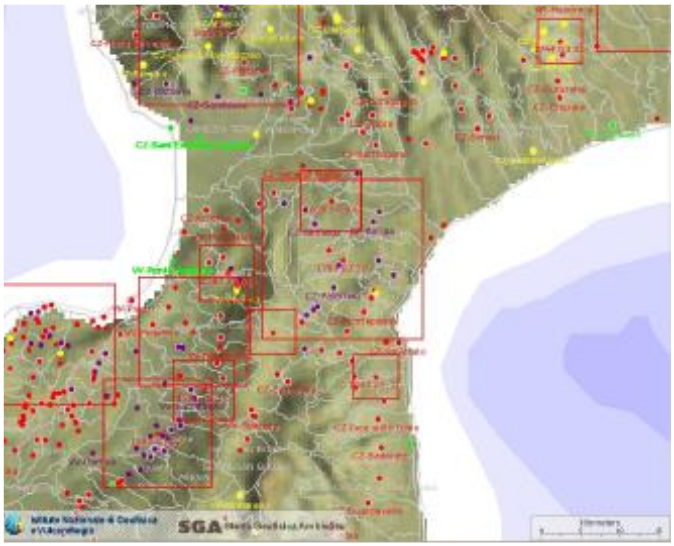
GL Garrad Hassan

EOLICA FOSSA DEL LUPO Srl
(ERG Group), Genova, Italy

"FOSSA DEL LUPO" Wind Farm
Provincia di Catanzaro, Calabria, Italy



TECHNICAL DUE DILIGENCE, REVIEW OF TURBINE FOUNDATIONS DESIGN
R E P O R T

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1. INTRODUCTION

1.1 About the Due Diligence documentation

This document consists of three short Chapters - (1) Executive Summary (2) Description of the Review Process and (3) List of Recommended Actions - which give a succinct but comprehensive overview of the due diligence findings, pending issues and recommended remedial / mitigating actions. Should the reader wish to deepen his/her knowledge of this DD review, he /she can do so by reading the documentation in the Annexes to this Report (separate documents).

The main issues which were raised and dealt with during the review process are documented in Interim Reports which are attached as Annexes (please refer to the Table of Contents).

GL-GH's independent calculations to verify the viability of the proposed design are given also as separate documents in the Annexes section of this report (again, please refer to the Table of Contents).

1.2 General

This assessment covers the **design for the foundations** of wind turbines in the wind farm developed by **EOLICA FOSSA DEL LUPO S.r.l. (ERG Group)** of Genova, Italy, in areas of the Municipalities of Vallefiorita, Palermiti and Gasperina in the Province of Catanzaro, Region of Calabria, Italy. The project comprises **41 no**. wind turbines. One turbine type is envisaged: **NORDEX N90, 2,5 MW power, rotor diameter 90 m, hub height 80 m**.

1.3 Authors of Proposed Design

As said, the developer is EOLICA FOSSA DEL LUPO S.r.l. (ERG Group) of Genova, Italy,
The developer's Consultants are:

- HYDRO ENGINEERING S.r.l., Via Rossotti 39, 91011 Alcamo, Province of Trapani, Sicily. (Designer);
- CIGIT, Via Schipani 16/E, Catanzaro, Calabria, Italy (Geotechnical Consultant)……
- Dott. Geol. Carlo CIBELLA, Sicily, Italy (Geotechnical Consultant)

1.4 Authors of Review

This due diligence technical review, the scope of which is limited to the WTG foundations, has been carried out for SCANGEA by the following professionals:

- Dott. Ing. Luigi Cesare Speranza, Roma (SCANGEA);
- Dott. Ing. Marco Franceschini, Bologna (SCANGEA external consultant);
- Prof. Ing. Claudio Scarponi, Roma (UNIVERSITA' 'LA SAPIENZA', ROMA – SCANGEA).

1.5 Documentation Reviewed

List of documents reviewed constitutes APPENDIX A to this Report.

1.6 Description of Proposed Foundation Design

The proposed design consists of two foundation types:

- **Type A – SHALLOW**
  Consisting of a square plinth (16 x 16 m), height varying from 1,5 m at the perimeter to 2,5 m at the centre. The plinth is connected to the WTG tower by a cylindrical ring, having 6,2 m diameter and 1,3 m heigh. Thus, the total height of the plinth at the foot of the WTG tower is 3,8 m.

- **Type B – DEEP**
  Consisting of an hexagonal plinth, side length 8 m, height varying from 1,5 m at the perimeter to 2,5 m at the centre. The plinth is connected to the WTG tower by a cylindrical ring, having 6,2 m diameter and 1,3 m heigh. Thus, the

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total height of the plinth at the foot of the WTG tower is 3,8 m. This plinth is resting on 12 no. piles, diameter 1000 mm, height varying from 16 m to 22 m.

1.7 Overview of the wind farm geological characteristics

The proposed wind farm area is characterized by a relatively short geological history. It is a mountainous site, part of the "Serre Calabre" ridge which in turn is part of the so called "Calabrian-Peloritan" ridge" (Arco Calabro Peloritano) connecting the southern tip of the Appennines system with the northern edge of the Sicilian / Maghreb orogenic system. The "Serre Calabre" ridge constitutes the watershed dividing the Tirrenian and Ionian sides of the Calabria region. It is formed by igneous metamorphic rocks of paleozoic origin, strongly impacted by tectonic forces, with a relevant presence of overthrusting strata.

Typical stratigraphies in the windfarm area are as follows:

- Sandy Pleistocene overlay, resulting from decay of granitoid rock. These formations are characterized by high permeability and proneness to erosion, with some potential for landslides. This is the typical stratigraphy in areas of the eastern part of the farm (Municipality of Gasperina).
- Sedimentary Pliocene overlay, consisting of a variety of lithotypes (sandstones, clay and marl, shale and gneiss). This is typical in the Municipality of Palermiti and the western edge of the windfarm.

1.8 Method of Review - Guidelines

The aim of GL-GH's technical due diligence review is ordinarily two-fold:

a) to verify the viability of the proposed foundation structures via independent calculations complying with international standards of calculation (Euro-Codes, IEC 61400-1 and Italian NTC-2008);
b) to evaluate the calculations and ancillary documentation of the proposed design so as to assess their compliance with current Italian standards. This in order to foresee potential bottlenecks in the path of approvals from Italian Authorities (Regione, Genio Civile etc.) and ensure that an adequate maintenance plan is drawn up and enforced.

In this particular case, as all permits have been granted to the Developer and construction has been completed, the second aim of the review is less important.

1.9 Method of Review – Evaluation Tables / Synoptic Table

Subjects of the review process are shown and itemized in tables called "Evaluation Tables". A comprehensive overview of the issues affecting each WTG site is given, stage by stage of the review process, in tables called 'WTG Sites Synoptic Tables'. Evaluation Tables and Synoptic Tables are the cornerstones of the review process.

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