BOILER INSTALLATION GUIDE

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1. INTRODUCTION

Boiler Model is a software package that solves equations of the multi-phase flow, convective and radiative heat transfer, and reactions inside a pulverized coal-fired boiler. 3-D spatial discretization is employed to solve the radiative heat transfer equation using discrete ordinates method. The 3-D cells are assigned to multiple zones along the height of furnace, forming 1-D spatial resolution for equations related to mass flow, chemical reactions, and energy balance. This hybrid approach can dramatically reduce the number of variables to be solved; therefore, requires much less simulation time compared to typical Computational Fluid Dynamics (CFD) models. The first-principles-based model contains advanced submodels for the calculation of radiation properties and for the heterogeneous reactions between coal particle and the gas reactants. The Boiler Model is applicable to both air-firing and oxy-firing conditions. The short simulation time and reasonable accuracy of the Boiler Model enable the fast generation of reduced steady state model for an oxy-combustion boiler and incorporation of the reduced model to a large-scale multi-variable optimization framework for system-wise optimization of the oxy-combustion system with carbon capture.

2. PREREQUISITES

2.1. Hardwad

A computer run on Windows operating system or Linux.

2.2. Software

Boiler Model is a software package that solves equations of the multi-phase flow, convective and radiative heat transfer, and reactions inside a pulverized coal-fired or other fossil-fuel-fired boiler. For those users who are not interested in further development, a Microsoft software installer "BoilerModelSetup.msi" is provided for the current version that can be installed on Windows platform (Windows 7 or higher). For developers who are interested in contributing to the boiler model, the executable can also be built on Windows by Microsoft Visual Studio and on Linux by gfortran and gcc.

2.2.1 Required third party software packages

For developers who are interested in future revision and enhancement of the software package, Microsoft Visual Studio (version 2012 or higher) is needed on Windows and gfortran is needed on Linux.

For end users who are not interested in modifying the source code, no computer language packages are needed. The installer will install binary executables and required libraries, along examples and documents.

3. BASIC INSTALLATION

3.1. Third Party Software Installation

N/A

3.2. Building Product (For Developers Only)

3.2.1 Build Executable on Windows

Developers need to install Microsoft Visual Studio (version 2012 or higher) on their Windows computer in order to compile and debug the program.

A third party package named "f2c" is also needed to compile "GasEmissivity.c" that is converted from a Fortran source code "GasEmissivity.f". The f2c source code can be found at http://www.netlib.org/f2c/. Download "libf2c.zip" file and unzip the file. In the f2c's source file directory, open Visual Studio prompt and issue the following command:

nmake –f makefile.vc all

A static library file named "vcf2c.lib" is created in the same directory. Copy this file to the "BoilerModel\f2c\lib_win32" folder under the boiler model's source directory. Also copy the file named "f2c.h" to the "BoilerModel\f2c\include" folder.

To build the executable file "BoilerModel.exe", follow the steps describe below.

1. Open the visual studio solution file "BoilerModel.sln" and Microsoft Visual Studio GUI displays as shown in Figure 1.

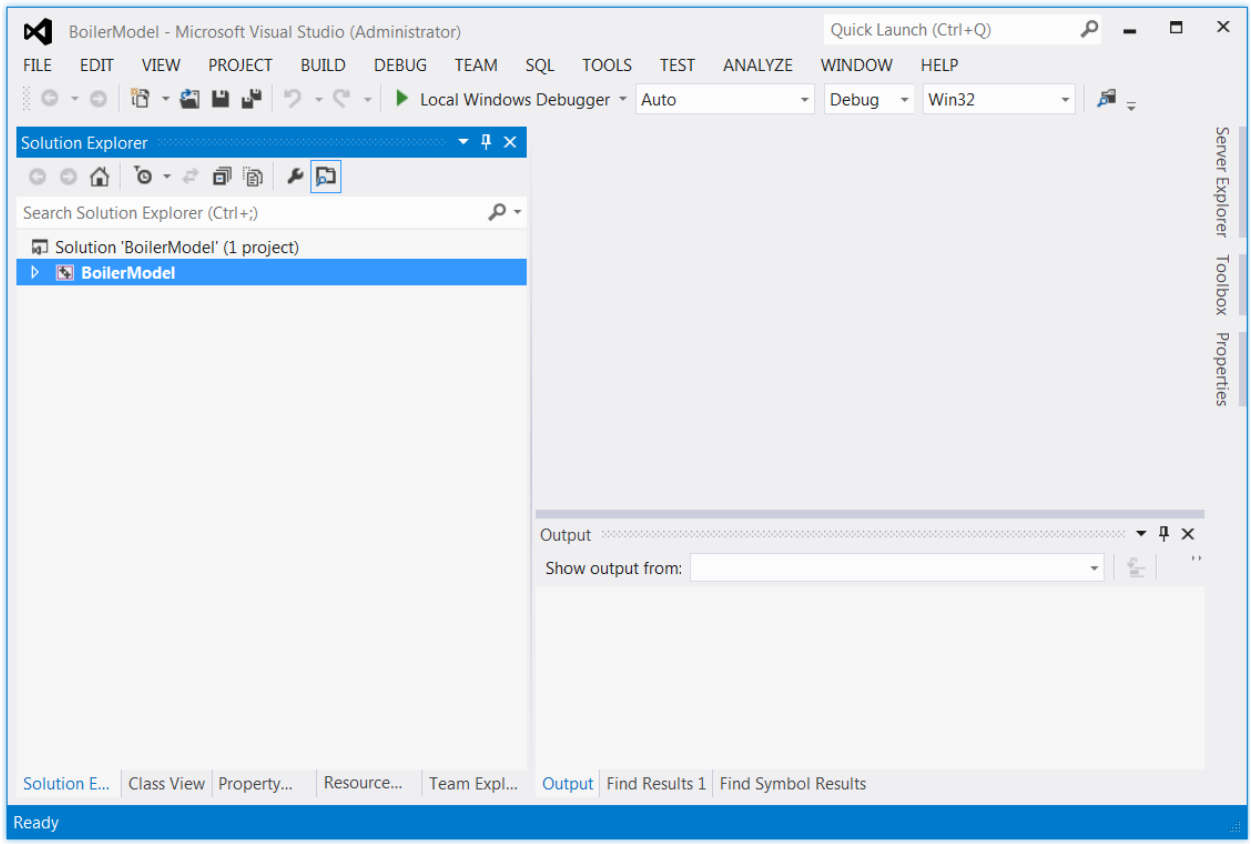

Figure 1. Visual Studio Window for Boiler Model Project

2. Click the dropdown box “Debug” and select “Release”. This allows Visual Studio to build a release version.

3. In the main window of Visual Studio, issue **Build→Build Solution** command. The “BoilerModel.exe” file will be created and written to the “Release” folder. Note the “Release” folder that contains the executable file is under the main folder of the boiler model project and there is also a “Release” folder created inside the “BoilerModel” folder that contains the object files.

3.2.2 Build Executable on Linux

If gfortran is not installed, install the gfortran compiler first. Then open a Linux window and change directory to the “BoilerModel” directory and is a “make” command. The “makefile” in the “BoilerModel” directory will be used to create the executable file “boilermodel”.

3.3. Product Installation

3.3.1 Install Boiler Model Manually

Simply copy the executable file built in Section 3.2 to an installation directory and change the computer’s path to make the file executable in any directory.

3.3.2 Install Boiler Model Using Installer on Windows

For end users, simply run the provided Windows installer “BoilerModelSetup.msi”. Follow the instructions of the installer to complete the installation process. It is required that the user accept the license agreement displayed in one of the dialog window. The user also has the option to install the program in a user specified directory. The default directory is “C:\Program Files (x86)\CCSI\BoilerModel”. After installation, the user need to add the “bin” directory to Window’s environmental variable “Path”. For example, if boiler model is installed in the default location, add “C:\Program Files (x86)\CCSI\BoilerModel\bin” to the path. Note: An end user does not need to install any third party software packages.

4. INSTALLATION PROBLEMS

4.1. Known Issues/Fixes

N/A

4.2. Reporting Installation issues

Contact ccsi-support@acceleratecarboncapture.org.

The email of lead development team for this product is
jinliang.ma@netl.doe.gov,