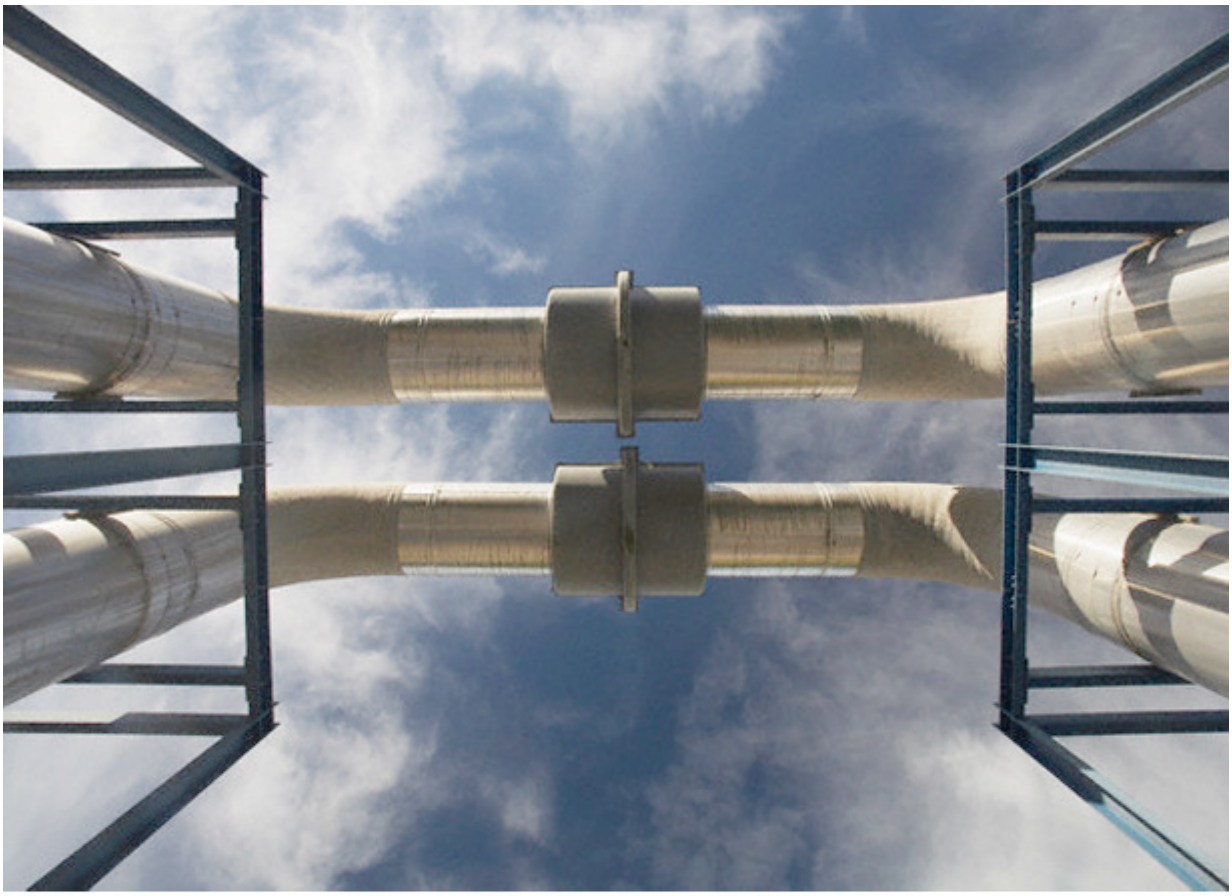

UtilitiesMasterplanning **&**
FeasibilityStudies

ACTSYS
Process management consultants

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introduction

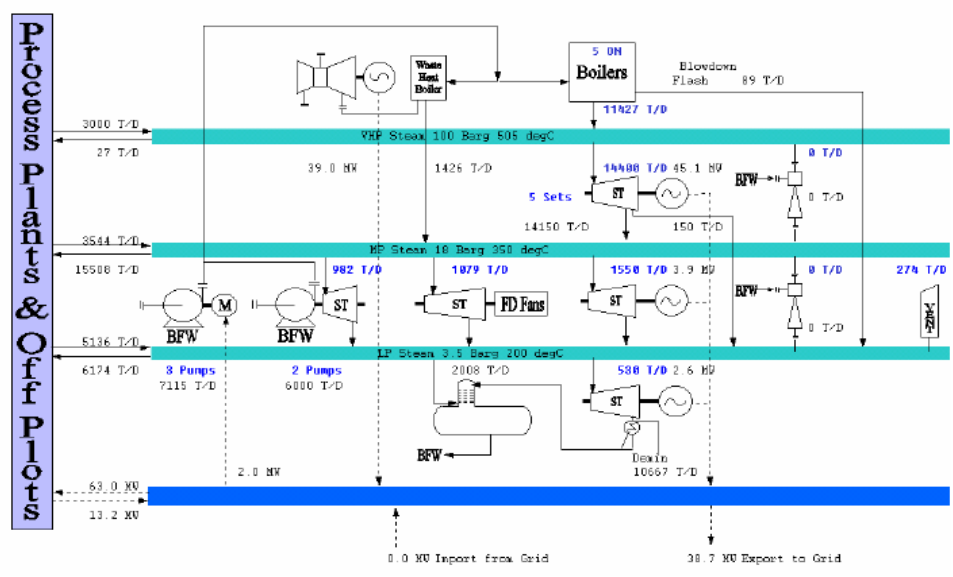
Most major process industries have Utilities generation plants which are integrated with the process units. The boilers and gas turbines should be fired with the most economical fuel(s) from the process units and in turn they generate steam and electricity required by the process plants. In some cases surplus electricity is sold to the National grid. Depending on ongoing Utilities demand, current equipment constraints, fuel cost, electricity import cost or electricity export price, optimizing the Utility plants for a minimum net cost operation is a continuous and complex task. This involves selecting the right combination of electric and turbine drives, the right level of steam generation from the respective fired equipment and the right level of power generation from the gas turbines and turbo-alternators.

With high crude oil prices, energy costs have become an even more significant proportion of operating costs. The need to know and to ensure that the Utilities System operates in an optimal way is therefore an important one.

ACTSYS process management consultants offer you technology consultancy services to help optimize your site Power, Fuel, Steam and Water utility operations. Through our operational and technological experience in this area and the use of proprietary software optimization tools to model your Utility systems, we can work with your process engineers to help you

- analyze current operation and identify improvement areas
- carry out feasibility studies for implementing an online Utilities Optimization system (also a product line of ACTSYS)
- feasibility studies for new Utility investment project options
- study the impact of new or changing Process Plants' Utility demands and identify new optimal Utility configurations
- set up a user friendly optimization system for your own use and analyses

optimization **methodology**



The boundaries of the optimizer model define the coverage of the site within which the loading levels and configuration of equipment will be determined by the optimizer.

All equipment which consume or generate Utilities (fuel gas, LPG, natural gas, refinery fuel oil, steam, electricity, boiler feed water, Demin water, condensate) at levels which can be significantly varied without affecting the process should be included within the boundary of the Optimizer model.

Together with production and consumption of Utilities by the Process Plants lying outside this boundary, mass balances are drawn up for each Utility. The consumption or production of Utilities with each piece of equipment is modeled by a combination of performance curves, material and enthalpy balances. The loading of equipment are the independent variables with maximum / minimum constraints applied to ensure they stay within range.

These relationships together with an objective function consisting of the resultant total cost of fuel, water, chemicals and electricity are then solved by an Optimization solver. This determines the values for the set of independent variables which gives the minimum objective function. A solver with Mixed Integer capability is used to turn equipment on and off to ensure all possible combinations of equipment on/off are examined in the optimization search.

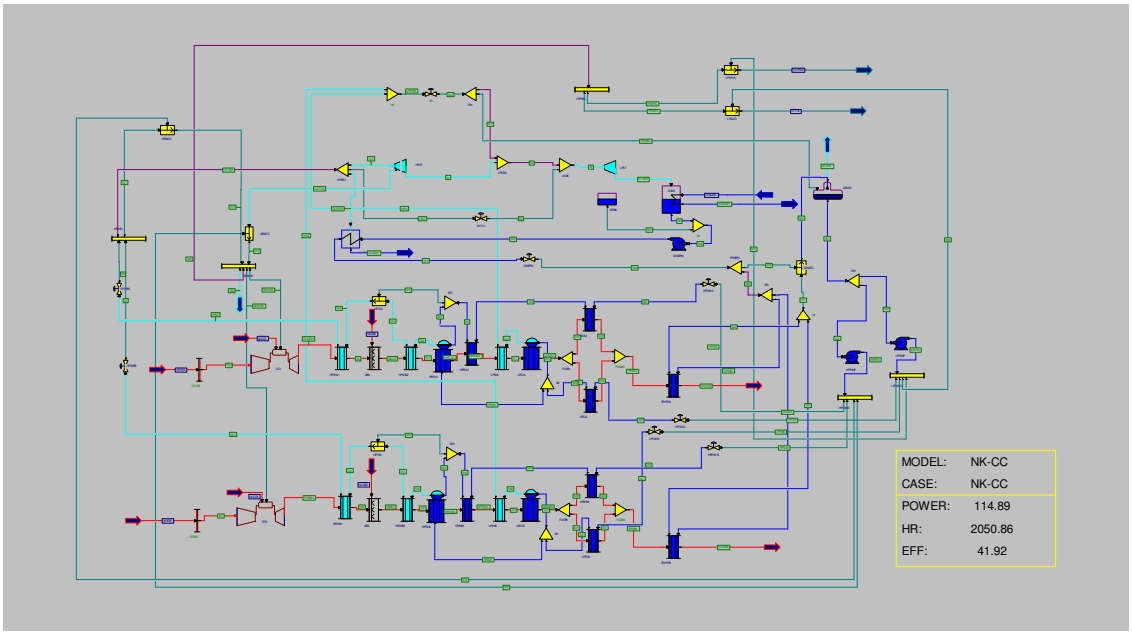
This optimizer model is used for studying optimizing current Utilities as well as configuration of new facilities that will affect the Utilities balances such as new process plants, new cogeneration plant, sea water distillers, etc.

Feasibility Studies for New or Retrofits to Steam / Power Generation Plant

In conjunction with the use of the above described Utilities Optimization Model to study the impact of new generation plant on the net cost of Utilities, a feasibility study also requires the comparison and quantification of different steam / power generation equipment.

- *Gas Turbines / HRSGs*
- *Backpressure or Condensing Steam Turboalternators*
- *Fired Boilers*
- *Gas Turbine Repowered Furnaces*

To carry out such detailed studies, the thermodynamic steam and power plant simulation software Gatecycle™ is used. For example in a configuration study for a new cogeneration plant, Gatecycle quantifies the performance of different manufacturer Gas Turbine models and gives the required sizing of steam generation heat transfer area for the required overall cogeneration efficiency.



key relevant **consultant capabilities**

Our senior consultants have the following track records to carry out the above described services

Major Cogen Investment	Shell UK Stanlow refinery. Use Utilities Optimization model to study the feasibility to replace the HP Boilers by GT/HRSGs
New Utilities infrastructure to cater for addition of new process plants	Shell Singapore Bukom refinery. The addition of a new HDS, CCR, LRCCU and Sea water Distillation unit had a major impact on the Utility balances in the refinery and the required new investments in Steam and Power generation was studied using a Utilities Optimization Model
Optimizing day to day Utilities Operations	Petronas Penapisan Terengganu Sdn Bhd. Online Utilities Optimization model was set up to guide operations to select turbine or motor driven pumps and compressors, in order to minimize steam letdown and venting / condensation
Power Plant Performance Monitoring using Gatecycle™	Tuas Power Singapore 3x370 MW Combined Cycle, Power Seraya Singapore 2x360 MW Combined Cycle, Samutprakarn Thailand 130 MW 2xGE Frame 6 Cogen Plant, Nongkhae Thailand 140 MW 2xGE Frame 6 Cogen Plant, Malakoff Tanjung Bin 3x700 MW Coal Fired Plant, Malakoff Prai 1x370 MW Combined Cycle Plant
Refinery Utilities Optimization	ThaiOil, Sriracha Thailand. Use Utilities Optimization model to quantify the benefits of steam turbogenerator investment