Amber

Traffic & Transportation Direction

Tilbuster Solar Farm

Traffic Impact Assessment

August 2021

Reference: 045 rep 210805 final

Tilbuster Solar Farm

Traffic Impact Assessment

Prepared for: NGH Consulting Pty Ltd

Status: Final report

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1. Background

1.1 Background

Amber Organisation Pty Ltd has been engaged by NGH Consulting Pty Ltd to conduct a review of the traffic implications of the Tilbuster Solar Farm and prepare a Traffic Impact Assessment.

The solar farm is proposed to have a capacity of 150MW and is located approximately 17km northwest of Armidale. Access to the site is proposed via an unnamed gravel road which extends south from New England Highway for approximately 800 metres to its connection with the site. Staff will primarily be located in nearby regional towns such as Armidale and Guyra, with plant expected to be delivered from the Port Botany along New England Highway.

1.2 Environmental Assessment Requirements

NSW Department of Planning & Environment issued Secretary's Environmental Assessment Requirements (SEARs) for the project. The required traffic and transport matters include the following:

- *An assessment of the peak and average traffic generation, including over-dimensional vehicles and construction worker transportation;*
- *An assessment of the likely transport impacts to the site access route (New England Highway), site access point, any Crown land, particularly in relation to the capacity and condition of the roads;*
- *A cumulative impact assessment of traffic from nearby developments; and*
- *A description of any proposed road upgrades developed in consultation with the relevant road and rail authorities (if required); and*
- *A description of the measures that would be implemented to mitigate any transport impacts during construction.*

1.3 Purpose of Document

This Traffic Impact Assessment has been prepared to assess the construction, operational, and decommissioning traffic impacts, and the access arrangements of the solar farm. The assessment responds to the Secretary's Environmental Assessment Requirements and details how road impacts of the project traffic, particularly from heavy vehicle use, will be avoided or managed using road-use management strategies.

More specifically, the report addresses the following key matters:

- Details of both light and heavy vehicle traffic volumes and proposed transport routes;
- An assessment of the potential traffic impacts of the project on road network function and safety;
- An assessment of the capacity of the existing road network to accommodate the type and volume of traffic generated by the project;
- Details of measures to mitigate and / or manage potential impacts, including construction traffic control, road dilapidation surveys and measures to control soil erosion and dust generated by traffic volumes; and

- Details of access roads within the site including how these connect to the existing road network and ongoing operational maintenance.

The traffic assessment has been undertaken in conjunction with consultation with Transport for NSW and Armidale Regional Council.

2. Existing Conditions

2.1 Road Network

New England Highway is a State Road under the care and management of Transport for New South Wales (TfNSW). It runs in a northwest-southeast alignment from Newcastle to Muswellbrook, before running in a northern alignment to its termination at the Queensland Border. Within the vicinity of the site, it has a sealed carriageway width of approximately 12 metres accommodating one lane of traffic in each direction and sealed shoulders on both sides of the road, and has a speed limit of 100km/hr.

The unnamed road is under the care and management of Armidale Regional Council. The road has a gravel surface which has a varying width of between 4.0-6.5 metres. The road extends south from New England Highway for approximately 800 metres where it continues south into private property. At this location the road reserve extends west for approximately 150 metres to the site boundary.

New England Highway is rated to accommodate B-Double movements which is indicated on the TfNSW Restricted Access Vehicle Map, whilst the unnamed road is located in an approved area with travel restrictions.

The intersection of the unnamed road with New England Highway is priority controlled and has no turn facilities, with vehicles exiting the unnamed road required to give way.

2.2 Traffic Volumes

Traffic volume data for New England Highway was obtained from the TfNSW traffic volume viewer. The closest available data was located south of Blanches Road (Station ID: 92065) and is summarised below in Table 1. In order to calculate the current traffic volumes on the road network a growth rate has been applied to calculate the traffic volumes for 2021.

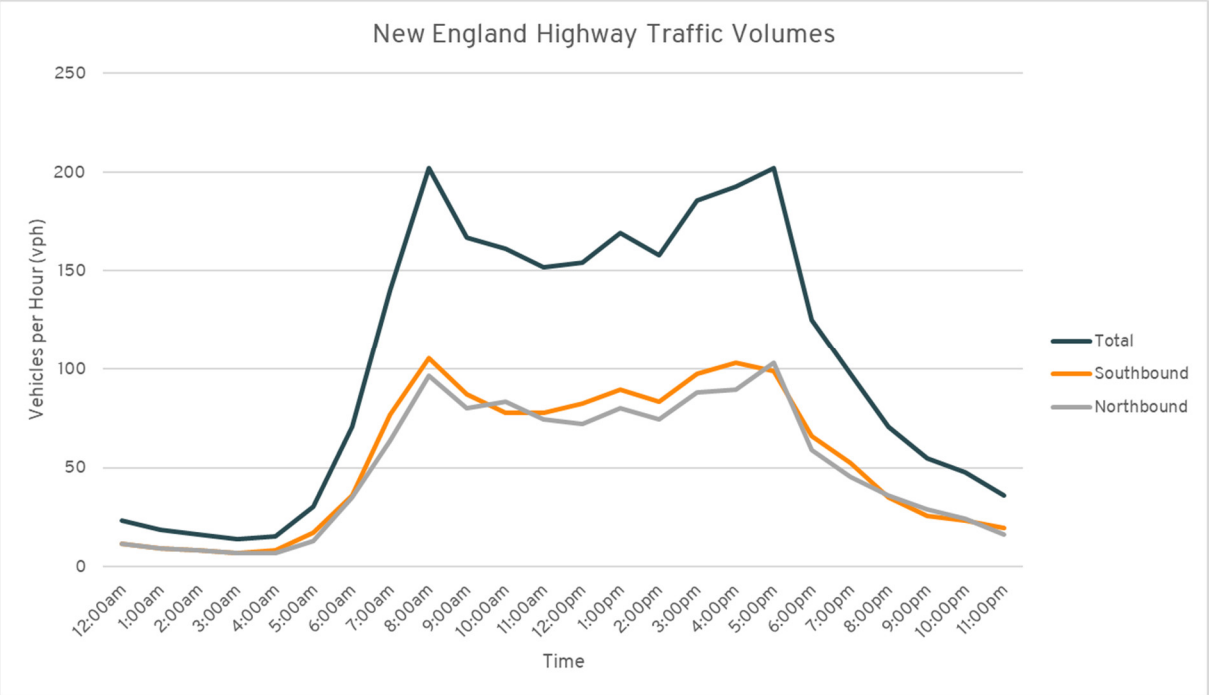
Table 1: New England Highway Traffic Volume Data

Road	Survey Location	Survey Year	Recorded Volume	Peak Hour	Growth Factor	Current Traffic Volume
New England Highway	50m south of Blanches Road	2011	2,143 vpd 83% light 17% heavy	AM - 174 vph PM - 174 vph	1.5%	2,487 vpd 202 vph (AM) 202 vph (PM)

The 2021 traffic volumes have also been calculated for each hour and separated in to north and southbound movements. The traffic volumes are shown below in Graph 1.

No traffic volume data is available for the unnamed road which is estimated to currently be carrying a negligible level of traffic given it only services a limit area of agricultural land to the south of the site.

Graph 1: New England Highway Traffic Volume Data Calculated to 2021



3. Traffic Assessment

3.1 Traffic Generation

3.1.1 Construction

The solar farm construction is expected to take approximately 12 months, with the peak construction period expected to take 3-4 months. A maximum of 125 staff will be on-site during peak construction periods with an average workforce of 90 staff expected throughout the construction period. The proposed working hours are as follows:

- Monday to Friday: 7am – 6pm;
- Saturday: 8am – 1pm;
- No work on Sundays or public holidays.

Any construction outside of these normal working hours would only be undertaken with prior approval from relevant authorities.

Construction traffic generated by the solar farm can broadly be separated into the following three categories:

- Light vehicles associated with transporting staff to/from the site, including mini-buses and personal vehicles;
- Medium and Heavy Rigid Trucks (MRV and HRV as defined within AS 2890.2:2009) will be used to deliver raw materials and smaller plant;
- Articulated Vehicles (AV as defined within AS 2890.2:2009) and 26 metre long B-Doubles will be used to transport plant such as the PV panels; and
- OSOM vehicles associated with the delivery of the larger plant and equipment.

OSOM vehicles will contribute a small percentage of trips to the project during the construction period and are subject to separate permit applications and regulations. The impacts of the OSOM vehicles are discussed within Section 4.1. The following assessment focuses on the impacts of the light and heavy vehicles which generate the bulk of the traffic and represent the typical traffic impact of the project on a day-to-day basis.

The construction traffic volume calculations for the project are provided within Appendix A, which has been prepared by Enerparc Australia Pty Ltd.

It is understood that 25-seater shuttle buses will be provided that can accommodate approximately 80% of staff, with the remaining staff to access the site using private vehicles. For the purposes of this assessment a vehicle occupancy of 1.35 people per car has been adopted to calculate the staff traffic generation, with staff expected to be encouraged to carpool to the site.

Overall, it is anticipated that during peak construction the site could generate up to 35 heavy and 66 light vehicle movements per day. Table 2 summarises the traffic movements generated during the construction period of the solar farm.

Table 2: Traffic Generation During Peak Construction Periods

Vehicle Type	Average Vehicle Movements per Day		Peak Vehicle Movements per Day	
	Daily (vpd)	Peak Hour (vph)	Daily (vpd)	Peak Hour (vph)
Light Vehicle (car / 4WD)	30	15	58	29
Shuttle Bus	2	1	8	4
MRV/HRV	2	0	16	2
AV/B-Double	12	2	20	3
Total	**46**	**18**	**101**	**38**

One-way volumes

Accordingly, the site is expected to generate approximately 38 vehicle movements during the morning and evening peak hours during the peak construction period, which will reduce to 18 vehicle movements over the typical construction periods.

3.1.2 Operational Traffic

During operation the solar farm is expected to generate a minimal level of traffic associated with maintenance and operation services. The solar farm is expected to generate up to 6 vehicle movements per day which would result in a negligible change to the traffic environment.

3.1.3 Decommissioning Traffic

At the end of the operational life of the project all above ground infrastructure will be dismantled and removed from the project site. Internal roads, if not required for ongoing farming purposes or fire access, would be removed and the site reinstated as close as possible to its original state.

Traffic generation during decommissioning would be similar to traffic generation during the average construction period. A comprehensive Construction Traffic Management Plan would be prepared prior to the decommissioning phase in conjunction with the relevant road authorities. This would aim to ensure adequate road safety and road network operations are maintained.

3.2 Traffic Distribution

Traffic accessing the site will do so via New England Highway and will then travel south along the unnamed road before entering the site using the access point. The following provides a breakdown of the access distribution for each of the vehicle classifications outlined within Table 2:

- Light Vehicles: It is anticipated that most staff will be located in nearby regional towns such as Armidale and Guyra. For the purposes of this assessment it is estimated that 75% of staff will be travelling from the south and the remaining 25% will travel from the north.
- Shuttle Bus: It has been assumed that all shuttle buses will travel to/from the south.
- MRV/HRV: These vehicles will predominantly be water trucks and vehicles transporting materials such as concrete and fencing supplies. These materials will be sourced within the surrounding area and as such, it has been assumed that 75% of these vehicles will be travelling from the south and the remaining 25% will travel from the north.

- AV/B-Double: Plant will be transported from Port Botany to/from the south.

The peak hour for the solar farm will occur at the start and end of the day when staff are transported to/from the site. During the morning peak all vehicle movements will be towards the site and in the evening peak all vehicle movements will be away from the site. Heavy vehicle movements will be distributed throughout the day and will be split evenly between inbound and outbound movements.

3.3 Traffic Assessment

Level of Service is a qualitative measure used to describe the operating conditions of a section of road or an intersection. Levels of Service are designated from A to F from best (free flow conditions) to worst (forced flow with stop start operation, long queues and delays) and represent the perception of the road conditions by motorists including speed and travel time, freedom to manoeuvre, traffic interruptions, comfort and convenience, and safety.

The *RTA Guide to Traffic Generating Developments*, dated October 2002, suggests that ideally rural roads should not exceed service volumes at Level of Service C. At this level, whilst most drivers are restricted in their freedom to manoeuvre, operating speeds are still reasonable and acceptable delays are experienced. Table 4.5 of the RTA Guide sets out two-way hourly road capacities for two-lane roads for different levels of service with a design speed of 100 km/hr based on different terrain types.

New England Highway is estimated to currently be accommodating 2,487 vehicles per day based on the 2011 traffic volume count data and applying a 1.5% growth factor. Further, the road is estimated to currently be accommodating 202 vehicles per hour in both the morning and evening peak periods. Therefore, during the peak hours New England Highway would accommodate approximately 240 vehicles per hour during peak construction, which is well within the capacity of the road network and the road is expected to continue to operate with a good level of service based on Table 4.5 of the RTA Guide.

During operation the increase in traffic of up to 6 vehicle movements per hour would result in a negligible change to the traffic environment.

Accordingly, the road network is able to readily accommodate the traffic generated by the development during the construction and operational periods.

3.4 Cumulative Impacts

The primary traffic impact of the solar farm is generated during construction which is anticipated to start late 2022 and be completed late 2023. The assessment outlined earlier demonstrates that the road network will continue to operate with ample spare capacity even during the peak construction period of the solar farm. The following provides an assessment of the cumulative impacts of major projects that are proposed in the surrounding area. The relevant major projects are described below to determine the potential overlap of construction traffic.

Table 3: Assessment of Cumulative Impacts of Nearby Developments

Project	Description	Potential Vehicle Conflict
Doughboy Wind Farm (Prepare EIS)	The project is located about 40 km east of Armidale and involves the construction of approximately 52 wind turbines. Access to the site is proposed from Waterfall Way and Guyra Road. The site is expected to generate approximately 40 vehicle movements during the morning and evening peak hours during the peak construction period, and 138 vehicle movements per day.	The construction periods for the projects could potentially overlap. Both projects are anticipated to have staff located in Armidale and Guyra.
New England Solar Farm (Determination)	New England Solar Farm is located approximately 6 kilometres east of the township of Uralla. Construction will take approximately 32-36 months and the project's construction workforce will be in the order of 300 people. The project is expected to generate 912 daily vehicle movements (760 by light vehicles and 152 by heavy vehicles) during the peak construction periods.	There is potential for construction of both projects to overlap. The traffic generated by the projects may interact within the township of Armidale where staff for both projects are proposed to be located.
Armidale School Redevelopment (Determination)	The proposed development is a major redevelopment of the existing Armidale High School with a capacity of approximately 1,580 students and 110 FTE teaching staff. The new school will combine students of Duval High School and Armidale High School. The construction work for the new school will be starting by 2019 and expected to be completed in November 2020, for the school start Term 1 in 2021.	The school is expected to be operating prior to construction commencing for the wind farm. Accordingly, the peak construction of the wind farm will not overlap with the school redevelopment. There is anticipated to be minimal interaction between construction traffic and vehicles accessing the school given the school is located in the north-western portion of the Armidale township.
UNE New Wright Block (Recommendation)	The proposed development will include the construction of four new buildings, which will deliver approximately 342 new beds for the existing Wright College. The traffic assessment prepared for the project demonstrates that the road network will continue to be provided with a good level of service.	There is anticipated to be minimal interaction between construction traffic and vehicles accessing the College.
Oxley Solar Farm (Prepare EIS)	Amber Organisation has assisted in the preparation of a Traffic Assessment for the solar farm, which is located approximately 10km southeast of Armidale, to the south of Waterfall Way. Construction workers are proposed to be located in Armidale, with access proposed via Waterfall Way and Gara Road. No detailed traffic information has been provided and a Traffic Impact Assessment is proposed as part of the EIS.	There is potential for construction of both projects to overlap. Construction traffic generated by the projects may interact within the township of Armidale where staff for both projects are proposed to be located. During operation the projects are both expected to generate a minimal level of traffic.

Thunderbolts Energy Hub and Wind Farm (SEARs)	The proposed Thunderbolt Energy Hub is located in the Kentucky Area approximately 40km northeast of Tamworth adjacent to New England Highway. The Thunderbolt Energy Hub is proposed to include wind and solar electricity generation and battery storage. The overall capacity of the Thunderbolt Energy Hub will be approximately 500MW plus a 400MW battery. No detailed traffic information has been provided and a Traffic Impact Assessment is proposed as part of the EIS.	The construction periods for the projects could potentially overlap. Both projects are anticipated to have staff located in Armidale.
Rangoon Wind Farm (Prepare EIS)	The wind farm is located near the villages of Ben Lomond and Glencoe NSW approximately 60km north of Armidale and 40km south of Glen Innes. The proposal involves construction of approximately 25 wind turbines. No detailed traffic information has been provided and a Traffic Impact Assessment is proposed as part of the EIS.	The construction periods for the projects could potentially overlap. Both projects are anticipated to have staff located in Armidale and Guyra.
Salisbury Solar Farm (Prepare EIS)	Salisbury Solar Farm is located on both sides of Thunderbolts Way approximately 10km south of Uralla. Traffic impacts include increased traffic movements from the nearby towns associated with staff and increased truck volumes delivering plant and equipment. The solar farm is anticipated to generate increased turning movements to/from Thunderbolts Way associated with vehicles accessing the site. A scoping report has been prepared for the development which indicates construction will occur between 2021 and 2023. No detailed traffic information has been provided and a Traffic Impact Assessment is proposed as part of the EIS.	There is potential for construction of both projects to overlap. The traffic generated by the projects may interact within Armidale where staff for both projects are proposed to be located.
Winterbourne Wind Farm (Prepare EIS)	Amber Organisation is currently preparing the Traffic Impact Assessment for the project which is located 7km east of Walcha and involves the construction of approximately 133 wind turbines. Access to the site is proposed from a number of local roads which link with Jamieson Street, which connects to the State road network via Thunderbolts Way.	The construction periods for the projects could potentially overlap. Both projects are anticipated to have staff located in Armidale and will utilise the a similar transport route with plant for the wind farm to be delivered from the Port of Newcastle.

Based on the above assessment the surrounding major projects have the potential to generate a number of staff vehicle movements during the peak periods associated with construction. In particular, a number of staff will be located in Armidale and Guyra. Key projects that are expected

to generate traffic on New England Highway at the connection with the unnamed road include the Doughboy and Rangoon Wind Farms and Oxley Solar Farm.

The traffic assessment provided within this report demonstrates that the road network is expected to continue to operate with a good level of service with ample spare capacity. As such, the combined increase in traffic generated by the site and these projects is expected to have a minimal cumulative impact on the road network, including through Armidale and Guyra. Further, it is noted that the peak traffic generated by these projects during construction occurs before 7am and after 6pm which is outside of the peak times of the road network.

It is recommended that the CTMP include making drivers aware of additional turning movements on New England Highway generated by the traffic from these projects. It is also recommended that any delivery of large plant be coordinated with the other solar and wind farm projects to ensure the vehicle movements do not conflict.

4. Route Assessment

4.1 Access Route

Port Botany has been identified as the preferred port where the solar farm plant will be imported. The proposed construction traffic access route from Port Botany to the site is proposed as follows; Friendship Road, Bumborah Point Road, Beauchamp Road, Denison Street, Wentworth Avenue, M1, Hunter Expressway, New England Highway, and the unnamed Road.

The access route utilises roads that are designated for B-Double vehicles as outlined within the TfNSW Restricted Access Vehicle Map excluding the unnamed road. Accordingly, the access route is generally able to accommodate the loads and type of vehicle movement to be generated during construction of the solar farm.

It is noted that an oversize and overmass vehicle may be required to deliver larger plant to the site such as the substation transformer. The vehicles are subject to specific road permits that will be applied for by the contractor once the dimensions of the load and the specific delivery vehicle are known. The Applicant has advised that the substation and the associated transport vehicle would be similar to the arrangement shown within Appendix B. The substation is expected to be delivered from either the Port of Newcastle or Port of Brisbane. It is anticipated that the road network is able to accommodate these vehicles given that similar loads and vehicles are regularly transported from these ports and similar projects have utilised the access route such as the Sapphire and White Rock Solar Farms which are both located within the vicinity of the site.

4.2 Local Road Network

The *Unsealed Roads Manual: Guidelines to Good Practice*, dated March 2009, notes that the average traffic for gravel roads usually varies between 20 and 200 vehicles per day. The document also notes that roads may warrant paving when maintenance costs increase to unacceptable levels, in wet climates, or when economic or social benefits are evident.

The unnamed road currently accommodates a negligible level of traffic and is expected to increase to 101 vehicle movements per day during peak construction periods and 46 vehicle movements per day during typical construction periods. Therefore, the traffic volumes along the unnamed road would be less than the recommended loading for gravel roads during peak construction periods.

Notwithstanding this, it is proposed to upgrade the unnamed road in accordance with the design requirements of a 'Rural Access Minor' road as provided by Armidale Regional Council and shown within Appendix D. A rural access minor road includes a 6.0 metre sealed carriageway with 0.75 metre wide unsealed shoulders on both sides of the road (total trafficable width of 7.5 metres).

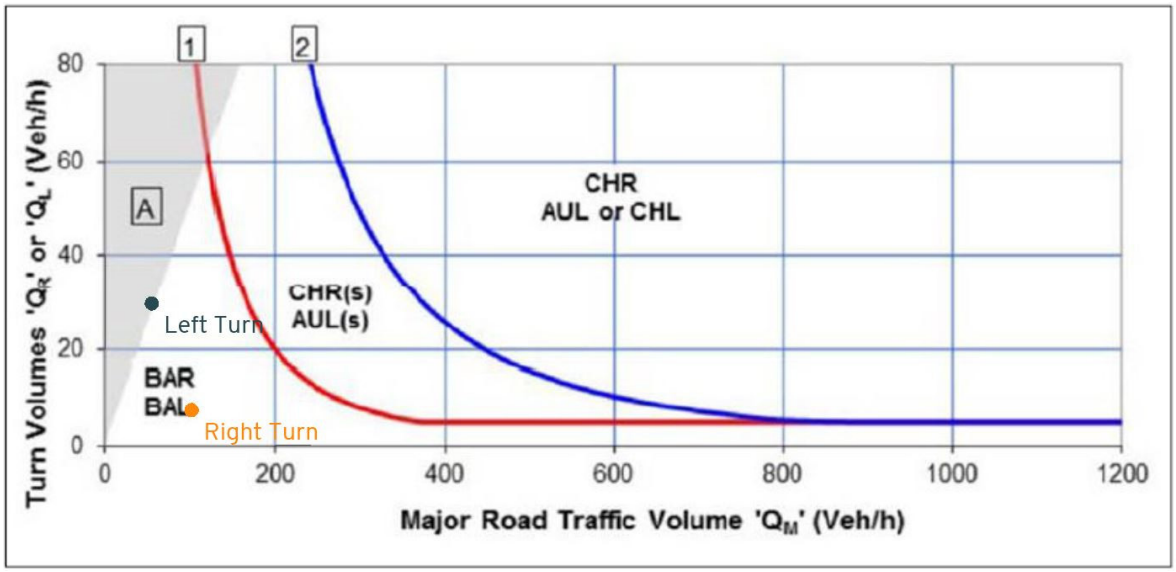
Given the expected traffic along the unnamed road during construction, it is concluded that the surface of the road with the inclusion of the proposed upgrades, is suitable to accommodate the future traffic volumes.

5. Intersection Assessment

5.1 Turning Treatments

Austroads Guide to Traffic Management Part 6: Intersections, Interchanges, and Crossings specifies the turning treatments required at intersections. Figure 2.26 of the guide specifies the required turn treatments on the major road at unsignalised intersections, and is provided below in Figure 1 for a design speed of greater than or equal to 100km/hr.

Figure 1: Figure 2.26 of Austroads Guide to Traffic Management Part 6



The peak hour turning volumes will predominantly be generated by staff accessing the site in the morning which occurs from 6:00am to 7:00am. Based on the traffic distribution described above the site will generate 31 left turn movements from the south and 7 right turn movements from the north during peak construction times. The Major Traffic Volume for the turn movements is shown below in Table 4 and the required turning treatments are illustrated in Figure 1.

Table 4: Turning Volumes for Turn Treatment Calculations

Turning Treatment	Traffic Volume (vph)		Requirement
	Turn Volume	Major Road	
Right Turn	7	102	BAR
Left Turn	31	31	BAL

Based on these volumes the intersection would require a Basic Left Turn (BAL) and a Basic Right Turn (BAR) treatment. No turn facilities are currently provided at the intersection and as such, it is proposed to provide both the basic left and right turn treatments in accordance with the Austroads Guideline.

The *Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections* specifies the requirements for the design of turn treatments. The proposed design for the intersection is provided within Appendix B and is based on a B-Double. A swept path assessment has been prepared for the intersection design using the software package 'AutoTurn'. The swept path assessment is shown within Appendix C and shows that the design vehicle is able to access the unnamed road in a suitable manner.

A swept path assessment has also been prepared for the OSOM vehicle which shows the vehicle is able to enter and exit the unnamed road.

Accordingly, the proposed intersection turning treatment has been appropriately designed and in accordance with the Austroads dimensional requirements.

5.2 Sight Distance Assessment

Austroads Guide to Road Design Part 4A: Unsignalised and Signalised Intersections specifies the Safe Intersection Sight Distance (SISD) as the minimum sight distance which should be provided along the major road at any intersection. Table 3.1 of the guide specifies the SISD required for various design speeds. Given New England Highway has a speed limit of 100km/hr, a design speed of 110km/hr has been adopted, which requires a SISD of 285 metres. The available sight distance at the intersection greatly exceeds the Austroads requirements given its straight and flat alignment and is illustrated within Figure 2.

Sight Line

Tilbuster Solar Farm
New England Highway / Site Access Intersection
Sight Distance Assessment

DRAWN: MW
DATE: 08/06/2021
SCALE: 1:400 @ A3
DWG NO: 045-S01E

Amber 2

6. Construction Management Plan

A Construction Traffic Management Plan (CTMP) will be prepared prior to construction commencing by the appointed contractor. The CTMP will provide additional information regarding the traffic volumes and distribution of construction vehicles that is not available at this time, including:

- Road transport volumes, distribution and vehicle types broken down into:
  - Hours and days of construction.
  - Schedule for phasing/staging of the project.
- The origin, destination and routes for:
  - Employee and contractor light traffic.
  - Heavy vehicle traffic.
  - Oversize and overmass traffic.

The following provides recommended measures that should be adopted within the CTMP to minimise the impact of construction traffic along the road network:

- Neighbours of the solar farm be consulted and notified regarding the timing of major deliveries which may require additional traffic control and disrupt access.
- Loading and unloading is proposed to occur within the work area. No street or roads will be used for material storage at any time.
- Delivery of larger plant to occur outside of school bus service times to prevent larger vehicles interacting with the school bus.
- All vehicles will enter and exit the site in a forward direction.
- Management of vehicular access to and from the site is essential in order to maintain the safety of the general public as well as the labour force. The following code is to be implemented as a measure to maintain safety within the site:
  - Utilisation of only the designated transport routes.
  - Construction vehicle movements are to abide by finalised schedules as agreed by the relevant authorities.
- Implementation of a proactive erosion and sediment control plan for on-site roads, hardstands and laydown areas.
- All permits for working within the road reserve must be received from the relevant authority prior to works commencing.
- A map of the primary haulage routes highlighting critical locations.
- An induction process for vehicle operators and regular toolbox meetings.
- A complaint resolution and disciplinary procedure.
- Local climatic conditions that may impact road safety of employees throughout all project phases (e.g. fog, wet and significant dry, dusty weather).

The above recommendations will ensure the construction traffic will create a minimal impact to the capacity and safety of the surrounding road network.

7. Conclusion

Amber has assessed the traffic impacts of the solar farm located approximately 17km northwest of Armidale, New South Wales. Access to the site will be provided via an unnamed road which connects to New England Highway. Staff will primarily be located in Armidale and Guyra, with plant expected to be delivered from the south along New England Highway. The above assessment determined the following:

- The site will generate up to 101 vehicle movements per day during peak construction times, including 35 truck movements;
- The road network is able to accommodate the traffic generated by the development during the construction, operation, and decommissioning periods. Further, the cumulative impact of the site traffic with nearby developments is expected to be minimal;
- It is proposed to upgrade the unnamed road in accordance with the design requirements of a 'Rural Access Minor' road as provided by Armidale Regional Council. A rural access minor road includes a 6.0 metre sealed carriageway with 0.75 metre wide unsealed shoulders on both sides of the road (total trafficable width of 7.5 metres;
- The design provided within Appendix C for the intersection of New England Highway and the unnamed road will ensure the intersection will operate in a safe manner; and
- In order to mitigate the impacts of the development during construction a CTMP will be prepared which should include the recommendations provided within this document.

Accordingly, based on the assessment above, it is concluded that the proposed access arrangements for the solar farm are suitable to accommodate the expected construction vehicle types and traffic volumes during the construction and operation phase of the project.

Amber Organisation

Appendix A

Construction Traffic Volume Calculations

Traffic Access Plan

Output (MW)		152 (AC)								
Construction Duration		12 month	3-4 months peak							
Transportation Type	**Item**	**Manufacture/Description**	**Specifications**	**Quantity**	**Type of Vehicle**	**Qty/Vehicle**	**Total Estimated No. of Vehicles/Trips**	**Estimated Daily Movements (Note 2)**	**Worst Case Daily Movements Estimation (per item)**	**Notes/Assumptions**
Equipment	Solar Panels	Longi	440 Wp	400,878	B-Double	810	495	4	8	Continuous delivery and pick up
	PCU	SMA	40' Container	30	Semi-Trailer	1.0	30	N/A	1	1 truck per PCU Continuous delivery and pick up during the first half of construction period
	Switchboards	Self-contained Building	-	1	Semi-Trailer	1	1	N/A	1	One-off delivery and pick up, no other heavy vehicles to enter site on the same day
	Substation Transformer	Grid Connection Transformer	-	1	Oversize Vehicles	1.00	1	N/A	1	TBD during construction tendering
	Total Cables	-	-	-	Semi Trailer	-	30	N/A	2	Continuous delivery and pick up during the construction period
	30 MWH Battery Storage	-	-	TBD	Semi-Trailer	1 MWH	-	N/A	-	1MWH/truck No battery is expected to be delivered (or installed) during constructoin period
	Auxiliary electrical equipment and machineries	Allowance for 5 deliveries/vehicles	-	-	Semi-Trailer	-	5	N/A	2	One-off delivery and pick up
	Steel - Posts, Tables, and Brackets	-	-	152	Semi-Trailer	0.5	304	N/A	6	Assume 2 trucks/1 MW Continuous delivery and pick up
Buildings	Control Room	-	-	1	Semi-Trailer	1	1	N/A	1	One-off delivery and pick up
	Warehouse	-	-	1	Semi-Trailer	1	1	N/A	1	One-off delivery and pick up
	Site Offices	-	-	5	Semi-Trailer	1	5	N/A	2	One-off delivery and pick up
Heavy Machineries	Earthworks and Grading Machine	-	-	3	Semi-Trailer	1	3	N/A	2	Delivery and pick up once during the entire construction period
	Telehandler	-	-	2	Semi-Trailer	1	2	N/A	2	Delivery and pick up once during the entire construction period
	Miscellaneous Trucks	-	-	Estimate	Standard Truck	1	700		10	Assume 5 trucks continuous delivery and pick-up only during the peak construction period
	Water Tankers	20000L Tanker	N/A		Standard Truck	20000	254	2	6	
Construction Personnel	Construction Workers	Peak construction workforce of 125 daily	N/A	125	Shuttle Buses	25	500	2	8	Assume 2 Shuttle buses available
					Cars	1.35	9000	30	58	
Total Vehicles							**11332**		**111**	

Notes:

1. No. of days assumed for construction is 260, for 12 months (52 weeks) of 5 working days/week.
2. Two movements per day per vehicle

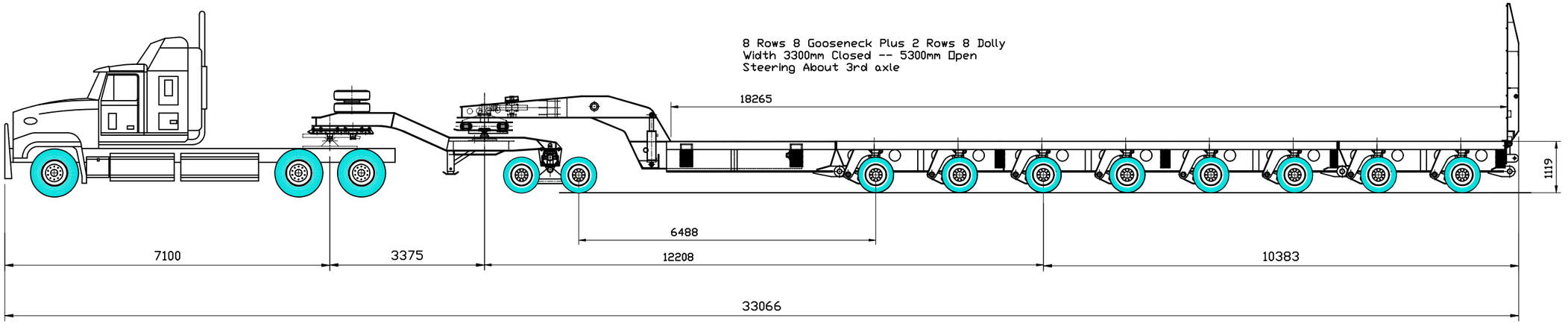
	AV/B-Double/Semi-trailer	877
	MRV/HRV	954

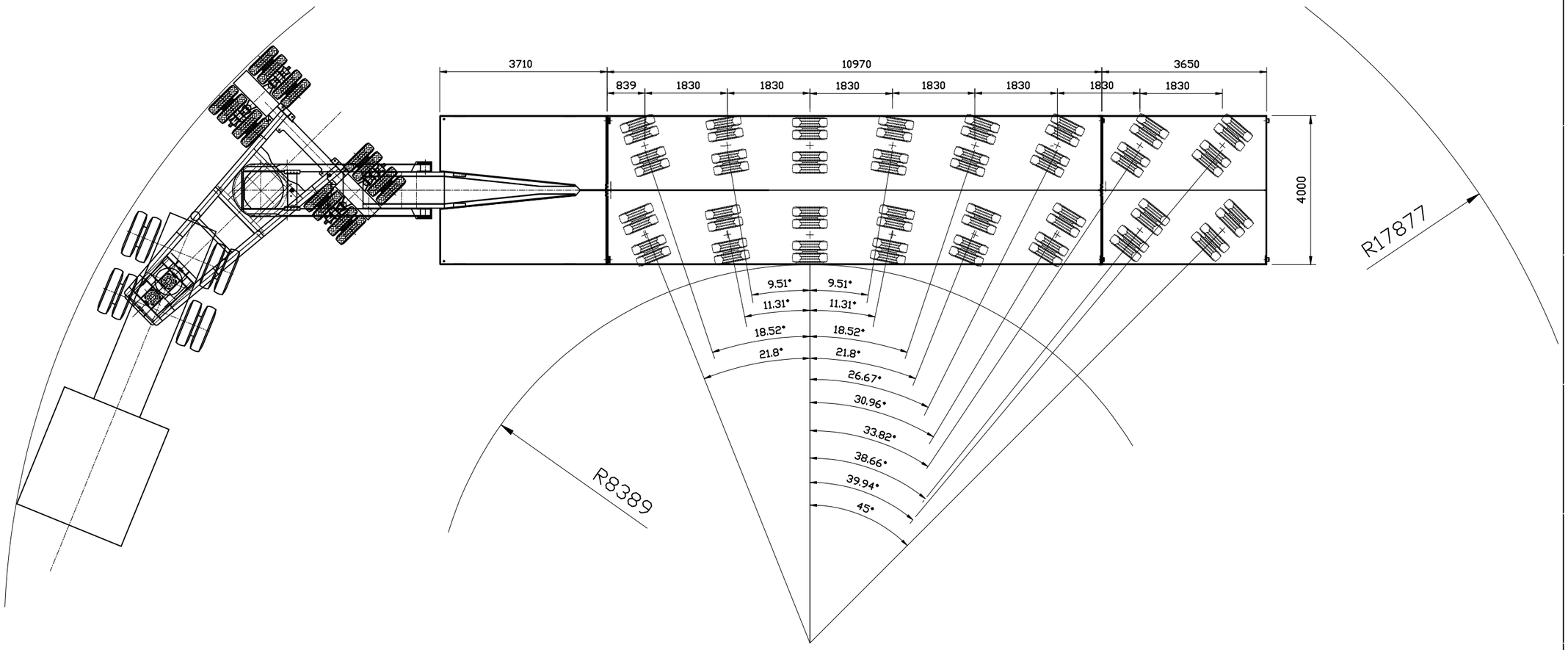
Appendix B

OSOM Vehicle Arrangement

IF IN DOUBT, ASK! DO NOT SCALE

8 Rows 8 Gooseneck Plus 2 Rows 8 Dolly
Width 3300mm Closed -- 5300mm Open
Steering About 3rd axle





MODERN TRANSPORT ENGINEERS 2002 LTD

8 Rows of 8 Module

Load Layout

zane

26/03/07

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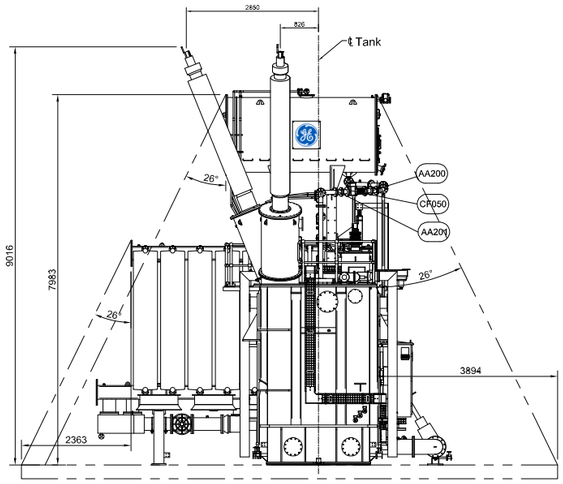

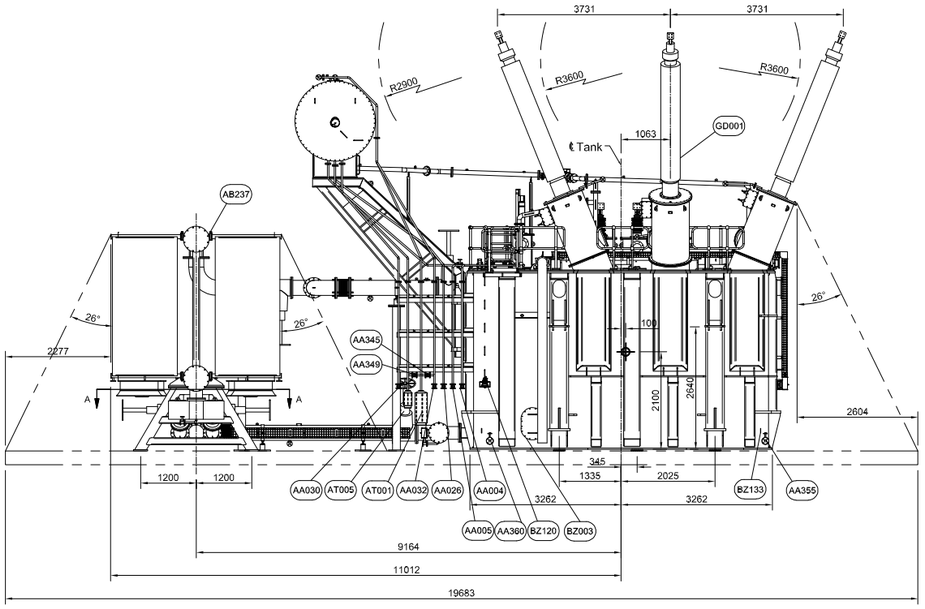

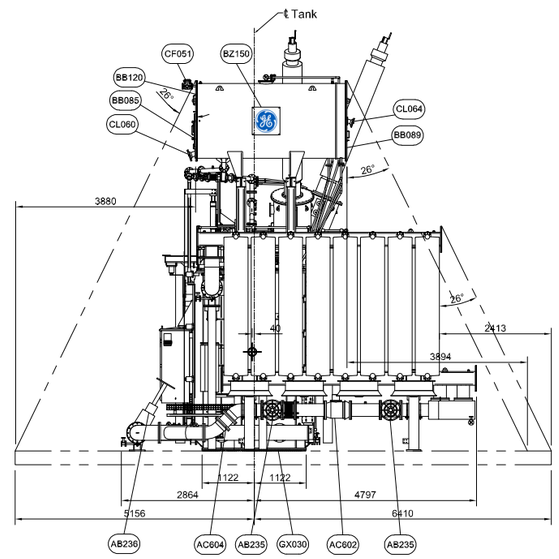

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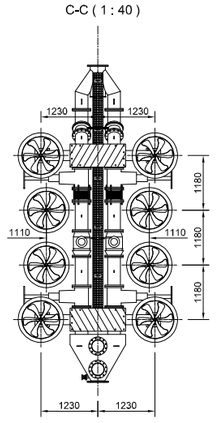
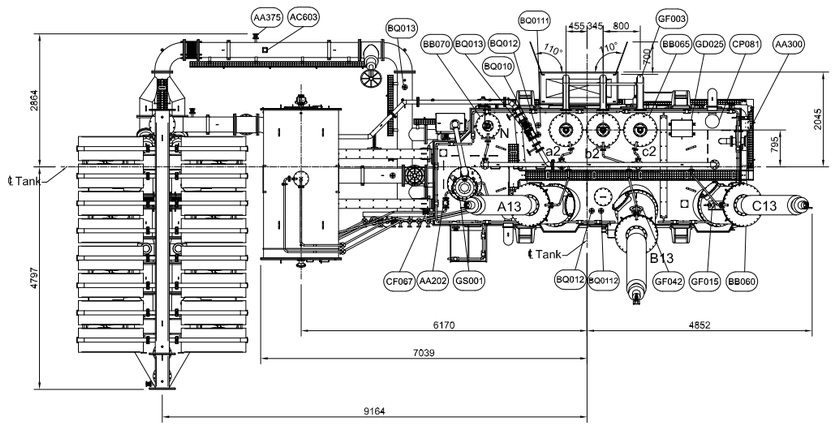
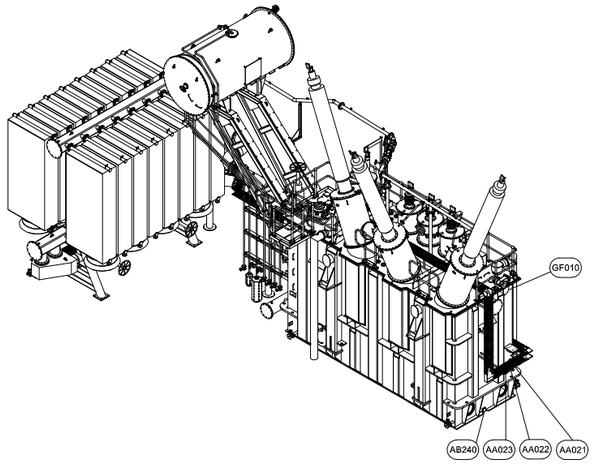
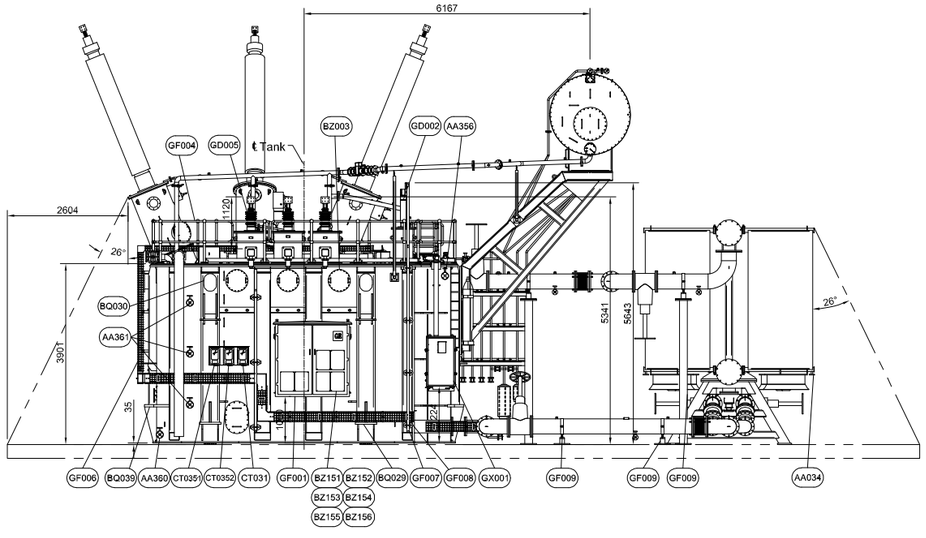




Rated Power	145 MVA	Oil Weight per radiator	215 kg
Voltage	330 (+15/-10)% / 33 kV	Untanking weight	85 000 kg
		Active part weight	82 000 kg
Current	253.7 / 2536.8 A	Pipes/Others	5 000 kg
Vector-group symbol	YNd11	Shipping weight (without oil)	111 500 kg
Frequency	50 Hz	Oil Weight/Volume	45 900 kg/51900L
		(Calculated-ref to R&D Plate for actual)	
Cooling System	ONAN / ODAF	Total weight	185 000 kg

ELECTRICAL CLEARANCE(According technical specification)			
	HV Side(330kV)	LV Side(33kV)	HVN
PHASE - PHASE	>=3600mm	>=440mm	–
PHASE - EARTH	>=2900mm	>=380mm	>=380mm





SPE-860032_00
PP6-15 ITEM 4A

02	2019/11/20	YL	MXJ	ZJ	Modified cooling bank to left side
01	2019/09/23	YL	MXJ	ZJ	Modified according customer's comments
00	2018.7.12	YL	MXJ	KZ	Original issue
No.	Date	Draw	Chk	Apr	Description	ECN

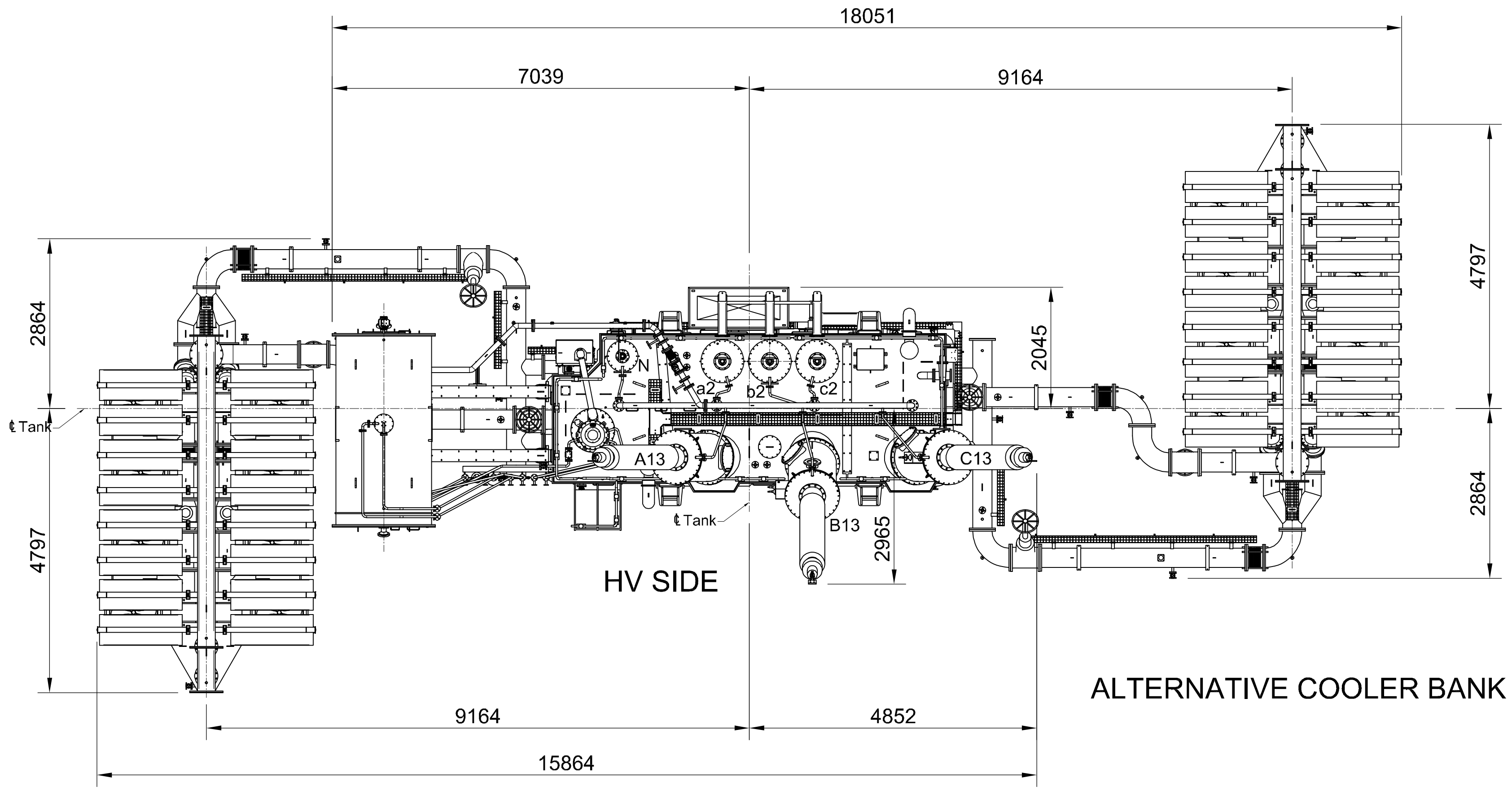
IF IN DOUBT- PLEASE ASK!

GE Grid Solutions Power Transformers

Project: TRANSGRID | Material: 1096 Final Assy.Stv

Title: 145 MVA 330/33 kV GENERATOR Transformer - Outline | Scale:

Drawing n°: H296TK020 | Sheet n°: 1 | Total: 3 | Size: A0



ALTERNATIVE COOLER BANK POSITION

SPE-860032_00
PP6-15 ITEM 4A

Rev	Date	Draw	Chk	App	Description	CDN
02	2019/11/20	YL	MXJ	ZJ	Modified cooling bank to left side	
01	2019/09/23	YL	MXJ	ZJ	Modified according customer's comments	
00	2019.7.12	YL	MXJ	KZ	Original Issue	

General tolerances: ISO 2768 "m for Machining; c for Fabrication"
Surface texture: ISO 1302
All dimensions in millimetres unless otherwise stated

IF IN DOUBT- PLEASE ASK !

Grid Solutions
Power Transformers

Project: TRANSGRID PP6-A C1561
Filename: H296 Final Assy.idw
Title: 145 MVA 330/33 kV GENERATOR Transformer - Outline
Scale:

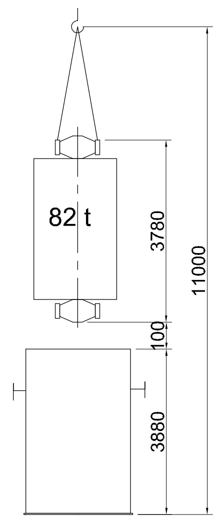
GE High Voltage Equipment (Wuhan) Co., Ltd
No.92 Hanshi Road,Yangluo Development Zone,
Wuhan, Zip 430415,HUBEI,CHINA

Drawing n°: H296TK020
Sheet n°: 2
Total: 3
Size: A0

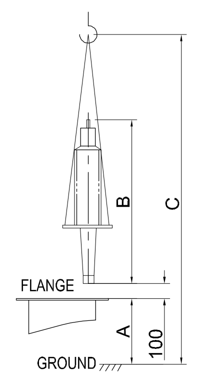
PARTS LIST

CODE	DESCRIPTION	MANUFACTURER	TYPE & SIZE	QTY.
AA004	Draining valve for OLTC	TBEA	ZFAB-16T-DN25	1
AA005	Filling valve for OLTC	TBEA	ZFAB-16T-DN25	1
AA021	Sampling valve at top of tank	TIANCHENG	TC35-VF	1
AA022	Sampling valve at middle of tank	TIANCHENG	TC35-VF	1
AA023	Sampling valve at bottom of tank	TIANCHENG	TC35-VF	1
AA026	Draining and filling valve for the conservator (Main tank)	TBEA	ZFAB-16T-DN25	1
AA030	Draining and filling valve for the conservator (OLTC)	TBEA	ZFAB-16T-DN25	1
AA032	Venting valve for conservator	TBEA	ZFAB-16T-DN25	1
AA034	Draining valve for radiators	TBEA	ZFAB-16T-DN25	16
AA200	Isolation valve between buchholz relay and conservator	TBEA	ZFAB-16T-DN80	1
AA201	Isolation valve between buchholz relay and tank	TBEA	ZFAB-16T-DN80	1
AA202	Valve between OLTC and conservator(OLTC)	TBEA	ZFAB-16T-DN25	1
AA300	vacuuming valve	TBEA	ZFAB-16T-DN100	1
AA345	Pressure equalizing valve (oil preservation membrane-conservator)	TBEA	ZFAB-16T-DN25	1
AA349	Pressure equalizing valve (main tank - OLTC)	TBEA	ZFAB-16T-DN25	1
AA355	Valve for oil filtering- bottom	TBEA	ZFAB-16T-DN50	1
AA356	Valve for oil filtering- top	TBEA	ZFAB-16T-DN50	1
AA360	Draining Valve for main tank	TBEA	ZFAB-16T-DN50	2
AA361	Additional valve	TBEA	ZFAB-16T-DN50	3
AA375	Draining Valve for cooling bank	TBEA	ZFAB-16T-DN25	5
AB235	Isolating valve for cooling pipe	TBEA	ZFAB-16T-DN250	4
AB236	Isolating valve for cooling pipe	TBEA	ZFAB-16T-DN300	3
AB237	Isolating butterfly valve for radiators	HUAFENG	BDZ-150/80	32
AB240	Residual oil drain	GE		1
AC600	Radiators	YOUBANG	PC520	16
AC601	Fans	ERG	DBF2-80Q12	8
AC602	Pumps	GEA	PR250/6	2
AC603	Oil flow relay	Yaming	YJ1	1
AC604	Non return valve	HUAFENG	DN250	2
AT001	Dehydrating breather for conservator (Main tank)	XINGONG	XS3-20II	1
AT005	Dehydrating breather for conservator (OLTC)	XINGONG	XS3-2II	1
BB060	Bushing turret with CT group(A13,B13,C13)	GE		3
BB065	Bushing turret with CT group (N)	GE		1
BB070	Bushing turret with CT groups (a2,b2,c2)	GE		3
BB085	Conservator for Main tank	GE	⌀1600×3000	1
BB089	Conservator for O.L.T.C.	GE	⌀1600	1
BB120	Air-cell for oil preservation	PRONAL	⌀1600×3000	1
BQ010	Thermometer pocket (OTI)	GE		1
BQ0111	Thermometer pocket (WTI)	GE		1
BQ0112	Thermometer pocket(WTI)	GE		1
BQ012	Thermometer pocket (Spare)	GE		2
BQ013	Thermometer pocket (PT100)	GE		3
BQ029	Jacking pads	GE		4
BQ030	Lifting bollard for complete transformer	GE		4
BQ039	Haulage lug for longitudinal and transverse movement	GE		8
BZ003	Manhole	GE		2
BZ004	Handhole	GE		7
BZ120	Buchholz relay drain and degassing	ETI		1
BZ133	Earthing pad for transformer tank	GE	Stainless steel	4
BZ150	Manufacturer name plate	GE		1
BZ151	Rating plate and connection diagram	GE		1
BZ152	Diagram plate of oil level curve	GE		1
BZ153	Valve and pipe plate	GE		1
BZ154	Safety instruction plate	GE		1
BZ155	Safety Boss Location plate	GE		1
BZ156	Fibre optic location plate	GE		1
CF050	Buchholz relay for main tank	ETI	GQ 80	1
CF051	Rubber bag rupture detector relay	EMB	AF 25/10	1
CF067	Protection relay of O.L.T.C.	ABB		1
CF080	Fibre optic connection flange	QUALITROL		1
CL060	Oil level indicator for conservator(Maintank)	Yaming	YZF2-250	1
CL064	Oil level indicator for conservator(O.L.T.C.)	Yaming	YZF-200	1
CP081	Pressure relief valve for transformer	QUALITROL	XPRD	2
CT031	Oil temperature indicator	AKM	AKM34	1
CT0351	Winding temperature indicator	AKM	AKM35	1
CT0352	Winding temperature indicator	AKM	AKM35	1
GD001	Bushing (HV)	ABB	GSB 362/1600	3
GD002	Bushing (N)	ABB	GSA52-OA/2000	1
GD005	Bushing (LV)	MGC	36kV/3150A	3
GD025	Earthing Bushing for core frame	NANJING ZHIDA	BPC-12/300-4	2
GX001	ON-load tap changer motor drive unit	ABB		1
GS001	ON-load tap changer	ABB	VUCGRN 380/450/III	1
GF042	CT Terminal box & panel on bushing turret	HONGYAN CHINA	HONGYAN CHINA	3
GF001	Main control&Cooling cubicle			1
GF003	LV bushing surge arrester support			3
GF004	Handrail			1
GF006	Cable duct			1
GF007	Copper bar		50X6.3; Covered TIN	3
GF008	Support Insulator		ZSW-12/4	10
GF009	Support cooler piping	GE		4
GF010	Fiber Optic Sensor	Qualitrol		1
GF015	CT test loop			3

UNTANKING DETAILS

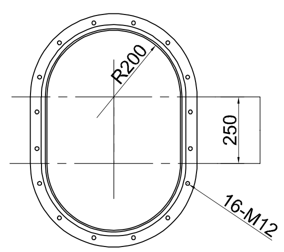


BUSHING LIFTING DETAIL



	A mm	B mm	C mm
HV	5550	5185	13500
LV	4650	1300	7500
N	4715	1150	7500

MANHOLE DETAILS



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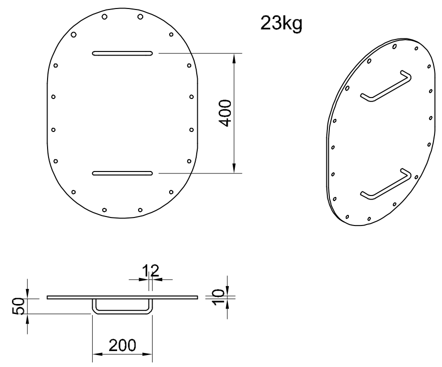
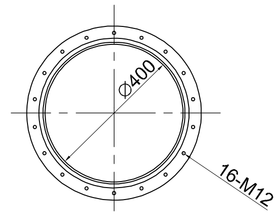


HANDHOLE DETAILS



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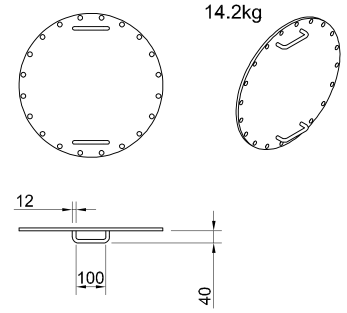
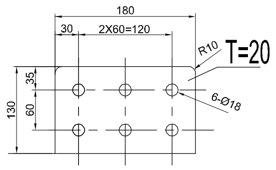
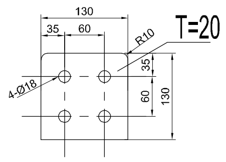


LV Terminal palm

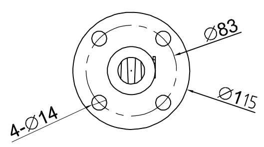


HV &HVNTerminal palm

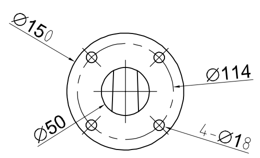


ALUMINIUM ALLOY 6101 T5 TO AS/NZS 1734:1997

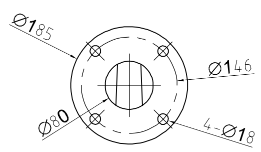
DN25 valve



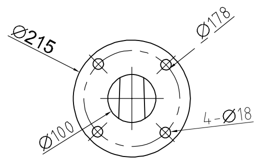
DN50 valve



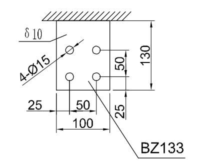
DN80 valve



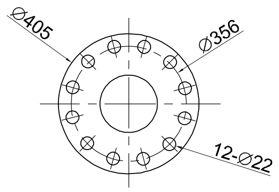
DN100 valve



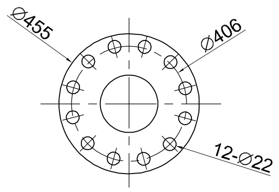
Tank earthing pad



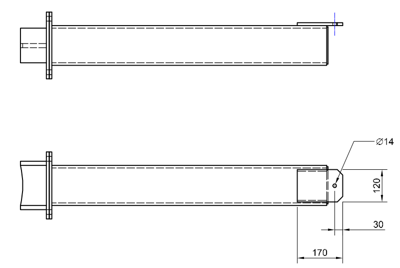
DN250 valve



DN300 valve



LV SURGE ARRESTER SUPPORT



SPE-860032_00
PP6-15 ITEM 4A

Rev	Date	Draw	Chk	App	Description	CDN
02	2019/11/20	YL	MXJ	ZJ	Modified cooling bank to left side	
01	2019/09/23	YL	MXJ	ZJ	Modified according customer's comments	
00	2018/11/25	YL	MXJ	KZ	Original Issue	

General tolerances: ISO 2768 "m for Machining; c for Fabrication" | Surface texture: ISO 1302 | All dimensions in millimetres unless otherwise stated

IF IN DOUBT- PLEASE ASK !

Grid Solutions
Power Transformers

Project: TRANSGRID PP6-A C1561
Filename: H296TK020 Final Assy.idw
Title: 145 MVA 330/33 kV GENERATOR Transformer - Outline
Scale: 1:40

GE High Voltage Equipment (Wuhan) Co., Ltd
No.92 Hanshi Road,Yangluo Development Zone,
Wuhan, Zip 430415,HUBEI,CHINA

Drawing n°: H296TK020 | Sheet n°: 3 | Total: 3 | Size: A0

Appendix C

Intersection Design

The following design details have been taken from Austroads Guide to Road Design Part 4A:

Rural Basic Right-turn Treatment (BAR) Section 7.5.1.
1: Design speed of 110km/h.
2: Lane widths of 3.5m have been used.
3: Formation/carriageway widening is 3.0m.
4: Taper lengths calculate to 46m.
5: Storage length is 22.5m for one 19m design vehicle.

Rural Left-turn Treatment (BAL) Section 8.2.1.
1: Design speed of 110km/h.
2: Lane widths of 3.5m have been used.
3: Formation/carriageway widening is 2.5m.
4: Taper length calculates to 38m.
5: Minimum length of parallel widened shoulder used from Table 8.1 is 35m.

Tilbuster Solar Farm

New England Highway / Access Road Intersection

Intersection Design

DRAWN: MW
DATE: 08/06/2021
SCALE: 1:600 @ A3
DWG NO: 045-S01F

Amber

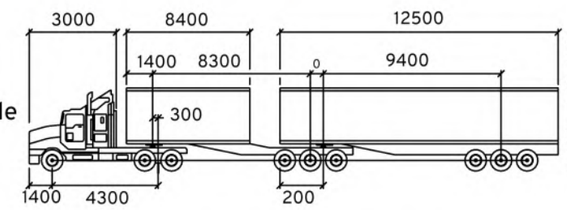
New England Highway

6.5m

Vehicle Envelope

300mm Clearance

B-Double



	mm
Tractor Width	: 2500
Trailer Width	: 2500
Tractor Track	: 2500
Trailer Track	: 2500
Lock to Lock	: 6.0s
Steering Angle	: 22.2
Articulating Angle	70.0

Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment

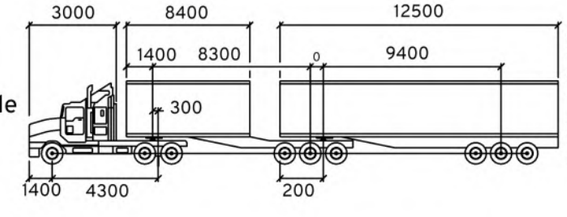
DRAWN: MW
DATE: 08/06/2021
SCALE: 1:600 @ A3
DWG NO: 045-S01F

Amber 2

Vehicle Envelope

300mm Clearance

B-Double



	mm
Tractor Width	: 2500
Trailer Width	: 2500
Tractor Track	: 2500
Trailer Track	: 2500
Lock to Lock	: 6.0s
Steering Angle	: 22.2
Articulating Angle	70.0

Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment

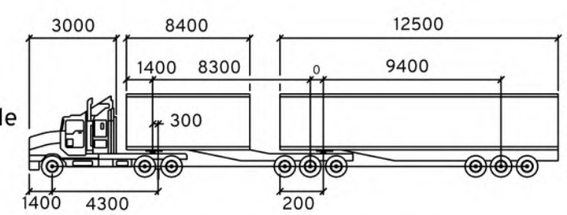
DRAWN: MW
DATE: 08/06/2021
SCALE: 1:400 @ A3
DWG NO: 045-S01F

Amber 3

Vehicle Envelope

300mm Clearance

B-Double



mm	
Tractor Width	: 2500
Trailer Width	: 2500
Tractor Track	: 2500
Trailer Track	: 2500
Lock to Lock	: 6.0s
Steering Angle	: 22.2
Articulating Angle	70.0

Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment

DRAWN: MW

DATE: 08/06/2021

SCALE: 1:400 @ A3

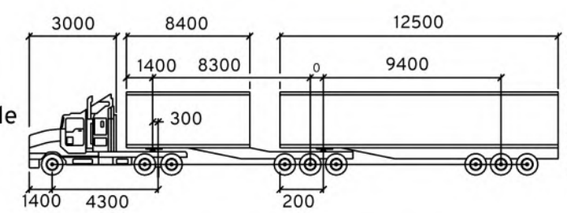
DWG NO: 045-S01F

Amber

Vehicle Envelope

300mm Clearance

B-Double



	mm
Tractor Width	: 2500
Trailer Width	: 2500
Tractor Track	: 2500
Trailer Track	: 2500
Lock to Lock	: 6.0s
Steering Angle	: 22.2
Articulating Angle	70.0

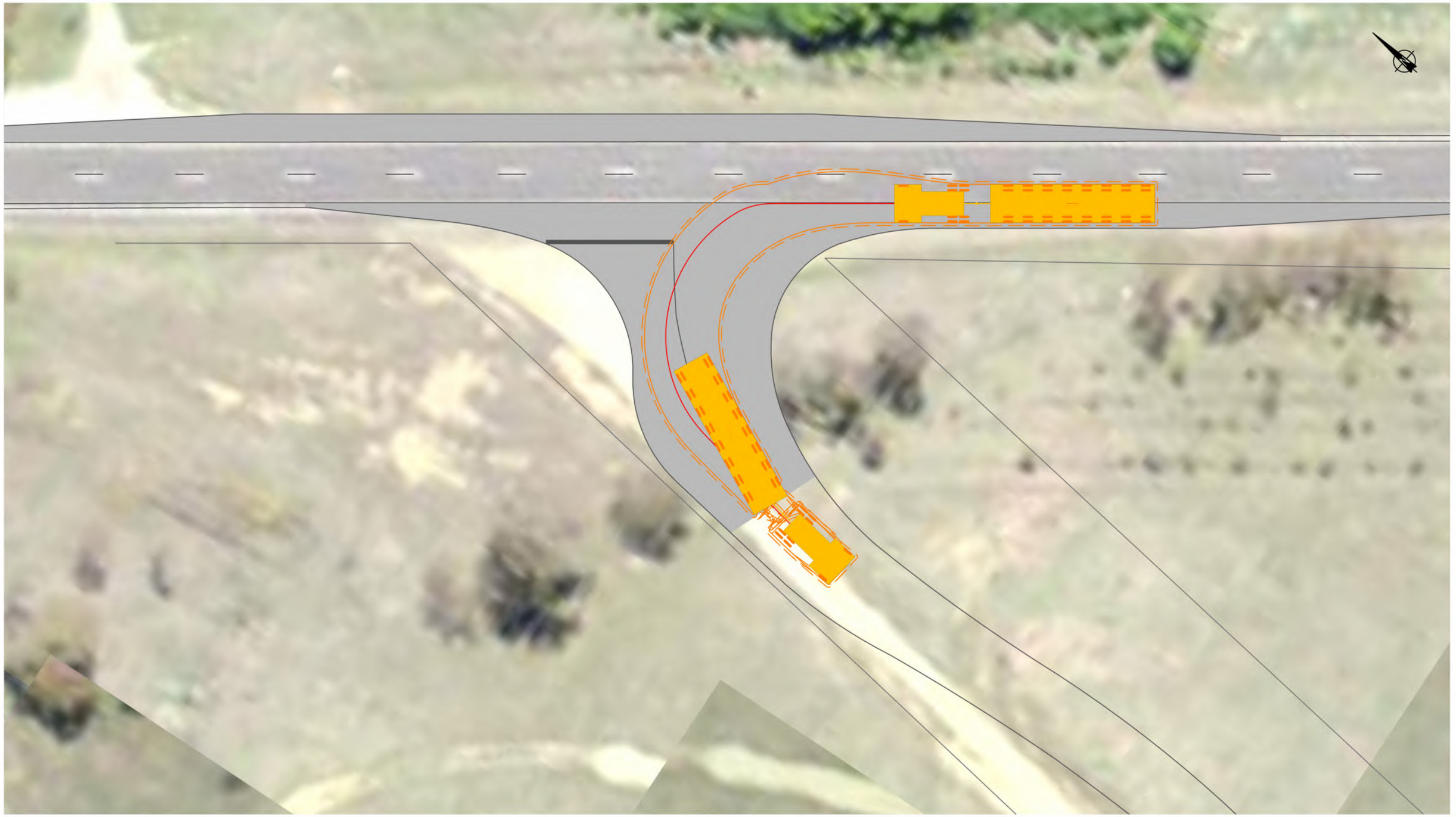
Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment

DRAWN: MW
DATE: 08/06/2021
SCALE: 1:400 @ A3
DWG NO: 045-S01F

Amber 5



Vehicle Envelope

300mm Clearance

Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment - OSOM Vehicle

DRAWN: MW

DATE: 08/06/2021

SCALE: 1:400 @ A3

DWG NO: 045-S01F

Amber

Vehicle Envelope

300mm Clearance

Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment - OSOM Vehicle

DRAWN: MW

DATE: 08/06/2021

SCALE: 1:400 @ A3

DWG NO: 045-S01F

Amber

Vehicle Envelope

300mm Clearance

Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment - OSOM Vehicle

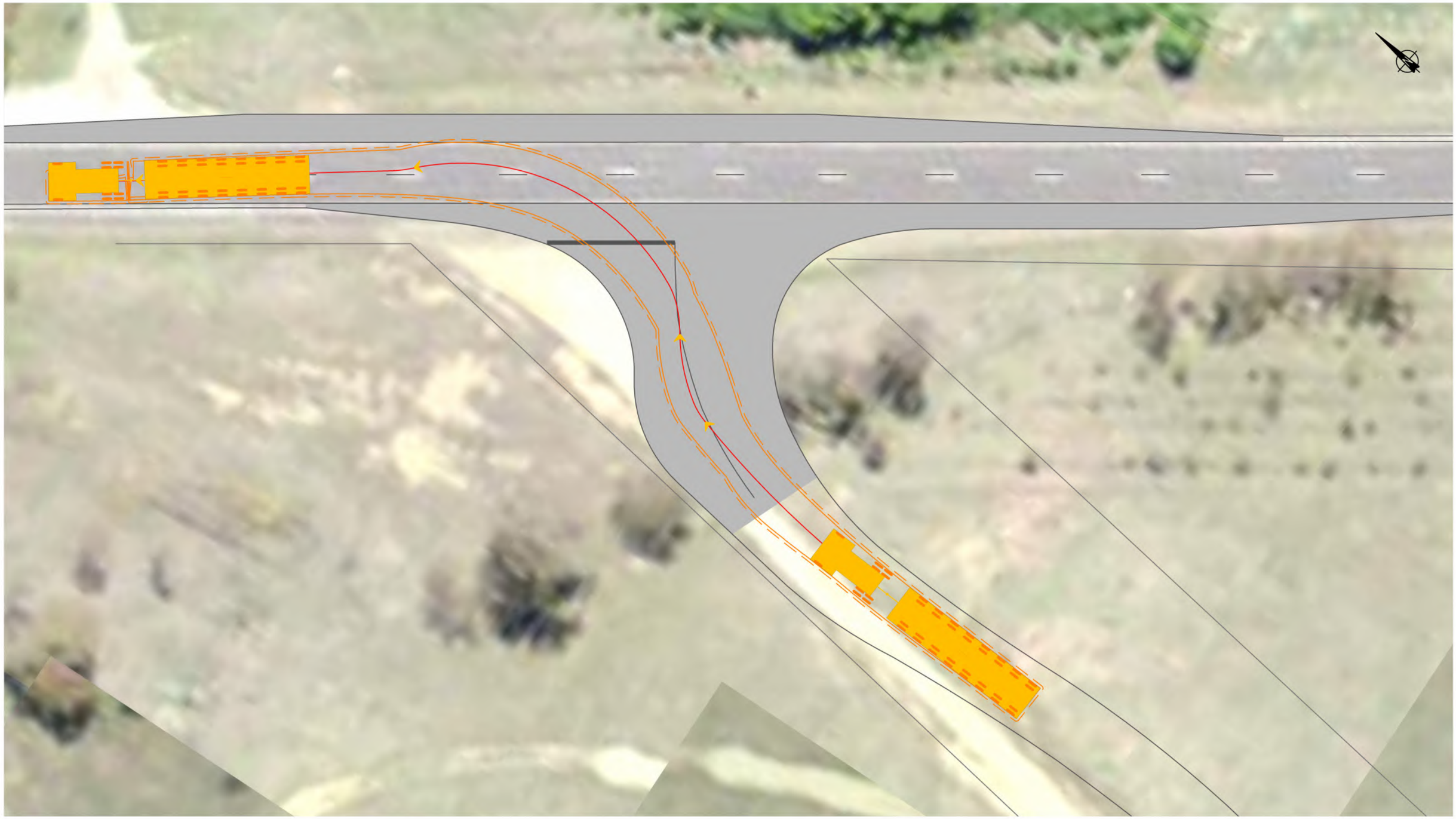
DRAWN: MW

DATE: 08/06/2021

SCALE: 1:400 @ A3

DWG NO: 045-S01F

Amber 8



Vehicle Envelope

300mm Clearance

Tilbuster Solar Farm

New England Highway / Site Access Intersection

Swept Path Assessment - OSOM Vehicle

DRAWN: MW

DATE: 08/06/2021

SCALE: 1:400 @ A3

DWG NO: 045-S01F

Amber

Appendix D

Armidale Regional Council – Road Design Requirements

Traffic Volume / Road Class	<10 VPD Rural Access Lane	10 – 99 VPD Rural Access Minor/Primary production, small lots	100 – 149 Rural Access Major/Primary production, small lots	150 – 999 Rural Collector, Minor	1000 - 7999 Rural Collector, Major	>8000 Major Distributor	Rural Village	Primary Production
LEP Zoning	RU4	RU4, RU1, E3, E4	RU1	Any zoning	Any zoning	Any zoning	RU5	RU1
Road reserve flat terrain ≤ 5%)	15m	20m	25m	25m	30m	30m	15m	20m
Road reserve undulating ≥ 5%)	20m	20m	30m	30m	30m	30m	20m	20m
Carriageway width	6.5m	7.5m	7.5m	8.0m	9.0m	11.0m	6.0m	7.5m
Seal width	5.5m	6.0m	7.5m	8.0m	9.0m	11.0m	7.0m	6.0m
Shoulder width	-	0.75m	0.75m	0.5m	1.0m	2.0m	1.0m	0.75m
Desirable Speed environment (km/h)	60	80	100	100	100	100	50	100
Design speed for individual elements (Min) (km/h)	60	80	80	80	80	100	40	80
Flood immunity (ARI years)	2	2	2	5	20	20	10	2
Trafficable Immunity (ARI years)	20	20	20	20	50	50	20	20

Table D1.5 - Characteristics of Roads in Rural Areas

ET - Equivalent Tenements – See latest RMS Traffic Generating Developments and Supplements 2013.
VPD - Vehicles per Day.
ESA - Equivalent Standard Axles.