Green Cat Renewables

WHITEHOUSE BURN WIND TURBINE

Route Access Report

September 2011

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Genesis Energy

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Project No. C0389-228

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1 Introduction

Genesis Energy is seeking planning permission for a wind turbine development on Kintyre, in Argyll. The development comprises a single Enercon E48 wind turbine to be erected at a site located approximately 7km south of Tarbert, along with all associated access track, sub-station building and cabling. In response to a request by the Planning Authority, Genesis Energy has commissioned Green Cat Renewables to conduct an Route Access report for the development.

1.1 Impacts

During the construction period of proposed development, the delivery of the various turbine parts, stone for tracks, concrete and steel for foundations, as well as the cranes and various plant required for construction, would be by road, which could result in impacts on the existing roads network. These impacts are described:

- Impact to roads infrastructure. The roads may not dimensionally suitable for the abnormal vehicle lengths and widths, and may not be structurally capable to take the loads.
- Impact to existing road users in the form of increased traffic volumes.

1.2 Scope

The aims of this report are to:

- Identify and describe the abnormal vehicles and loads on which the development is dependent, and which will require the use of the public road network.
- Identify the route(s) to the site.
- Assess the suitability of the roads in terms of dimensions and structural capacity, and describe any upgrading works required.
- Assess the significance of increased traffic volumes, and propose mitigation.

1.3 Approach / Methodology

This assessment has been carried out by a combination of map based assessment, visual inspection of potential pinch-points, and computer simulated 'swept-path' analysis of key pinch-points.

The map based assessment is used to identify potential pinch points which are then assessed on site. The visual inspection involves checking dimensions on site and simulating the path of the transporting vehicle. The swept path analysis involves a computer simulation of a transporting vehicle which is superimposed on an O.S. plan. The vehicle is then driven to simulate both the axle route and the overhang.

The main considerations addressed with regard to access route and site access are as follows:

1. The geometry of the delivery vehicles and their loadings.
2. Suitability of roads to safely support the proposed loads.
3. The requirements for Third Party Land.

4. Foreseeable costs and disruption caused by road alterations to street furnishings and services (e.g sign post and telecoms etc).

1.4 Proposed Routes

The Turbine components will be shipped by sea to one of the Scottish ports. Given its proximity to the site, the port of Campbell town appears the most likely, but if the turbine manufacturers have many orders in another part of Scotland, it may be more viable to have it shipped to another port such as Invergordon or Peterhead and then hauled by land to the site.

From Campbeltown, the route to the site is very simple: the Turbine Delivery Vehicles (TDVs) will take the A83 north and turn right onto the B8001, which will take them to the site access track. There have been much larger developments in the area for which a turbine were delivered to Campbeltown and transported using the A83, so there is confidence that roads network is good enough. Similarly, if the turbine is shipped to another port such as Invergordon or Peterhead, the turbine will be hauled via the trunk roads network, and approach the site via the A83 from the north. In any case, the turbine manufactures Enercon and their haulage company will complete a full access survey prior to delivery and are responsible for load transportation to the Delivery Transition Point. The Delivery Transition Point is normally the nearest A class road to the proposed site, which would be the junction of A83 and the B8001.

Vehicles coming from the rest of the Scottish Mainland would use the trunk roads network and come to the site from the north via the A83. The largest of these vehicles would be the cranes which are easily capable of traversing the trunk roads network.

This assessment, therefore, will focus on stretch of road comprising the B8001 from its junction with the A83 and the site access track

Figure 1 – Site Location and TDV route from Campbeltown

2 Traffic Management

2.1 Construction Traffic

The construction of the wind farm would take place in three phases; site preparation, foundations construction and erection of wind turbine. For each phase different level of vehicles will arrive and depart.

During all three phases construction approximately 10 personnel would be employed on site every day which equates to an average of some 4-8 cars/vans arriving exiting the site during the AM and PM peak hours respectively.

As part of the preparation of the site, it is anticipated that approximately 100 lorry loads of aggregates in total would be required to construct the site track and crane hard standing. It is anticipated that this stone will be sourced on-site, but, if sourced off-site, the aggregate would be hauled to the site via the B8001

During the construction of the foundation it is estimated that approximately 24 deliveries of concrete would be required together with a further one articulated trailer lorry carrying reinforcement steel. The deliveries would arrive on site over a period of days and would access the site outwith the AM and PM peak hours.

For the erection of the wind turbine the components would be delivered to the site on articulated lorries. Extended trailers would be used to deliver the turbine blades, as noted in Section 3. Up to six articulated low loader deliveries are required to deliver the tower, nacelle and the blades, with a further lorry-load being required to transport the necessary cabling to the site. A police escort would take the lorries in convoys of up to 5 articulated vehicles, as shown in Photos 1 and 2.

Photo 1 – 1st long load vehicle of a turbine convey

Photo 2 – 2nd long load vehicle of a turbine convey

In addition, two cranes are required for the erection of the wind turbines, typically a 250 tonne and a 100 tonne mobile crane. A typical 250 tonne crane would have a travelling weight of 72 tonnes on six axles with a maximum axle load of 12 tonnes and would have steering on all axles to help navigate bends. The maximum ballast that would be taken would be 97.5 tonnes total ballast. A couple of smaller vans would accompany the cranes but again would only have minimal effect on the A90 and would not require any traffic management.

2.1.1 Mitigation

Use of on-site borrow pits and existing access tracks

As previously noted, it is proposed that the stone for the upgrading of the site track into the access road would come from an on-site borrow pit, if this is feasible and planning consent can be gained. This measure has the potential to significantly reduce the number of HGV movements during the first phase of construction.

Route Management Plan

A Route Management Plan (RMP) finalizing traffic management measures will be produced during the post-planning stage and agreed with Strathclyde police, Argyll and Bute Council and Transport Scotland.

The RMP will set out in detail:

- The route to be followed by the Turbine Delivery Vehicles (TDVs) and HGVs.
- The schedule of deliveries. Deliveries will be scheduled outside of peak hours to minimize impact on the road network.
- Suitable escort arrangements for each turbine convoy, from the port of entry to the site access itself.
- More detailed information on construction traffic numbers and construction phasing.
- Appropriate road signs warning other road users of increased HGV activity and abnormal loads in the vicinity of the site. This will be particularly pertinent on the B632.
- Information to be supplied to the general public regarding the movement of abnormal loads, and any road closures or diversions.
- Considerate construction methods to be employed such as wheel cleaning and road sweeping.

Scheduling of turbine delivery

It is envisaged that the turbine would be delivered over up to a three day. Deliveries would be staged for the quietest times of the day (in traffic terms) to minimise disruption. The turbine delivery schedule would be made publically available to ensure that local residents were aware of planned road closures and diversion routes.

It is anticipated that the turbines would be transported along the A83 outside of peak hours, preferably in the early morning before 8am.

It is envisaged that five deliveries could be made per day, in either one convoy of five vehicles or in two convoys of two and three vehicles.

Note: It is the responsibility of the haulier appointed by the turbine manufacturer to apply for and obtain all necessary permits.

Passing Places

Between the junction with the A83, and the start access track, there are a significant amount of passing places, and areas that can be used as passing places, along the B8001. There are six passing places in the first 750m of road, which is straight and has good visibility along its length. The next 700m has bends, but there are nine passing places spread along this stretch. The final 800m are straight with good visibility, and there are six passing places. These places are sufficient, and will help to mitigate the increase of traffic .

2.2 Operational Traffic

Once the wind development is operational the turbine is monitored off-site using telecommunications, therefore the wind farm will only require maintenance every six months with no other scheduled visits required. In addition, the maintenance would only require a single vehicle to access the site which would not require any traffic management.

3 Assessment of Route

This section presents the assessment of the suitability of the proposed route and existing infrastructure with and its ability to cope with the abnormal vehicle dimensions and loads. The extent of upgrading works required is set out.

3.1 Abnormal Vehicle Information

The long Turbine Delivery Vehicles carrying the blades and tower sections, and the cranes required for construction are the abnormal vehicles that will need to traverse the route to the site.

3.1.1 Turbine Delivery Vehicles

The details given below have been extracted from Enercon's "Access Roads and Crane Platforms, E48, 49m and 55m steel tower" document and give details of the turbine sections and transport vehicles.

Each tower consists of three separate sections; 20m, 17m and 17m in length, and the three turbine blades will each be a maximum of 24m long. As noted below, the turbine delivery vehicle (TDV) is 27.5m, but loads such as blades may protrude from rear of the transport vehicle by up to 7m during transport.

The TDV is 2.6m wide, with the widest load being 4.5m. Therefore, the access roads need a minimum clearance width of 5m and a minimum clearance height of 4.6m, with the transport vehicles requiring a minimum ground clearance of 0.15m. Roadways, bridges and access tracks along the access route will have to be able to withstand loads up to a maximum axle load of 12 tonnes and a maximum overall weight of up to 120 tonnes.

Details of each Turbine Delivery Vehicle required to transport one E48 Turbine is shown in Annex A, with a summary illustrated below.

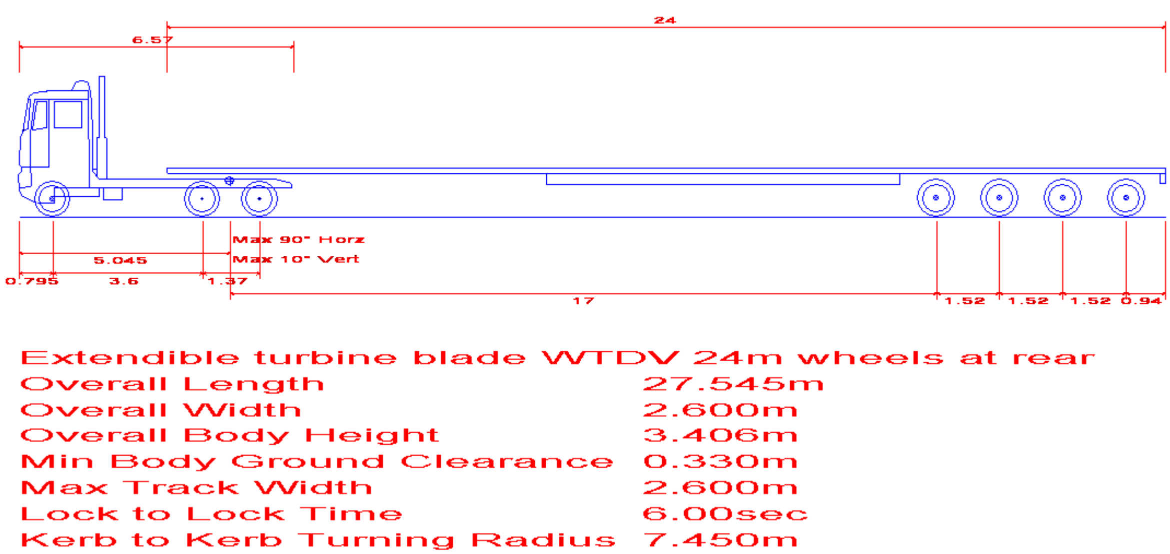


Figure 3 – Elevation of Turbine Delivery Vehicle

3.1.2 Cranes

Two cranes are generally required to lift the turbine sections and blades into place on site, the key details of the largest crane that will be used on site are noted below and have been extracted from Liebherr Crane Specification which is shown in Annex B.

The largest crane proposed to be used on site, Liebherr Crane LTM 1500-8.1, is 21.4m long and 3.0m wide. The crane has 8 axles, all of which have axle loads of 12 tonnes, with the total vehicle weight of 96 tonnes.

The crane subcontractor will be asked to inspect the route to the site before cranes are brought on, to assess its suitability.

3.2 Road Description and analysis

The initial desktop study of the B8001 shows that it is a narrow single track. On a site visit conducted in August 2011, a detailed inspection was undertaken. The road is in good condition and was resurfaced recently. It is between 3.0 and 3.2 m in width, with numerous sections of up to 6.5m in width on corners and forming passing places along most of its length. For the most-part, the road has between 1-2m of grass verge on both sides, level with the road surface. Either side of the verge, the road is mostly bordered by stone dykes, drainage ditches or hedges/small trees.

The first 750m of the B8001 are straight, and climbs with slopes of up to 8%. The next 700m has several S-bends as well as dips and climbs, with average slopes of approximately 10%, with short extremes of up to 14%. For the final 800m leading to the start of the site access track, the B8001 is straight and undulating, with a gradients of approximately 8%.

3.2.1 Crane Access

The cranes have the widest wheel base (3m) of the vehicles that will need to traverse the route, and the road may require widening to accommodate them, particularly on the bends. The risks of having a crane traverse an overly narrow road are that the road edge can crumble away, or that the crane can come of and lodge its tyres in the softer verge. The road is in reasonably good condition, but it may require widening of up to 0.5m with crushed rock material. The site visit showed that there is sufficient verge along the length of the B8001 for this to be achieved.

A trial run conducted by the crane subcontractor prior to any access attempts will highlight the works that are required.

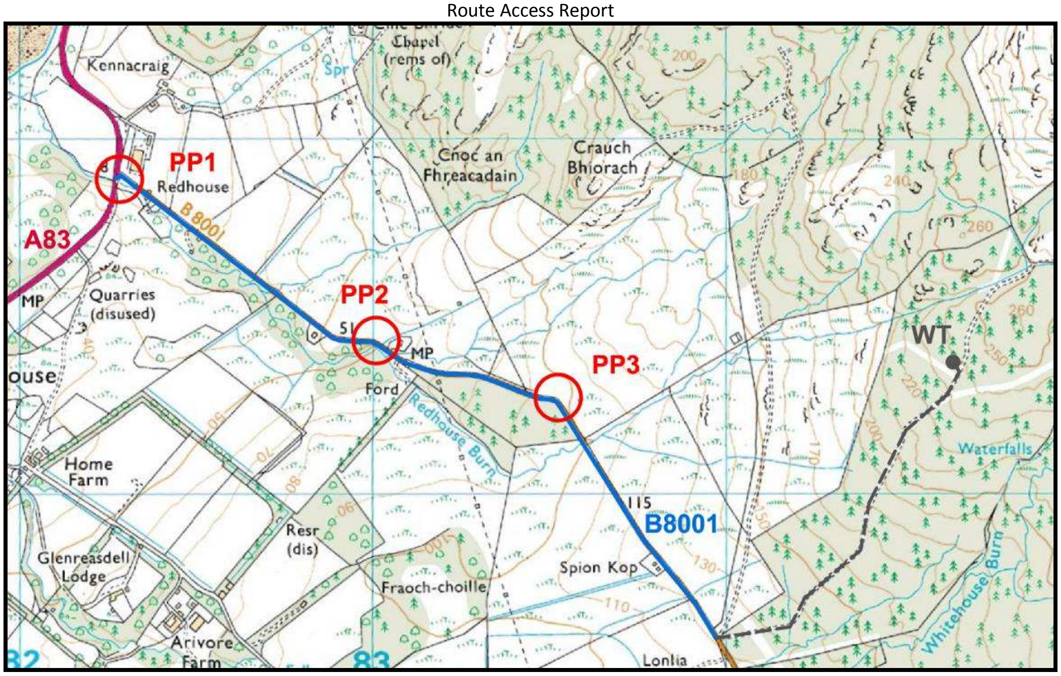


Figure 2 – Pinch Points

3.2.2 Pinch Points

Potential pinch points were identified from the desktop study and site visit. These pinch points may require remedial works to accommodate turbine delivery vehicles. The main problems are the length of the extendable vehicles required for turbine blade deliveries, and those locations requiring confirmation of their load carrying capacity.

Further to an evaluation of the route, the following key manoeuvres will need to be assessed (as depicted on Figure 2):

- Pinch Point 1: Right turn (East) at junction of the A83 and B8001.
- Pinch Point 2: Bend in the B8001 at Craig View.
- Pinch Point 3: Bend in the B8001 before bridge over Red House Burn.

Note: The turn onto the site access track off the B8001 will not be a pinch point. The mouth of the access will be designed in a way that allows all the vehicles to enter without difficulty.

Pinch-point 1: Right turn off the A83 through 120° onto the B8001 eastbound.
O/S Grid Ref: 182280,661890

Photo 3 – approach to right turn, looking ahead in direction of travel

Photo 4 – from mid-point of right turn, looking ahead in direction of travel

Road Width	A83: Width of straight sections is 5.5m, with grass verge on both sides. B8001: Width of road has a long taper away from the junction to 3.0m.
Road Surface	Bituminous material. Good condition.
Borders	The sides of the roads at the junction are bound by grass verges, with verge widths of 1m – 2.5m. There are ditches and stone dykes beyond the verge.
Obstacles	There are several signs by the road side
Swept Path Analysis	Given the sharpness of the turn, and signs by the road side, swept path analysis is required

Pinch-point 2: Bend in the B8001 at Craig View
O/S Grid Ref: 183010,661420

Photo 5: approach to right bend, in direction of travel

Photo 6: beyond bend, looking back

Road Width	Width of B8001 sections are approximately 3.0m throughout
Road Surface	Bituminous material. Condition is mostly good, though there are rougher patches towards the road edge.
Borders	The northern side (left in direction of travel) is bound by a grass verge 1m in width. Beyond this the verge is overgrown with small trees. There is a stone dyke on the inside of the bend, the corner of which comes to 0.5m from the road edge at the middle of the bend. There is more verge between road and dyke, up to 3m, to either side of this corner.
Obstacles	The manoeuvre of this bend is limited by the trees on the outside of the bend, and the proximity of the stone dyke on the inside of the bend
Swept Path Analysis	Required

Pinch-point 3: The right-hand bend in the B8001 before bridge over Red House Burn
O/S Grid Ref: 183520,661260

Photo 7: approach to bend taken in direction of travel

Photo 8: taken looking back at bend in the road

Road Width	The road widens into a passing place on the bend at this point, giving the 6.0m or more road width.
Road Surface	Bituminous material. Good Condition.
Borders	Grass verge on both sides, of approximately 2.0m
Obstacles	There is a small tree growing within 2.0m of the road on the inside of the bend.
Swept Path Analysis	Required

3.2.3 Culverts and bridges

Culverts and bridges can represent structurally weak points of a road. From the desktop study and site visit, there were seven culverts identified along the B8001 to the site. There is also a bridge which crosses Red House Burn. A cursory visual inspection of these culverts showed no obvious signs of structural deficiency, though the overgrown nature of the verges made a thorough inspection difficult. The Red House Burn Bridge appears to be modern and sound.

Heavy forestry vehicles carrying timber use the B8001 quite regularly. These can have loads of up to 44 tonnes spread over three axels, giving axel loads of approximately 15 tonnes. Though some of the heavier vehicles required for delivery and construction of the proposed development have a greater total weight (e.g. the cranes), their axel weights are not greater than 12 tonnes.

It is anticipated that the Planning Authority will furnish their Bridges Unit with a copy of this report, which sets out the weights of all the abnormal vehicles that will need to access the proposed site. In any case, when the Turbine haulage company and crane subcontractor conduct their dry run of the route, the requirement for any strengthening works to culverts will be highlighted.

3.3 Swept Path Analysis of Pinch Points

3.3.1 Limitations of Swept Path Analysis Technique

Swept path analysis is indicative of what can be achieved with a real vehicle, but as with any simulation it is an approximation and its accuracy is only as good as the data fed into it. There are a number of sources of potential inaccuracy the main ones being;

1. Inaccuracies in the OS Mastermap data,
2. Differences between the steering of the simulated lorry and the real lorry,
3. Flaws in the AutoTrack 7 software, and
4. Human error by Green Cat Renewables 'driving' the software.

As such no guarantee can be given that results of the swept path analysis will accord with what real delivery vehicles can achieve on the ground. We recommend that these results be passed to the contractor that eventually carries out this work with an instruction that they must satisfy themselves as to the conclusions.

3.3.2 Analysis Technique

Swept path analysis was carried out using AutoTrack 7. This software allowed a model of a standard articulated lorry tractor and trailer units to be modified to the dimensions required by turbine delivery vehicles (TDV's). The longest of the TDV's, the blade delivery vehicle, was utilised throughout the analysis to provide a worst case scenario for the extents of the swept paths, which are indicative of the required land take extent and civil works.

An extendible platform vehicle from the AutoTrack vehicle library was chosen as the basis for the computer model and its dimensions modified to mimic potential blade delivery lorries. The AutoTrack vehicle data was modified to that of a Volvo FH 6x4 Tractor unit and 24m long flatbed trailers with 4 axles at the rear of the trailer, similar to the diagram in the Vestas Transport Guidelines. Rear wheel steering is modeled on Ackerman rear axles linked to the tractor steering. In practice the rear steering is completely independent of the main steering, being remotely operated by an operative walking behind the lorry, as such the real vehicle are likely to be slightly more manoeuvrable than the simulation. Unfortunately Autotrack 7 does not allow the simulation of independent rear steering, but it is possible to use a series of different linkage ratios to approximate manual rear wheel steering as accurately as possible.

Swept Path Annotation

Note that the area bound by the green line indicates the maximum extent of the TDV sweep. The red coloured line shows the movement of the tractor and trailer wheels.

3.3.3 Pinch Point Analysis

Pinch-point 1: Right turn off the A83 through 120° onto the B8001 eastbound.
O/S Grid Ref: 182280,661890

The swept path analysis using a 24m trailer indicates that the turn is not navigable without the tractor and trailer wheels riding slightly onto the verge on the north side of the B8001.

Figure 3 shows that approximately 12 m^2 of the verge will requiring reinforcement, as indicated in grey. As discussed in the previous section, the swept path shown is a conservative estimate. In any case, the haulage company responsible for delivery of the turbines will also perform an assessment of the route, followed by a "dry run" of the route where required. More accurate dimensions of those areas requiring reinforcement will then be available.

No third party land is required for the TDV to undertake this manoeuvre, and it is not anticipated that the any of the signs by the road side are in the way.

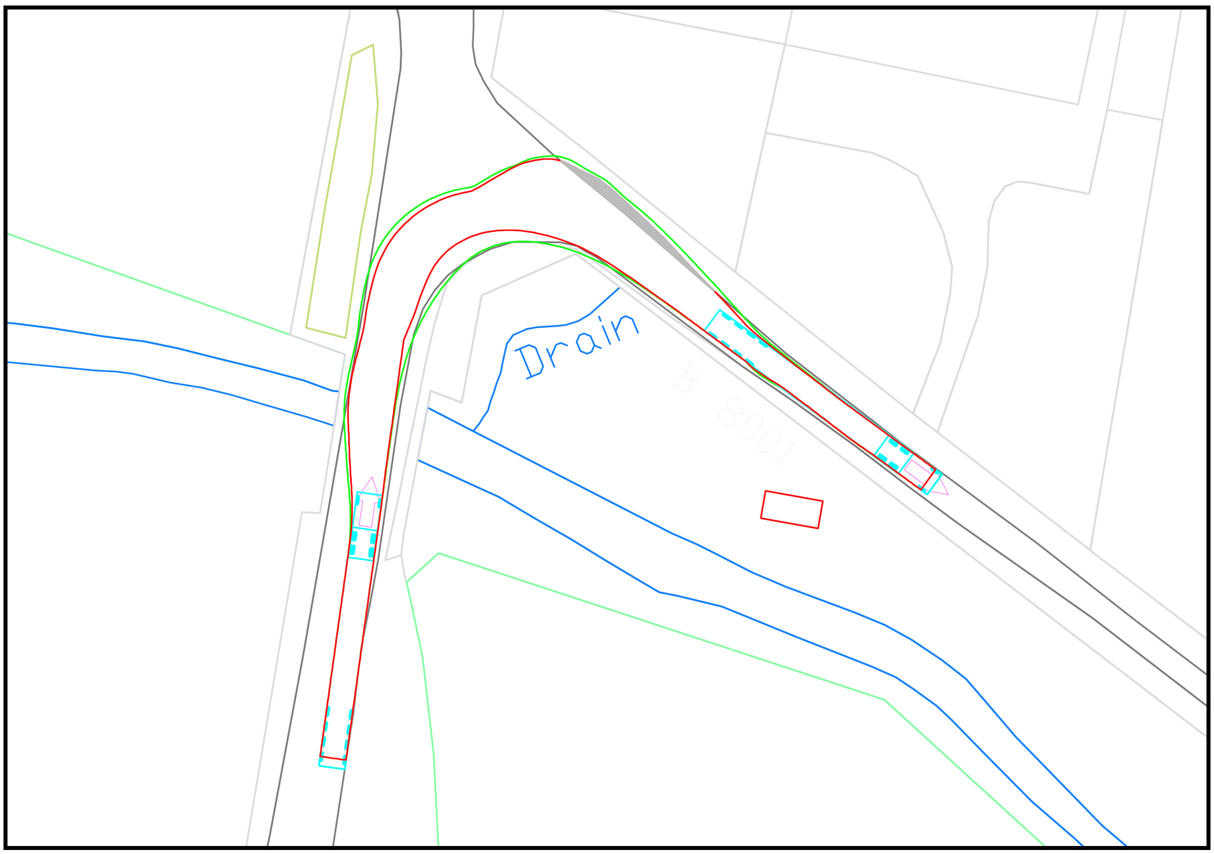


Figure 3 – Swept Path of Pinch Point 1

NOTE: If the turbine is transported to different port than Campbeltown, it would approach this junction of the B8001 and A83 from the north. In this case, traversing the junction would represent no difficulty to any of TDVs.

Pinch-point 2: Bend in the B8001 at Craig View
O/S Grid Ref: 183010,661420

The swept path analysis using a 24m trailer indicates that the turn is not navigable without the tractor and trailer wheels riding onto the verge.

Figure 4 shows that about 13 m^2 of the verge will requiring reinforcement, as indicated in grey. As discussed in the previous section, the swept path shown is a conservative estimate. In any case, the haulage company responsible for delivery of the turbines will also perform an assessment of the route, followed by a "dry run" of the route where required. More accurate dimensions of those areas requiring reinforcement will then be available.

No third party land is required for the TDV to undertake this manoeuvre, though some of the vegetation on the northern (outside) verge of the bend may require trimming back.

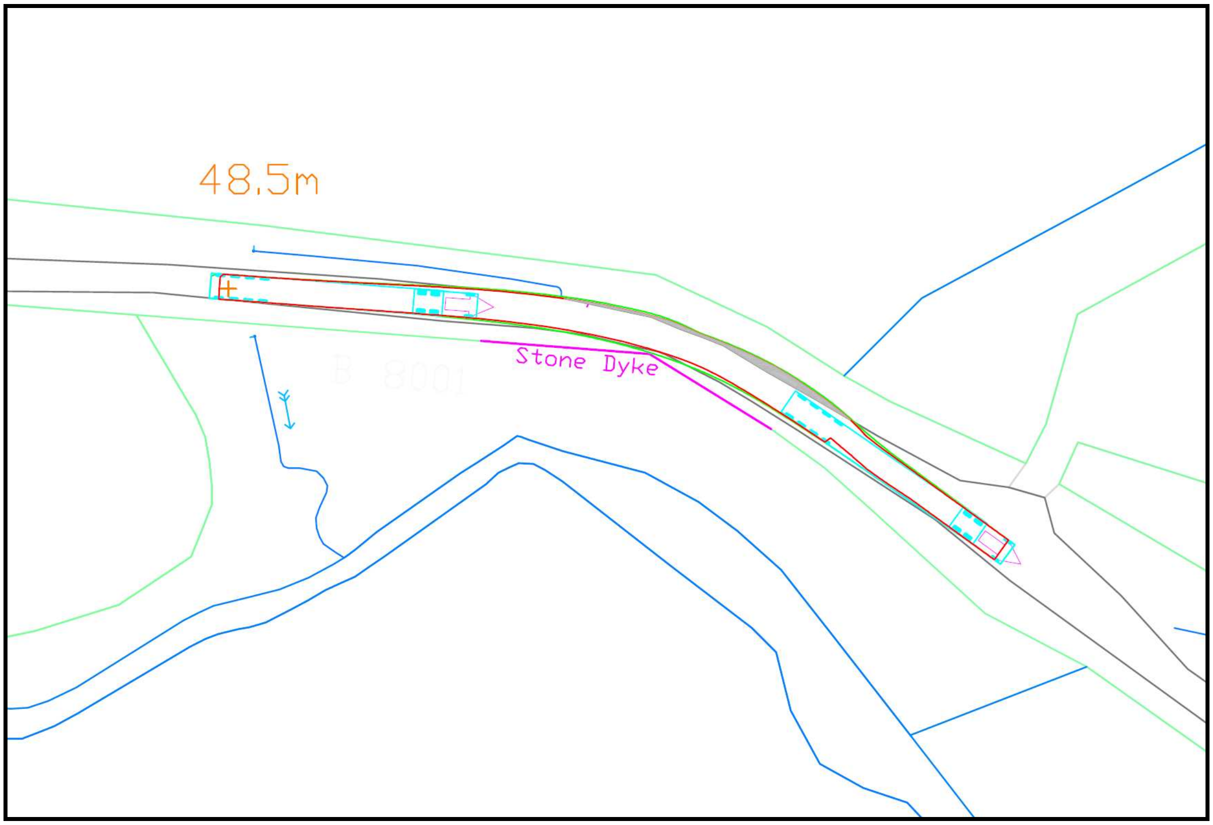


Figure 4 – Swept Path of Pinch Point 2

Pinch-point 3: The right-hand bend in the B8001 before bridge over Red House Burn
O/S Grid Ref: 183520,661260

The swept path analysis using a 24m trailer indicates that the series of turns is navigable without the tractor and trailer wheels riding onto the verge. No additional works are required.

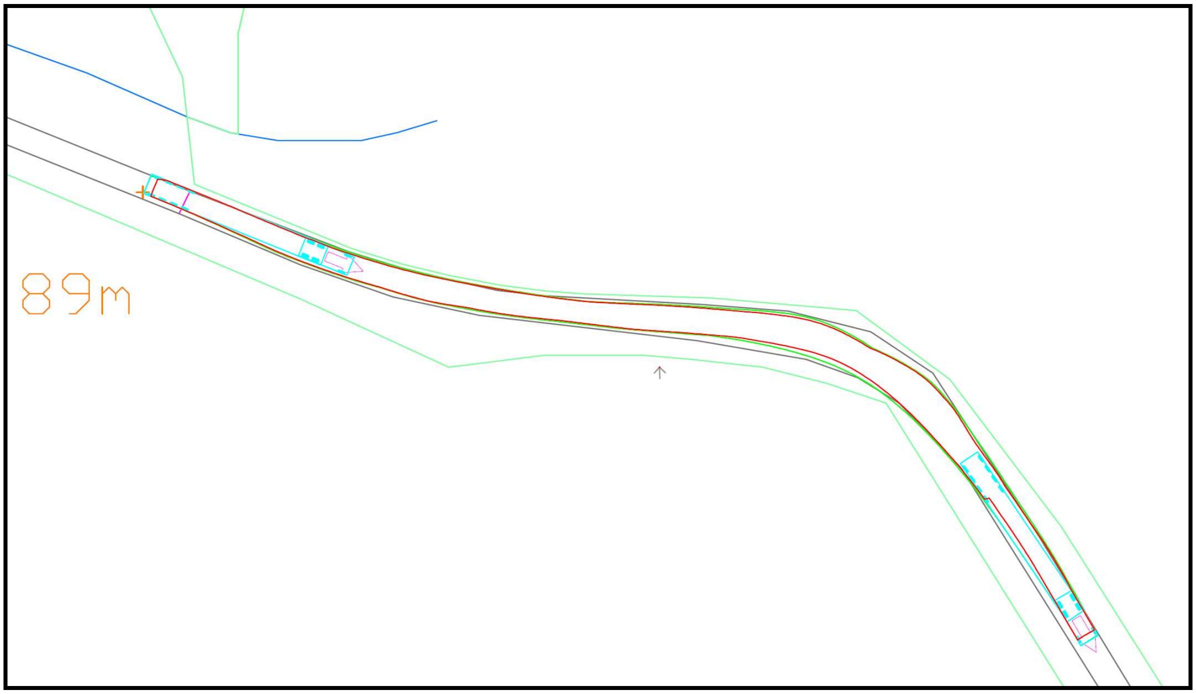


Figure 5 – Swept Path of Pinch Point 3

3.4 Summary of Upgrading Works

Based on the findings of the assessment, it is necessary that works be carried out on the B8001 to facilitate access to the proposed development. Note that these works are subject to the completion of a dry run by both the Turbine hauliers, and the crane subcontractor. The works proposed are as follows:

- Reinforcement of the northern verge at the entrance to the B8001 coming off the A83 to facilitate TDV manoeuvres. Reinforcement area required is approximately $12m^2$.
- Reinforcement of the northern verge beyond the right-hand bend in the B8001 adjacent to Craig View to facilitate TDV manoeuvres. Reinforcement area required is approximately 13 m^2.
- Reinforcement of the road verge along the length of the B8001, to increase the road to a width of between 3.2 – 3.5m, particularly on bends. The road currently has an average width of 3m.
- For ease of passage of the wider vehicles (i.e. the cranes and generator delivery vehicle), some of the road side vegetation and tress may require trimming back.

Verge reinforcement will consist of digging to approximately 350mm, and filling with suitable structural aggregate material.

4 Conclusions

This report covers a desktop study, initial site visit and detailed analysis to review access to the Whitehouse Burn Wind Turbine site. From the initial findings, the proposed route would appear to be feasible for delivery of a single Enercon E48 turbine, and associated construction plant and material delivery, provided upgrading works are done on the B8001.

It should be noted that the Turbine Manufactures and Haulage companies will complete a full survey and, if required, a dry run of the delivery route. They will also be responsible for the transportation of turbines to the delivery transition point, which is taken to be the A83.

The development is likely to cause disruption to the B8001, and it is suggested that the compilation of a full traffic management plan will mitigate this to acceptable levels.

Annex A – Wind Turbine Delivery vehicles

Wind Turbine Nacelle

Overall length of vehicle	17m	Projection – front	~	Projection – rear	~	Total length	20m

Overall width	4.95	Maximum height	4.6	Gross weight or Gross Train Weight	55t

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of wheels/axle	2	4	4	4	4	4								
Axle weight	8	10	10	9	9	9								
Axle spacing		3.2	1.36	10	1.36	1.36								

Wind Turbine Blades

Overall length of vehicle	25m	Projection – front	~	Projection – rear	~	Total length	28m

Overall width	3	Maximum height	4.2	Gross weight or Gross Train Weight	44t

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of wheels/axle	2	4	4	4	4	4								
Axle weight	7	8	8	7	7	7								
Axle spacing		3.2	1.36	18	1.36	1.36								

Wind Turbine Top Tower

Overall length of vehicle	20m	Projection – front	~	Projection – rear	~	Total length	24m

Overall width	3	Maximum height	4.6	Gross weight or Gross Train Weight	50t

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of wheels/axle	2	4	4	4	4	4								
Axle weight	8	9	9	8	8	8								
Axle spacing		3.2	1.36	14	1.36	1.36								

Wind Turbine Mid Tower

Overall length of vehicle	18m	Projection – front	~	Projection – rear	~	Total length	22m

Overall width	3	Maximum height	4.6	Gross weight or Gross Train Weight	58t

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of wheels/axle	2	4	4	4	4	4								
Axle weight	8	10	10	10	10	10								
Axle spacing		3.2	1.36	12	1.36	1.36								

Wind Turbine Base Tower

Overall length of vehicle	18m	Projection – front	~	Projection – rear	~	Total length	22m

Overall width	3.6	Maximum height	4.6	Gross weight or Gross Train Weight	60t

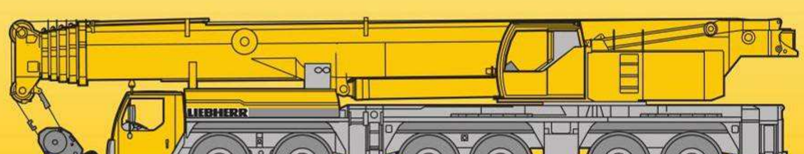
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
No. of wheels/axle	2	4	4	4	4	4								
Axle weight	8	11	11	10	10	10								
Axle spacing		3.2	1.36	12	1.36	1.36								

Annex B – Crane Specs

Mobilkran • Mobile Crane LTM 1250-6.1

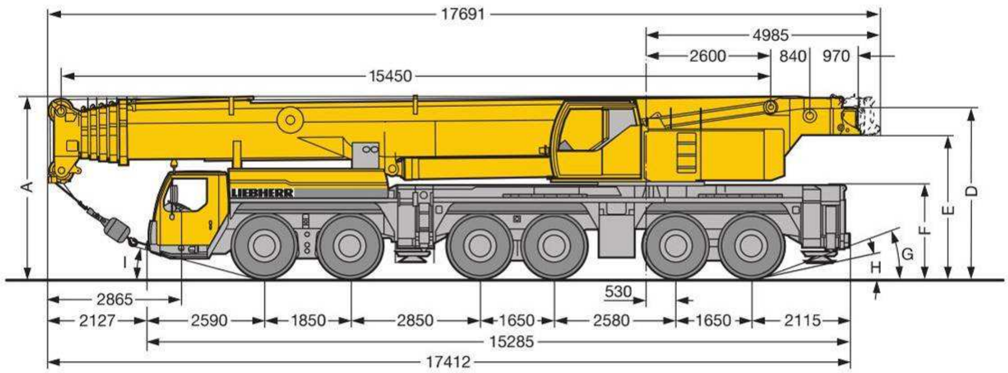
Grue mobile • Autogrù
Grúa móvil • Мобильный кран

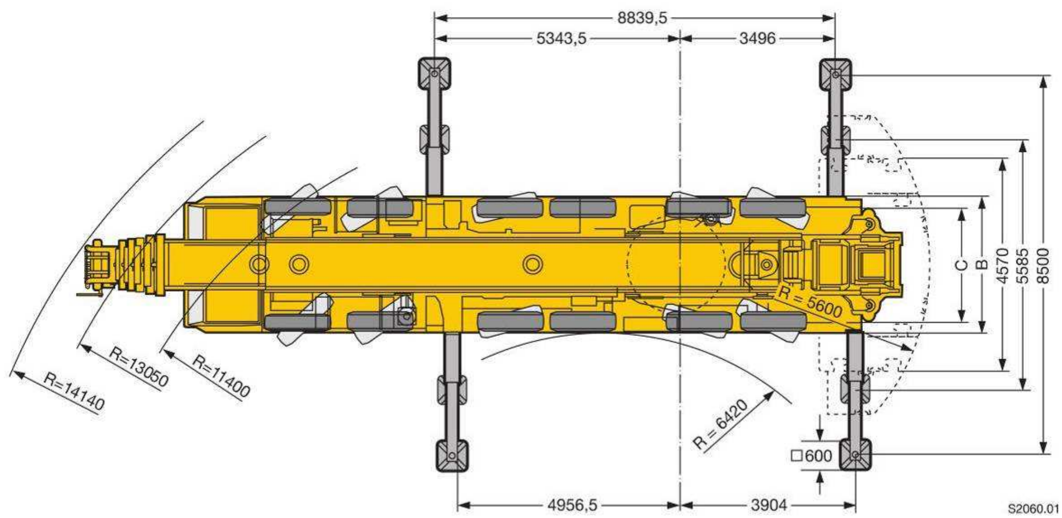
Technische Daten • Technical Data
Caractéristiques techniques • Dati tecnici
Datos técnicos • Технические данные



LIEBHERR

Maße
Dimensions
Encombrement • Dimensioni
Dimensiones • Габариты крана





	Maße · Dimensions · Encombrement · Dimensioni · Dimensiones · Размеры mm									
	A	A 150 mm*	B	C	D	E	F	G	H	I
385/95 R 25 (14.00 R 25)	3950	3800	3000	2612	3705	3098	2015	17°	11°	13°
445/95 R 25 (16.00 R 25)	4000	3850	3000	2552	3755	3148	2065	19°	13°	15°
525/80 R 25 (20.5 R 25)	4000	3850	3240	2702	3755	3148	2065	19°	13°	15°

* abgesenkt · lowered · abaissé · abbassato · suspensión abajo · шасси осажено

Gewichte
Weights
Poids • Pesi
Pesos • Нагрузки

Achse · Axle Essieu · Asse Eje · Мосты	1	2	3	4	5	6	Gesamtgewicht · Total weight t Poids total · Peso totale t Peso total · Общий вес, т
t	12	12	12	12	12	12	72

Traglast · Load t Forces de levage · Portata t Capacidad de carga · Грузоподъемность, т	Rollen · No. of sheaves Poulies · Pulegge Poleas · Канатных блоков	Stränge · No. of lines Brins · Tratti portanti Reenvíos · Запасовка	Gewicht · Weight kg Poids · Peso kg Peso · Собст. вес, кг
176	9	19	2000
143	7	15	1500
108	5	10	1300
71	3	6	1040
31,2	1	3	840
10,5	–	1	500

Geschwindigkeiten
Working speeds
Vitesses • Velocità
Velocidades • Скорости

	1	2	3	4	5	6	7	8	9	10	11	12	R 1	R 2	
385/95 R 25 (14.00 R 25) (km/h)	5,2	6,7	8,7	11,1	14,1	18	23,8	30,5	39,5	50,6	64,2	75	5,6	7,2	53,4 %
445/95 R 25 (16.00 R 25) 525/80 R 25 (20.5 R 25) (km/h)	5,7	7,3	9,4	12,1	15,3	19,6	25,9	33,2	43	55,1	69,8	80	6,1	7,9	47,9 %

Antriebe · Drive Mécanismes · Meccanismi Accionamiento · Приводы	stufenlos · infinitely variable en continu · continuo regulable sin escalonamiento · бесступенчато	Seil ø / Seillänge · Rope diameter / length Diamètre / longueur du câble · Diametro / lunghezza fune Diámetro / longitud cable · Диаметр / длина	Max. Seilzug · Max. single line pull Effort au brin maxi. · Mass. tiro diretto fune Tiro máx. en cable · Макс. тяговое усилие
1	0 – 135 m/min für einfachen Strang · single line m/min au brin simple · per tiro diretto · a tiro directo м/мин при однократной запасовке	23 mm / 360 m	105 kN
2	0 – 130 m/min für einfachen Strang · single line m/min au brin simple · per tiro diretto · a tiro directo м/мин при однократной запасовке	23 mm / 425 m	105 kN
360°	0 – 1,6 min^{-1} об/мин		
	ca. 60 s bis 82° Auslegerstellung · approx. 60 seconds to reach 82° boom angle env. 60 s jusqu'à 82° · circa 60 s fino ad un'angolazione del braccio di 82° aprox. 60 segundos hasta 82° de inclinación de pluma · ок. 60 сек. до выставления стрелы на 82°		
	ca. 600 s für Auslegerlänge 15,5 m – 72 m · approx. 600 seconds for boom extension from 15.5 m – 72 m env. 600 s pour passer de 15,5 m – 72 m · circa 600 s per passare da 15,5 m a 72 m aprox. 600 segundos para telescopar la pluma de 15,5 m – 72 m · ок. 600 сек. до выдвижения от 15,5 м до 72 м		

Ausstattung
Equipment
Equipement • Equipaggiamento
Equipamiento • Оборудование

Crane carrier

Frame	Liebherr designed and manufactured, box-type, torsion resistant design of high-tensile fine grained structural steel.
Outriggers	Four hydraulically extendable sliding beams with hydraulic jacks and supporting pads. The front outrigger casing is mounted between axles 2 and 3 and the rear casing is located at the rear of the carrier. Supporting basis: 8.8 m longitudinally x 8.5 m transversally.
Engine	8-cylinder Diesel, make Liebherr, type D9508 A7, watercooled, output 450 kW (612 h.p.) at 1900 min^{-1}, max. torque 2840 Nm at 1100 min^{-1} – 1500 min^{-1}. Exhaust emissions acc. to 97/68/EG stage 3 and EPA/CARB Tier 3. Fuel reservoir: 537 l.
Transmission	Automatic transmission system with converter control clutch, make ZF, type TC-TRONIC with 12 forward speeds and 2 reverse speeds, transfer case with transfer differential.
Axles	Crane carrier axles of minor maintenance. All axles suspended. Axles 1 to 3 and 5 and 6 steered. Axles 1, 5 and 6 are planetary axles, intermediate differential at axle 5, all driven axles with transverse differential locks.
Cardan shaft	All cardan shafts with 70° diagonal toothing and maintenance-free.
Suspension	All axles with hydropneumatic suspension and automatic levelling system. Load equalization between the axle pairs 1 + 2, 3 + 4 and 5 + 6. The suspension can be locked hydraulically.
Tyre equipment	12 tyres, all axles equipped with single tyres. Size of tyres: 385/95 R 25 (14.00 R 25).
Steering	ZF semi-integral power steering, dual circuit system with hydraulic servo-system and additional backing pump driven by an axle.
Brakes	Service brake: All-wheel servo-air brake, dual circuit system. Supplementary brakes: Exhaust brake with Liebherr supplementary brake system, retarder in the automatic transmission. Hand brake: Spring-loaded, acting on all wheels of axles 2 to 6.
Driving cab	Spacious sheet steel cab, cataphoretic dip-primed, mounted on rubber shock absorbers, safety glass windows, operating and control elements.
Electrical system	Modern data bus technique for the control of the electric and electronic components. 24 Volt DC, 2 batteries of 170 Ah each, lighting according to traffic regulations.

Crane superstructure

Frame	Liebherr-made torsion resistant, welded construction of high-tensile structural steel, linked to carrier by a roller slewing rim for 360° continuous rotation.
Crane engine	4-cylinder Diesel, make Liebherr, type D934L A6, watercooled, output 180 kW (245 h.p.) at 1800 min^{-1}, max. torque 1140 Nm at 1500 min^{-1}. Exhaust emissions acc. to 97/68/EG stage 3 and EPA/CARB Tier 3. Fuel reservoir: 275 l.
Crane drive	Diesel-hydraulic, with 5 axial piston variable displacement pumps, with servo-control and capacity control.
Crane control	Two self-centering control levers (joy-sticks). Electronic control by means of the LICCON system, infinitely variable crane motions through displacement control of the hydraulic pumps. Additional working speed control by variation of the Diesel engine speed.
Hoist gear	Axial piston variable displacement motor, Liebherr hoist drum with integrated planetary gear and spring-loaded static brake.
Luffing gear	1 differential hydraulic rams with nonreturn valve.
Slewing gear	Hydraulic motor, planetary gear, slewing pinion and spring-loaded static brake.
Crane cab	Galvanized steel construction, powder coating, safety glazing, operating and control elements. Cab tiltable backwards by 20°.
Safety devices	LICCON safe load indicator, test system, hoist limit switches, safety valves against rupture of pipes and hoses.
Counterweight	72.5 t counterweight comprising 1 basic slab of 10 t and 3 slabs of 12.5 t each, 2 lateral hang on slabs of 12.5 t each.
Telescopic boom	1 base section and 5 telescopic sections. All telescopic sections extendable individually by means of the rapid-cycle telescoping system TELEMATIK. Boom length 15.5 m to 72 m.
Electric system	Modern data bus technique for the control of the electric and electronic components, 24 Volt DC, 2 batteries of 170 Ah each.

Additional equipment

Folding jibs	Single folding jib, 12.2 m long, for mounting on telescopic boom at 0°, 20° or 40°. Double folding jib, 12.2 m to 22 m long, for mounting on telescopic boom at 0°, 20° or 40°. Hydraulic ram for operating the swing-away jib from 0° – 45° (option).
Intermediate sections	2 intermediate sections of 7 m each for the extension of the biparted swing-away jib to 29 m or 36 m.
Lattice jibs	Fixed lattice jib 14 m to 42 m long, installation at 0°, 20° or 40°, luffing lattice jib 17.5 m to 70 m long.
2nd hoist gear	For 2-hook operation or for operating the luffing lattice jib.
Additional counterweight	2 additional lateral hang on slabs of 12.5 t each for a total counterweight of 97.5 t.
Tyre equipment	12 tyres, all axles with single tyres. Tyre size 445/95 R 25 (16.00 R 25) or 525/80 R 25 (20.5 R 25).
Drive 12 x 8	Axle 3 additionally driven.
TELMA-type eddy current brake	Fitted to the 4th axle for increasing the sustained-action braking performance.

Other items of equipment available on request.