

## Tritium Transport Libraries for dynamic hydrogen transport modeling

*Cryogenic and tritium permeations are strong challenges in fusion technology. Empresarios Agrupados Internacional (EAI) has been working, in close collaboration with CIEMAT, in different EFDA tasks concerning tritium transport modelling. They especially developed a set of libraries for the simulation of systems and processes involving hydrogen isotopes for the study of transport phenomena and of physico-chemical processes related to the extraction and purification of tritium. Easy to reuse in many different systems without having to be reprogrammed, this tool could find promising application in every area which requires the simulation of processes involving hydrogen isotopes*

### Description of the technology

For today's engineering firm, using simulation tools to improve the **design process of new products has become an absolute necessity**. Systems simulations allow companies to reduce design and manufacturing costs **while shortening development times**. Fusion power is based on the fusion of deuterium with tritium creating He-4 and releasing a significant amount of energy. Special attention must be paid to the production systems, the test blanket modules (TBM) and the auxiliary recovery systems.

A leading Spanish engineering company, in collaboration with Fusion Spanish Lab (CIEMAT), **has developed a set of libraries for the simulation of systems and processes involving hydrogen isotopes for the study of transport phenomena and of physico-chemical processes** related to the extraction and purification of tritium. Based on ECOSIMPRO, a software tool for modelling and simulating multidisciplinary continuous and discrete systems, the toolkit TRITIUM\_LIBS includes two different areas of application:

- Test Blanket Systems (TBS), where Test Blanket Modules (TBMs) and their ancillary systems are modelled **for studying the behavior of tritium and its transport phenomena**.
- Tritium Plant, focused **on the process for recovering tritium from the torus exhaust gases**.

EcosimPro is designed so that **components can be reused in many different systems without having to be reprogrammed**. It provides a highly intuitive environment that enables the user to easily display simulation schematic diagrams and carry out both transient and steady state studies.

One of the main characteristic of EcosimPro is the possibility **to modify the existing components due to fact that the libraries can be delivered with the source code**.

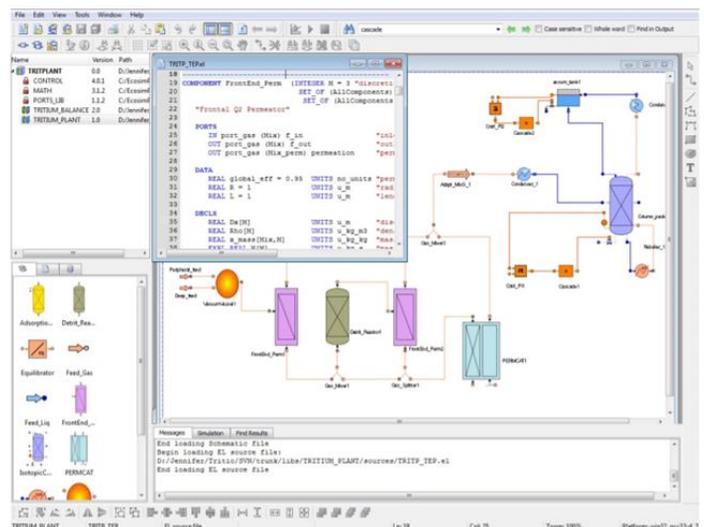


Figure 1: EcosimPro interface

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### ■ Innovation and advantages of the offer

The TRITIUM\_LIBS libraries contain components for the simulation of systems and processes involving hydrogen isotopes for the study of transport phenomena and of physicochemical processes related to the extraction and purification of tritium. The availability of models of such systems is especially important for the ITER project (International Thermonuclear Experimental Reactor), where control of the tritium inventory has to be strict at all times. The components of these libraries allow the dynamic calculation of the tritium inventory to be carried out, as well as the quantification of its flow into the environment, and between subsystems.

### ■ Non-fusion Applications

TRITIUM\_LIBS could find promising application in every area which requires the simulation of processes involving hydrogen isotopes : Transient analysis of the tritium inventory; concentration of tritium at different process locations; Support of decision-taking for process engineering; Support with deciding on the materials to be used; Analysis of tritium transfer surface phenomena; Dynamic analysis of tritium inventory under conditions of no tritium generation; Modeling of different scenarios of pulsed generation of tritium; Simulation of changes in the composition of the process fluid.

In parallel, EcosimPro and PROOSIS have several professional toolkits for the 0D/1D modeling and simulation of space propulsion systems and aeronautics, power, water, and processes.

### ■ EUROfusion Heritage

Cryogenic and tritium permeations are strong challenges in fusion technology, and no other tool is ready to simulate these phenomena without limitations in materials characteristics and work conditions. The ECOSIMPRO based toolkit **TRITIUM\_LIBS has been recognized as one of the reference modelling tools in the field of tritium**. EAI has been working, in close collaboration with CIEMAT, in different EFDA tasks concerning tritium transport modelling.