SCOPE OF THE WIND ENERGY FACILITY PROJECT CHAPTER 7

This chapter provides details regarding the scope of the proposed wind energy facility on the West Coast, including all required elements of the project and necessary steps for the project to proceed. The scope of project includes construction, operation and decommissioning activities. This chapter also explores alternative options with regards to the proposed wind energy facility development, including the "do nothing" option.

7.1. Project Alternatives

Through the regional assessment site identification and selection process, Eskom were guided to site/locate their proposed wind energy facility within an area/zone of preference (the site selection process undertaken is clearly described in Chapter 4). No location/site alternatives are, therefore required to be considered further. The following project alternatives, however, will be investigated in the EIA:

» **The 'do nothing' alternative:** Eskom does not establish a wind energy facility in the Western Cape (maintain status quo).

  Internationally there is increasing pressure on countries to increase their share of renewable energy generation due to concerns such as climate change and exploitation of resources. The South African Government has set a 10-year cumulative target[5] for renewable energy of 10 000 GWh renewable energy contribution to final energy consumption by 2013, to be produced mainly from biomass, wind, solar and small-scale hydro. This is amounts to ~4% (1 667 MW) of the total estimated electricity demand (41 539 MW) by 2013.

  In responding to the growing electricity demand within South Africa, as well as the country's targets for renewable energy, Eskom has a drive to establish renewable forms of energy generation capacity and contribute to the targets published in the Renewable Energy White Paper. Through research, the viability of a wind energy facility has been established, and Eskom propose that up to 200 MW can be realised from the facility on the West Coast.

  The 'do nothing' alternative will not assist Eskom or the South African government in reaching their set targets for renewable energy. In addition,

[5] At present no sector or company specific targets have been put in place. Government is currently finalising proposals which will impose renewable energy obligations or targets on energy generators such as Eskom.

the Western Cape power supply will not benefit from the additional generated power being evacuated directly into the Province's grid. This is, therefore, not a preferred alternative.

» **Site-specific alternatives:** in terms of turbine positions within the broader 37 km^2 area.

Once sufficient information is available from an environmental and planning perspective for the broader 37 km^2 site, a detailed micro-siting exercise will be undertaken to effectively 'design' the wind energy facility. As local level issues were not assessed in sufficient detail at the regional level, these issues are now being considered within the site-specific studies and assessments through the EIA in order to delineate areas of sensitivity within the broader area. Through the process of determining constraining factors, the layout of the wind turbines and infrastructure can be planned. The overall aim is to maximise electricity production through exposure to the wind resource, while minimising infrastructure, operation and maintenance costs, and social and environmental impacts. Specialist software is available to assist developers in selecting the optimum position for each turbine. This micro-siting information will then be provided, and will inform the specialist impact assessments at the EIA phase. The planning process will also include the positioning of other ancillary infrastructure, including access roads, laydown areas and substation sites.

This alternative will, therefore, be considered in extensive detail in the EIA phase.

» **Alternative technologies:** for use in the establishment of the wind facility.

There is a limited range of alternative technologies (turbines) for commercial scale wind energy facilities. In addition, the technology is constantly evolving. Table 7.1 summarises the types of variables associated with existing wind turbine technologies. There are no significant differences from an environmental perspective between technologies. Eskom will embark on a competitive process (i.e. call for bids from suppliers) to arrive at the most cost-effective solution.

Table 7.1: Alternative Wind Turbine Technologies

Variables	Types of Technologies
Type	The horizontal axis wind turbine completely dominates the commercial scale wind turbine market.
Size	Typical land-based utility scale wind turbines are in the 600 kW to 2,5 MW range.
Foundation	The foundation is usually poured concrete. Its size and shape is dictated by the size of the wind turbine and geotechnical considerations.

Variables	Types of Technologies
Tower	Tubular steel towers are standard.
Rotor	3- bladed rotor is standard.
Rotor Speed Control	Fixed or variable speed rotors
Gears	Geared and Gearless
Generator	Standard high speed generator (geared) or custom low-speed ring generator (gearless)
Other variables	Yaw gears, brakes, control systems, lubrication systems and all other turbine components are similar on modern wind turbines

» **Transportation Route Alternatives:** for transportation of all components associated with the project to the site.

The various transportation options (harbour, rail, air, road), as well as the possible routes associated with these options were assessed through the transportation study (refer Appendix W).

The various transportation routes, location of harbours and airfields are depicted regionally in Figure 7.1.

Harbours

Three harbours were identified as possible entry points for the imported wind turbine components, namely Cape Town, Saldanha Bay and the fishing harbour at Lamberts Bay. Cape Town and Saldanha are both deepwater ports with heavy lifting equipment on the quayside. There has been no consultation with the Port Authorities at this stage. Lamberts Bay would require further investigation to determine draught clearance on entry to the port and whether the lifting equipment within the harbour has the capacity to transfer the larger loads to road based transport vehicles. Abnormal vehicle access and the adequacy of the access roads to the harbour and the road network would also require careful evaluation. All harbours are assumed possible entry points, and transport routes between these harbours and the proposed wind energy facility site are evaluated.

Rail Transport

At a regional level, a rail network does exist between Cape Town, Saldanha Bay, Koekenaap and ends at Bitterfontein. The railway line to the north commences at Bellville and diverges at Kalbaskraal with one route passing through Darling, Hopefield, Bergrivier and Vredenburg while the other route passes through Abbotsdale, Malmesbury, Rust, Moorreesburg, Koringberg, Piketberg, Eendekuil, Het Kruis, Paleisheuwel, Sandberg, Graafwater, Ratelfontein, Klawer, Vredendal, Lutzville, Koekenaap, Landplaas, Komkans and ending at Bitterfontein.

The Saldanha - Sishen Iron Ore railway line runs from the Iron Ore terminal at Saldanha Bay, past Velddrif and follows the coastline until Standfontein where it swings north-east passing south of Lutzville on a north-east alignment. This is a purpose built facility for transporting iron ore from the mines in Sishen to the export terminal at Saldanha Bay with no connection to the "local" rail network.

This benefit of this option, if feasible, would be to reduce the abnormal load impact on the road network. Investigations have revealed that the maximum load width is 3.302 m and maximum load height is 2.896 m. There is no rolling stock that can accommodate rigid 45 m long blade containers, the 20 m tower sections or the Nacelles, and therefore rail is cannot be considered as an alternative for the transportation of the wind turbine components to the site. This alternative is therefore not considered further.

Air Fields and Air Transport

At a regional level, local airfields are indicated at Vredendal, Papendorp, Dooringbaai, Lamberts Bay, Clanwilliam, Citrusdal, Malmesbury, Vredenburg, Langebaan AFB, Ysterplaat AFB as well as Cape Town International Airport. The local airfield at Skaapvlei is no longer in use. The viability of this option would rely on the compatability between the size of the aircraft required to move the turbine components and the ability of the airfield to accept such aircraft. In addition, transport by road would still be required from the airstrip to the site.

The option of a ship to shore load transfer of the wind turbine components between a bulk cargo carrier moored off-shore and the site was also explored. This benefit of this option, if feasible, would be to reduce the abnormal load impact on the road network. However, the Sikorsky S-92 "Multi – Mission Helicopter", one of the largest commercial helicopters in the Sikorsky range can only lift a maximum of 4 536 kg external load. This capacity is far too small to be considered of any use in the transportation of wind turbine components. Therefore, this cannot be considered as an alternative for the transportation of the wind turbine components to the site. This alternative is therefore not considered further.

Road Transport

It is anticipated that the tower sections, nacelles and the 45 m blades will require transport from either Cape Town Metropolitan area or the Saldanha Bay area.

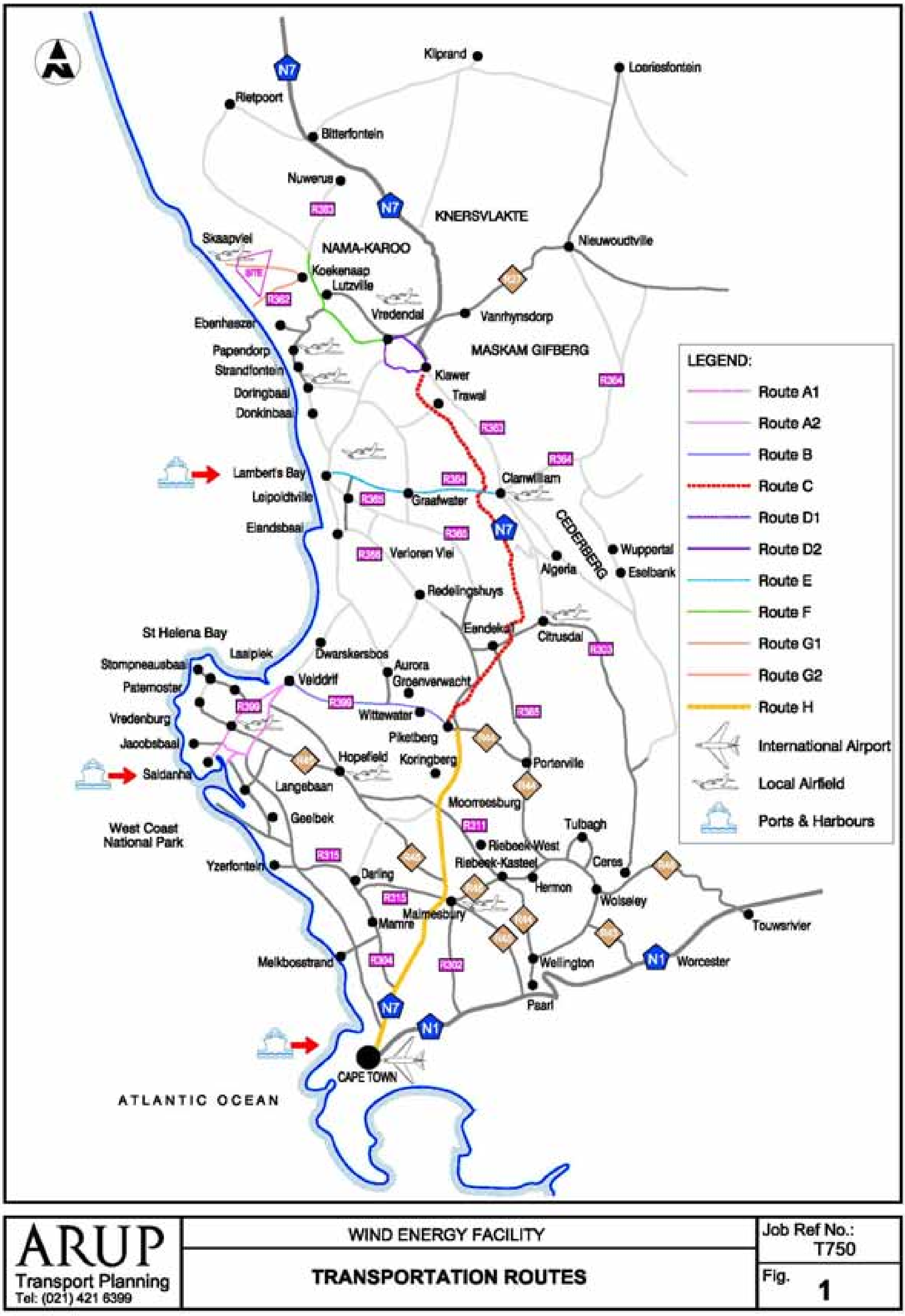

Figure 7.1: Transportation route map illustrating alternatives for the transportation of components to the facility site

The main transport routes include:

* N7 (Cape Town to Klawer)
* R27 (West Coast Road, Cape Town to Velddrif), with possibly a diversion along Boundary Road – Koeberg Road and Blaauwberg Road in the Milnerton / Table View area for an super-load (GVM > 125 Ton);
* R399 (Saldanha Bay to Picketburg);
* R362 and/or R363 (Klawer to Vredendal);
* R363 (Vredendal to Koekenaap);
* Koekenaap to Site along the existing local surfaced and gravel access roads

The use of road-based transport for the movement of the components to the site is a viable option which required consideration. These alternatives have been investigated in more detail through the specialist scoping study. Alternative routes/corridors will be assessed in the EIA phase, where required.

» **Alternative servitudes for powerline routing:** Network integration studies, planning and design for the transmission of the power generated at the wind energy facility is still being finalised. This will be informed through understanding the local power requirements and the stability of the local electricity network.

A 132 kV powerline is proposed to connect the substation/s at the wind energy facility to the electricity distribution network/grid at either the Koekenaap Distribution Substation or the Juno Transmission Substation (outside Vredendal). The connection point to the Eskom power grid will be confirmed through the network integration and planning exercise.

Alternative routes/corridors for the 132 kV powerline will be assessed in the EIA phase. The powerline servitude option available at this time are proposed to follow other existing linear infrastructure (including roads and or other powerlines) as closely as possible to consolidate linear infrastructure in the area, and to minimise the need for additional points of access. Figure 7.2 indicates potential powerline corridors between the wind energy facility substation, Koekenaap substation and Juno substation.

7.2. Project Construction Phase

In order to construct the proposed wind energy facility and associated infrastructure, a series of activities will need to be undertaken. The erection and commissioning of the turbines will be completed in a phased approach, as this facility lends itself to phased-construction. It is proposed that Phase 1 comprise a facility with a capacity of approximately 100 MW (i.e. in the order of 50 industry-standard 2 MW turbines). The construction phase for erection of approximately 50 wind turbines plus all of the required associated infrastructure is expected to take in the order of 24 months.

It is expected that there will be between 6 and 15 people in a construction crew, depending on the construction phase of project and the nature of activities being undertaken. There may be more than one crew operating on the site at any one time. Construction crews will constitute mainly skilled and semi-skilled workers. No employees will reside on the site at any time during the construction phase.

Figure 7.2: Map indicating proposed corridors for powerline construction – alignments to be investigated in detail in the EIA Phase.

The following construction activities have been considered to form part of the project scope of the Wind Energy Facility on the West Coast.

7.1.1. Conduct Surveys

Prior to initiating construction, a number of surveys will be required including, but not limited to, geotechnical survey, site survey and confirmation of the turbine micro-siting footprint, survey of substation site/s and survey of powerline servitude/s to determine tower locations.

7.1.2. Establishment of Access Roads to the Site

Access/haul roads to the site as well as internal access roads within the site are required to be established. The proposed site is in a remote location but with good access owing to the existing road network providing access to the diamond mining concession areas. As far as possible, existing access roads to the site (including the road to Skaapvlei) will be utilised, and upgraded where required. Within the site, access will be required between the turbines for construction purposes. Special haul roads may need to be constructed to and within the site to accommodate abnormally loaded vehicle access and circulation. The internal service road alignment will be informed by the final micro-siting/positioning of the wind turbines. The internal service roads will be gravel roads.

Figure 7.3: Photograph indicating the existing gravel access road to the proposed site (i.e. the road to Skaapvlei from Koekenaap)

These access roads will have to be constructed in advance of any components being delivered to site, and will remain in place after completion for future access and possibly access for replacement of parts if necessary.

7.1.3. Undertake Site Preparation

Site preparation activities will include clearance of vegetation at the footprint of each turbine, the establishment of internal access roads (as discussed in 7.1.2 above) and excavations for foundations (refer to 7.1.4 below). These activities will require the stripping of topsoil, which will need to be stockpiled, backfilled and/or spread on site.

7.1.4. Construct Foundation

Concrete foundations will be constructed at each turbine location. Foundation holes will be mechanically excavated to a depth of approximately 2 m. Concrete will possibly be batched at an appropriate location off-site and brought to site when required via ready-mix cement trucks. The reinforced concrete foundation of approximately 15 m x 15 m x 2 m will be poured and support a mounting ring. The foundation will then be left up to a week to cure. If the geological conditions dictate, the use of alternative foundations will be considered (e.g. reinforced piles).

Figure 7.4: Photograph illustrating the construction of the foundation of one of the turbines at the Klipheuwel demonstration facility (photo courtesy of Eskom)

7.1.5. Transport of Components and Equipment to Site

The wind turbine, including tower, will be brought on site by the supplier in sections on flatbed trucks. Turbine units which must be transported to site consist of a tower comprised of 4 segments of approximately 20 m in length, a nacelle weighing approximately 83 tons, and three rotor blades (each of approximately 45 m in length). The individual components are defined as abnormal loads in terms of Road Traffic Act (Act No 29 of 1989)[6] by virtue of the dimensional limitations (abnormal length of the 45 m blades) and load limitations (i.e. the nacelle). In addition, components of various specialised construction, lifting equipment and counter weights etc. are required on site (e.g. 200 ton mobile assembly crane and a 750 ton main lift crawler crane) to erect the wind turbines and need to be transported to site.

Figure 7.5: Photograph illustrating the equipment required for the transportation of turbine components to site (photographs courtesy of Eskom at during the construction of the Klipheuwel demonstration facility)

[6] A permit may be required for the transportation of these loads on public roads.

In addition to the specialised lifting equipment, the normal civil engineering construction equipment will need to be brought to the site for the civil works (e.g. excavators, trucks, graders, compaction equipment, cement mixers, etc.).

The components required for the establishment of the substation (including transformers) as well as the powerlines (including towers and cabling) will also be transported to site as required.

The dimensional requirements of the load during the construction phase (length/height) may require alterations to the existing road infrastructure (widening on corners, removal of traffic islands), accommodation of street furniture (electricity, street lighting, traffic signals, telephone lines etc) and protection of road-related structures (bridges, culverts, portal culverts, retaining walls etc) as a result of abnormal loading.

The equipment will be transported to the site using appropriate National and Provincial routes, and the dedicated access/haul road to the site itself.

7.1.6. Establishment of Lay Down Areas on Site

Lay down areas will need to be established at each turbine position for the storage of wind turbine components. The lay down area will need to accommodate the cranes required in tower/turbine assembly. Lay down and storage areas will be required to be established for the normal civil engineering construction equipment which will be required on site.

A large lay down area (approximately 20 m wide x 150 m long) will be required at each position where the main lifting crawler crane may be required to be erection and/or disassembled. This area would be required to be compacted and levelled to accommodate the assembly crane, which would need to access the crawler crane from all sides.

7.1.6. Construct Turbine

A large lifting crane will be brought on site. It will lift the tower sections into place. The nacelle, which contains the gearbox, generator and yawing mechanism, will then be placed onto the top of the assembled tower. The next step will be to assemble or partially assemble the rotor (i.e. the blades of the turbine) on the ground. It will then be lifted to the nacelle and bolted in place. A small crane will likely be needed for the assembly of the rotor while a large crane will be needed to put it in place. It will take approximately 2 days to erect the turbine, although this will depend on the climatic conditions as a relatively wind-free day will be required for the installation of the rotor.

Figure 7.6: Photograph illustrating the assembly of a turbine tower utilising a large lifting crane (photographs courtesy of Eskom taken during the construction of the Klipheuwel demonstration facility)

Figure 7.7: Photograph illustrating the assembly of a turbine (nacelle and blades) utilising a large lifting crane (photographs courtesy of Eskom from construction at the Klipheuwel demonstration facility)

The wind turbine which will be utilised at the facility on the West Coast is likely to consist of a tower of approximately 78 m in height, a nacelle with hub height at approximately 80 m, and a rotor approximately 90 m in diameter.

It is proposed to construct up to 100 turbines in roughly straight parallel lines, which will begin approximately 2 km inland from the coastline. Turbines will be sited up to 300 m apart from each other, with rows being 500 m (but up to as much as 700 m) apart (refer Figure 7.3). This is to minimise wake effects and wind turbulence.

The lifting cranes will be required to move between the turbine sites. The crawler crane is self-powered and can "crawl" between locations should the ground conditions allow. When assembled, the crawler crane has a track width of approximately 11 m.

7.1.7. Construct Substation/s

One or more substations will be constructed within the site. The turbines will be connected to the substation/s via underground 33 kV cabling (refer to 7.1.9 below). The position/s of the substation (or substations) will be informed by the final micro-siting/positioning of the wind turbines. The layout of the turbines will determine the optimum position for the construction of a substation. The substation/s will be constructed with a high-voltage (HV) yard footprint of up to 80 m x 80 m (refer Figure 7.8).

The proposed substation/s would be constructed in the following simplified sequence:

Step 1: Survey of the site
Step 2: Site clearing and levelling and construction of access road/s to substation site (where required)
Step 3: Construction of terrace and foundations
Step 4: Assembly, erection and installation of equipment (including transformers)
Step 5: Connection of conductors to equipment
Step 6: Rehabilitation of any disturbed areas and protection of erosion sensitive areas.

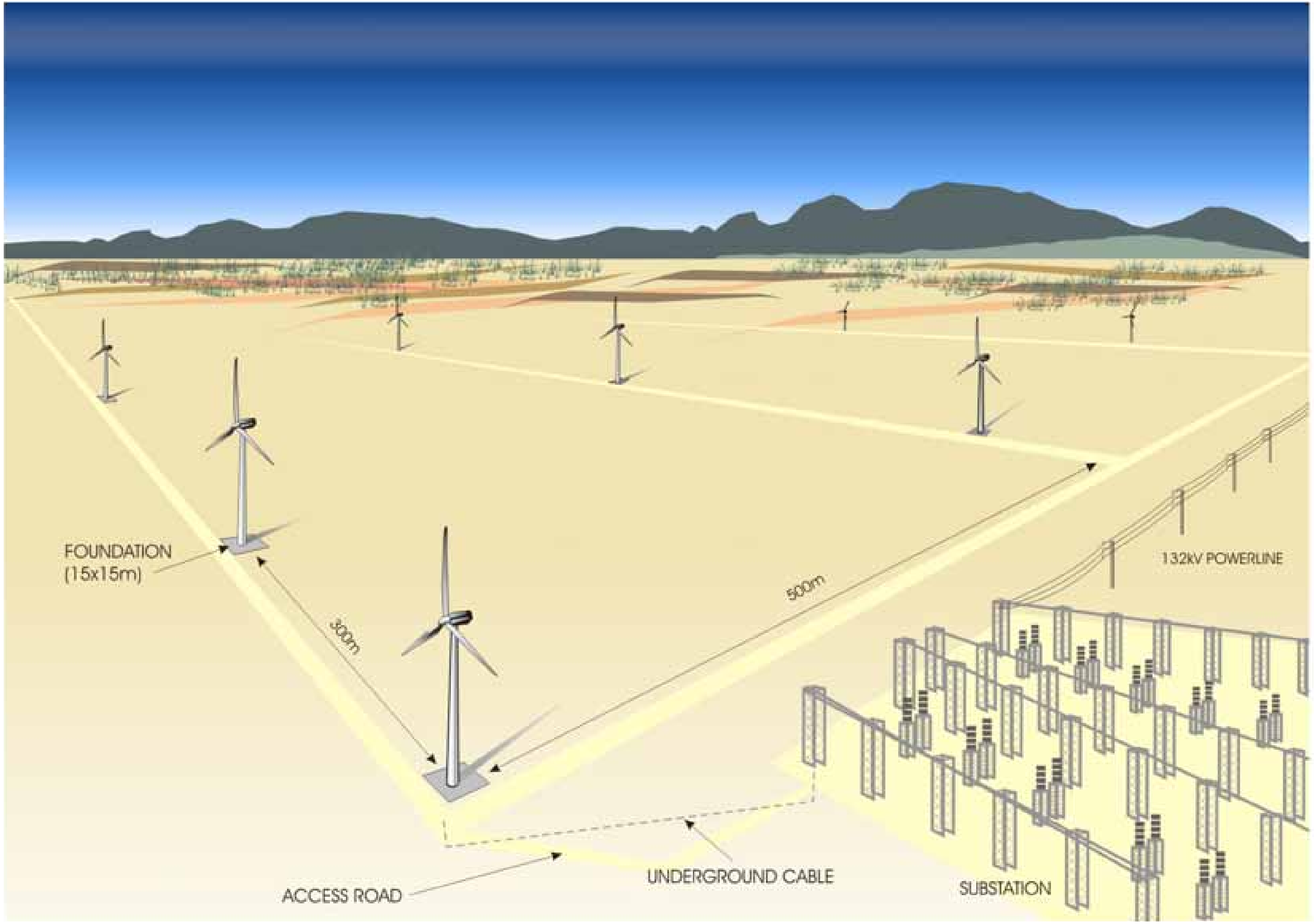

Figure 7.8: Artists impression of a portion of a wind energy facility, illustrating the various components and associated infrastructure

7.1.8. Establishment of Ancillary Infrastructure

A small office structure and visitors centre may also be constructed at the entrance to the wind energy facility. These structures would occupy a footprint of about 150 m^2. The establishment of these buildings will require the clearing of vegetation and levelling of the development site and the excavation of foundations prior to construction. A lay down area for building materials and equipment associated with these buildings will also be required.

7.1.9. Connection of Wind Turbines to the Substation

Each wind turbine will be connected to an optimally positioned substation by underground electrical cables (33 kV). The installation of these cables will require the excavation of trenches, approximately 1 m in depth within which these cables can then be laid. The underground cables will be planned to follow the internal access roads, where possible.

7.1.10. Connect Substation/s to Power Grid

A 132 kV powerline will connect the substation/s to the electricity distribution network/grid at the Koekenaap Distribution Substation or the Juno Transmission Substation (outside Vredendal). The connection point to the Eskom power grid will be confirmed through a network planning exercise. A route for the powerline will be assessed, surveyed and pegged prior to construction. The powerline servitude will follow other existing linear infrastructure (including roads and or other powerlines) as closely as possible to consolidate linear infrastructure in the area, and to minimise the need for additional points of access.

The powerline will be constructed utilising a monopole steel pole structure with stand-off insulators and will be approximately 24 m in height. A servitude of approximately 32 m will be required for this powerline.

7.1.11. Commissioning

Due to the nature of the plant and the process of construction, it is proposed that the facility be commissioned in phases. The first phase of the wind energy facility is proposed to comprise a generating capacity of approximately 100 MW (i.e. in the order of 50 industry-standard 2 MW turbines). The remainder of the turbines would be built and commissioned in subsequent phases.

Prior to the start up of a wind turbine, a series of checks and tests will be carried out. This will include both static and dynamic tests to make sure the turbine is working within appropriate limits. Grid interconnection and unit synchronisation will be undertaken to confirm the turbine and unit performance. Physical adjustments may be needed such as changing the pitch of the blades. The schedule for this activity will be subject to site and weather conditions.

7.1.12. Undertake Site Remediation

As construction is completed in an area, and as all construction equipment is removed from the site, the site rehabilitated where practical and reasonable. On full commissioning of the facility, any access points to the site which are not required during the operation phase will be closed and prepared for rehabilitation. Due to the mobility of the sandy soils, and as rehabilitation and recovery of vegetation on the site will be slow, rehabilitation activities will (as far as possible) be carried out at each turbine location once construction of that particular turbine is completed.

7.2. Project Operation Phase

Once operational, the wind energy facility will be monitored remotely. It is estimated that the operational phase of the project will provide employment for approximately 6 skilled staff members, who will be responsible for monitoring and maintenance when required. No permanent staff will be required on site for any extended period of time.

Each turbine within the wind energy facility will be operational except under circumstances of mechanical breakdown, extreme weather conditions or maintenance activities. The following operation activities have been considered to form part of the project scope of the Wind Energy Facility on the West Coast.

7.2.1. Maintenance

The wind turbine will be subject to periodic maintenance and inspection. Periodic oil changes will be required. Any waste products (e.g. oil) will be disposed of in accordance with relevant waste management legislation.

7.3. Decommissioning

The turbine infrastructure which will be utilised for the proposed wind energy facility on the West Coast is expected to have a lifespan of approximately 20 - 30 years (with maintenance). Equipment associated with this facility would only be decommissioned once it has reached the end of its economic life. It is most likely that decommissioning activities of the infrastructure of the facility discussed in this EIA would comprise the disassembly and replacement of the turbines with more appropriate technology/infrastructure available at that time.

The following decommissioning activities have been considered to form part of the project scope of the Wind Energy Facility on the West Coast.

7.3.1. Site Preparation

Site preparation activities will include confirming the integrity of the access to the site to accommodate required equipment and lifting cranes, preparation of the site (e.g. lay down areas, construction platform) and the mobilisation of construction equipment.

7.3.2. Disassemble and Replace Existing Turbine

A large crane will be brought on site. It will be used to disassemble the turbine and tower sections. These components will be reused, recycled or disposed of in accordance with regulatory requirements. All parts of the turbine would be considered reusable or recyclable except for the blades.