

Power Stations Thermal Plumes

Clients: ETI – Canal & Rivers Trust – ARAMCO – AEA – RC Jubail

Demand for More Energy

The ever-increasing demand for power is set against the need to ensure that the impact of thermal plumes is minimised and that waste heat is put to use wherever possible. Power stations which rely on gas, oil or nuclear steam generation all require cooling water for the condenser. CCGT systems also require cooling water for the secondary steam generation condenser. Large power stations



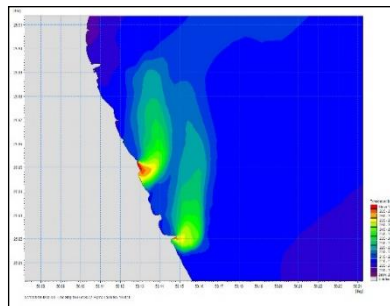
3 GW Thermal Discharge

may dump several GW of heat into the receiving waters. The capacity of all water bodies to absorb heat is limited and governed by a need to restrain the impact of temperature rise and thermal shock on ecosystems. Recirculation of discharged cooling water into intakes and other systems such as nearby desalination plants must be avoided. Even though renewables are making a greater contribution to the overall energy supply a base load generated by power stations will always be needed. In the future fusion power will still require cooling water. If SMRs are built they too will require cooling water. Unless all the waste can in the future be used beneficially the need to

ensure minimal impact from these systems will remain.

Developing a Sound Accurate Model

Models must be based on sound bathymetry with some knowledge of the water body bottom characteristics. Boundary conditions specification and high-quality boundary data are essential for achieving a credible model. Together with a well-developed suitably resolved mesh these features will form the basis for



Two interacting thermal plumes 5km in length

a model that can be accurately calibrated. We apply MIKE3 by DHI and our own Aquatic Heat Model for this work. We may use CORMIX in certain cases for modelling the near field or preliminary diffuser configuration.

Surveys and Data Analysis

Modelling must be supported by data derived from field surveys of sufficient length to provide meaningful data. We design surveys, analyse the results and apply them to model calibration and verification. We can carry out the complete range of tidal and current analysis and predictions using our own modern efficient tidal analysis and prediction software.

Regulatory Requirements

The discharger will aim to obtain a licence to discharge at the earliest opportunity, using an efficient system which avoids recirculation and therefore optimises the system cooling. The regulator will require a robust analysis to show the long-term detailed variation of temperature

throughout the water body. Often constraints are expressed in statistical terms and monitoring may also be required once a system is operational. A near field mixing zone distance coupled with an upper 95%ile temperature limit is also a commonly used criterion. TechnoEconomica, in numerous projects, has provided a way forward for all the parties involved to arrive at a satisfactory solution.

Experience

TechnoEconomica has undertaken studies for many clients including IBM, Canal and Rivers Trust, ETI AEA and ARAMCO among others, providing modelling services to support EIAs, preliminary design of single outfalls, and investigative modelling to optimise outfall and intake locations or very large infrastructure developments. This includes modelling four multi-GW power stations, a phosphate plant discharge and several desalination systems all in one large development. Our experience is wide and includes very large metasaline discharges from MSFD systems. We also have experience in assessing the performance of old damaged outfalls and modelling scenarios where outfall performance has been compromised.

Services Provided

- Specification of thermal & hydrographic survey
- Analysis of thermal survey data
- Specification and analysis of wind tunnel test
- 3-D Modelling of thermal discharges
- Prediction of the long-term thermal evolution of lakes and docks
- Helping the client to navigate the regulatory issues

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