

# Modeling an Integrated Energy System in OpenModelica to Utilize the Output of a Nuclear Reactor for Producing Energy and Powering a Desalination Plant

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OpenModelica is an open-source modeling and simulation environment intended for industrial and academic usage. OpenModelica has built-in components and models in the Modelica Standard library. Users can develop their own model either using their own components or library components or using a combination of both. In this work OpenModelica has been used to model an Integrated Energy System (IES) where the output of a power source (such as a nuclear reactor) can be utilized to produce steam, electricity and also power a desalination plant; specially in remote areas or regions with lack of freshwater and high salinity of the groundwater.

The model was developed using components of the thermopower and modelica libraries, and by creating the desalination block. Initially, the reactor has been modeled using a generic equilibrium boiler where heat flux is fed from a furnace to boil off the water. The steam from the boiler is then fed to a turbine in the first loop, then to a simple condenser and finally to the equilibrium boiler through the prescribed pressure pump. In the second loop steam is fed to a turbine, then to the desalination plant and finally back to the boiler. Depending on potable water requirements steam will be fed to the desalination plant and the remaining will be sent to consumers for further utilization like district heating.

Initially, the desalination block was modeled using mass and energy balance and utilizing the data published on the amount of energy required to produce per unit desalinated water of the required concentration. Later a more detailed approach was considered; desalination block was modeled as a multi-effect distillation (MED) unit like it was in the Shevchenko nuclear desalination plant. The desalination block and the results are illustrated in the figures below and shows close resemblance to the output of the five-effect commercial desalination plant at Shevchenko.

Future work will be to incorporate a controller in the desalination block that will allow entrance of a certain amount of steam depending on the potable water requirement and limiting criteria of the desalination plant. Finally, the desalination block will be unified in the IES.

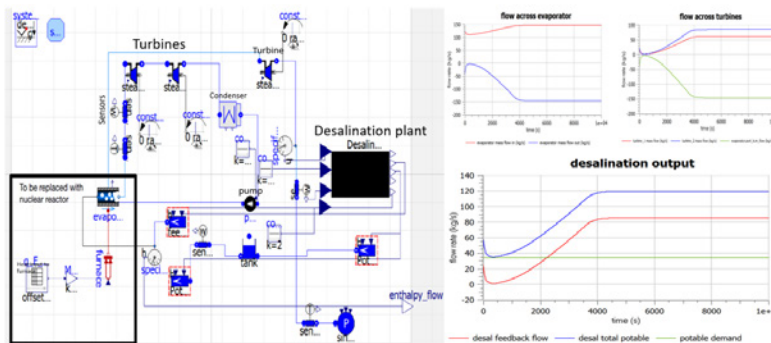


Figure 1. IES block of power source with the initial desalination plant