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A risk assessment tool for improving safety standards and emergency management in Italian onshore wind farms

Davide Astiaso Garcia [a,b], Daniele Bruschi [a,*]

[a] Department of Astronautical, Electrical and Energy Engineering (DIAEE), Sapienza University of Rome, Via Eudossiana, 18, 00184 Rome, Italy
[b] Italian Wind Energy Association (ANEV), Lungotevere dei Mellini, 44, 00193 Rome, Italy

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ABSTRACT

The renewable energy sector has seen a rapid expansion in recent years and the number of green jobs is quickly increasing. The development of wind sector, associated with a strong focus on innovation, has given importance to the assessment of new and emerging hazards and risks for ensuring adequate, safe and healthy working conditions.

The main aim of this paper is to provide a tool for improving proactive safety standards in onshore wind farms. The emergency management was outlined integrating some pinpointed indicators identified by wind turbines owners and manufacturers in a simple and practical instrument (risk assessment tool) aimed to facilitate emergency responses in case of accidents. The idea was to develop a systematic pattern that allows the employers and those responsible for the plant prevention to better manage an emergency event based on a risk assessment in an onshore wind farm during the operation stage. Specifically, the tool was tested and used to classify the risk level for occupational safety in 56 Italian onshore wind farms.

The results obtained provide an overview of the crucial factors for optimizing the emergency management process in onshore wind farms at national level.

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Introduction

The European Union has committed to reduce by 20% the greenhouse gas emissions, as well as to increase by the same percentage both energy efficiency and the market share of renewable energies by 2020 reducing GHG emissions and energy dependence on oil and gas imports [1]. Achieving these objectives in the field of renewable energy and energy efficiency entails more than one million new employees and new challenges about their safety. The Community Strategy (2007–2012) highlighted the risks related to new technologies as an area where the prediction of these risks should be improved [2].

The impetus towards a green economy, combined with a strong emphasis on innovation, points out the importance of developing an appropriate prevention strategy for green jobs that takes into account the specificities of each of them. Green jobs, indeed, should offer benefits not only to the environment, but also to workers ensuring adequate, safe and healthy working conditions [3].

In this framework, wind energy sector has experienced a remarkable growth in the last years being one of the main renewable energy sources in EU. In 2010, about 240,000 employees were engaged doubling in just two years the number of employees. According to Blanco and Rodrigues [4], by the end of 2008, the European wind energy sector provided jobs for 104,000 people. Furthermore, it is expected that by 2020 the number of operators (including design and construction phases) should be about 520,000 units [5]. Apart from the slowdown in wind energy installations of the last two years, due to a delay in the enactment of the Ministerial Decree for the 2015 and 2016 incentives to electric energy production by renewable energies except photovoltaic, Italy shows the same trends: according to the European Wind Energy Association – EWEA [6], the Italian wind capacity at the end of 2015 was equal to 8953 MW. This amount is almost double compared to only 6 years ago. These data underline how the wind sector in Italy was rapidly expanding and it could represent an important jobs source also for the next years. Employment within this sector is estimated to grow from 34,000 workers (direct and indirect) in 2013 to 67,000 by 2020 [7]. This sharp increase in wind energy workers poses significant implications for occupational health and requires specialized safety measures. Despite the

* Corresponding author.
E-mail address: daniele.bruschi@uniroma1.it (D. Bruschi).

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upgrading of production techniques and the development of new processes for monitoring and control have made a valiant contribution to the implementation of safer operations, workers in the wind farm are still exposed to several risks. Occupational injury is an externality of energy that has received less attention than other prominent externalities of energy affecting human health, such as global warming or particulate emission [8]. Wind energy facilities, as each industrial plants, are required to meet accepted quality and safety standards considering each particular parameter of wind farms. The plant construction remains dangerous and the high number of turbines is often accompanied by skills shortages, as wind technology competes with other sectors with higher profit margin (i.e. oil and gas industries) for qualified personnel [9]. Moreover, the speed with which the European wind industry is expanding is leading to skills gaps, with inexperienced workers involved in processes for which they have not been specifically trained [10]. Finally, with respect to other industrial plants, onshore wind farms are often located in remote locations with poor accessibility (i.e. access via unsurfaced tracks) and low mobile phone coverage. Consequently, it might not be possible to rely on emergency services for assistance or more simply, it could be registered a significant delay in response to an emergency situation [11].

Despite a strong increase in wind turbines installation around the world, statistics of accidents at work remain fragmented and show a poor description of the situation regarding health and safety at work in this sector [12]. In this framework, the Caithness Wind Farm Information Forum (CWFIF) maintains up-to-date information taken from press reports or official information releases. Statistics as at 31 December 2014 are reported in Table 1.

Regarding data reported in Table 1 and 110 of 1662 turbine incidents were fatal accidents where on the whole 151 people have died worldwide; 90 of whom were wind industry and direct support workers (workmen, operation and maintenance workers, engineers, etc.), or small turbine owner/operators. As underlined by Ragheb [14], the total number of accidents in the wind power industry in terms of deaths is quite small, but the percentage is relatively high compared to other industrial sectors, due to its being a labour intensive option of energy production.

As in any other industrial sector, also in the wind energy sector an Emergency Management Plan (EMP) must be produced. It should define the procedures and responsibilities through which a company identifies, monitors and manages emergency situations (environmental and safety), in order to minimize the consequences thereof (intervention times included). According to Italian legislation, employers are obliged to take all necessary measures and make available all equipment required to ensure occupational health and safety at workplaces, whereas employees are obliged to comply with such measures taken for occupational health and safety [15]. Furthermore, as underlined by Burton [16], recently there is a growing evidence that employers across a range of sectors are increasingly concerned about employees health and its impact on sickness absence rates and productivity.

In this framework, the EMP represents an important tool to respond to emergencies, considering that handling these emergencies in wind energy sectors normally takes times not even acceptable in many other industrial sectors (times that rarely are below 1–1½ h). Some of the possible emergency scenarios that could happen in an onshore wind farm are reported below:

- Altitude rescue: i.e. injured staff in the nacelle/tower;
- Fires: i.e. from transformers;
- Shock, fractures, injuries and first aid interventions;
- Environmental pollution;
- Extreme weather events that require the turbine safety (i.e. tornadoes, etc.);
- Bomb/sabotage alarms.

Analysing the block diagram showed in Fig. 1, most of the actions are intended to improve the communication between actors involved and to identify the critical issues related to the site achievement. Furthermore, the EMP must include preparedness for potential emergencies, response procedures, the information required by the organizations intervened in the emergency, instructions and guidelines to be followed in case of emergencies independent from the company.

Generally, the emergency management can be summarized into three main categories and it could be represented by a block diagram (see Fig. 1):

1. Emergency call – Communication;
2. Route and emergency vehicles definition – Wind farm classification;
3. Arrival at the accident site – Wind farm layout.

Other fundamental aspects in emergency management are planning and preparedness actions. These two activities must be analysed upstream of the wind farm construction (or during its realization). For a responsible wind farm design, it is necessary to develop a detailed territorial analysis able to identify some essential parameters such us the placement of each WTG (wind turbine generator) with respect to the main urban centres, or the distance from each WTG to the nearest rescue centres (i.e. the firefighters). Considering the planning activity, the involvement of the emergency and relief agencies (i.e. operators of first aid) is a fundamental aspect. These agencies, if not involved, cannot imagine which risk scenarios and conditions may face accessing the wind farm. In fact, as will outlined in the next paragraph, the basic information known in the design and construction phases of the wind farm (altitude, access points, geographical coordinates, etc.) are very useful data to clearly share with all those involved in the farm management (internal personnel, relief agencies, etc.). In this framework, the risk assessment tool aims to bring out this side of the wind farm design which has a weight absolutely not indifferent in the reduction of response time.

Finally, the suspension trauma is one of the worst accidents that can happen in wind farms since it is one of the main risks that affect people who work at height. Specifically, it occurs when the human body is held upright without any movement for a certain time period. Because of the suspension harness in a state of immobility, the heart muscle slows its function and the lack of oxygen can pass quickly on brain function. To reduce this risk is essential that the operator is evacuated from the hanging position soon. On this issue, the literature describes almost exclusively cases resulting from sports accidents or studies on volunteers, while specific data on the suspension trauma in workplaces have not been found.

Simulations results carried out by different wind operators belonging to ANEV, the Italian Wind Energy Association, with the

Table 1
Number of accidents in the wind industry registered until 31 December 2014 [13].

Year	70s	80s	90s	00s	10	11	12	13	14	Total
n° of accidents	1	9	98	781	119	166	166	165	157	1662

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