rad. (1)	Target Convec. (1)	Target Temperature (2)	Target Flux (2)	Target Fire Rad. (2)
0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
10	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
20	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
30	OK	OK	OK	0.0000	OK	OK	OK	OK	OK	OK	OK
40	OK	OK	OK	0.0000	0.0000	0.0000	OK	OK	OK	OK	OK
50	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	OK	OK	0.0000	OK
60	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	OK	OK	OK	OK
70	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	OK	0.0000	0.0000	OK
80	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
90	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
100	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
110	OK	OK	OK	0.0000	0.0000	0.0000	OK	OK	0.0000	0.0000	OK
120	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
130	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
140	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
150	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
160	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
170	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
180	OK	OK	OK	0.0000	0.0000	0.0000	OK	0.0000	0.0000	0.0000	OK
190	OK	OK	OK	0.0000	0.0000	0.0000	OK	0.0000	0.0000	0.0000	OK
200	OK	OK	OK	0.0000	0.0000	0.0000	OK	0.0000	0.0000	0.0000	OK
210	OK	OK	0.0000	0.0000	0.0000	0.0000	OK	0.0000	0.0000	0.0000	OK
220	0.0000	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
230	OK	OK	0.0000	0.0000	0.0000	0.0000	OK	0.0000	0.0000	0.0000	OK
240	OK	OK	OK	0.0000	0.0000	0.0000	OK	0.0000	0.0000	0.0000	OK
250	OK	OK	OK	0.0000	0.0000	OK	0.0000	0.0000	OK	0.0000	OK
260	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK	0.0000	OK
270	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
280	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
290	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
300	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	OK
310	OK	OK	0.0000	0.0000	0.0000	0.0000	OK	0.0000	0.0000	0.0000	OK
320	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
330	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
340	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
350	OK	OK	0.0000	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
360	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
370	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
380	OK	OK	0.0000	OK	OK	0.0000	0.0000	OK	0.0000	0.0000	OK
390	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
400	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
410	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK	OK
420	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
430	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
440	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	OK
450	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	OK
460	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	OK
470	OK	OK	OK	0.0000	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000	OK
480	OK	OK	0.0000	0.0000	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	OK
490	0.0000	OK	OK	0.0001	-0.0001	0.0000	0.0000	0.0002	0.0000	0.0000	OK
500	OK	OK	0.0000	0.0000	-0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	OK
510	OK	OK	OK	0.0000	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	OK
520	OK	OK	OK	0.0000	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	OK
530	OK	OK	0.0000	0.0000	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	OK
540	OK	OK	0.0000	0.0001	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0000	OK
550	OK	OK	0.0000	0.0000	-0.0001	0.0000	0.0000	-0.0001	0.0000	0.0000	OK
560	OK	OK	0.0000	0.0000	-0.0001	0.0000	0.0000	OK	0.0000	0.0000	OK
570	OK	0.0000	0.0000	0.0001	-0.0001	OK	0.0000	0.0002	0.0000	0.0001	OK
580	OK	OK	0.0000	0.0001	-0.0001	0.0000	0.0000	0.0001	0.0000	0.0001	OK
590	OK	OK	0.0000	0.0001	-0.0001	OK	0.0000	0.0001	0.0000	0.0001	OK

TIME	Target Surface Rad. (2)	Target Gas Rad. (2)	Target Convec. (2)	Upper N2 (1)	Upper O2 (1)	Upper CO2 (1)	Upper CO (1)	Upper HCN (1)	Upper HCL (1)	Upper TUHC (1)	Upper H2O (1)
0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
10	OK	OK	-0.0001	OK	OK	OK	OK	OK	OK	OK	OK
20	OK	OK	-0.0002	OK	OK	OK	OK	OK	OK	OK	OK
30	OK	OK	-0.0009	OK	OK	OK	OK	OK	OK	OK	OK
40	0.0000	OK	-0.0028	OK	OK	OK	OK	OK	OK	OK	OK
50	0.0000	OK	-0.0073	OK	OK	OK	OK	OK	OK	OK	OK
60	0.0000	OK	-0.0226	OK	OK	OK	OK	OK	OK	OK	OK
70	0.0000	OK	0.2907	OK	OK	OK	OK	OK	OK	OK	OK
80	0.0000	OK	0.0381	OK	OK	OK	OK	OK	OK	OK	OK
90	0.0000	OK	0.0251	OK	OK	OK	OK	OK	OK	OK	OK
100	0.0000	OK	0.0202	OK	OK	OK	OK	OK	OK	OK	OK
110	0.0000	0.0000	0.0174	OK	OK	OK	OK	OK	OK	OK	OK
120	0.0000	0.0000	0.0155	OK	OK	OK	OK	OK	OK	OK	OK
130	0.0000	0.0000	0.0148	OK	OK	OK	OK	OK	OK	OK	OK
140	0.0000	0.0000	0.0174	OK	OK	OK	OK	OK	OK	OK	OK
150	0.0000	0.0000	0.0256	OK	OK	OK	OK	OK	OK	OK	OK
160	0.0000	0.0000	0.0652	OK	OK	OK	OK	OK	OK	OK	OK
170	0.0000	0.0000	-0.0743	OK	OK	OK	OK	OK	OK	OK	OK
180	0.0000	0.0000	-0.0227	OK	OK	OK	OK	OK	OK	OK	OK
190	0.0000	0.0000	-0.0108	OK	OK	OK	OK	OK	OK	OK	OK
200	0.0000	0.0000	-0.0059	OK	OK	OK	OK	OK	OK	OK	OK
210	0.0000	0.0000	-0.0035	OK	OK	OK	OK	OK	OK	OK	OK
220	0.0000	0.0000	-0.0020	OK	OK	OK	OK	OK	OK	OK	OK
230	0.0000	OK	-0.0011	OK	OK	0.0000	OK	OK	OK	OK	OK
240	0.0000	0.0000	-0.0003	OK	OK	0.0000	OK	OK	OK	OK	OK
250	OK	0.0000	0.0003	OK	OK	0.0000	OK	OK	OK	OK	OK
260	0.0000	0.0000	0.0009	0.0000	OK	OK	OK	OK	OK	OK	OK
270	0.0000	0.0000	0.0014	OK	OK	0.0000	OK	OK	OK	OK	OK
280	0.0000	0.0000	0.0021	OK	OK	0.0000	OK	OK	OK	OK	0.0000
290	0.0000	0.0000	0.0027	OK	OK	0.0000	OK	OK	OK	OK	OK
300	0.0000	0.0000	0.0033	OK	OK	0.0000	OK	OK	OK	OK	0.0000
310	0.0000	0.0000	0.0039	0.0000	OK	0.0000	OK	OK	OK	OK	0.0000
320	0.0000	0.0000	0.0045	OK	OK	0.0000	OK	OK	OK	OK	0.0000
330	0.0000	0.0000	0.0050	OK	OK	0.0000	OK	OK	OK	OK	0.0000
340	0.0000	0.0000	0.0056	OK	OK	0.0000	OK	OK	OK	OK	0.0000
350	0.0001	0.0000	0.0061	OK	OK	0.0000	OK	OK	OK	OK	0.0000
360	0.0001	0.0000	0.0066	OK	OK	0.0000	OK	OK	OK	OK	0.0000
370	0.0001	0.0000	0.0070	OK	OK	0.0000	OK	OK	OK	OK	0.0000
380	0.0001	0.0000	0.0074	0.0000	OK	0.0000	OK	OK	OK	OK	0.0000
390	0.0001	0.0000	0.0078	0.0000	OK	0.0000	OK	OK	OK	OK	0.0000
400	0.0001	0.0000	0.0080	OK	OK	0.0000	OK	OK	OK	OK	0.0000
410	0.0001	0.0000	0.0082	OK	0.0000	0.0000	OK	OK	OK	OK	0.0000
420	0.0001	0.0000	0.0083	OK	OK	0.0000	OK	OK	OK	OK	0.0000
430	0.0001	0.0000	0.0083	OK	OK	0.0000	OK	OK	OK	OK	0.0000
440	0.0001	0.0000	0.0082	OK	OK	0.0000	OK	OK	OK	OK	0.0000
450	0.0001	0.0000	0.0081	0.0000	OK	0.0000	OK	OK	OK	OK	0.0000
460	0.0000	OK	0.0081	OK	OK	0.0000	OK	OK	OK	OK	0.0000
470	0.0000	OK	0.0080	OK	OK	0.0000	OK	OK	OK	OK	0.0000
480	0.0000	OK	0.0079	OK	OK	0.0000	OK	OK	OK	OK	0.0000
490	0.0000	OK	0.0077	OK	OK	0.0000	OK	OK	OK	OK	0.0000
500	0.0000	OK	0.0076	OK	OK	0.0000	OK	OK	OK	OK	0.0000
510	0.0000	OK	0.0075	OK	OK	0.0000	OK	OK	OK	OK	0.0000
520	0.0000	OK	0.0074	OK	OK	0.0000	OK	OK	OK	OK	0.0000
530	0.0000	0.0000	0.0072	OK	OK	0.0000	OK	OK	OK	OK	0.0000
540	0.0000	0.0000	0.0070	OK	OK	0.0000	OK	OK	OK	OK	0.0000
550	0.0000	OK	0.0067	OK	OK	0.0000	OK	OK	OK	OK	0.0000
560	0.0000	0.0000	0.0065	0.0000	OK	0.0000	OK	OK	OK	OK	0.0000
570	0.0000	OK	0.0061	OK	OK	0.0000	OK	OK	OK	OK	0.0000
580	0.0000	0.0000	0.0056	OK	OK	0.0000	OK	OK	OK	OK	0.0000
590	0.0000	0.0000	0.0050	OK	OK	0.0000	OK	OK	OK	OK	0.0000

TIME	Upper OD (1)	HCl c (1)	HCl uw (1)	HCl lw (1)	HCl f (1)	Lower N2 (1)	Lower O2 (1)	Lower CO2 (1)	Lower CO (1)	Lower HCN (1)	Lower HCL (1)
0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
10	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
20	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
30	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
40	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
50	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
60	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
70	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
80	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
90	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
100	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
110	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
120	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
130	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
140	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
150	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
160	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
170	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
180	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
190	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
200	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
210	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
220	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
230	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
240	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
250	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
260	OK	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK
270	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
280	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
290	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
300	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
310	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
320	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
330	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
340	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
350	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
360	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
370	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
380	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
390	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
400	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
410	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
420	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
430	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
440	OK	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK
450	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
460	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
470	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
480	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
490	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
500	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
510	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
520	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
530	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
540	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK
550	OK	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK
560	OK	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK
570	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
580	OK	OK	OK	OK	OK	0.0000	0.0000	OK	OK	OK	OK
590	OK	OK	OK	OK	OK	0.0000	OK	OK	OK	OK	OK

TIME	Lower TUHC (1)	Lower H2O (1)	Lower OD (1)	HCl c (1)	HCl uw (1)	HCl lw (1)	HCl f (1)	Upper Inflow 1-Outside (1)	Upper Outflow 1-Outside (1)	Lower Inflow 1-Outside (1)	Lower Outflow 1-Outside (1)
0	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
10	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
20	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
30	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK
40	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
50	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
60	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
70	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
80	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
90	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
100	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
110	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
120	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
130	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
140	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
150	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
160	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
170	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
180	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
190	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0000
200	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
210	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
220	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
230	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
240	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
250	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
260	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
270	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0001
280	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0001
290	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0003
300	OK	OK	OK	OK	OK	OK	OK	OK	OK	OK	0.0011
310	OK	OK	OK	OK	OK	OK	OK	OK	OK	-0.0078	OK
320	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0013	OK
330	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0008	OK
340	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
350	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0005	OK
360	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0004	OK
370	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0005	OK
380	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
390	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
400	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0007	OK
410	OK	0.0000	OK	OK	OK	OK	OK	OK	OK	-0.0008	OK
420	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0008	OK
430	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0008	OK
440	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0007	OK
450	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0007	OK
460	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0007	OK
470	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
480	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
490	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
500	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
510	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
520	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
530	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
540	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0006	OK
550	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0008	OK
560	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0010	OK
570	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0013	OK
580	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0021	OK
590	OK	0.0001	OK	OK	OK	OK	OK	OK	OK	-0.0053	OK

Appendix 8 - Comparison of Parameters with Significant Differences

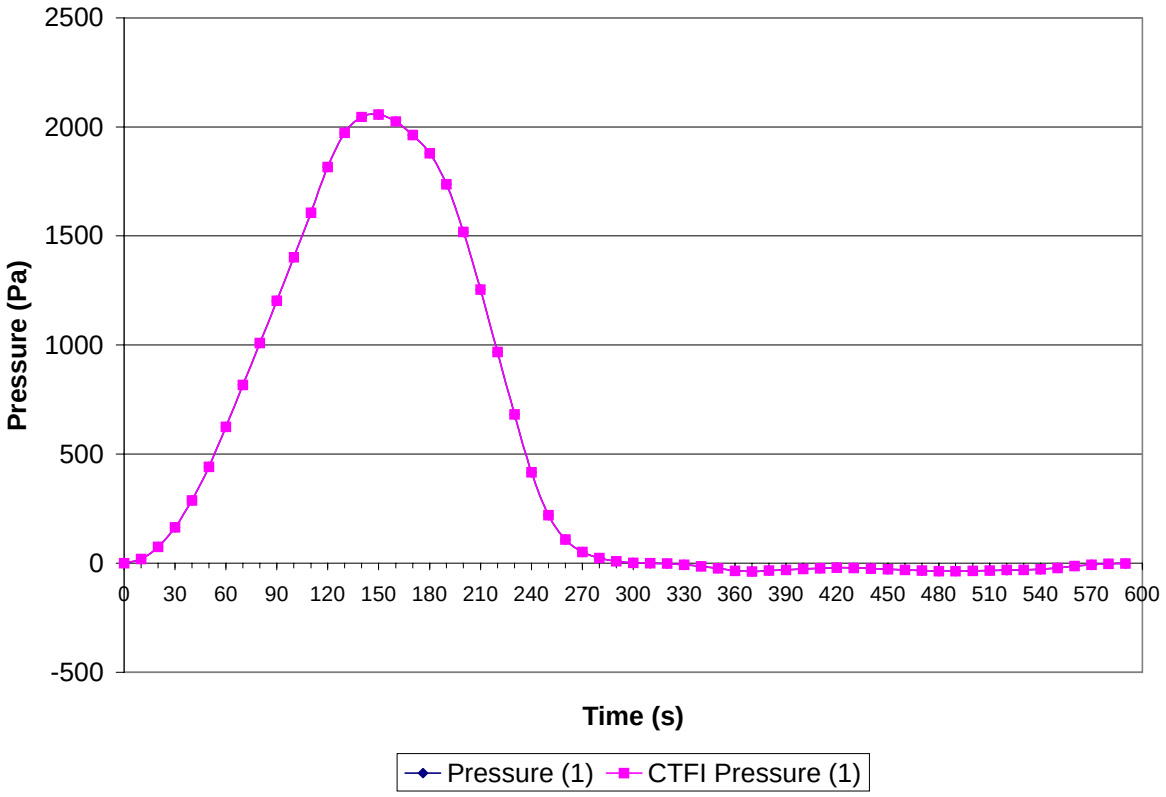

Figure 1 - Pressure Comparison

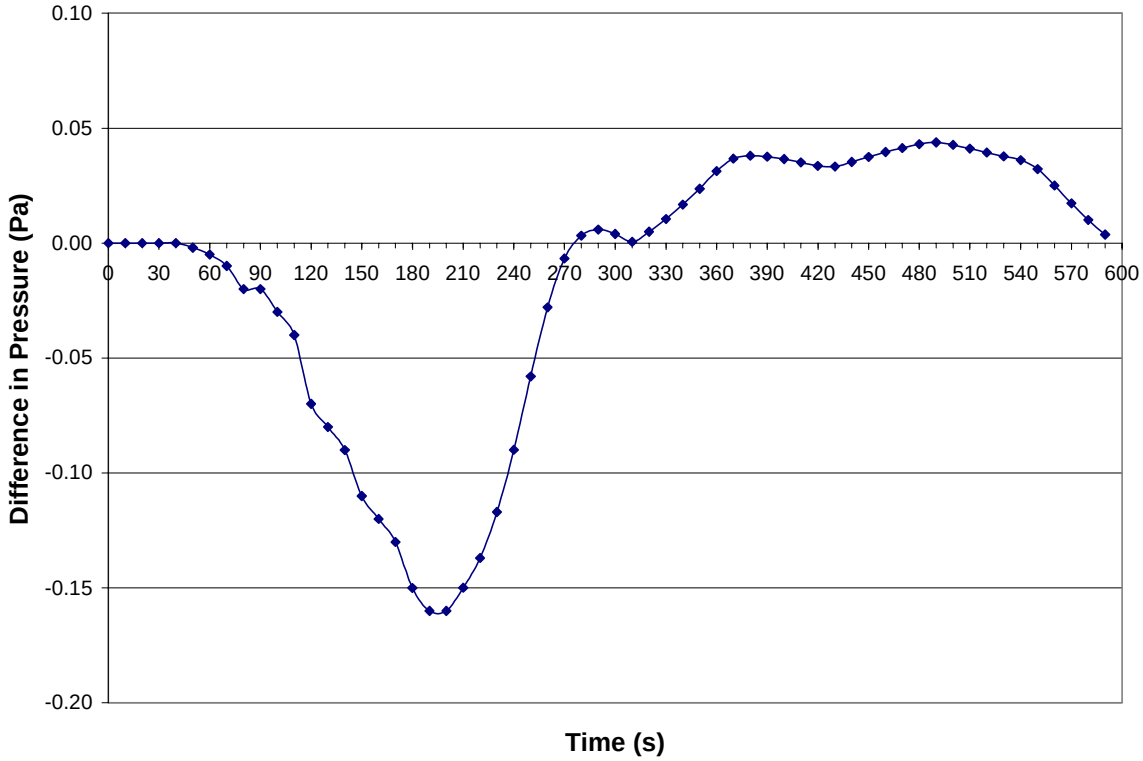

Figure 2 - Pressure Delta

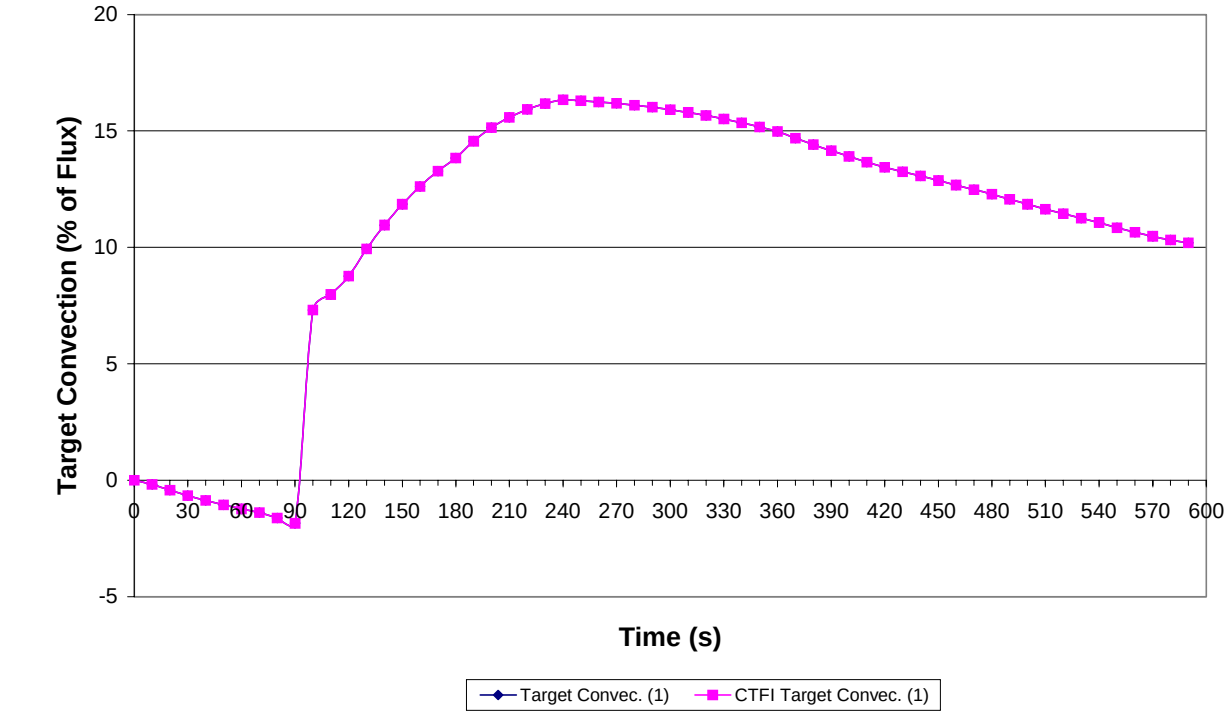

Figure 3 - Target Convection Comparison

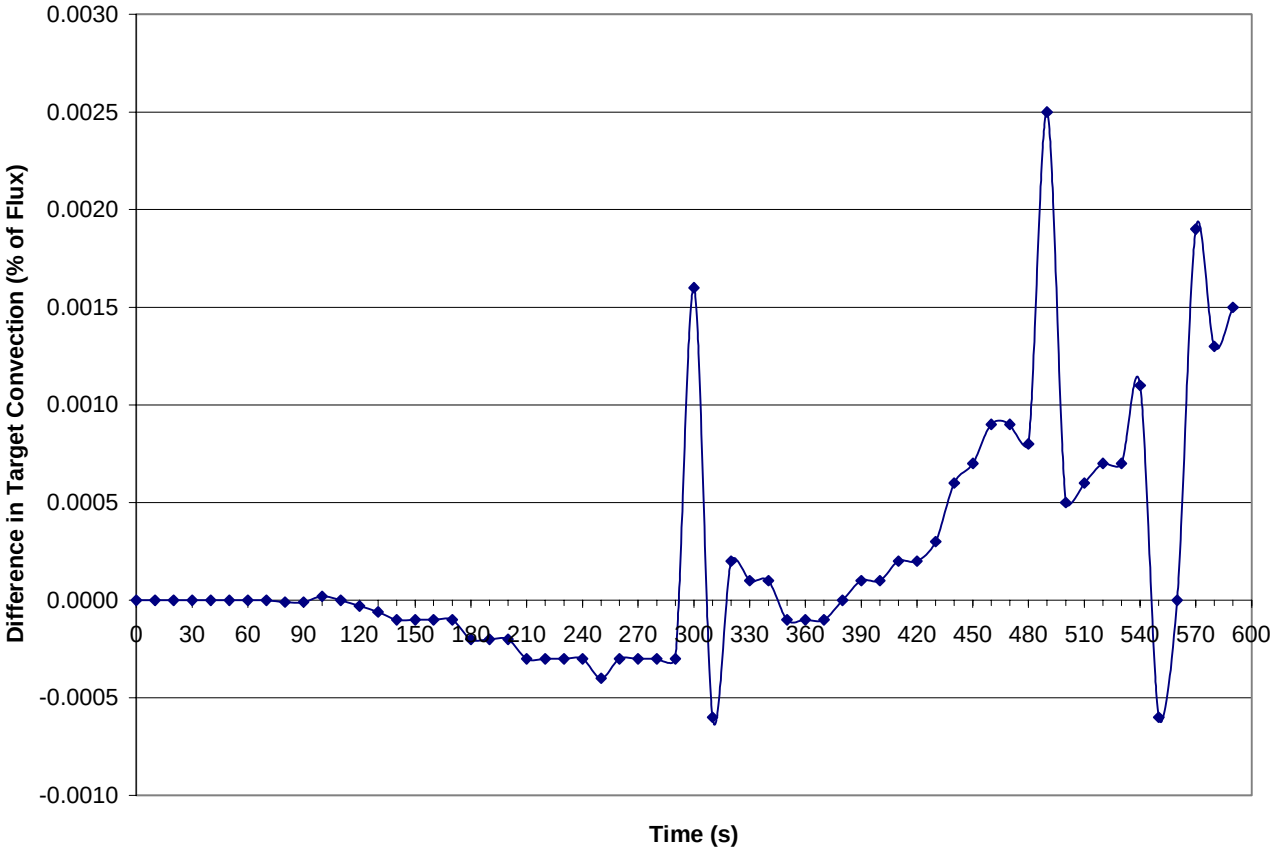

Figure 4 - Target Convection Delta

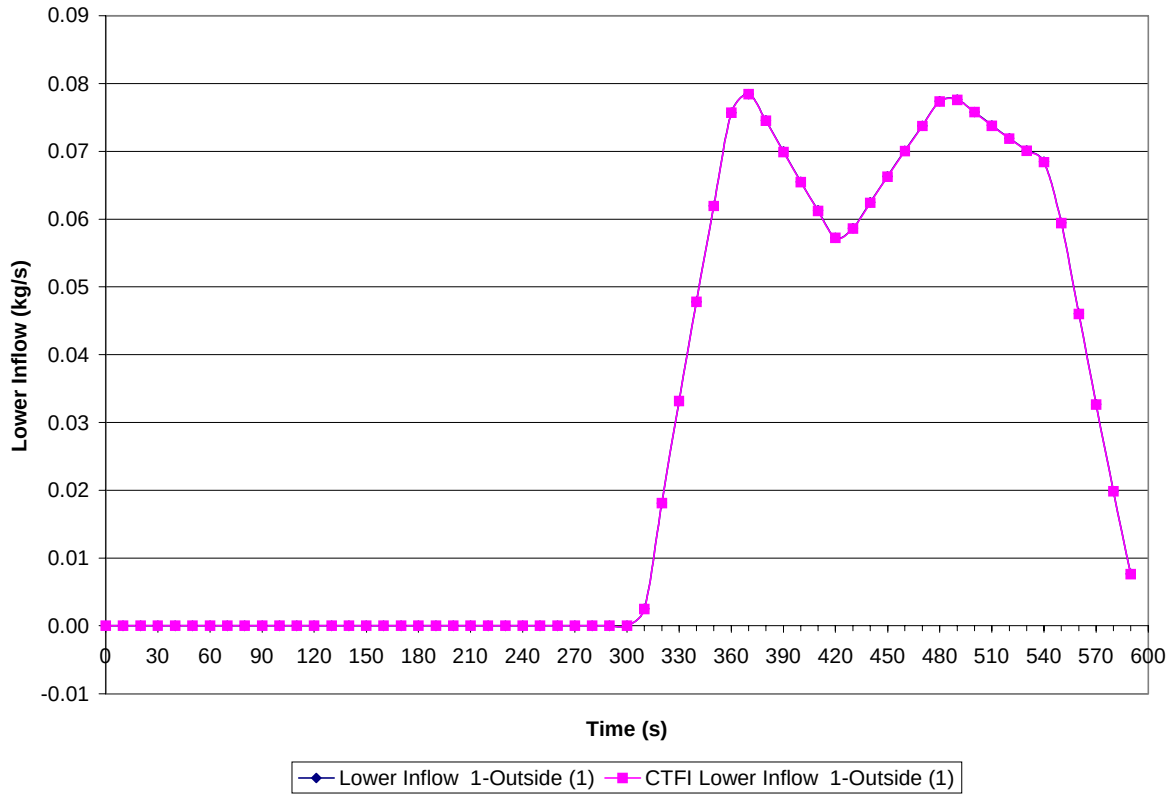

Figure 5 - Lower Inflow Comparison

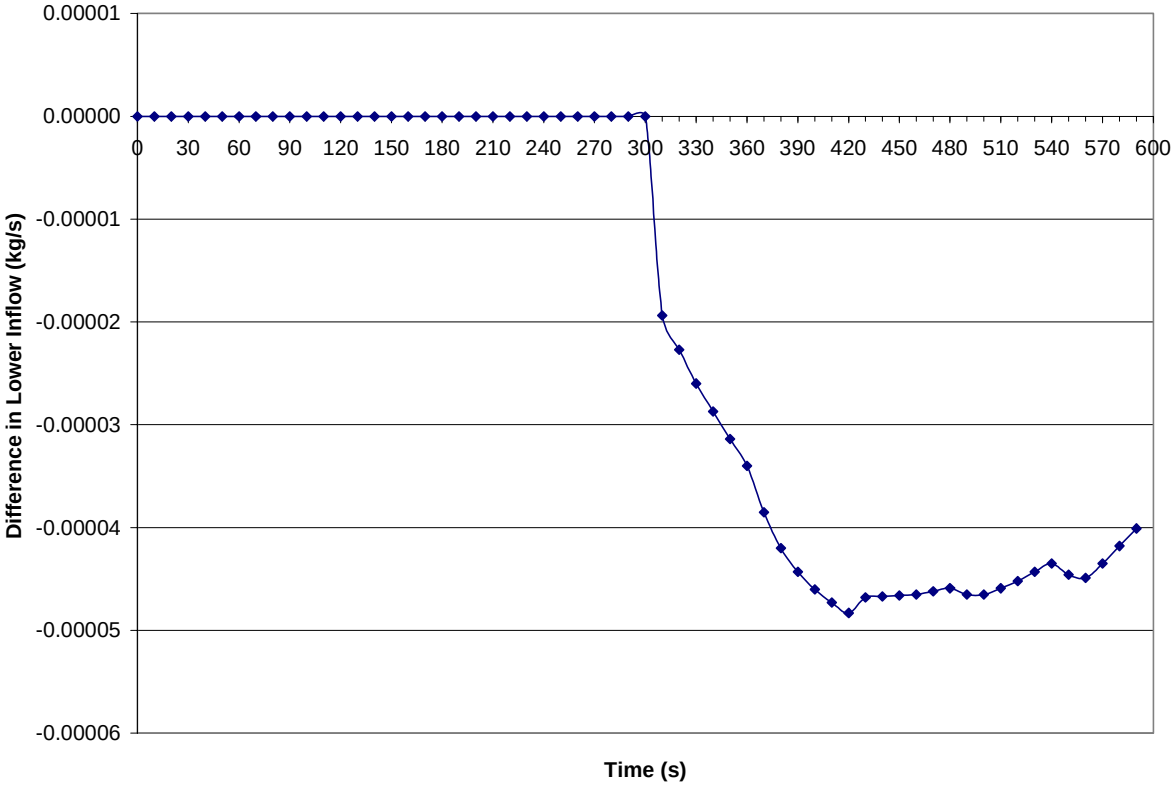

Figure 6 - Lower Inflow Delta

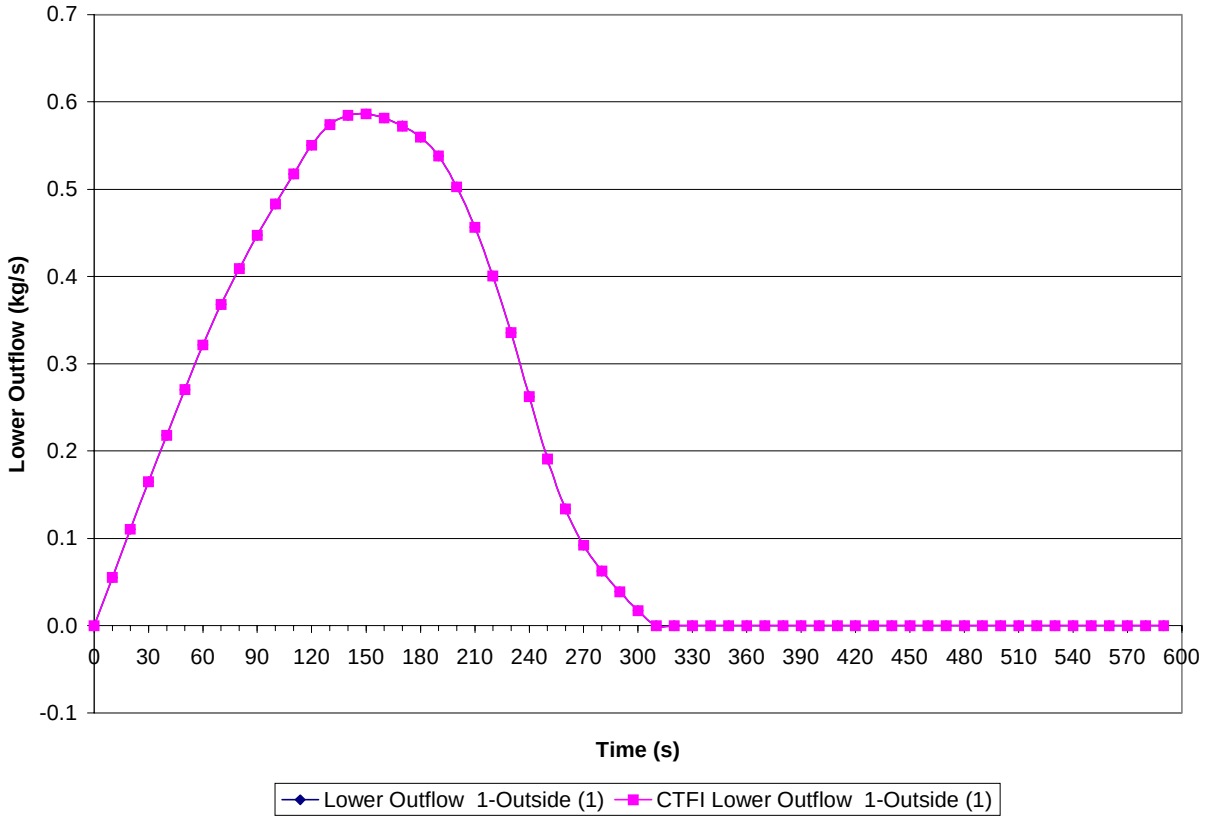

Figure 7 - Lower Outflow Comparison

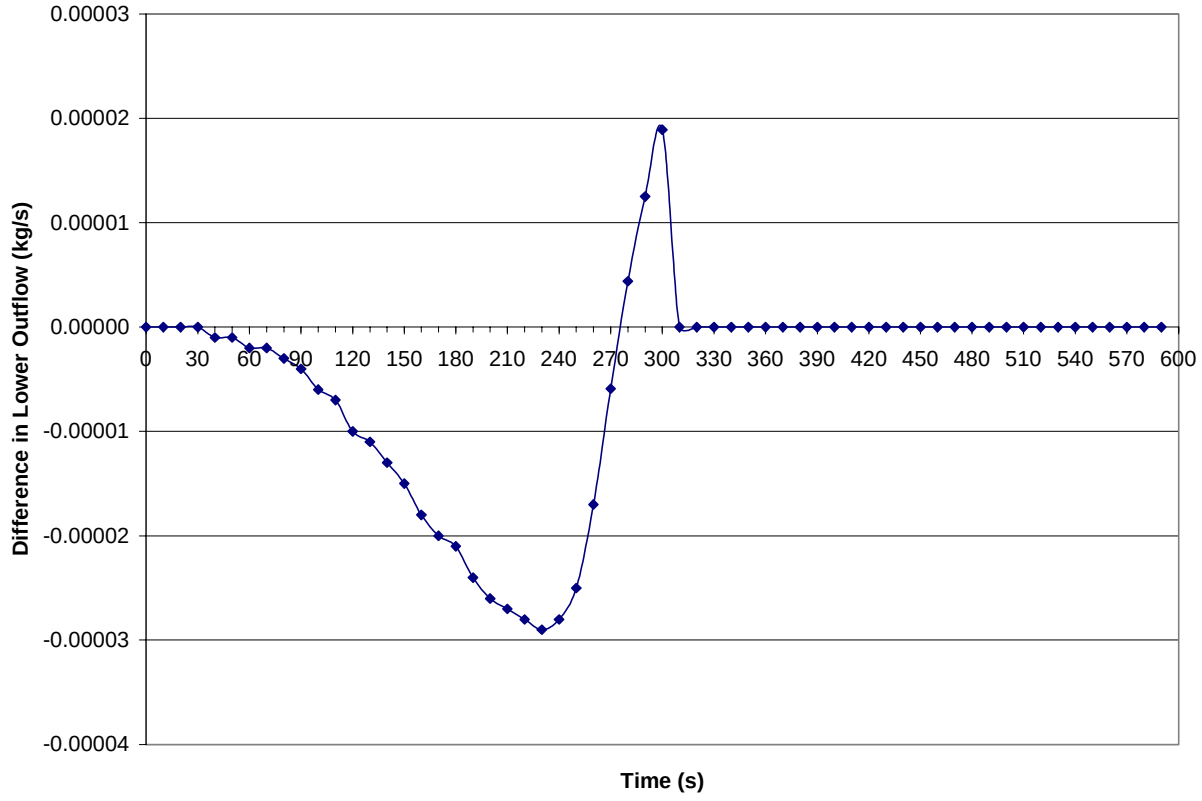

Figure 8 - Lower Outflow Delta