

## GENERAL SPECIFICATION

### CIVIL WORKS

#### GS EP CIV 102

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|---------------------------------------|
| <b>Dredging and Reclamation Works</b> |
|---------------------------------------|

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| General Specification          |                         | GS EP CIV 102 |
|--------------------------------|-------------------------|---------------|
| Dredging and Reclamation Works |                         |               |
| Rev.: 07                       | Effective date: 11/2016 | Page: 2 of 32 |

## Contents

|                                                                                     |           |
|-------------------------------------------------------------------------------------|-----------|
| <b>1. Scope .....</b>                                                               | <b>4</b>  |
| <b>2. Reference documents .....</b>                                                 | <b>4</b>  |
| <b>3. Abbreviations .....</b>                                                       | <b>6</b>  |
| <b>4. Scope of Work .....</b>                                                       | <b>6</b>  |
| 4.1 Introduction and purpose of the document .....                                  | 6         |
| 4.2 Survey Datum .....                                                              | 7         |
| 4.3 Required experts .....                                                          | 7         |
| 4.4 Possible dredging scope .....                                                   | 7         |
| <b>5. Tasks within pre-project stage .....</b>                                      | <b>8</b>  |
| 5.1 Introduction .....                                                              | 8         |
| 5.2 Company provided data .....                                                     | 8         |
| 5.3 List tentative scope of work for possible locations and layouts .....           | 8         |
| 5.4 Review desk study on geological, metocean and geotechnical data .....           | 9         |
| 5.5 Site investigation .....                                                        | 9         |
| 5.6 Provide input for studies on environmental effects of dredging activities ..... | 12        |
| 5.7 Define options (Scope of Work) .....                                            | 13        |
| 5.8 Define equipment and working methods .....                                      | 15        |
| 5.9 Assess indicative range of budget and schedule .....                            | 16        |
| 5.10 Statement of Requirements .....                                                | 17        |
| <b>6. Basic Engineering .....</b>                                                   | <b>17</b> |
| 6.1 Introduction .....                                                              | 17        |
| 6.2 Company to provide design dossier from pre-project stage .....                  | 18        |
| 6.3 Management of Scope of Work .....                                               | 18        |
| 6.4 Site Investigation - Basic Engineering campaign .....                           | 18        |
| 6.5 Existing installations and adjacent users of site .....                         | 21        |
| 6.6 EBS and EIA .....                                                               | 22        |
| 6.7 Define Scope of Work resulting from Basic Engineering .....                     | 24        |
| 6.8 Assessment of Dredging Works .....                                              | 25        |
| 6.9 Risk and constraints database .....                                             | 28        |

|                                |                         |                      |
|--------------------------------|-------------------------|----------------------|
| <b>General Specification</b>   |                         | <b>GS EP CIV 102</b> |
| Dredging and Reclamation Works |                         |                      |
| Rev.: 07                       | Effective date: 11/2016 | Page: 3 of 32        |

|            |                                                                                                         |           |
|------------|---------------------------------------------------------------------------------------------------------|-----------|
| 6.10       | Scope of Work of dredging works for drafting EPC tender .....                                           | 28        |
| <b>7.</b>  | <b>Preparation of execution phase (Invitation to Tender) .....</b>                                      | <b>29</b> |
|            | <b>Bibliography.....</b>                                                                                | <b>30</b> |
| Appendix 1 | Example of template for cost estimate of dredging and reclamation works in Basic Engineering phase..... | 31        |

| General Specification          |                         | GS EP CIV 102 |
|--------------------------------|-------------------------|---------------|
| Dredging and Reclamation Works |                         |               |
| Rev.: 07                       | Effective date: 11/2016 | Page: 4 of 32 |

## 1. Scope

This document specifies the tasks to be performed during development of Company projects with an element of underwater excavation by dredging equipment, hydraulic soil transport, offshore soil disposal, or hydraulic reclamation works.

## 2. Reference documents

The reference documents listed below form an integral part of this General Specification.

- When local national standards, regulations and codes exist, their particular requirements and those of the standards or codes to which they refer shall be applied, supplementing or amending the provisions of this document.
- If there are no mandatory national regulations, then precedence is given to:
  - Total General Specification
  - International regulations, standards and codes.

In case of lack of international norms and standards, national norms and standards (mainly American, British and French) listed hereafter, in any other General Specification or Project Particular Specification (PPS), shall be applied.

In all cases the system adopted shall be consistent, i.e. the various texts shall present no incompatibility and shall respect the same philosophy (French, British, US or European). In case of discrepancies between documents the most stringent shall apply in the same philosophy.

In all cases, Contractor shall inform Company of any deviation required and justify the changes. Such deviation shall be approved by Company.

The list of norms and standards provided in this document or in Project Particular Specification shall not be considered as exhaustive. Contractor shall respect the secondary standards and regulations, which cover the works described in the present specification.

Specific standards for dredging and reclamation works are rare. Usually existing standards from for instance Earthworks are applied. However project circumstances can have a significant impact on actual design requirements. Geotechnical and structural demands shall be fulfilled by dredging and reclamation works, and it is the task of the dredging engineer to make assessments whether this is feasible (or not). Professional documents as listed below go into significant detail on important issues.

| General Specification          |                         | GS EP CIV 102 |
|--------------------------------|-------------------------|---------------|
| Dredging and Reclamation Works |                         |               |
| Rev.: 07                       | Effective date: 11/2016 | Page: 5 of 32 |

## External Documents

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published at the effective date of this document.

| Reference                                                    | Title                                                                                                                                                                   |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Clark A.R. and Walker, B.F.                                  | A proposed scheme for the classification and nomenclature for use in the engineering description of Middle Eastern sedimentary rocks, Geotechnique, 27, p. 93-99 (1977) |
| Environmental Aspects of Dredging                            | Bray, R.N. (Editor), ISBN13: 978-0-415-45080-5 (2008)                                                                                                                   |
| Gordon R.                                                    | Coastal limestones, Australian Geomechanics, 38, p. 7-23 (2003)                                                                                                         |
| Hydraulic Fill Manual                                        | CURNET publication 244, ISBN 978-0-415-69844-3 (2012)                                                                                                                   |
| ISO 19901-8                                                  | Petroleum and Natural Gas Industries - Specific Requirements for Offshore Structures - Part 8: Marine Soil Investigations                                               |
| PIANC Report 144                                             | Classification of soils and rocks for the maritime dredging process (2014)                                                                                              |
| PIANC Report of Working Group 23, Supplement to Bulletin 103 | Site Investigation requirements for Dredging Works (2000)                                                                                                               |

## Total General Specifications

Unless otherwise stipulated, the applicable version of these documents, including relevant appendices and addendums, is the latest revision published.

| Reference     | Title                                                                               |
|---------------|-------------------------------------------------------------------------------------|
| GS EP CIV 203 | Design of harbour                                                                   |
| GS EP CIV 501 | Execution of Dredging and Rock Dumping Works                                        |
| GS EP ENV 112 | Environmental baseline and monitoring studies: Offshore and Nearshore Sites         |
| GS EP ENV 120 | Environmental impact assessment of E&P activities                                   |
| GS EP EST 001 | Documents necessary for Cost Estimating at the end of a FEED or a Basic Engineering |
| GS EP GEO 101 | Offshore Geotechnical Survey                                                        |
| GS EP GEO 102 | Onshore Geotechnical Investigation                                                  |
| GS EP GEO 201 | Offshore Geophysical Site Investigation                                             |
| GS EP GEO 501 | Meteorological and Oceanographic survey                                             |
| GS EP GEO 504 | Comprehensive evaluation of metocean conditions                                     |

| General Specification          |                         | GS EP CIV 102 |
|--------------------------------|-------------------------|---------------|
| Dredging and Reclamation Works |                         |               |
| Rev.: 07                       | Effective date: 11/2016 | Page: 6 of 32 |

| Reference     | Title                                  |
|---------------|----------------------------------------|
| GS EP POS 003 | Land surveying and positioning works   |
| GS EP POS 007 | Airborne Laser Scanning Survey (LIDAR) |

### 3. Abbreviations

|              |                                                              |
|--------------|--------------------------------------------------------------|
| <b>CPT</b>   | Cone Penetration Test                                        |
| <b>Cu</b>    | Undrained Shear Strength                                     |
| <b>CSD</b>   | Cutter Suction Dredger                                       |
| <b>DTM</b>   | Digital Terrain Model                                        |
| <b>EBS</b>   | Environmental Baseline                                       |
| <b>EIA</b>   | Environmental Impact Assessment                              |
| <b>EPC</b>   | Engineering, Procurement and Construction                    |
| <b>HAT</b>   | Highest Astronomical Tide                                    |
| <b>LAT</b>   | Lowest Astronomical Tide                                     |
| <b>PIANC</b> | Permanent International Association of Navigation Congresses |
| <b>PPS</b>   | Project Particular Specifications                            |
| <b>ROV</b>   | Remotely Operated Vehicle                                    |
| <b>TSHD</b>  | Trailer Suction Hopper Dredger                               |
| <b>UCS</b>   | Unconfined Compressive Strength                              |

### 4. Scope of Work

#### 4.1 Introduction and purpose of the document

There are in general four stages in Company project development. This guideline is applicable after the project has been qualified and it is decided to commence on the pre-project stage. Chapter 5 details the pre-project phase and Chapter 6 lists the detailed tasks for the Basic Engineering phase. Chapter 7 lists the requirements for preparing technical exhibits of the execution contract.

This document deals with dredging projects, with the term "dredging" referring to the total cycle of excavation, transport and deposition. It should be emphasized that these activities are part of a complex technical activity involving various combinations of dredging equipment, techniques and processes, depending on site and project specific circumstances and environmental conditions (like weather conditions and soil properties, environmental constraints).

| General Specification          |                         | GS EP CIV 102 |
|--------------------------------|-------------------------|---------------|
| Dredging and Reclamation Works |                         |               |
| Rev.: 07                       | Effective date: 11/2016 | Page: 7 of 32 |

## 4.2 Survey Datum

### 4.2.1 Geodetic parameters

The Project Geodetic system to be used shall be specified by Company by means of an official Company geodetic system data sheet including an example of coordinates transformation.

Transformation from WGS-84 to local datum shall be tested, using a set of coordinates provided by Company.

All the coordinates shall be based on the single reference datum.

### 4.2.2 Vertical datum

All bathymetry measurements and depth specifications shall be referenced to the Company official vertical datum, as defined in the PPS, determined using standards recognized by the Company and relating to the working area.

If tide tables do not exist for the work area, tidal level shall be established using observed tidal readings obtained from tide gauges deployed offshore, during the relevant surveys.

## 4.3 Required experts

The main technical topic here is dredging but liaison with designers of the facilities, civil works and interfacing activities on site is essential. Also cooperation with geotechnical and environmental engineers is required.

The expert knowledge of an experienced dredging engineer already in the pre-project stages of the project is required, so that constraints, risks and opportunities can be identified and dealt with adequately throughout the subsequent phases. Hence this part of the document is aimed at the Engineering Contractor performing the assessments and the dredging engineer assisting with the expert topics.

Besides the assistance of the dredging engineer the Engineering Contractor shall acquire early assistance of professional experts for a variety of engineering fields, likely to include:

- Geology
- Site investigation/Hydrography/Geophysics
- Geotechnics
- Hydraulic and sediment transport modelling
- (Marine) ecology.

All engineers referred to hereafter are deemed part of the Engineering Contractor team, unless otherwise agreed with Company.

## 4.4 Possible dredging scope

The dredging and reclamation works in the project can consist of the following (examples):

- Construction of a harbour (basin and terminal area)
- Navigation channel(s)

| General Specification          |                         | GS EP CIV 102 |
|--------------------------------|-------------------------|---------------|
| Dredging and Reclamation Works |                         |               |
| Rev.: 07                       | Effective date: 11/2016 | Page: 8 of 32 |

- Construction of manmade islands
- Backfilling behind quay walls
- Reclamation for onshore facilities
- Dredging/backfilling for sea defence structures
- Ballasting of gravity structures
- Free span correction or pre-trenching for pipelines.

This document does not cover design and execution of rock works like: pipeline coverage, bed levelling, scour protection, breakwater construction, and similar.

## 5. Tasks within pre-project stage

### 5.1 Introduction

This chapter describes the tasks that shall be performed by the Engineering Contractor with the aid of an expert dredging engineer, in order to achieve the level of information and detail as required at the start of the next phase (i.e. Basic Engineering). Due to the great variability in dredging scope of work and the local circumstances that can be encountered, these tasks are compiled truly as high-level specifications.

### 5.2 Company provided data

At the start of the pre-project phase Company shall provide the Engineering Contractor with all technical and environmental data available from the qualification phase of the project. In case of missing or ambiguous information it is the task of the Engineering Contractor with the aid of the dredging expert to seek clarification or confirmation with Company.

### 5.3 List tentative scope of work for possible locations and layouts

Confirmation of data provided by Company is required in this phase of the project. Based on size requirements for proposed vessels/installations, indicative dimensions of dredge areas for possible locations and layouts shall be drawn. With the aid of the dredging engineer the Engineering Contractor shall list assumptions for design parameters clearly, including but not limited to:

- Vertical reference (see chapter 4.2.2)
- Water levels (tides, storm surge)
- Max vessel dimensions: draught, length, width
- Local morphologic behaviour (waves, swell, currents, ice, sand drift / waves, erosion / sedimentation)
- Vertical ship movements due to speed and wave action
- Underkeel clearance
- Slopes

| General Specification          |                         | GS EP CIV 102 |
|--------------------------------|-------------------------|---------------|
| Dredging and Reclamation Works |                         |               |
| Rev.: 07                       | Effective date: 11/2016 | Page: 9 of 32 |

- Dredge tolerance
- Maintenance buffer.

As part of the design for the marine and civil works, the dimensions of onshore areas, construction/civil works, and sea defence structures shall be presented on drawings with typical layouts and cross sections:

- Quay walls and jetties
- Industrial areas for plants, installations, pipelines, etc.
- Breakwaters
- Revetments
- Dikes.

For the design of harbours reference is made to **GS EP CIV 203**.

Design of marine works is primarily performed by the marine design engineer, liaising with the dredging engineer when it comes to defining the dredging works. Main task of the dredging engineer is here to provide to the design team the following:

- Feedback on design assumptions of dredging and related works
- Feedback on dredging impact on surrounding areas (cf. Chapter 5.6)
- Assist in preparing alternatives by providing expert views on dredging/filling possibilities
- Information needed from the design in order to perform the dredging assessment as described below.

Indicative volume estimates for dredge and fill quantities shall be calculated for the design alternatives. For subsoil conditions not known at this stage, assumptions shall be made and clearly listed along with the reported results.

## 5.4 Review desk study on geological, metocean and geotechnical data

Company shall provide desk study results on geological, metocean and geotechnical data as already performed in the previous project phase (qualification of site). At the start of the pre-project design the Engineering Contractor shall review this study, and identify missing data. This serves as starting point for the definition of the site investigation program.

## 5.5 Site investigation

The scope of work of all site investigation activities shall be prepared by the Engineering Contractor and submitted to Company approval. Following approval, Company will carry out the agreed site investigations and surveys.

### 5.5.1 Metocean and sediment transport

Sufficient data on a large number of parameters is required to perform further design of the works as well as assessment of the execution. Public or private databases shall be consulted and their data compiled. For most parameters statistical analysis is to be performed yielding the need for data acquisition over a longer period of time. Data collection shall start in this phase of

| General Specification          |                         | GS EP CIV 102  |
|--------------------------------|-------------------------|----------------|
| Dredging and Reclamation Works |                         |                |
| Rev.: 07                       | Effective date: 11/2016 | Page: 10 of 32 |

the project to enable adequate design works and execution assessment. Data on an area of interest beyond the actual project footprint, to be defined by the Engineering Contractor and approved by Company, is required on the following:

- Meteorological conditions: winds, precipitation, fog, air and water temperature, ice. For various parameters also frequency distribution for every month of the year and for every direction.
- Sea conditions: Currents, tides, waves and swell, ice cover. For various parameters also frequency distribution for every month of the year and for every direction.
- Sedimentation study: origin of sediments, suspended sediment concentrations, sediment flux through the mouth of rivers and/or parallel to shore, design (size, number, duration and location) and monitoring of trial dredge pit.

The collection of these data shall be in parallel in order to correlate observations and data.

**GS EP GEO 501** and **GS EP GEO 504** describe the requirements for the metocean survey and their analyses in detail.

### 5.5.2 Bathymetry and geophysical investigation

A reconnaissance survey shall be performed covering the base case and alternative locations of the project:

- Bathymetric survey with multibeam echosounder and overlapping coverage
- Topography and coastal morphology assessment
- Geophysical survey.

This reconnaissance survey is to be seen as the first phase of the full-scale ground investigation that will be executed (in a phased manner) throughout the project stages preceding the actual construction.

**GS EP GEO 201** describes the requirements for offshore/nearshore geophysical surveys as well as bathymetric surveys.

When defining the scope of work for this survey the Engineering Contractor shall specifically aim at collecting data for the design of marine facilities as well as the dredging and reclamation scope, possibly including offshore disposal or borrow areas.

Shallow water surveys shall be performed at high tide, and combined with land surveys at low tide, in order to fully cover the full LAT-HAT area and preferably enable overlap. Land survey techniques shall conform to **GS EP POS 003**. If airborne techniques are envisaged, the scope of work and methods shall comply with **GS EP POS 007**.