Modular Substation Functional Requirements

Appendix - Datasheets

January 2016

Contents

Appendix B. Site Datasheet

Key Information	Details
Grid Reference	*Pin-point location*
Height above sea level	*The atmospheric conditions change depending on the height above sea-level travelled. Electrical equipment can be affected by changing atmospheric conditions.*
Distance from the sea	*Seaside environments tend to be more salty and have a higher water content in the atmosphere. Electrical equipment and metals can be affected by salt and water in the air.*
Temperature Range	*Average summer and winter temperatures. Design to the extremes on the temperature range. Electrical equipment operates within an optimum temperature range. Heaters or air conditioning units may be required to maintain a suitable temperature environment for the electrical equipment.*
Wind Conditions	*Strength and direction of wind as well as maximum gusting values will ensure that the structural design of the module is robust enough.*
Precipitation	*Annual rainfall will enable the drainage systems and associated equipment to be correctly sized. In addition this information will also enable any necessary discharge licences to be applied for.*
Map of the Site and surrounding area **(1:25000, A4 size, section of map, with the site location identified)**	*Will provide information about the surrounding landscape, how populated the area is, the road system, the land usage, the land terrain etc.*
Brief description of the site location…. (providing more information on the Site, could include photographs)	*Summarise the additional information that the a map does not do justice too. Include pictures, descript what can be seen presently at the modular substation location.*
Access to site gained from …	*Location of the existing road. Has a route already been identified, if so, attach a map.*
Parameters stated or requirements defined in the conditions of the Consent or Planning Permission	*Looking for any details provided in formal documentation:* • *such as the height of structures on-site will not be higher then 15m, or* • *any civil work must take place between 1st May and 31st August, etc.*
Site surveys conducted…. **(Ground surveys / environmental surveys /**	*List any surveys that have been undertaken.* *Be mindful that without ground survey information, estimates*

Key Information	Details
earthing surveys / noise / utility searches etc.)	*surrounding the civil design of the substation are likely to be higher to balance the associated risk of the uncertainty of the ground conditions.*
Location of the nearest Telecommunication infrastructure	*Useful as it identifies a possible route for outgoing communication*
Location of the nearest Electrical Distribution infrastructure	*Useful as it identifies a possible source for site electricity*
Location of the nearest Water Service infrastructure	*Useful as it identifies a possible source for both incoming and outgoing water.*
Any other information that is note worthy surrounding the connection site …	

Appendix C. Design and Operation Expectations Datasheet

Table C1. Information associated with the modular substation operation

Key Information	Details
Modular substation Use	Permanent / Relocatable (temporary/emergency) *This information will help design a suitable transportation solution if the preference is relocatable.* *Additional detail on how often the modular substation would be moved is also worth while including, to enable a range of transportation design solution to be evaluated.*
Modular substation Operational Life	*The number of years the modular substation will be in use.*
Modular substation Maintenance preference	*Provide an aspiration for maintenance requirements of the modular substation. Discussion with manufactures highlight that maintenance free equipment is fast becoming a reality.*
Modules within the modular substation will be…..	Switchgear module ……. Transformer module ….. Welfare module …… Other module ……. *List the main modules, and their voltage levels, that are required to be placed together to form the substation.*
Interface or Ownership Boundaries between the existing system and new modular substation	Civil …… Electrical Plant …….. Protection & Control ……. Commercial Metering …….. Operational …….. Safety …… Other ……. *It is very helpful to define and agree the boundaries between the existing Network Owner and modular substation. The wider this exercise is and the more boundaries discussed and detailed will ensure that all aspects of the modular substation are optimised*

Key Information	Details
	economically and efficiently.
Electrical Single Line Diagram showing Electrical Ownership Boundaries	*A simple diagram showing the proposed key electrical components of the connection between the Network Owner and modular substation.*
Any other key elements associated with the modular substation operation which are worthy of note ……	

Table C2. Information associated with the modular substation connection to Network Owner

Key Information	Details
Grid Reference of the nearest existing substation	*Helpful as it may be necessary to design and build the necessary connection infrastructure to this point.*
Grid Reference to the nearest existing cable or overhead line	*Helpful as it may be necessary to design and build the necessary connection infrastructure to this point.*
Existing Network Owner	*Primarily this will either be a Transmission Owner or a Distribution Owner in the UK.*
Reason for Connection to the Electrical Network	Network Owner Extension / New Generation Connection (Developer not Self-Building) / New Generation Connection (developer Self-Building) / Other *The reason for the connection will influence the connection regulations that must be adhered to during the modular substation project.*
Description of the Connection Works the Network Owner will undertake	*Explain what the Network Owner will provide at the point of connection, this may be a switchgear bay at an existing substation or a cable / overhead line to the modular substation.*
Associated Timescale for the Network Owners Works	Consent or Planning Application Approval Expected ……. Date of first electrical back-feed ……. *If consent / planning approval is required, then the anticipated date is very important, as no construction works on-site will be progressed until this has been achieved. This date needs to be*

Key Information	Details
	incorporated within the modular substation build programme, as the modular consent & planning processes / spend need to align. *The date the Network Owner can first provide electrical energy to the modular substation is critical to progress on-site commissioning.*
Specifically for a New Generation Connection the Agreement is with..	National Grid System Operator / Distribution Owner *A new Transmission Connection requires a formal agreement with the Transmission System Operator, who will instruct the appropriate Transmission Owner.* *A new Distribution Connection is with the appropriate Distribution Owner.*
Connection Regulations to be complied with ….	**Connection & Use of System Code (CUSC)**: contractual framework for connection to, and use of, the national electricity transmission system. **Grid Code**: covers all material technical aspects relating to connections to, and the operation and use of, the national electricity transmission system. **Security & Quality of Supply (SQSS)**: sets out criteria and the methodology for the planning and operation of the National Electricity Transmission System. **System Operator – Transmission Owner Code (STC)**: defines the high-level relationship between the national electricity transmission system operator, National Grid Electricity Transmission plc (NGET), and onshore and offshore transmission Owners. **Distribution Code**: technical aspects relating to connection & use of electricity distribution licensees' distribution network. **Distribution Connection & Use of System Agreement (DCUSA)**: provides a single centralised document which relates to the connection and use of the electricity distribution networks. *The reason for the connection into the Network Owner system will help identify which of the Connection Regulations are applicable.*
Any specific connection requirements requested as part of the Connection Application or returned in the Connection Agreement	Blackstart Services …. Frequency Response Services …..

Key Information	Details
…	Reactive Services ….. Specific Appendix Requirements …… Other …… *There is an opportunity with a new connection to provide certain 'services' that are desirable to the System Operator. Any 'service' agreed needs to be designed into the operation of the modular substation.* *With new Generation Connection Agreements there will be specific information within the Appendix's which is specific to a connection at that point in the network. It is worth drawing out anything that is unusual and that may influence the modular substation design.*
Any other key elements associated with the connection point which are worthy of note ……	

Appendix D. Civil Datasheet

Key Information	Details
Weight of the heaviest load	*To aid the design of the access / site roads / undertake structural assessments of delivery routes.*
Maximum length and width of module delivery vehicle on-site	*To aid the design of the access / site roads and determine if any public road improvements are necessary.*
Allowances for vehicle movements	*This information could be used in a swept path analysis review of the transport route which will inform public road improvement requirements and movements within the site boundary.*
Provisions for unloading equipment on-site	*How will the modules / heaviest loads be unloaded from the delivery vehicles and moved into position?* *Will cranes be required, in one or several locations? Details helpful to calculate the required bearing capacity.*
Geotechnical Investigations already undertaken	*List of surveys undertaken which will be available for review.*
Recommended geotechnical Investigations	*Further site surveys that the Contractor wishes to undertake and detail how the results of these will be used in the design.*
Treatment of excavated material on-site	*Detail the proposed treatment of spoil?* *Can this be utilised in landscaping or can a platform be constructed from site won material?*
On-site drainage	*Detail the preferred solution to treating surface water within the platform area*
Ground Improvement Techniques	*Detail the preferred ground improvement techniques if deemed necessary.*
Platform materials	*Detail the preferred materials to be used that achieve requirements for modules and movements of plant and personnel around site.*
Fencing	*Detail the type of perimeter fence. Is there a preference to use the modules in the fence line?*
Roads	*Detail the preferred make-up of access road, internal site roads.*

Preference associated with the finish of the site within the fence area	*Suggest materials for site area.*
Cables / Services / water	*Will there be a mixture of directly buried / troughed and surface mounted cables/services? Will there be dedicated cable corridors on-site? Is there scope to utilise a water permanent supply or suggested treatment of harvested water, as an example.*
Layout drawings	*Proposed layouts for internal access roads, the distance expectations between fences and structures?*
Any other information that is note worthy surrounding the civil requirements …….	

Appendix E. Enclosure Datasheet

Key Information	Details
Modules to be enclosed will be …	Example: *1. 33kV switchgear and associated infrastructure* *2. Welfare facilities* *There are several factors which need to be considered when deciding how much of the module is to be enclosed. It may be the preference not to enclose the high voltage switchgear or the transformer, however it should be suitable to enclose for the associated protection and control equipment.*
Enclosure modular fabrication location preference ….	Example: *33kV housing to be delivered to site then equipment installed and the welfare facility manufactured off-site.* *It is worth bearing in mind that the enclosures could be erected on-site and suitable for off-site fabrication of electrical equipment to be installed inside.* *There may be a trade off between time spent on-site and the cost of the enclosure. As an on-site enclosure will cost less than a container that needs to be suitable for transportation. But the on-site enclosure will lengthen the time and associated labour on-site.*
Modules fabricated off-site transportation challenges	Include the transportation survey of the local area around the site to be developed for the modular substation, if undertaken… Alternatively detail the size of roads, the steepness and known challenges leading up to the modular substation location … *The party delivering the module will need to carry out a more detailed transportation survey. The survey may for example influence the width and weight of the module, due to the transportation roads available.*
Modular Installation on-site	Example: *Skidded into place* *An opportunity to detail any preferences on how the module is to be removed from the transportation trailer and placed onsite.* *Craning the module will require an enclosure that is suitably strengthened, with appropriate lifting attachments; this will increase the cost of the enclosure. Using a crane, consideration will also require the provision of a suitable hardstanding area.*

Key Information	Details
Modules Fabricated Off-site Location	Key electrical equipment will come from ……. Locations where the modules are built ……. *Will depend on the manufacturer. The substation modules may be built in different locations. This information will be helpful in identifying transportation requirements and challenges.*
Modular enclosure material	Example: *Non conducting material such as GRP* *An opportunity to detail the preference for the material of the modules enclosure. E.g. non-conducting*
Modular enclosure maintenance requirements	Example: *Minimum maintenance* *An opportunity to detail the preference for the maintenance of the modules enclosure. E.g. minimum maintenance*
Modular enclosure external finish	*An opportunity to detail requirements such as the colour or 'look' that was agreed with local planning authorities.*
Telecommunication attached to the external of modular enclosure	*An opportunity to detail the preference for the number and type of telecommunication devices to be attached to modules enclosure.*
Cable entries into modular enclosure	*An opportunity to detail the preference as to how cables will enter the modular enclosure.*
Bus bar entries into modular enclosure	*An opportunity to detail the preference as to how bus-bars will enter the modules enclosure*
Security & Safety of the modular enclosure	The whole module ….. The doors type and size …… Locking facilities ….. Emergency exit, number and type …. *An opportunity to detail the preferences associated with the security and safety of the modules enclosure.*

Key Information	Details
Services within the modular enclosure	Illumination requirements both standard and emergency …… Heating requirements ….. Humidity / ventilation requirements …. Electrical plugs and sockets requirements … Earthing requirements ….. Acceptable methods of managing internal cabling within the container and through walls …. Acceptable methods of reconnecting internal services within the modules if for transportation reasons it is required to be broken down into smaller sections …. Fire detection requirements ….. Telecommunication requirements ….. Welfare requirements ….. Internal finish of the module …. *An opportunity to detail the key services within the modular enclosure, lighting, heating, electric plugs, telephones etc. are necessary and need to be designed in at the initial stages.*
Height of modular enclosure	*An opportunity to detail the preference for the height of the modules enclosure. There may be benefit in raising the module above ground level, if this is the preference then steps will be required to allow personal to enter, as well as a method to be identified for the removal of equipment.*
Location of equipment within the modular enclosure	*An opportunity to detail the preference for the location equipment within the modules enclosure. As there may be panels that require access both front and back, therefore they need to be placed in the middle as opposed to an auxiliary transformer which is better located in a corner behind a cage to protect personnel from electrocution.*
Any other information that is note worthy surrounding the enclosure …….	

Appendix F. Primary Electrical Connections between Modules

Table F1. Information associated with the cables

Key Information	Details
Cable Voltages / phase	*Example: Single phased 132kV cable between the transformer and the 132kV module.* *Detail the different voltages of cables required, their phasing and their purpose.*
Cable Rating and Load requirements	*Example: 33kV cables must be capable of carrying 60A continuous load all year round.* *Detail any preference in the current carrying ability of the cable. The ability of the cable to carry current will change with the temperature and seasons, the most challenging time is during periods of warm weather.*
Cable Installation	*Example: 132kV cable is to be directly buried.* *Detail the preference as to how the cable should cross the site.*
Cable Protection (physical)	*Example: If cabling is buried, cable tiles and warning tape are to be laid above the cable, prior to trench being refilled. If the cable is laid under a vehicle pathway suitable backfill or load diverting measures are to be installed.* *Detail the preference associated with protecting the cable from physical damage.*
Cable Protection (Electrical)	*Example: On long lengths of 132kV cable the installation of surge arrestors should be considered.* *Detail the preference associated with protecting the cable from electrical damage.*
Cable Monitoring	*Example: On the 132kV cable, distributed temperature sensing monitoring should be considered.* *Detail the preferences associated with cable monitoring.*
Cable Testing	*Example: The Owner's representative is to witness any cable factory acceptancy testing.* *Detail the preferences associated with cable testing.*
Cable Commissioning	*Detail the preference associated with on-site cable*

	commissioning.
Any other information that is note worthy surrounding the cables …….	

Table F2. Information associated with the cables which will be provided by the manufacturer

Key Information from Manufacturer	**1st Cable Voltage**	**2nd Cable Voltage**
Cable voltage range		
Cable 1-ph / 3-ph		
Cable Overall Diameter		
Cable Mass (KG/m)		
Cable bend radius (installation and static)		
Cable continuous Current Carrying capacity		
Cable fault current carrying capacity		

Table F3. Information associated with the bus-bar

Key Information	**Details**
Type of Bus-Bar	*Detail the type of bus-bar and the equipment it is to connect. .*
Bus-Bar Rating and Load requirements	*Detail any preference in the current carrying ability of the bus-bar.*
Bus-Bar Installation	*Detail the preference as to how the bus-bar should cross the site. It may be helpful to include drawings.*
Any other information that is note worthy surrounding the bus-bars …….	

Appendix G. Switchgear Datasheet

Key Information	Detail associated with *132kV*	Detail associated with *33kV*
Practical		
Installation location	*Indoor / outdoor* *Select preference*	*Indoor / outdoor* *Select preference*
Insulation medium	*Example: Oil* *There are a wide range of insulation mediums available, the location and the space available may rule out options. The switchgear cost will increase as the size dimensions decrease.*	*Example: hermetically sealed* *There are a wide range of insulation mediums available, the location and the space available may rule out options. The switchgear cost will increase as the size dimensions decrease.*
Temperature range based upon location of switchgear	*Minimum temperature:* *Maximum temperature:* *If the switchgear is to be housed outside then the temperature range will be the same as stated in the SITE DATASHEET. If the switchgear is indoors the temperature range is likely to differ from the SITE DATASHEET. If indoors heating / cooling systems may need to be installed to maintain the temperature within the range.*	*Minimum temperature:* *Maximum temperature:* *If the switchgear is to be housed outside then the temperature range will be the same as stated in the SITE DATASHEET. If the switchgear is indoors the temperature range is likely to differ from the SITE DATASHEET. If indoors heating / cooling systems may need to be installed to maintain the temperature within the range.*
Maintenance Requirements	*List any preferences*	*List any preferences*
Technical		
Rated Incoming Voltage	*Example: 132kV, 3ph*	*Example: 33kV, 3ph*
Rated Frequency	*50Hz typical of the UK AC network*	*50Hz typical of the UK AC network*
Rated short-duration power-frequency withstand voltage	*Example: 245kV (this value maybe stated by the manufacturer based on their equipment testing)*	*Example: 66kV (this value maybe stated by the manufacturer based on their equipment testing)*

(1min)	*The switchgear will be able to withstand a voltage greater then the rated incoming voltage for a short time. The electrical components may influence the withstand voltage, if this is the case then the voltage level needs to be calculated and stated.*	*The switchgear will be able to withstand a voltage greater then the rated incoming voltage for a short time. The electrical components may influence the withstand voltage, if this is the case then the voltage level needs to be calculated and stated.*
Rated lightning impulse withstand voltage (1.2/50us)	*Stated in kV* *Provided by the manufacturer based upon their equipment testing.*	*Stated in kV* *Provided by the manufacturer based upon their equipment testing.*
Rated normal current – busbar feeder	*Example: 2000A* *The electrical components will influence the current rating of the busbar, calculation necessary and requirements stated.*	*Example: 1000A* *The electrical components will influence the current rating of the busbar, calculation necessary and requirements stated.*
Rated short circuit-breaking current	*Stated in kA* *Provided by the manufacturer based upon their equipment testing.* *The electrical components may influence the short circuit-breaking current, calculations necessary.*	*Stated in kA* *Provided by the manufacturer based upon their equipment testing.* *The electrical components may influence the short circuit-breaking current, calculations necessary.*
Rated short-time withstand current (up to 3s)	*Stated in kA* *Provided by the manufacturer based upon their equipment testing.*	*Stated in kA* *Provided by the manufacturer based upon their equipment testing.*
Rated peak withstand current	*Stated in kA* *Provided by the manufacturer based upon their equipment testing.*	*Stated in kA* *Provided by the manufacturer based upon their equipment testing.*
Dimension of the switchgear	*Height, width, depth (normally stated in mm)*	*Height, width, depth (normally stated in mm)*
<u>Preference</u>		
Switchgear	*List Switchgear types that are*	*List Switchgear types that are*

Manufacture Preferences	*acceptable* *There may be a preference for the type of switchgear to be used or standards it should be tested against.*	*acceptable* *There may be a preference for the type of switchgear to be used or standards it should be tested against.*
Switchgear aspects that are not acceptable	*List aspects of the switchgear that are to be avoided.* *This may be an insulation medium, it may be manufacturer or a type of switchgear that has historically been problematic.*	*List aspects of the switchgear that are to be avoided.* *This may be an insulation medium, it may be manufacturer or a type of switchgear that has historically been problematic.*
Any other information that is note worthy surrounding the Switchgear …….		

Appendix H. Transformer Datasheet

Key Information	SI Unit	Details / Response
Highest System Voltage:		
HV	V	*Stated by Owner and details the highest level of voltage output from the transformer.*
LV	V	*Stated by Owner and detaisl the lowest level of voltage incoming to the transformer.*
Rated Voltage Ratio (at no-load & principle tap)		*Provided by manufacturer and details for each volt on the primary coil how many there will be on the secondary coil.*
Rated Minimum Continuous Power Rating at all Tap Positions	MVA	*Provided by manufacturer*
Tappings:		*Provided by manufacturer*
Type of tap-change switch		On-load / off-circuit *Detailed by the manufacturer*
Number of tap positions		*Provided by manufacturer*
Tapping range	%	*Provided by manufacturer*
Tapping steps on-load tap-changers	%	*Provided by manufacturer*
Connections:		
Vector grouping		*Provided by manufacturer*
System Conditions:		
System short circuit apparent power	MVA	HV – MVA LV – MVA *Provided by manufacturer*

Key Information	SI Unit	Details / Response
HV System Earthing:		*Example: solid* *Provided by manufacturer*
LV System Earthing:		*Provided by manufacturer*
Insulation Levels for HV windings:		
With stand Power frequency	kV	*Provided by manufacturer*
With stand Lightning impulse	kV	*Provided by manufacturer*
With stand Switching Impulse	kV	*Provided by manufacturer*
Impedance:		
Transformer impedance at continuous maximum rating at nominal tap and 75^{o}C on CMR base. (% on 100MVA base)	%	*Provided by manufacturer*
Line Terminals:		
HV		Bushing / Cable Box *Provided by manufacturer*
LV		Bushing / Cable Box *Provided by manufacturer*
HV Neutral		*Example: HV star point to be brought out on an AIS bushing and connected to earth lead brought to ground level.* *(Test bushing may be utilised)* *Provided by manufacturer*
Horizontal co-ordinating gaps required for surge protection?		Yes / No *Provided by manufacturer*

Key Information	SI Unit	Details / Response
LV Termination Cable Sizes:		*Specified as required by manufacturer*
HV current transformers required:		*Detail how many CTs are required per phase on the transformer HV side.* *Manufacturer will outline their standard, the Owner may require more.*
Transformer Noise:		*Provided by manufacturer*
Maximum noise level from transformer	db	*May have been specified in EIA documentation used to support planning permission or set as a condition of planning permission*
Is provision for a noise enclosure required?		Yes / No
Transformer Electrical Losses:		
No-load loss	w	*Provided by manufacturer. The Owner can calculate the finance impact assocaited with the transformer.*
Load loss	w	*Provided by manufacturer. The Owner can calculate the finance impact assocaited with the transformer.*
Special Tests:		*Manufacture can provide the Owner with guidance on benefits of the test.*
Frequency Response Analysis (FRA)		Yes / No
Capacitance and power factor, Recovery Voltage Method (RVM),		Yes / No
Current Injection (Load Test)		Yes / No
Neutral Earthing Transformer:		*Provided by manufacturer*
Ratio		*Example: 11,500/400 V*
Rating of auxiliary winding	kVA	

Key Information	SI Unit	Details / Response
Impedance	%	*Example: 4.75 Ohms / ph - Zp* *12.0 Ohms / Ph - Z0*
Vector Grouping		*Example: Zy1/11*
Rating		*Example: 11kV - 625A 10 Sec*
Neutral Resistor:		*Example: 11kV –NER 10.16 Ohms*

Appendix I. Protection and Control Datasheet

Key Information	Details
Protection & Control schematic	*Provide a Key Line Diagram indicating where the instrumentation (current and voltage transformers) should be situated and where the instrumentation data is going.* *If may be necessary to produce several Key Line Diagrams to represent the feeder, transformer bays etc., as there might be too much detail to fit onto a single diagram.*
Fault Clearance times for protection relay schemes	*Name the documentation to be adhered to and if possible detail the voltage levels and target times.* *Example: 132kV and below, target fault interruption time of main in-feeding circuit 120ms, target back-up clearance time 1000ms (which is in compliance with Grid Code)*
Relay Panels which house the P&C equipment	*Detail preferences in relay panels*
Intelligent Electronic Devices, Relays & Auxiliary	*Detail preferences for Intelligent Electronic Devices, Relays and Auxiliary*
Software & Hardware	*Detail preferences surrounding software and hardware which may be associated with the P&C systems*
Current Transformer Ratings	*Detail preferences associated with the current transformers*
Voltage Transformer Ratings	*Detail preferences associated with the voltage transformers*
Wiring Specification	*P&C relay panels contain a large amount of fine wiring this is an opportunity to detail preferences, such as the wiring colour for example.*
Labelling	*Detail preferences surrounding the labelling*
Communication Systems	*Detail preference surrounding communication systems, as it will be necessary to send information/data/instructions from and to site. The method of communication and the number of pathways are also important to detail.*
Functional Requirements	*Detail the operational preferences surrounding the P&C system, as in tripping schemes.*
Test Requirements (location modular substation is	*Detail the factory acceptance tests for the individual P&C items. Also detail the testing to be undertaken prior to the module*

Key Information	Details
assembled)	*leaving the assembly location.* *The aspiration for testing P&C at this stage is right back to the Owner's remote control room This will require a suitable communication link and investment in substation control infrastructure at the assembly location. This may not be possible but there would be value in understanding the blockers or challenges.*
Test Requirements (in permanent location)	*Detail the site acceptance tests*
Equipment Life	*Detail the acceptable lifespan of the hardware and software.* *P&C equipment will have a lifespan which mirrors the modular substations requirements. The element that is unlikely to meet the modular substation lifespan is the hardware and software for the electronic equipment as this technology continually improves or is up-graded.*
Control Philosophy	*Detail as clearly as possible the operations that are to be carried out by the Bay Controller Unit, including the information that the remote control room should see.*
Fault Recorder	*Detail preferences surrounding the fault recorder.*
P&C Additional Options	*Below are a selection of additional P&C options that may or may not be suitable to be included:* • *Fault Locators: specifically for overhead lines.* • *Phasor Measurement Units: ability to module electrical energy in 3-dimensions.* • *Harmonic Monitoring: measures the distortion in the electrical energy form.* • *Point On Wave Switching: monitors the electrical energy wave form and makes the connection to the system when conditions are suitable.* • *GPS: used for synchronising.* • *Interlocking: either electrical or mechanical and will stop operations that should not occur, a safe system.*
Protection	*Detail preferences in the basic protection arrangements for the modular substation. Provide supporting detail for the P&C schematic.*
Any other information that is note worthy surrounding the Protection and Control …….	

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