Status of the Object Oriented Program based Graphic User Interface Development for HyPEP

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1. Introduction

Hydrogen is being promoted as the energy-carrier for the future under the proposed hydrogen economy.[1] As large reservoirs of hydrogen molecules do not exist in nature, the hydrogen needs to be produced using other energies such as nuclear, coal, natural gas, etc.

The nuclear hydrogen production facility, where nuclear power is used to split water to produce hydrogen molecules, is presented as one of the optimal solutions for the large scale hydrogen production. Compared to other large scale hydrogen production methods, the nuclear hydrogen production can have better overall economics and less damaging environmental impacts such as global warming and pollution.

In order to assess the overall economics of the hydrogen production, it is important to assess the hydrogen production efficiencies. In the conceptual design stage of the plant, various different plant layouts need to be studied to optimize the production efficiency.

The main development aim of the HyPEP (Hydrogen Production Efficiency calculator Program) is the rapid assessment of the overall hydrogen production efficiency of a nuclear hydrogen production facility. The program is being developed with extensive GUI features to enhance the user-friendliness and the rapid model build-ups. This paper presents the current status of the development of HyPEP especially the GUI.

HyPEP is being developed under an International Nuclear Engineering Research Initiative (I-NERI) Project.

2. Graphic User Interface

The input/output of the HyPEP program is being developed using the Graphic User Interface (GUI). The HyPEP GUI is being developed with the Delphi program language using object oriented program techniques.[3] The various components such as the circulators, the Very High Temperature Reactors, and the heat exchangers that make up the nuclear hydrogen production facility are being modeled as object classes. These component object classes are derived from the base class by using the inheritance or polymorphism of the Object Oriented Program (OOP) paradigm.

2.1 Component Object Class Hierarchy

The thermal hydraulic solution scheme of HyPEP is based on the node-link-block formulation for flow networks. The node, the link and the block are the base components, and they represent the control volume, the connection, and the solid (heat) structure, respectively. HyPEP models the three basic components as the base classes TNode, TLink and TBlock. Other component model object classes (circulators, heat exchangers, etc.) are derived from these base classes. The example component classes of the HyPEP are structured in a hierarchy as shown in Figure 1. Using the OOP, it is trivial to generate new classes from the existing object classes by using the inheritance and polymorphism methods. It is also trivial to treat the descendant classes as the base object classes (or the parent object classes) by using the typecasting.
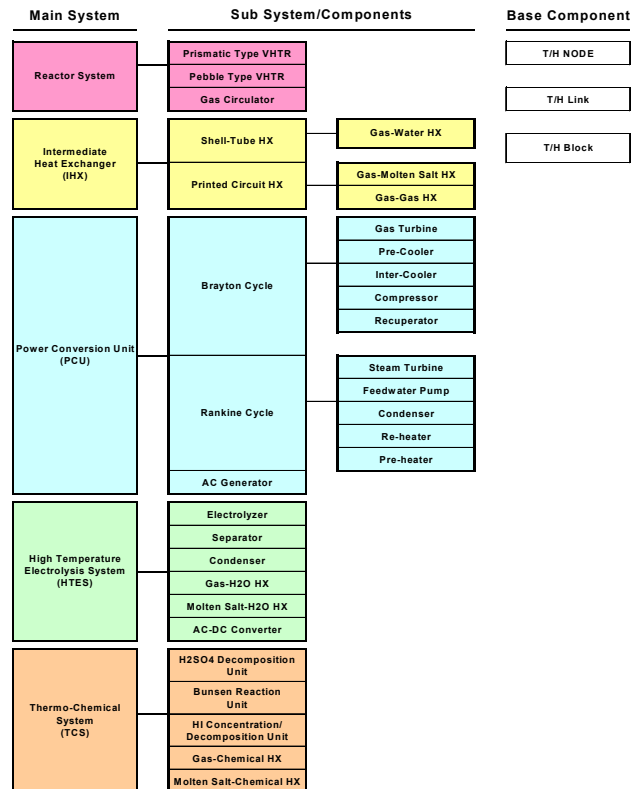

Figure 1. Hierarchical System/Component of HyPEP

2.2 Component Generation and Connection

A screen capture of the HyPEP is shown in Figure 2. As shown in Figure 2, the HyPEP form consists of 3 major sections: the main menu section, the drawing canvas section and the component palette section.

The main menu section contains the menu, the information panel and the tool bar. Most of the commands and the menus of HyPEP are located within the main menu section. Additional menus such as making links between components, selecting

components, etc, are located in the pop-up menu of the drawing canvas.

The canvas of HyPEP is where the nuclear hydrogen production facility models are built using the GUI. The Canvas is an instance of the TdxFlowChart Object class marketed by the Developer Express Company.[3] The drawing canvas maintains the records of the components built and connected in the canvas.
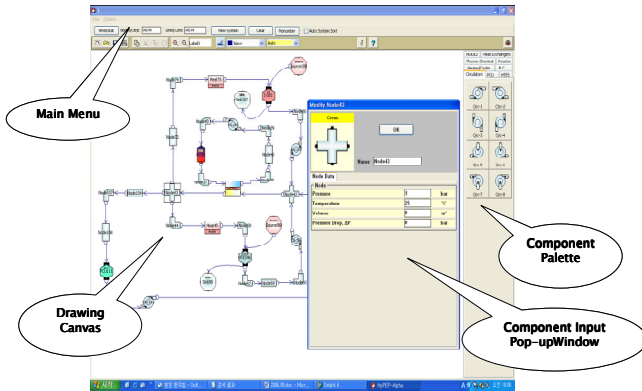

Figure 2. A Screen Capture of HyPEP

The component palette section contains the templates for the various components. The user can build a model of a nuclear hydrogen plant by first selecting the desired component from the palette and then drag-dropping the selected component onto the canvas to create an instance (object) of the component class. As the component is created on the canvas, the component input pop-up window appears where the user can enter parameters such as the volume, pressure, temperature, etc. of the component. User can repeat the process until the all desired components are created on the canvas. The components can then be connected using the connection command invoked by either double clicking on the components to be connected or by right clicking to bring up the pop-up menu. The connection wizard then pops up and user can make the connection through the wizard. The screen capture of the connection wizard is shown in Figure 3.
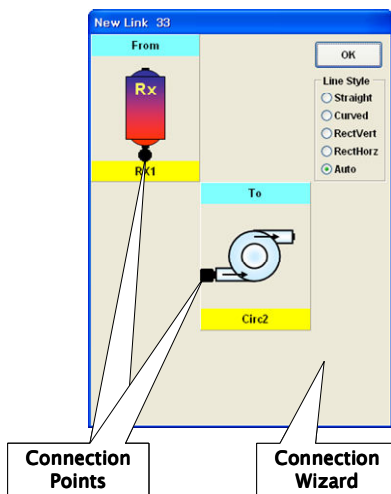

Figure 2. A Screen Capture of Connection wizard

2.3 System Configuration Build

The numerical solution scheme of the HyPEP requires the number of TH systems. A TH system represents a group of linked nodes where a member node must be connected via a link to at least one of the other members of the system. A system will have an independent solution matrix for solving the hydraulic part. Different systems can be connected via a block component. The final function of the HyPEP GUI is the build-up of the system configuration. The HyPEP GUI arranges components into different systems using the connection information. The GUI sorts and provides such information as the number of nodes, links, blocks in a system, the number of inlets and outlet links connected to a node, to what system a component belongs, etc. that is needed to build the hydraulic solution matrices. GUI also provides T/H details such as initial pressure, temperature, and flowrates of the components

With this information, the numeric solver of the HyPEP can carry out the numerical calculations.

3. Conclusion

GUI for HyPEP is being developed with the aims of enhancing the user friendliness and simplifying the model build-up to make it possible to rapidly model the nuclear hydrogen production plants. The alpha version of HyPEP has been developed with major GUI functions installed. The alpha version demonstrated the validity and the effectiveness of the GUI. The rapid build-up of models with alpha version has been demonstrated. The HyPEP GUI has been found to greatly enhance user convenience which will be a valuable feature for use in the optimization of complex facilities such as the nuclear hydrogen production plants.

REFERENCES

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