Wind Turbines

What Is The Risk In Barwon South West Region?

Senior Station Officer Steve Alcock
Corio Fire Station

Version Control

Version	Date	Description	Author
V 1.0	30/10/2012	Draft	SSO S. Alcock
V 1.1	20/11/2012	Document	SSO S. Alcock

Table of Contents

Introduction

With the increasing trend of renewable energy, country Victoria has become the focus for erecting power generating wind turbines.
While they are principally designed to do one thing, generate electricity, it has become apparent that they come in various designs and are produced from a variety of different companies.
While there is still a lot to learn about wind generated electricity and the turbines that do it, we have already learnt that there are numerous dangers associated with wind turbines both in the construction phase and once they are operational. As an industrial environment The Country Fire Authority is the primary response agency responsible for effecting rescues from within this environment.

The purpose of this document is to provide the evidence required to calculate the risk to Barwon South West Region (BSW) by identifying:

- The number of wind turbines currently operating in BSW
- The number of proposed development sites within BSW
- The number of different turbine designs
- The different companies that run the turbine sites
- How often the turbines are frequented by maintenance staff
- CFA's capability to perform a rescue in BSW which includes
    - Location of appropriately trained personnel
    - Location and quantity of rescue equipment
    - Timeframes to respond to and perform a rescue
- Training and skills maintenance for CFA personnel in wind turbine access and rescue.

It is visioned that this document will provide the information required for the BSW Region in conjunction with all relevant stakeholders to formulate an adequate response plan to ensure a safe and timely response should the need ever arise.

What is a Wind Turbine?

A wind turbine is a device that converts kinetic energy from the wind, also called wind energy, into mechanical energy; a process known as wind power. If the mechanical energy is used to produce electricity, the device is called a wind turbine. When there is more than one wind turbine connected electrically they are known as a wind farm. In a wind farm each wind turbine generates electricity independently but shares common cabling to connect to the main power grid. The location of each wind turbine is chosen to maximize its efficiency.

Wind Turbines – The Key components.

To understand the associated dangers with wind turbines we need to look at and understand the components that go together to form a wind turbine.

Figure 1-An 80 meter high wind turbine

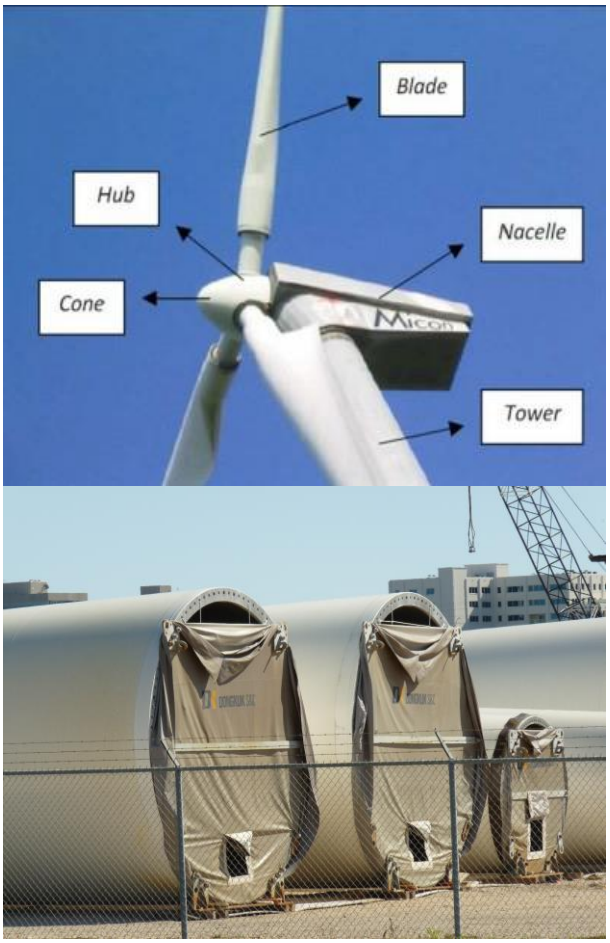

Figure 2- Labeled components of a wind turbine & a view of the tower pieces on the ground.

Figure 1 shows a completed wind turbine. Figure 2 shows the names of the components that form a turbine.
The pieces that form this turbine are:

- Tower- Extends from the ground to the base of the Nacelle.
- Nacelle- The box on top of the tower that incases the generator and gearbox. The outer casing is generally constructed of thin fiberglass and is NOT

structurally capable of holding weight. However there is reinforcing components within the Nacelle that are load rated.

- Hub- Positioned on the front of the Nacelle, the Hub is where the Blades connect into, to attach them to the rest of the Nacelle.
- Blades- Generally a wind turbine will have three blades. They will differ in length according to the height of the tower.
- Cone- Covers the hub to protect the area where the blades are fixed to the hub. Generally made from a thin fiberglass, not designed to hold weight.

What's inside the Tower and Nacelle?

Depending on the design of the wind turbine, the tower will have inside it:

- Ladder- Extends from the ground to the base of the Nacelle. Can be configured differently as shown below. In each case the climber is attached to a cable via a Ladsafe.

Figure 3- Ladder fixed to side of tower. Climbers back towards the inside of tower

Figure 4- Ladder fixed to side of tower. Climbers back towards the side of tower

- Elevator- Acciona Energy has constructed an elevator inside all of the towers at their Waubra site. An assessment of the wind farm will determine if elevators are available.
- Gantries- Located just below the joins of the tower, allows construction workers and maintenance workers a chance to rest from the climb to the top. Can be used as a work platform for rescuers.

Figure 5- CFA Rescue staff working on a Gantry. Also note electrical cabling running down the side of the tower.

- Electrical Cables- Extend from the generator in the Nacelle to the kiosk at the base of the tower.

The Nacelle is where all the work is done. The hub connects into the front of the Nacelle. The shaft that extends out of the hub runs into a gearbox. From the gearbox the next shaft connects to the generator. From the generator electricity is transferred to the cable system and down to the kiosk.

Figure 6 & 7- The inside of the Nacelle depicting the amount of space taken up by the gearbox and generator

Figure 8- Access door from the Nacelle to the Hub. Note shaft connection underneath access door

Figure 9- Depicts the Hub and blade connection. Cone over the outside.

Access to this area is required so maintenance can be performed on the inside of the Hub. There is hydraulics in the hub used to adjust the pitch of the blades to achieve maximum benefit from little wind. The worker accessing this area is required to crawl over the hub. See Figure 10

Figure 10- Maintenance worker crawling over the top of the Hub to access the inside of the Hub

How much power does one turbine produce?

On average in Victoria a single wind turbine is rated at about 1.8MW. One 1.8 MW wind turbine at a reasonable site would produce over 4,700 000 kWh of electricity each year, enough to meet the annual needs of over 1,000 households.
In BSW the average wind farm operational and/or proposed is rated at 40MW. That's approximately 20 wind turbines per site.

Wind Farms in BSW Region- Currently Operating

Barwon South West Region due to its locality close to the southern coast of Australia makes a wonderful spot for wind farms. The table below lists the current wind farms operating with BSW Region.

Project Name	Sponsoring Company	Capacity (MW)	Status
Codrington Wind Farm	Pacific Hydro	18.2	Operating
Cape Bridgewater	Pacific Hydro	51	Operating
Cape Nelson South	Pacific Hydro	44	Operating
Yambuk	Pacific Hydro	30	Operating

Neighbouring BSW Region there are another three Wind Farms operating in which a brigade from BSW may be required to respond to support neighbouring rescue activities.

Project Name	Sponsoring Company	Capacity (MW)	Status
Challicum Hills Wind Farm	Pacific Hydro	52.5	Operating
Waubra Wind Farm	Acciona Energy	192	Operating
Hepburn Community Wind Farm	Hepburn Wind	4.1	Operating

Wind Farms in BSW Region- Under Construction

Currently in BSW Region there are a number of wind farms in the construction phase. Included in the table below are the wind farms currently being constructed in BSW Region and also two from a neighboring Region but within 150km of District 7 Headquarters.

Project Name	Sponsoring Company	Capacity (MW)	Status
Portland Wind Project	Pacific Hydro	195	Under Construction
Macarthur Wind Farm	AGL Energy	420	Under Construction
Cape Nelson	Primergy Ltd & Wind Project P/L	15	Under Construction
Cape Bridgewater and Cape Nelson	Energy Equity Corp	18	Under Construction
Oaklands Hill	AGL Energy	67.2	Under Construction
Yaloak Wind Farm	Pacific Hydro	115	Under Construction

Future Wind Farms in BSW Region (Planning Approved)

The following table shows the number and size of wind farms that have had planning approved by local municipalities. Included are three neighbouring Region sites within 150km of District 7 Headquarters.

Project Name	Sponsoring Company	Capacity (MW)	Status
Mount Mercer Wind Farm	Meridian Energy	131	Planning Approved
Salt Creek Wind Farm	Sustainable Energy Australia	<30	Planning Approved
Mortons Lane Wind Farm	Tian Run Australia	<30	Planning Approved
Naroghid	Wind Farms Developments	30	Planning Approved
Mount Gellibrand	ProVentum	232	Planning Approved
Newfield	Acciona Energy	22.5	Planning Approved
Hawkesdale	Union Fenosa Wind Aust	62	Planning Approved
Ryan Corner	Union Fenosa Wind Aust	136	Planning Approved
Berrybank	Union Fenosa Wind Aust	200	Planning Approved
Darlington	Union Fenosa Wind Aust	300	Planning Approved
Moorabool Wind Project	West Wind Energy	321	Planning Approved
Lal Lal Wind Farm	West Wind Energy	160	Planning Approved
Chepstowe Wind Farm	Future Wind	6	Planning Approved

There are a number of feasibility studies and proposals currently being carried out so we could expect the numbers in the tables above to change quite frequently.

Construction and Maintenance of a Wind Turbine

Construction

Wind turbines are manufactured off site in factories specialising in a particular component. Systematically these components are shipped to the site in which the turbine is to be erected. On site footings are laid to support the weight of the turbine and an area large enough for a crane and a multi combination vehicle are cleared and consolidated to be ready to begin the construction phase.
The tower comes in pieces depending on the height. For example at the Waubra Wind Farm the towers are 80 meters high. To achieve this height the tower is erected in three pieces. A crane lifts each piece into position, and once located into position workers fix off the piece with nuts and bolts. Once fixed off the next section is raised and so on.
Once the tower is complete, the Nacelle (complete with gearbox and generator) is lifted into position. At this point the construction takes a bit longer as the Nacelle needs to be able to rotate on the tower to align with the wind.
The next stage is the connection of the Hub to the Nacelle. Note the blades are not attached to the Hub when it is connected to the shaft of the Nacelle. Once the Hub is fitted off the Blades are attached and finally the Cone.
The next step is for the electricians to enter and fix off the wiring from the base of the tower to the generator.

Maintenance

Each wind farm will have a maintenance schedule. It is known that the Waubra Wind Farm conduct maintenance of some sort every weekday. Each wind turbine has a maintenance schedule which requires entry into the tower, nacelle and hub. Therefore there are at least two workers working with in a turbine every day at height, and this is at one wind farm. As the numbers of wind farms increase so will the amount of people working at height increasing the potential risk of an accident.

Wind Farm- Procedures for Emergencies

Without visiting each individual wind farm, it is impossible to assess each ones procedures in the event of an emergency. To date the recorded dealings that CFA has had with wind farms have shown that they have little to no knowledge of the Emergency Management Manual and the Emergency Management Act 1986. They have little to no knowledge of Command and Control arrangements and believe they are responsible for rescuing their own employees when an accident happens. They are not aware that CFA has a capability to rescue from height and that CFA is the controlling agency for Industrial Vertical Rescue.
CFA needs to liaise with each wind farm to establish a relationship where all of the stakeholders are aware of each other's expectations should an incident occur. Boundaries need to be clearly established to ensure early notification when an incident occurs and that on site workers don't make the situation worse by trying to affect a rescue.

CFA Rescue Capability

The following is an assessment of BSW Regions capability to perform a rescue from height at a wind farm site. The assessment is broken up into two categories, personnel and equipment.

Personnel

BSW Region has a number of personnel competent to perform a Rescue from height in a vertical environment. They are scattered across four districts and are made up by career staff and volunteers. The table below shows each Districts capability from a personnel point.

District	Number of Members competent	Brigade	Career Staff / Volunteer
4	1	Narrawong	Volunteer
4	1	Casterton	Volunteer
4	1	Gorae West	Volunteer
4	1	Portland	Volunteer
5	7	Warrnambool	Staff
5	1	Warrnambool	Volunteer
5	2	Hamilton	Volunteer
5	1	Koroit	Volunteer
5	1	District 5	Staff
6	7	Apollo Bay	Volunteer
6	1	Gerangamete	Volunteer
6	1	Corangamite	Volunteer
7	27	Geelong City	Staff
7	2	Geelong City	Volunteer
7	4	Corio	Staff
7	1	Corio	Volunteer
7	3	Belmont	Staff
7	1	Belmont	Volunteer
7	1	Geelong West	Volunteer
7/6	1	Wurdale / D06	Staff/Volunteer
7	6	District 7	Staff

The table shows a deficient number of trained personnel in Districts 4, 5 and 6 to perform the role if required. Consideration needs to be given to the fact that most of the qualified members in these districts are volunteers and may not be available to attend a call when it arrives.
To safely perform a rescue from height at a wind turbine the CFA would require a minimum of ten personnel on scene.

1. Incident Controller
2. Rescue Commander
3. Safety Officer
4. Main Line Attendant
5. Belay Line Attendant
6. Assistant / Edgeman
7. Rescuer / Litter Attendant
8. Tracking Line Attendants X 2
9. Local Operations Officer for EMT purposes

Note: *the incident Controller does not need to be Vertical Rescue qualified but personnel fulfilling the roles from position 2-8 need to hold the competency of Undertake Vertical Rescue PUASAR004 or equivalent as recognised by CFA.*

Equipment

BSW Region currently has roping gear located at six (6) locations.
They are:

- **Portland,** District 4
- **Casterton,** District 4
- **Hamilton,** District 5
- **Warrnambool,** District 5
- **Apollo Bay,** District 6
- **Geelong City,** District 7

A note needs to be made that there is no standard equipment list. All of these locations will have slightly differing inventories of Rope Rescue Gear. The only standard is that the rope lengths will be 50 meters, 100 meters or 200 meters. Not all of the listed stations have 200 meter ropes. Rope lengths will need to be reviewed as turbine heights are increasing in some areas, e.g. 120 meters high.

Current Rescue Response Arrangements.

An investigation into the four Districts with BSW Region and in particular their SOP's for response to a vertical rescue from a wind turbine have exposed the following.

- District 4 at present does not have a formal SOP in regards to responding to an incident at a wind turbine. It is a project that is on the list for completion, but due to the amount of staff in the District and current work load, a detailed SOP has yet to be produced. With the amount of wind farms currently operating and the additional one under construction a SOP needs to formulated and implemented ASAP.
- District 5 at present does not have a formal SOP in regards to responding to an incident at a wind turbine. They currently rely on the ESTA call taker linking the call type as a vertical rescue and responding the appropriate brigades. This approach has failed once when there was a vertical rescue event at the Macarthur wind farm and only Hamilton were paged to go. With the amount of wind farms currently operating and the additional one under construction a SOP needs to formulated and implemented ASAP.
- District 6 at present does not have a formal SOP in regards to responding to an incident at a wind turbine. As they do not have an operating wind farm at presents this would not be expected. However there are two wind farms due to begin construction in the near future. Both of these wind farms a more that 150km away from Apollo Bay, the designated Rescue Brigade.
- District 7 at present does not have a formal SOP in regards to responding to an incident at a wind turbine. As there are no wind farms currently operating or planned for within this District, District 7 would be a support response for the other Districts both in BSW and Grampians Regions.

Recommendations

Based on the evidence collected the following recommendations are being made to Barwon South West Region.

1. A working party is formed to give a constant and consistent approach to forming relationships with all relevant stake holders. Included are:
    a. The Wind Farms (Across BSW)
    b. Country Fire Authority (District Level)
    c. County Fire Authority (Protective Equipment Dept.)
    d. Victoria Police
    e. Ambulance Victoria
    f. Victoria State Emergency Service (where applicable)
    g. Local Municipal Shires (MERO)
2. The working party is to assist all relevant stake holders in providing CFA with site specific action plans and maps.
3. The working party to assess each wind farm and provide to local Districts recommendations for equipment required to perform a rescue from height. This should include site specific equipment, e.g. Ladsafe
4. The working party assist at District level to create specific assignment areas for each Wind Farm. This will assist CAD in dispatching the correct response for an event requiring “Rescue from height”
5. The working party to work with each District to identify deficiencies in qualified personnel to perform vertical rescue and produce strategies to overcome current issues.
6. Each District is to provide detailed data to the CFA Specialist Response Officer as to how they are not currently meeting there statutory requirements, and request assistance in training and development of suitable personnel.
7. The working party to form a pre-plan document dedicated to “Rescuing Casualties from a Wind Turbine” for distribution to all brigades responsible for rescuing from height with in BSW. Pre-plan to suggest methods for rescue for the three most common situations likely to be found.
8. Each District form a SOP for response to a wind farm to perform a rescue from height
9. The working party to assist each brigade responsible for rescue from a wind turbine to arrange and facilitate annual training session. All stake holders to be included.