# OVERALL SITE LAYOUT

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## Contents



## Summary

In the field of industrial engineering, the "layout design" function is a comprehensive and difficult one. It is comprehensive in that it involves many tasks, the main ones being:

1. Siting of the buildings at the site;
2. Routing the links between the buildings;
3. Allocating the spaces to the equipment inside the buildings;
4. Designing the routes of the connections between the various equipment (piping, ducts, cable racks, ...);
5. Layout of the various spaces necessary for operation and maintenance.

These tasks must take into consideration both the logic of the process itself and the requirements for having a pleasant architecture. The function is a difficult one because two major challenges have to be met:

1. A multidisciplinary design team has to have its work integrated without losing any of the individual functional excellence, and the work coordination requirements are high.
2. Ultimately, a layout must be achieved in which the surface areas and volumes are as small as possible, though effective and justified.

When the layout design function is fully aware of the targets it has been set, it will contribute to a significant extent to the reduction of:

1. The initial investment cost.
2. The operation and maintenance costs throughout the life of the installations.

The above aspects have a direct effect in relation to the Client's three major concerns: quality, time-schedule, cost

## 1. Introduction

Within this extensive subject, only the desalination facilities are described. Of the wide variety of types of installations that may be involved, the following systems are considered: MSF, ME with and without vapor compression, reverse osmosis and electrodialysis.

The present section describes from the general to the specific, recommendations about the overall site layout, which are complemented by guidelines for equipment/buildings layout design. In the following sections, for each type of desalination, the plant layout itself and the arrangement of the directly connected auxiliaries is focused upon, with the layout study also taking into account the relative locations of the various systems/subsystems. The details of the P&I diagrams of a single unit (MSF, MED, RO, ED), e.g. the arrangement of piping, installation of instruments and control devices, are covered in Ancillary Components and Electrical Equipment.

## 2. Overall Layout of the Site

Usually, layout considerations are involved at the very beginning of a project to invest in desalination facilities, i.e. as soon as the feasibility study phase begins.

Based on the targets set, and the various requirements and the criteria defined by the client, such as cost of the land, cost of construction, cost of operation and maintenance, environmental impacts, esthetic, interferences with existing facilities, a number of options that are technically and economically possible are presented. From this choice, the client can select the option that best meets his interests.

In order to commence this phase of the study, the "layout design" function has the following information available:

1. A general description of the process and its alternatives (based on documentary research and information sought from main equipment manufacturers).
2. The site investigation results (based on information such as topography, hydrography, geology and soil properties, environment, access, available utilities, sources of raw water and energy, ambient conditions, etc.).
3. The process diagrams (including the flow charts, preliminary monitoring and control diagrams, cabling diagrams, etc.).
4. The regulations and codes relevant to the project, e.g. noise, effluent emission, liquid effluent release, visual impact on the landscape.

Based on the above information, the overall drawings are established. These include outline sketches, location drawings, and overall layout drawings. These general drawings are aimed at situating, locating and giving the layout of the installation as a whole at the site .

The outline sketches are established on a small scale at the stage of the investigation and discussions. They represent one or more potential layouts of the main systems of the installation. Among these systems, the main ones are:

1. Evaporator/membranes.
2. Raw water supply, recirculation and outfall systems.
3. Pretreatment system.
4. Product water treatment system.
5. Water storage tanks and product water pumping station.
6. Electrical auxiliaries.

These systems/buildings are positioned relative to each other taking into account the main connections (piping and others) between them. Their layout aims at:

1. Making the best possible use of the (limited) surface area available;
2. Keeping as short as possible the connection routes of:

- Piping systems,
- Gas and air systems,
- Electrical connections,
- Handling.

Whether on a virgin site or on a site where installations are already in operation, or whether the desalination process is associated with a power plant or not, the least surface area consuming layout has to be retained (location and overall layout drawings), taking into account elements including (Figure 1):

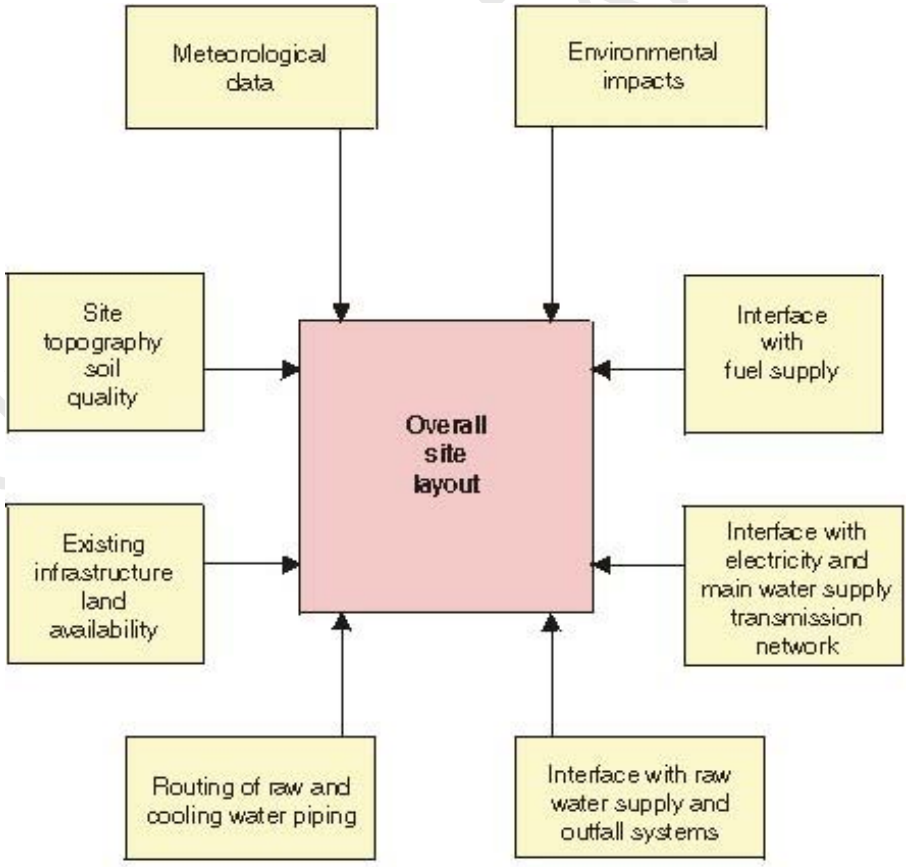


Figure 1. Overall site layout inputs.

1. The meteorological data and particularly the prevailing wind directions, aiming at

- Limiting nuisance to the environment as concerns noise and emissions,
- Avoiding the recycling of emissions by the existing installations (as in the case of a site with existing installations that have air intakes).

2. The risk of pollution deriving from storage of chemicals.
3. The interface requirements with the electricity and main water supply transmission networks, new or existing, to which the installations are to be connected, to:

- Guarantee the feasibility of the connections (this requires coordination with the substation and main water supply transmission design engineers),
- Avoid existing or future facilities being crossed by HV transmission lines, this for obvious reasons of safety and of HV line construction.

Let us bear in mind, however, that the connections between the transformers and the HV substation may be arranged with buried cables, this method offering greater flexibility and better visual impact.

4. The interface requirements with the fuel supply, if any.
5. The interface requirements with the raw water supply and outfall systems .
6. The routing of the raw water and cooling water piping, taking into account:
- The length of the piping routes should be kept as low as possible (investment and operating costs due to the pressure losses),
- Water piping is generally buried and the system must be kept as simple as possible, reducing, for instance, the number of pipe crossings;
- Allowing for future extensions, making sure that future piping (if need be) can be connected to the same source.
7. The site topography, to the extent that it is important that:
- The quantities of cuts and fills be reduced, through adequate selection of the foundation levels of equipment/buildings and structures (if the relief is hilly, various levels may be envisaged),
- When the level is uneven, other aspects may need closer consideration such as:
– The functional links between the various equipment/buildings (to be arranged at least cost),
– Raw water and cooling water pumping costs,
– Civil works constraints with respect to infrastructure and foundations.
8. The soil quality regarding the foundations.
9. The existing infrastructure, if any, for example:
- The accesses and roads to which the installations will be connected (and of which the connection feasibility must be checked),
- Installations already in operation at the site and for which interfaces with the new installations will have to be envisaged.

A frequent example of this is when the existing lifting equipment (travelling crane) is to be used also by the extension.

10. The land availability specially in built-up areas where the cost of the land is high.

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