EQUIPMENT DESIGN, FABRICATION, AND CONSULTANCY SERVICES

1. Equipment Design and Fabrication

1.1 Design, fabricate, and deliver InvisiHead intake head systems of 6-14 mm mill-finish 316L stainless steel to adequately deliver the required flow capacity at a max entrance velocity of 0.091 m/s. System performance remains in full compliance with environmental regulations including flow velocity with an extra wide margin of safety over the US EPA standards and to maintain a lifetime of compliance –Figs 1.1 and 1.2.

![InvisiHead anchored to the sea floor via a concrete block and connected to the intake pipe](image)

**Fig. 1.1** InvisiHead anchored to the sea floor via a concrete block and connected to the intake pipe

1.2 Design and supply anti biofouling hypochlorite solution or any disinfectant dispensing system built-in near the entrance perimeter and installed in the InvisiHead intake head in such a way that no chemicals bleed out of the structure into the open environment. The system is added to prevent biological biofouling and slime formation. The disinfectant can be supplied from onshore via a 1-4” HDPE hose/pipe.

1.3 Design, fabricate, and deliver InvisiHead marine outfall systems of mill finish 316L SS or Duplex steel according to the nature of the discharged liquid whether it is power plant cooling water or desalination brine to adequately discharge, disperse, and dilute the cooling water or brine so as to remain in full compliance with US EPA environmental regulations for a lifetime of over 50 years- Fig. 1.3. and 1.3-2.
Fig 1.2. Omni directional 3-D gravity-driven flow streamlines speeding up toward the InvisiHead entrance with a sea floor takeoff velocity of about 0.002m/s rising to an entrance velocity of 0.09m/s

Fig 1.3. InvisiHead marine outfall system gravity driven

Fig. 1.3-2. Omni directional 3-D gravity-driven discharged flow streamlines funneling out in a 3-D fashion to
reach ambient conditions a short distance away from the outfall

2. **Professional Engineering Services**

2.1 **InvisiHead system installation supervision**
We have installation supervisors who can assist the main marine contractor to install intake systems. We can supervise the installation of the entire seawater intake and discharge systems system including InvisiHead systems or parts of the intake and discharge systems.

2.2 **Configure intake and discharge pipes** and produce dimensions so that they can adequately deliver or discharge the required flow capacity seawater and remain within the Elmosa Velocity Envelope (EVE) to maintain a self-cleansing environment inside the pipes while providing a relatively flexible flow capacity; produce pipe and ballast weight design and specifications where required, ballast weight spacing and installation methodology in case of HDPE pipe.

*Delivered to customer’s desktop by email. Delivery is done* within 48-72 hours from payment receipt.

![Intake and discharge pipes can be configured to be HDPE or GRP](image1)

**Fig. 2.2.** Intake and discharge pipes can be configured to be HDPE or GRP

2.3 **Configure the onshore NatSep intake basin/ pump sump** and produce dimensions so that it can adequately receive and process the required flow capacity of seawater, remove the cut-line sediment and deliver clean flow to the pump sump at the downstream portion of the NatSep. We design the NatSep to be free of any equipment and to contain no mechanical screens or any kind of mechanical systems or control machines. The NatSep is designed to perform two major functions:

1. Control the flow and force the water through the InvisiHead at the shore location when the seawater pumps onshore at the plant are activated. The water level at the NatSep keeps dropping until full capacity is reached, at which level drop stops – Fig. 2.3.1;
2. Naturally separates sediments and debris from the flow. The default cut-line size of sediments separated from the flow is fine sand and larger. We can design the NatSep to be cleaned once every years to 5 years. The NatSep is designed to have 2-100% bays to provide an interrupted operation during the cleaning process that should last for more than 8 hours.

Fig. 2.3.1 Seawater pumps just activated showing a full NatSep is in action

Fig. 2.3.2 Plan view showing 2-compartment NatSep, each is 100% capacity
**NatSep configuration is delivered** to customer’s desktop be email within 48-72 hours from payment receipt.

2.4 **Configure effluent discharge syphon and pipes** and produce dimensions so that they can adequately discharge the required flow capacity, produce pipe and ballast weight specifications, ballast weight spacing and installation methodology in case of HDPE pipe.

**Discharge syphon and pipe configuration is delivered** to customer’s desktop by email within 48-72 hours from payment receipt.

2.5 **Perform the US EPA Visual Plume modeling** runs applying site data to demonstrate marine outfall discharged flow plume dispersion, mixing, and dilution process and compliance with environmental regulations and how discharged water reaches equilibrium with local conditions only a few meters away from the discharge point.

**Dispersion modeling demonstration is delivered to customer’s desktop by email** within 48-72 hours from payment receipt.

2.6 **Intake installation supervision:**
Upon the contractor’s request, an expert or two from Amecosys would be dispatched to supervise intake system installation. A senior supervisor and an assistant can be dispatched to assist and systems installation:

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**THE NATURAL SEAWATER INTAKE SYSTEM**

Self-operating, Self-maintaining, Gravity-low Passive Seawater Intake System

No pumps. We let nature do the work

US EPA: Best Technology Available BTA)

Do you have problems in your intake with:

- Zebra Mussels?
- Fish, Fish larvae, Sand, Trash and debris?
- Seagrass or Potentil for oil spills?

Our Design Philosophy is based on:
- Pro action rather than Reaction
- Prevention rather than Curing
- Preservation & Capsulation rather than Fragmentation

* The 2013 Fundshearts hurricane and 8-maid wave storm, it be streamlined and built to last full operation for over 50 years.

* The NatSep* Setting Basin

* The NatSep*

* The Natural Pump

* The Natural Water

* Users: Electric Power Plants, Seawater Desalinatet Plants, Oil refineries, Mining, Fish Farms, Aquaculture, Distric Cooling, Municipalities and Others

* We have the permanent and the nature solution

American Eco Systems Corporation

540 Centre St, Nudley, New Jersey 01210 US

* 419339631320

* 60268894

* elmosa@amecosys.com

* elmosa@amecosys.com

* elmosa@amecosys.com

Fig. 2.6. Full intake system including the three major Elmosa intake components: the InvisiHead, intake pipe and NatSep

**Duration:**

1. 2-3 days for the InvisiHead intake head system;
2. 2-3 days for the InvisiHead marine outfall system;
3. As long as it takes for the entire seawater intake system installation based on joint coordination with the main contractor.

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Design, engineering, fabrication, delivery and supply of the InvisiHead intake head and discharge outfall system, systems engineering, and other professional services
2.7 Engineering review and site selection:
We can provide assistance to review the entire intake system design, do site inspection and offshore upstream end site selection. The per diem rate applies for site investigation and selection. As for engineering review, any work done at home base would be estimated, an hourly charge applies.

2.8 Training of client operating personnel:
A one-week training course or more will be made by a senior intake expert at the plant site.
**Fig 3.** Seaweeds can really become a killer to intake systems except the InvisiHead which is highly selective and can stealthily squeeze water out of weeds and have the marine currents flush them away.

The InvisiHead is highly site-specific. We custom-design each system according site conditions. The InvisiHead technology can be tuned up during the design phase to local site criteria. Where marine life is present in large quantities we design the InvisiHead to have an internal outlet positioned between the entrance and external outlet that is connected to the intake pipe inlet. The addition of the internal outlet is to drop the internal velocity from about 0.09m/s down to 0.03m/s to give supremacy to marine currents to control debris and weeds and flush them out through the opposite end of the InvisiHead into the ambient.
Seawater intake and discharge outfall systems.

1. The intake system is formed of the Inlet, the pipeline, and the outlet. The inlet is made of the InvisiHead intake head system flanged to the HDPE or GRP pipeline riser inlet flange or flange adapter and anchored to a concrete base installed at offshore at a reasonable depth. The pipeline spans between the InvisiHead intake head or outfall and the onshore discharge syphon or NatSep gravity-flow control and sediment-separation basin. At the upstream end of the NatSep seawater is discharged a flow breaking barrier, and at the downstream end the seawater pump intakes are placed.

2. The brine discharge system is made up of a surge/gravity-flow control chamber located onshore to receive brine or condenser water from the RO concentrate or the power plant and to drive it through the discharge HDPE or GRP pipe and disperse it through the InvisiHead outfall located several meters offshore at the same direction of the intake pipeline or a different direction as dictated by the bathometry survey.

The following is the recommended engineering process that will be performed to get the systems installed and commissioned using the FEED documents if available as the basis for the design.

A. Pipe design
   1. Configure the appropriate HDPE or GRP pipe diameter to maintain a flow environment inside the pipe that will prevent sediment settlement and marine growth as long as the design pumping capacity is maintained;
   2. Select the appropriate Standard Dimension Ratio, SDR to meet site and operation requirements and provide the minimum size that would adequately achieve the required discharge capacities in both intake and outfall cases.
   3. Stipulate pipe material properties;
   4. Apply the ISO 4427 and ASTM and other applicable standards, and DNV Offshore Codes in the analysis;
   5. Check pressure rating for short and long-term performance taking into consideration operating temperature, pipe parameters and application environmental conditions;
6. Do pressure design and apply the ISO equation to calculate internal pressure using applicable hydrostatic design basis, hydrostatic design surge, stress induced in both pipes – intake and discharge;
7. Check critical buckling pressure, pressure drop at both ends of the vacuum line (the intake) and the pressure line (the discharge) which both are gravity-driven;
8. Check overall frictional pressure loss at downstream ends of both lines;
9. Check surge pressure at the upstream end of the intake line and estimate critical time and prescribe controls;
10. Check ring and wall deflections of the pipes due to earth and other external loading and calculate the critical buckling stress where applicable;
11. Check pipe linear deflection or change in diameter;
12. Check effects of temperature and calculate the amount of expansion/contraction;
13. Find the amount of change in pipe length and estimate the distance between concrete weights;
14. Estimate the allowable pulling pipe length;
15. Estimate the final minimum backfill depth.

B. Pipeline stabilization
1. Compute the required concrete weighting, impact resistance covers, pipe stabilization mattresses, and spacing required to have the pipeline positioned into place;
2. Investigate the option of bundling the intake pipe with the outfall’s for the discharge pipe length at same trench and check the use of common weight impact resistance covers and mattresses.
3. Compute buoyant forces, weight of pipe and weight of seawater displaced by the pipe;
4. Calculation formulas adapted by the industry will be used to achieve proper floatation, sinking, and anchoring of the pipelines into position at the sea floor;
5. Ensure not to have air entrapped inside the pipe that will negatively impact the ballasting system.
C. Other jobs

1. Select site to store, join, and launch pipe installation process that should be conducted onshore close to shoreline and near the NatSep site where a land-water transition zone is to be located and prepared for the pipe-water entering operation;

2. Heat-fuse individual pipe lengths into the proper long and continuous lengths;

3. Conduct field inspection using survey data and check pipeline paths during preconstruction and post construction;

4. Stipulate testing procedures including
   i. leak testing,
   ii. pressure testing with precautions,
   iii. test duration,
   iv. pre-test inspection,
   v. hydrostatic testing,
   vi. monitored make-up water test.

5. Mount concrete weights from the barge on the pipe and lower the pipeline into position progressively.

6. Mount the InvisiHead intake head all system into the riser located at the end of the intake pipeline and sink the complete assembly along with the concrete base into the final position.

7. For the InvisiHead outfall, conduct several computer modeling runs using US EPA Visual Plumes to determine the height at which the InvisiHead outfall will be positioned to achieve optimum dispersion and dilution results of the brine plume discharge;

8. Prepare the appropriate outfall riser on which the InvisiHead outfall will be mounted;

9. Proceed with the outfall mounting and repeat the same process done with the intake head installation.

10. Post pipeline installation inspection is to be performed by an experienced diver to make certain that the pipeline is properly positioned along the preset path and that all weights are sitting properly on the sea floor.

11. Chlorination hose is then to be strapped to the weights and connected to the chlorination dispensing ring built in the InvisiHead intake head,
13. Place mattresses trench over the pipelines;
14. Backfill;
15. To minimize impact of the outfall on the environment and marine life, dredging should be reduced as much as possible by limiting trench depth in such way that the topside of the pipelines remain at seabed level except at the beach and the shallow coastal zone where the seabed sediment transport takes place during stormy weather.

Manufacturer’s recommendations and the FEED will be used as the main project implementation references.

Cost estimates
This engineering job is divided into two parts:

Part I
- Site acquaintance visit, meeting with contractor and client and collecting data
- Homebase desktop work.

Part II
- Residency period at the project site to supervise project implementation; number of personnel is 2-3.

The field visit in Part I is made by one person from Elmosa/AES charged at $850 per day including travel time plus travel and accommodation expenses. The homebase part is charged at $140/hour. 10-15 days or 80-120 hours would be needed.