CIVIL ENGINEERING IN DESALINATION PLANTS

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Contents

Summary

The particular concerns of the civil engineering in the desalination plant are reviewed. Site investigations will determine the constraints of the local environment to be taken into consideration during the design and erection phases. Some design considerations are developed regarding the load analysis and the foundation system. The multidisciplinary nature of the project affects the time scheduling as well as requiring various stages of development and iterations. Standard cost control and payment methods are used. Quality control measures will centre attention on the durability of the concrete and the interfaces with the other disciplines.

1. Introduction

Civil engineering in a desalination plant is not essentially different from that of other industrial projects. It consists in providing foundations to the process equipment as well as erecting buildings to house the electrical and instrumentation services, the various stores and workshops, the administration, the social facilities, etc.

Like other industrial projects, the main targets are:

- To keep within the budget;
- To keep within the time frame;
- To reach the required quality standard.

Moreover, civil engineering in industrial projects is seldom repetitive and a standardized design cannot be applied to all projects, *mutatis mutandis*, for the following reasons:

- The process itself may differ from one plant to another while governing the design in defining the technical requirements to the other disciplines.

- The technical culture of the owner, who tends to personalize the project according to his own experience together with the operational constraints of the project.
- The site characteristics, such as its size, shape, level, underground.
- The environment.
- The local regulations and the applicable standards.
- The technology available to the local civil contractors which may notably differ from one country to the other.

One can indeed say that each project is very different. In desalination plants, one of the most difficult problems to be dealt with is the durability of the reinforced concrete structures. This aspect is reviewed in section 5 of this chapter.

2. Site Investigations

The collection of all pertinent site data will be performed in two stages:

- *During the preliminary studies*, in order to evaluate the suitability of a site; if several sites are considered, the site data will be used for the selection of the most appropriate.

- *During the design stage*, in order to determine basic design parameters and so allow the precise definition of the civil engineering works. Tasks such as preparatory works, foundations, intake and outfall, site drainage and site arrangement are indeed heavily dependent on the site conditions.

In general, the data will be collected from inquiries to the local organizations such as ministries, port authorities, universities, laboratories etc. This activity alone may well require several visits to the project site. The obtained data will be complemented by the results of site investigations carried out by specialized contractors under the instruction and supervision of the designer. The site investigations are often time-consuming, especially offshore investigations, which are highly dependent on the climate. It is therefore recommended to have them started as soon as possible, on pain of delaying the progress of the design activities. The site investigations will therefore be more or less extensive according to the amount of information readily available and the stage of project development.

At first, the topography of the site will be studied in order to set the level of the plant and so determine the amplitude of the preparatory earthworks and various reference levels. Benchmarks will be established to provide references for the other site investigations and the construction. For the intake and outfall systems, shore protection or other marine structures, marine conditions need to be studied as well, so the bathymetry in the vicinity of the projected off shore and on shore structures will be determined. For the convenience of the other activities, a local system of co-ordinates will be established and materialized on site.

If no data are available marine conditions will need to be further studied, notably the tides, currents, waves, temperatures and flow, all parameters which have a direct influence on the design of the marine structures.

The site investigations will then deal with the underground for the onshore and offshore works. One of the civil engineer's main concerns is indeed the soil conditions, which notably influence the costs of the foundations and therefore of the civil works (see Section 5). Theoretically a set of different techniques are at his disposal. The availability of such techniques in the concerned country is yet to be verified in any case. *In situ* investigations will allow the determination of the soil nature and mechanical characteristics. They generally consist of borings, possibly with pressuremeter tests, and penetration tests in soils (typically Cone Penetration Tests). Samples are taken to perform laboratory tests that will release further indications on the nature of the ground and its mechanical and chemical characteristics. The presence and concentration of chlorides, sulfates and other detrimental chemicals in the ground and in the water will be determined. The presence of swelling clays will also be verified. Finally, the level of the ground water table will be observed, as it may influence the execution methods for the excavations and the durability of the structures. The interpretation of the results of the soil investigations normally requires the intervention of a specialist in geotechnical engineering to establish the design bases of the foundations. He will assess the load bearing capacity of the soil at various depths and its susceptibility to settlements. On this basis, the most suitable types of foundation for the projected structures will be selected, taking into account other technical and economical constraints (see Section 3). Other data, such as the permeability of the various soil layers in case it is necessary to excavate below the water table or the possibility to re-use the excavated material for backfill will be useful for the proper assessment of the civil works.

Finally, if an extensive building industry does not exist in the area where the site is located, the contractor needs to have some investigations made to mine natural materials like sand, aggregates, rock or backfill. The inquiry will consist of research and selection of appropriate sites for quarrying the required material. The research will be conducted on the basis of geological data and site inspections. Samples will be taken and analyzed. The contractor will also check the accessibility of the possible quarry sites and consider how to organize the transportation between the quarries and the construction site.

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