GFM 4.0 Files

This document provides a brief description of files that are created in the process of setting up and simulating a case in GFM. The number of files that are created in the course of setting up and running a simulation has been greatly increased in GFM Version 4. However, file management was also automated in GFM 4, changing the focus of user work in the user interface and control program to "cases." The user interface and control program builds and manages all the files needed to run a simulation without the user having to open, change, or save individual files when working in the GFM application. Instead, cases are opened, changed, saved, copied, or chosen for simulation or post processing, and all of the file operations needed to accomplish user initiated actions or maintain furnace geometry and operating data are handled automatically by the control program. Except for files that contain progress data that can be plotted and summary data, the user does not need to know the details of file content or how files are used. The files can be divided into several types that are indicated by the file extension. In general there are files that define the model of a glass furnace including geometry, material properties, and other parameters of a case, files that contain intermediate results and boundary conditions that are used by one of the GFM components, and output files that contain simulation progress data and results that are of primary interest to the user.

Probably the most useful tables are Tables 2 and 5 that list the files that contain simulation progress and monitoring data that can be plotted with the RunPlot program. The "*nnnn*" in file names in tables stands for a four digit case number. In plots generated by RunPlot, the x axis is an iteration count from one of the solver loops. In many cases it is the iteration count from the CFD flow solver for either the gas in the combustion space or the molten glass in the melt space. However, in some cases it may be the iteration count associated with the particular data plotted, such as radiation solver iterations in a plot of residuals from the equation governing radiosities in the wall and boundary radiation exchange computation. The y axis quantities are in SI units: temperatures are in degrees Kelvin (K), energy transfer rates are in watts (W), etc. The title bar and legend indicate what quantities are plotted, such as mean temperature in the melt. In cases where the dependent variable spans many orders of magnitude, the y axis is usually a *log* scale, and this fact is also noted in the title bar.

Because the user interface and control program creates, copies, and deletes files on a case basis and automatically updates and moves control and boundary condition files between the melt and combustion space directory case folders for more involved simulations such as coupled cycling between combustion and melt, the user normally

does not need knowledge of the files used or their contents. However, a list of these files is provided here for those interested. The files related to building a model, saving its definition, and controlling a simulation for a case are listed in Tables 3 and 6 with a brief explanation of content.

Result files summarizing results, giving run termination status and used in post processing are listed in Tables 4 and 7. The `summary` files contain information that appears at the beginning and end of the `info` files in the relevant case folders in the melt and combustion space directories.

Table 1 defines the categories of files based on file extension. Table 8 lists miscellaneous files not saved in the case folders.

Table 1: GFM File Types

File Extension	*Type*	*Explanation*
d	binary	simulation state data for restart or other data
dat	text	data defining grid geometry, simulation setup parameters, and boundary conditions
out	text	main output of 3D field variable values for post processing
plt	text	simulation progress data that can be plotted with RunPlot
pre	text	geometry, parameter, and material property data used by the pre-processor
txt	text	various result summary, case definition, and message files for a case

Table 2: Combustion Space Simulation Monitoring Data Files

File Name	*Explanation*
conv_wall*nnnn*c.plt	equation residuals for radiation wall exchange
convg*nnnn*c.plt	mean and maximum mass residuals
fchg*nnnn*c.plt	relative change in mean melt surface heat flux from one cycle to the next
gresid*nnnn*c.plt	residuals from gas energy, pressure, and momentum equations
gresidp*nnnn*c.plt	pre-solve residuals from gas energy, pressure, and momentum equations
gresid_xtra*nnnn*c.plt	residuals from major species and turbulence equations
gresid_xtrap*nnnn*c.plt	pre-solve residuals from major species and turbulence equations
Info*nnnn*c.plt	evolution of energy sources, sinks, and transfers
mresid*nnnn*c.plt	residuals from minor and radiating species equations
rad_detail*nnnn*c.plt	radiation details from volume
soot_cal*nnnn*c.plt	evolution of values during soot calibration
Tave*nnnn*c.plt	evolution of mean temperatures over the volume, exits, and walls

Table 3: Combustion Space Simulation Setup and State Files

File Name	*Explanation*
case*nnnn*c.txt	case title, description, and user case notes
gd*nnnn*c.dat	combustion space grid definition and cell types
gd*nnnn*c.pre	preprocessor data including case geometry, inlet flow rates, material properties, case conditions and simulation control parameters
it*nnnn*m.dat	heat flux distribution at melt surface transfered to melt simulation in coupled simulations
it*nnnn*t.dat	temperature distribution at melt surface transfered from melt simulation in coupled simulations
it*nnnn*T_relax.dat	relaxed temperature distribution at melt surface used to damp large oscillations in coupling conditions
rg*nnnn*c.d	restart data for gas CFD computation
rr*nnnn*c.d	restart data for gas and wall radiation heat transfer computation
rs*nnnn*c.d	restart data for minor and radiating species computation
sbc*nnnn*c.dat	setup and boundary condition data

Table 4: Combustion Space Result Files

File Name	*Explanation*
rt*nnnn*c.out	field variable values over the domain used by post processor to display and visualize results
runend.txt	message indicating normal or error termination of run
summary*nnnn*c.txt	summary of results of run including energy and mass balances, in and out flows, energy transfer rates and losses, and other information
twall*nnnn*c.txt	grid cell array showing wall temperatures

Table 5: Melt Space Simulation Monitoring Data Files

File Name	*Explanation*
convg*nnnn*m.plt	mean and maximum mass residuals
gresid*nnnn*m.plt	residuals from glass melt energy, pressure, and momentum equations
gresidp*nnnn*m.plt	pre-solve residuals from glass melt energy, pressure, and momentum equations
Info*nnnn*m.plt	evolution of energy sources, sinks, and transfers
Tave*nnnn*m.plt	evolution of mean temperatures over the volume and exits
Tchg*nnnn*m.plt	relative change in mean melt surface temperature from one cycle to the next

Table 6: Melt Space Simulation Setup and State Files

File Name	*Explanation*
case*nnnn*m.txt	case title, description, and user case notes
gd*nnnn*c.dat	combustion space grid definition and cell types used to interpolate coupling conditions at melt surface between combustion and melt grids
gd*nnnn*m.dat	melt grid definition and cell types
gd*nnnn*m.pre	preprocessor data including case geometry, inlet flow rates, material properties, case conditions and simulation control parameters
it*nnnn*m.dat	heat flux distribution at melt surface transfered to melt simulation in coupled simulations
it*nnnn*m_adjflux.dat	surface heat flux scaled to meet batch and melt heat rate needed
it*nnnn*m_relax.dat	relaxed surface heat flux distribution used to damp large oscillations in coupling conditions
it*nnnn*t.dat	temperature distribution at melt surface
rg*nnnn*m.d	restart data for melt CFD computation
sbc*nnnn*m.dat	melt setup and boundary condition data

Table 7: Melt Space Result Files

File Name	*Explanation*
rt*nnnn*m.out	field variable values over the domain used by post processor to display and visualize results
runend.txt	message indicating normal or error termination of run
summary*nnnn*m.txt	summary of results of run including energy and mass balances, in and out flows, energy transfer rates and losses, and other information

Table 8: Miscellaneous Files

File Name	*Explanation*
cycleInfo.txt	temporary file, cycle number from GUI to CFD program
gfm.dat	temporary file, status from CFD program to GUI
gui-update.txt	temporary file, request from GUI to change update status in CFD program
kinetic.d	constant kinetic data supplied by GFM program
relaxfactorc.txt	combustion relaxation factors used to control changes to computed variables
relaxfactorm.txt	melt relaxation factors used to control changes to computed variables
runs.dat	specification of case to run
runstop.dat	request from GUI to end CFD program