Instructions for RFQ Check Sheet for Specifying Trayer Switchgear

This document provides instructions and guidance for completing the RFQ Check Sheet	
Field	**Information required or description**
Name, Company, Address	Enter key contact information – decision makers, engineers, rep etc.

One-Line Diagram	Using the symbols sketch a one-line diagram of the proposed switchgear. Pay attention to the order of ways as the order will be reflected in Trayer design.
Visible Disconnect	Indicate if a visible disconnect is needed. This is an important safety feature that provides a secondary disconnect in line with a vacuum breaker (VFI) or vacuum switch. It is not intended to break load which is achieved by the vacuum components. The visible disconnect can only be operated if the circuit is first opened via the vacuum components. The visible disconnect handle is interlocked to prevent operation of the visible disconnect if vacuum components are still closed. A window allows visual confirmation that visible disconnect contacts on each phase are open, and therefore the circuit is open. A visible disconnect eliminates the need to physically remove elbows from their bushings to create a visible open. It is particularly helpful on 600A circuits since elbows are larger. Window and mechanism is larger for gas insulated units.
2-Position (open/close)	Standard configuration.
3-Position (open/close/ground)	3rd position grounds the opened circuit for safety.

Way Configuration	The table matches the one-line diagram to confirm and establish the order of ways (important), with a description of each way (such as fused, switch, visible disconnect etc.) and the kVA for each way.
kVA per each way	On the one line-diagram indicate the maximum kVA that each way will convey. Serves as a "sanity check" to insure proper ratings of other components on the way, such as switches and fuses.
OPTIONAL Removable-stud 200 amp bushing wells	Indicate if required. Some utilities require bushings with a screwed-in stud that screws into the main bushing conductor so that in the event the screwed-in stud breaks they can be easily removed by unscrewing them and replacing with a new stud. 200 amp copper bushing conductor studs are soft and easily broken if over tightened by a technician. Without the removable stud if the bushing stud were broken a major repair would be required (i.e. removal of entire tank) since the bushing is welded to the tank.

Type of Equipment - Vault Mount, Pad Mount, or Submersible	
Indoor Dry Vault Mounted with no cable compartment or enclosure	Specify for locations that are not subject to being flooded. External equipment or control cabinet does not need to be waterproof. Bushings and handles are visible and exposed so this equipment would be installed in a secured location such as an equipment room or vault that only qualified personnel have access to. Submersible vaultmount

Indoor Dry Vault Mounted with Cable Compartment / Enclosure	Specify for locations that are not subject to being flooded. Control cabinet does not need to be waterproof. This design provides a lockable enclosure to prevent access and tampering with high-voltage cables and controls.
Submersible Vault Manhole Top- Operable	Specify for wet environment locations with possibility of flooding. The switchgear is accessed and operated from the top only. (I.e. not from a front or side operation because the installation space is confined and access is only available from the top.) You must choose between round or rectangular tank (see enclosure options). Submersible SF6 VFI switch Square submersible switch
Submersible Vault Mount Front- Operable	Specify for wet environment locations with possibility of flooding. Wet Vault Unit will be accessed and operated from the front. This means that the installation space is sufficient around the tank for a technician to work. You must choose between round or rectangular tank (see enclosure options). Submersible vaultmount Submersible vaultmount wet applications
Round Tank	Check for Submersible or for Dry Vaultmount for switchgear to insert into round man-holes, and where the equipment takes up the entire vault space. Submersible Round Tank
Rectangular Tank	Specify instead of round tank if for Submersible Vault Mount or Vault Mount. Submersible Rectangular Tank
Padmounted Outdoor	Specify for outdoor equipment sitting on a concrete pad where the location is not subject to flooding or submersion, but will be subjected to rain. Padmount 1 Padmount 2
Padmount Access - Hoods and Doors	Choose from the following three configurations for accessing Padmount equipment. Larger equipment may require swinging doors or a combination of swinging doors and a lift-up hood or top, see below.
Vertical Lift-up Hood for Padmount equipment.	This is the standard configuration for smaller padmounted equipment. With larger equipment a vertical lift-up hood may be too heavy for operators. A combination of lift-up top and horizontal doors can be used depending on equipment size or where the location imposes access restrictions; if so provide specific details of the access considerations. Padmount hood
Horizontal Swinging Doors for Padmount equipment.	Doors open to the left and right up to a 135° and must be allowed to be fully opened so they can lock in the open position. If they are not fully opened they will not lock and will become a hazard in windy conditions. Padmount doors
Swinging Doors and Lift-up Top for Padmount equipment	Doors open horizontally first and then a top is lifted up to expose equipment controls and cables. Door + Hood

Special Size and Access Requirements	Please note any special dimensional requirements or restrictions. This includes clearance for swinging doors, unusual vault dimensions, or cable restrictions.
Size of Switch Tank	Note any size restrictions affecting installation or operation for tank equipment.
Size of Switch Tank Base	Note any size restrictions affecting installation of the tank plus tank stand.
Size of High Voltage Cabinet	Note any size restrictions affecting installation of Padmount systems or Vaultmount systems.

Cable Entrance to Padmount or Vaultmount Equipment	Usually cables are brought in from the bottom of the equipment and routed up to the front. If the installation in question calls for a different routing please describe to prevent difficulties with final installation or to prevent cables from fouling controls and handles.
Height of lowest bushing	Specify the height of the lowest bushing from the ground. This is an important consideration to allow cables and elbows to be pulled off from their bushings more easily. If bushings are too low to the ground it becomes difficult for the technician or operator to pull the cables and elbows off with a hot-stick. Important for front-operable equipment – not applicable for top-operable equipment. Vault applications

Construction	
Tank Stainless Steel	Specify type of stainless steel for the tank. 304 is standard. 304L costs more but more corrosion resistant around the welds.
304 Stainless	304 Stainless
304L Stainless	304L Stainless
Tank Stand	Specify the construction of the Tank Stand for Vaultmount or Submersible equipment to be mounted. Hot Dipped Galvanized standard. Stainless 304 and 304L are available
Parking Stand	Parking stands are used to park a cable when pulled off of a bushing to allow maintenance. An insulated parking bushing fits into the parking stand and the cable elbow attaches to the insulated parking bushing. Specify whether the parking stand is for a load break or non-load break type of elbow.

Padmount Options & Accessories	
Copper Ground Rod	Check if a 1/2in copper grounding rod should be installed. A copper grounding rod allows service technicians to connect ground wires (or drain wires) from elbows, and ground shields from cables for safety, and/or for testing tools. The copper rod is usually installed on the front of padmount equipment near the bottom of the equipment using the ground nuts.
Drain Plug Option	A drain plug can be located at bottom of tank to allow draining of liquid insulation (similar to oil pan drain plug on a car). Spillage can be a hazard so see the drain valve option below.
Drain Valve with Sampler	Facilitates a hose connection so that liquid insulation can be drained away via a hose into a container. This option is similar to a “faucet” to control the flow and minimize spillage than the standard drain plug which can gush uncontrolled. The “sampler” is an additional small valve to allow a small amount of oil to be collected for testing.
Drip Shield	Used with wet well fuses. This option adds mounting provisions to the tank (tabs or clips) for hanging a sheet metal “tray” to collect oil drips when fuses are removed. This option must be specified in the design since it cannot be retrofitted at a later date.

Fuse Wipes	Used with wet well fuses. Changes the grommets in the wet fuse wells to a circular rubber blade to "squeegee" oil off of the fuse into the fuse-well as it is removed, resulting in less spillage. The fuse wipe is fuse-specific.
Second Liquid Level Gauge	Useful for large equipment that are mounted on pads where the grade may have a slight slope. The gauge would be located on the opposite end of the standard Liquid Level Gauge so that the worst case oil level can be detected.
Fault Indicators (Location and Make/Model/Type is required)	This is a device that is mounted on padmount equipment that indicates if a fault has occurred at this point. It is useful for finding faults in outage situations since crews can locate the specific location of a fault by simply "driving by". The customer needs to provide the style of indicator and its location on the equipment.
Special Paint	Some customers require special paint and colors. Specify paint color and manufacturer and provide sample.

Types of Insulation	Specify the type of insulation. Liquid and gas or solid insulation help to reduce the required spacing between conductors and therefore the overall switchgear size resulting in more compact designs. IMPORTANT Note that switching and interruptions occur within the vacuum components (switches or VFI's) and not in the insulating dielectric. Insulation also helps with heat transfer.
10C Insulating Oil	a.k.a. 10C Transformer Oil. Standard oil used in Trayer equipment. This is a type of mineral oil. Transformer Oil
Alpha-1 Insulating Oil	Synthetic paraffin hydrocarbon fluid. Better dielectric, cooling, and flashpoint characteristics than 10C. More expensive than 10C Alpha-1 Oil
Biotemp Insulating Oil (Not to be used below 15° F)	Biodegradable insulating fluid based on vegetable oil. Excellent fire resistance and dielectric characteristics and high temperature stability. Not suitable for cold environments. Biotemp Oil
Luminol, Insulating Oil (to be used in cold climates)	Petro-Canada hydrotreated isoparaffin based liquid electrical insulating fluid suitable for use to -40°C High dielectric impulse strength
SF-6 Insulating Gas	Inorganic, colorless, odorless and non-flammable gas. Basically inert. SF-6 Gas
Solid Dielectric	All active components encased in a **cycloaliphatic resin epoxy**. All buss work insulated with high voltage rated polyolefin busbar tubing.

Potential Transformers (PT) Required	Specify whether PT's (potential transformers) are needed for providing control power, or voltage sensing, or both as follows: Control Power PT's are installed to provide 120 VAC at 1500 VA max for powering relays or control electronics, or for trip devices, or heaters. They can also power a battery charger for the internal battery to operate motors such as linear actuators. Usually only one is needed. The exception is for ATS (Automatic Transfer Systems) where two control PT's are recommended so that the control electronics always receives power from one of the two sources. A PT is not needed when CT's are used to provide power for the control relay, as well as provide current signals to the relay, (for 4000 series equipment). The exception is when the 4000 series is used for Automatic Transfer Systems then control power PT's must be used.

	For voltage sensing and for power calculations Voltage Sensing PT's must be installed. The number of PT's needed for voltage sensing for 3 phase systems are: For Delta configurations - use 2 PT's For Wye configurations - use 3 PT's Trayer uses high accuracy ("metering accuracy") PT's that deliver an output proportional to the line voltage, and is industry-standard 120 VAC at full line voltage. PT signals are sent to relays or other control devices that operate breakers and/or to calculate power flow parameters (in conjunction with installed CT's-current transformers); to calculate values such as watts, VA, VAr, power factor, etc. If space inside the tank is a constraint voltage sensing PT's can also be used to provide control power thus eliminating the control PT - but this would only be recommended if the voltage sensing PT's are used for sensing voltage only. This approach must be discussed and clarified with the customer.
Number of Voltage Sensing PT's	Specify if PT's are needed for voltage sensing and power calculations.
Number of Control Power PT's	Specify if 120 VAC power is needed for relays or other controls. Usually enter 1, enter 2 if an ATS. Enter 0 if none are required or if control power comes from a voltage sensing PT above and make a check in the Shared PT's section below.
Number of Shared PT's	Check if control power comes from a voltage sensing PT – Number of control power PT's above should therefore be zero.

Control Box Requirements	
Location of Low Voltage Control Box Left is default Right or Rear are options	Customer may want to specify the location of the control box. By default it is located on the left side of padmount equipment when looking at the front of the tank. Moving the low voltage control box to the right side or rear requires additional engineering time and charge.
Additional entrance to Low Voltage Control Cabinet	Allows customer to access controls with their own wiring and conduit. A cord grip is placed around the control cord to seal it in an entrance hole. Conduit routes the control cable into the control box. Customer must provide the details on the location of the additional entrance hole, and size of the cord / wire being used, and conduit hub size.

Existing Operating Voltage (line to line)	
2400 – 34500	Choose operating voltage for the utility system the equipment will be used with.
Other Voltage	Unique operating voltages can be specified
Provision for easy change to future voltage of:	If future plans call for a higher voltage the equipment can often be designed to operate on a different voltage system. You must specify the highest voltage. The PT circuits can be designed with a switch to add a step-up transformer to ensure control power will always be maintained at 120 VAC. Internal components will be specified for the higher operating line voltage
Utility System Configuration	As a helpful cross-check check one of the diagrams that describes the utility power system topology that the switchgear will be operated on.

Protection Required	If protection is required, choose between Fuse protection or Vacuum Fault Interrupt protection (VFI). Specify Wet or Dry Well fusing. Note the kVA rating of each way.
Specify Fused Ways	
Wet Well (200-amp maximum)	Requires a wet well fuse holder with 200A bushings.
Dry Well (50-amp maximum)	For a dry well fuse holder and for 200A bushings.
Other Fuse Rating	Specify if a different value is required. For Trayer Engineering to verify the suitability of the fuse rating it is important to have noted the kVA rating of the way.
Specify VFI Circuit Breaker with Relay Control	Vacuum Fault Interrupter with Relay control
Single Phase VFI	Specify if the vacuum fault interrupter (VFI) is located on a single-phase way and will trip if only that phase has an overcurrent condition. It operates independently of current conditions on other phases.
Three Single Phase Ganged VFI	Specify if the handle is ganged to operate all three VFI's. Depending on how the relay is programmed the VFI's can be controlled to trip just the one VFI that experiences an overcurrent, or trip all three VFI's if any one phase experiences an over-current. Note that in this configuration to manually reset the equipment via the handle will mean first opening ALL phases before they can be closed.
Three Phase VFI	Specify if the VFI is located on all three-phase ways. If any phase has an overcurrent condition, all three phases will open.

Over-current Relays	
Manufacturers	Specify the relay manufacturer. Relays are programmed to trip VFI circuit breakers at specific overcurrent levels and can be programmed to emulate fuse curves. Trayer offers the choice of two standard manufacturers, typically either SEL or T&B, depending on the configuration and level of control desired.
SEL	Schweitzer Engineering Laboratories https://www.selinc.com/
T&B	Thomas & Betts self-powered with 4000 series.
Fault Current Requirements	
Momentary Make & Latch Amps (Asymmetrical)	Find out and note the maximum asymmetric fault current that a utility system will experience under fault conditions. Assymetrical Momentary Rating
Maximum Symmetrical Fault Current available from system	Find out and note the maximum amount of current that the utility source can provide to a short circuit. Symmetrical Fault Current
T&B Relay Options	Choose the mode of trip to determine the type of T&B relay
Single/Three-phase selectable	T&B Relay Model 10 has a selector to set the relay for independent single-phase tripping, or to trip all three phases if any one of the phases senses overcurrent.
Ganged Three-Phase	T&B Relay Model 20 will trip all three phases if any one of the phases senses overcurrent, or will trip on a ground fault.
Special Relay Programming Requirements	Trayer will provide basic programming of relay operation according to the switchgear design configuration, such as described in the one-line diagram and the RFQ checklist, etc. Customers who have special requirements must provide an instruction sheet that details their required operation. An additional engineering charge will be added to cover the programming for special requirements.

Transceiver Communications	Transceivers are used to remotely communicate relay status and control settings to a remote control center, for monitoring and remote control.
Optical Transceiver	Select if optical transceiver is preferred.
Radio Transceiver	Select if radio transceiver is preferred.
Other transceiver	Describe any special transceiver required. Could be blue tooth, WLAN, etc
Battery Backup	Primarily used for Auto Transfer Systems (ATS) or units with Remote Terminal Units as a source of backup power. In the case that main power is lost, this allows remote control and monitoring systems to still communicate with the equipment, and in some cases operate any DC power motor actuators to open and close switches. Indicate location requirements, and whether operation is for Relay or Motor Control

Automatic Transfer System (ATS)	An Automatic Transfer System has two power sources, of which one supplies power to the load, usually designated as the primary source. If the primary source fails it automatically switches to the alternate source, and vice-versa. The decision to switch to the secondary source when the primary source fails is made by a programmable relay. Two types of ATS are available.
ATS Standard	Standard ATS can take up to 12 seconds to complete the transfer from one source to the other after receiving a transfer command.
High-Speed ATS	The High-Speed ATS uses solenoids to switch between sources improving the response time to 10 cycles.
ATS Operation document submitted to customer	IMPORTANT: A separate document here: ATS specifying Trayer ATS operation must be submitted to the customer. Confirm in the check-box.

Control Options	
Auxiliary Contacts (Open / Closed/ Ground / Tripped / Charged)	Auxiliary contacts are connected to micro switches inside the switchgear to provide indication of the various state(s) of load-break switches, VFI's and visible disconnects. Depending on the design the auxiliary contacts can be specified to indicate the following conditions: Load-break (vacuum) switches – open or closed VFI – open, closed, tripped (or charged for High-Speed ATS equipment) Visible Disconnect –closed, grounded, and open High-Speed ATS – charged The table shows the different indicated conditions that Auxiliary Contacts can provide. Fill in the table for their required use. Not available where greyed out.
Motor Operators	Trayer uses two types of motor operator; the submersible MotoPak and the linear actuator. These motors operate switch handles on a tank. This allows Auto Transfer operation or remote control operation of the switch. Automation
Padmount Linear Actuators - 24VDC	Linear actuators are used on Vaultmount and Padmount equipment. They are always 24VDC and have battery backup.
Submersible MotoPak motor operators	The MotoPak is used in submersible equipment. The motor and controls are housed in a hermetically-sealed stainless steel box that is attached to the switch tank. These are available in 120VAC and 24VDC versions. MotoPak
Provision only for future linear actuators (Padmount only)	Since the addition of the linear actuators requires mounting on the tank the provisions to attach them later must be made when the tank is built. When the customer decides to add linear actuators they can be retrofitted in the field. There is no provision to retrofit a tank to accept linear actuators at a later date.

Manual and Remote Operation Options	Cable, rope, and pendant operation are safety features that allow a technician to perform manual operation at a safe distance.
Cable Operator (Submersible only)	A length of cable can be attached to the tank to allow operation of the switch levers by a cable similar to brake cables on a bike.
Provision for Future Cable Operator	The addition of the Cable Operator requires mounting brackets to be attached to the tank. Choosing this option allows easy retrofit in the field.
Plain Rope Operation	The Plain Rope option operates switch handles by pulling on a rope from in front or above the tank.
Provision for All-Direction Rope Operation	The All-Direction option adds a bar with eyelets to provide the ability to pull the rope from the sides.
Pendant Box	A Pendant Box is an external controller on a multi-conductor cord that can remotely open and close the switches, and show the status of the switch with indicator lights. The operator can stand outside of the manhole or at a distance from the equipment to operate it. Specify either 20 ft or 30 ft length.
Remote Control	Allows remote operation of the switch over fiber or radio etc.
RTU (Remote Terminal Unit)	The RTU allows the switch to be controlled and monitored over a SCADA network remotely.
Interlocks	Interlocks are mechanical or lock devices that prevent switches from being opened or closed unless the proper key is in hand or a slide bar is first moved into the proper position as safety precautions.
Slide-bar Interlocks between adjacent handles	Slide-bar interlock between adjacent handles prevents the closing of two switches simultaneously. Sliding the bar only allows one switch handle to be closed
Slide-bar Interlocks between dry-well fuse wells and handles	This interlock between the dry-well fuse wells and handles makes sure that the switch is open and the fuse is de-energized before the fuse wells can be accessed.
Key Interlock between switch handles	Operation of switch handles is done with a single key. It is set up such that the same key operates a handle in location “A” or location “B” but cannot operate both. This prevents the closure of the handle at location “B” before the one at “A” is opened, and vice-versa.
Provision for future Key Interlocks on handles	Since the addition of the Key requires hardware that is mounted on the tank the provision to retrofit must be installed when the tank is first built.
Additional Name Plates and Decals (attach plate/decal instructions)	The location of the additional name plates and decals must be specified by the customer.

Special Seismic Requirements (attach sheet)	If special requirements for seismic considerations are needed provide an additional document with specifications to insure that the mechanical design will meet the requirements.