SEA WATER INTAKE & OUTFALL SYSTEM FOR COASTAL POWER PROJECTS

Thermal power plants have very large requirements of raw water which is mainly used for condenser cooling and to a smaller extent for the production of demineralized water (DM water) which is used as boiler feed water to produce steam. Sea water is very often the source of raw water for coastal power plants.

Based on the type of cooling water system and the size of the power plant; the requirement of cooling water can vary. TCE have executed sea water intake systems with capacities ranging from 5,000 m^3/h to 6,00,000 m^3/h.

During the engineering of sea water cooling system; a number of engineering studies are carried out by TCE which include numerical model studies for reviewing impact of tidal hydrodynamics, thermal and salinity dispersion studies, sedimentation studies in addition to the systems engineering for the power plants. Experience is crucial to effectively model the problem and also to interpret and validate the results of numerical model studies.

Thermal power plants located on sea coasts generally use sea water as the source of raw water. Sea water is conveyed to the plant through the sea water pipelines from intake structures. The sea water is used as cooling water and also used for producing DM water. The cooling water systems for power plants could be of “once through” type or “Recirculating type”. The decision for the type of cooling water system is done considering environmental stipulations, site condition, availability and ease of drawl of water, local regulations and evaluation of techno-economic aspects. Recirculating type sea water cooling system consists of an intake, pump house and pipe lines to convey sea water to the plant. In addition to these structures in a once through cooling system there will be an outfall and pipelines / channels to convey reject water to the outfall.

In the design of sea water cooling systems care has to be taken about the following:-

Environmental and Local regulations: - Statutory clearances are required to be obtained for drawl of cooling water for the power plant and also for the layout of intake and outfall. Each country/region has certain norms for disposal of the reject water into the sea from Thermal power plants; to meet the environmental criteria. In India as per MOEF guidelines water temperature at outfall point shall not exceed 5^0C above receiving water temperature.

Stability of structures: - The effects of cyclones and storm surges on the stability of the marine structures need to be taken care of in their design.

Operational problems: - Effects of fish, jelly fish, marine growth (barnacles) on the marine structures need to be considered in the design. Suitable chambers and screens are provided at the pump house to prevent the entry of fish/ Jelly fish. Additionally at the pump house before pumping; the cooling water is dosed with suitable amount of chlorine to prevent barnacle growth in the pipeline.

Seawater Intake and Outfall system design involve:

- **Field Activities and Data Collection**

- Bathymetric and Topographic Survey
  - Sea bed profile is a critical input that decides the type of Intake.
- Oceanographic Data Collection
  - Data regarding tide levels, tidal currents, wave conditions and storm surges are critical basis for designs for the intakes and outfalls. These data are generally collected from survey agencies and also from “National Institute of Oceanography” (NIO) in India.

- Geotechnical Investigation & Surveys
  - Both off shore and on shore geotechnical investigations are carried out to get soil data which is required to decide on the location of various structures and to decide the type of foundation.
- Environmental Impact Assessment
  - The impact of the intake / outfall structure on marine life during construction stage and during the life time of the project needs to be studied.

➢ **Conceptual Design of Schemes**

There are three main types or schemes/ concepts for the intake:

- **Intake channel with onshore pump house**
  Here sea water is conveyed through an intake channel dredged from the deep seabed to the Intake pump house located on the shore. The channel is usually dredged to sufficient depth using dredgers and limited underwater blasting.

- **Offshore Intake Structure, Submarine Pipeline & Onshore Pump House**
  Here an offshore intake is constructed by sinking a well that is constructed on shore and conveyed to the site in the sea either by floating it or by barges. The pump house is on shore and water is conveyed to it from the intake using submarine pipelines made of HDPE, GRP or Mild Steel with suitable internal and external corrosion protection linings. The pipelines are provided with RCC anchor blocks to take care of buoyancy.

- **Offshore Intake Well with pump House and Pipeline over trestle approach**
  Here an off shore intake well is constructed with pump house as super structure. Sea water is conveyed by pumping to the power plant on the shore through pipelines. The pipelines are supported over trestles/approach bridge from the intake well to the shore.

  For once through cooling water systems the Reject water from the power house is discharged back to sea through Outfalls. The configurations of the outfall are:

- **Outfall channel for surface discharge**
  In this configuration, a channel is dredged from the shore up to the desired depth in the sea to convey reject water from power plant to sea.

- **Outfall Pipeline with Diffuser for submerged discharge**
  Here reject water from power plant is disposed to sea through submarine pipeline or pipeline over trestle with suitable Diffuser arrangement.

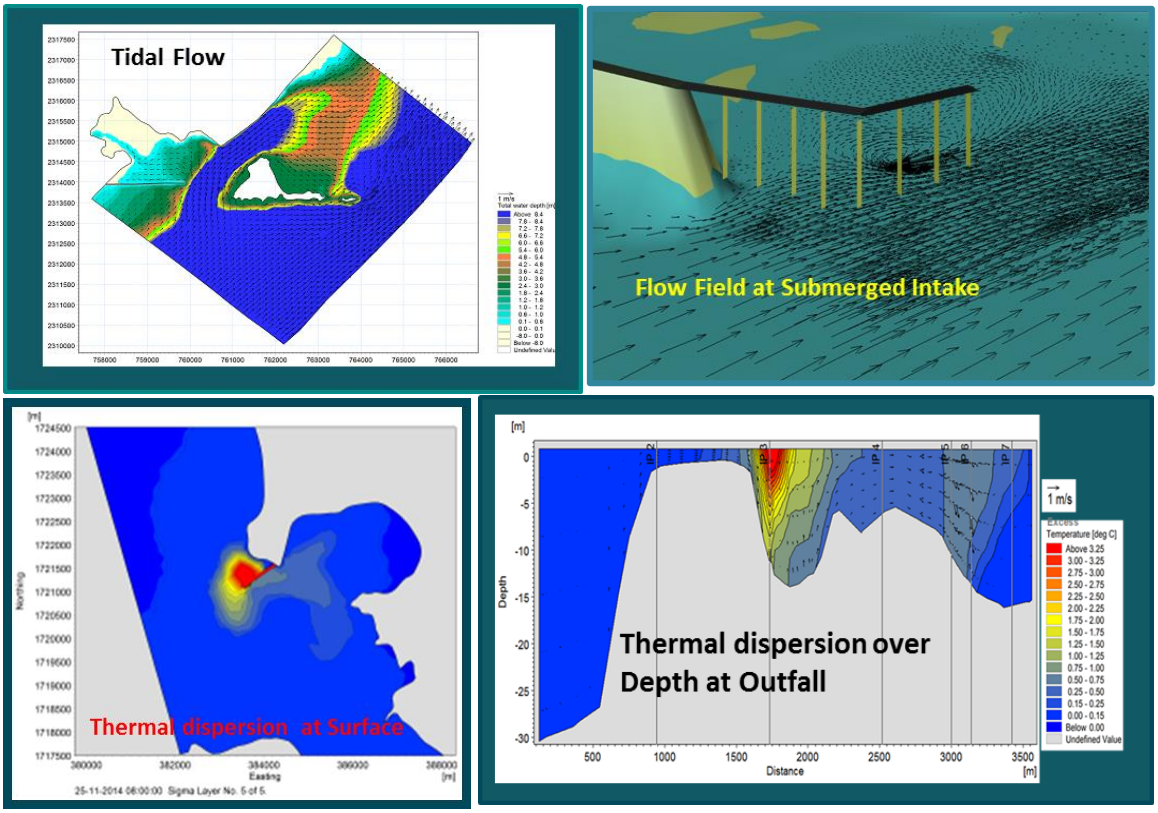
Detailed techno-economic evaluation of the options for intake and outfall is done for performance, site constraints, regulations and cost effectiveness. The most suitable layout of the intake and outfall depends on the thermal recirculation of cooling water.

➢ **Numerical Models & Studies**

Tidal hydrodynamics and thermal dispersions are very critical elements of the intake and outfall design. The feasibility of the intake and outfall system significantly depends on the location of the intake and outfall. The hydraulic performance of the intakes and for outfalls; compliance to regulatory requirements regarding discharge standards and dispersions are very critical and need to be adequately designed for. Experience and understanding of coastal hydraulics is essential to carry out numerical model studies and assess the impact of drawl of cooling water and disposal of reject water on coastal hydrodynamics and marine life. The numerical model studies using state of art Software help to realistically assess the operating scenarios and provide most suitable and efficient Intake and outfall System.

Software's like Mike-21/ Mike-3/ CORMIX are used to carry out the following simulation studies:

- Simulation of Flow conditions under the action of tides, waves and wind in the coastal areas, tidal creeks and estuarine rivers considering seawater drawl and effluent disposal flows.
- Sedimentation in Intake channels and sedimentation pattern in the coastal area.
- Thermal Dispersion Study to simulate development of thermal plumes.
- Salinity Dispersion study development of Salinity plumes.
- Simulation of near field and far field mixing zone for various diffuser arrangements to arrive at the most appropriate Diffuser system for disposal of effluent.



TCE have engineered a number of cooling water systems for power plants and other industries both in India and abroad which cover both once through and recirculating systems. TCE have also carried out feasibility of existing Intake & outfall system to augment capacities of cooling water systems and have suggested best possible upgrade requirements.