LET'S BE PACIFIC™

March 2005 Volume 5 Number 1

Primary Metering
Another Opportunity for Padmounted Switchgear — In 6-Compartments

Federal Pacific has offered primary metering in padmounted switchgear for many years. Recent changes in utility electric-power rate structure along with the increased value of land promotes further expansion of offerings previously furnished.

Rate Structure Developments

Electric power utilities have developed new rate structures that (a) reward commercial/industrial power consumers for accepting power at higher voltages and (b) allow the utility to reduce installed inventory and therefore investment dollars.

By purchasing power at medium-voltages (such as 12.47kv, 13.2kv, 13.8kv, 24.9kv, 34.5kv, etc.), power consumers accept the responsibility of purchasing the transformer that reduces voltage to the traditional utilization levels (120v, 240v, 480v, etc.). The consumer also purchases the additional capital equipment associated with the transformation substation, i.e. primary-side switching and protection components and the medium-voltage cable. The utility will meter the customer at medium voltage but will retain control of, and access to, the metering transformers (voltage and current transformers) and the meters. Thus, the power consumer purchases the equipment with provisions to accommodate utility purchased and installed metering components.

Controlling Access

In addition to retaining custody of and access to the metering transformers, the utility may service and operate the complete assembly. The customers, point of control/possession occurs right after the metering components. It makes sense then that the transition from utility to power-consumer control should occur for underground distribution circuits in a unit of padmounted switchgear. A unit recently produced is pictured in this newsletter.

Access control includes keeping out vandals and the curious. Figures 1a and 1b show the typical outdoor enclosure, which meets the ANSI C57.12.28 Enclosure Security requirements. In addition, the unit is provided with external windows with security covers.

Installation views of primary metering unit shown with customer installed (on center compartment doors) kilowatthour meter (in green box) and key interlock transfer block (in gray box) for the connected distribution transformers.

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Figure 1a. Exterior view of Primary Metering assembly of FP padmounted switchgear. The compartments on the side pictured above include (from left) incoming switch, metering transformers, and tap switch. Switch compartments include windows on door to allow view of switch position without opening door and security window covers.

Figure 1c. Exterior view of unit with incoming bus-termination compartment on right and fuse compartment on left. Door on fuse compartment includes key interlocks to prevent access to fuses unless tap switch is open and to transfer block for connected transformers. Inset in Figure 1b shows the key interlock on switch-operating shaft behind access cover identical to that on the tap switch.

Figure 1b. Unit pictured with security window covers removed. Inset shows key interlock on switch handle that sequences access to key interlock on metering compartment door.

Figure 1d. Open door view of incoming bus-termination compartment (at right) and outgoing fused-feeder compartment at left with dual-purpose barriers in place. Independent compartment doors allow access control.

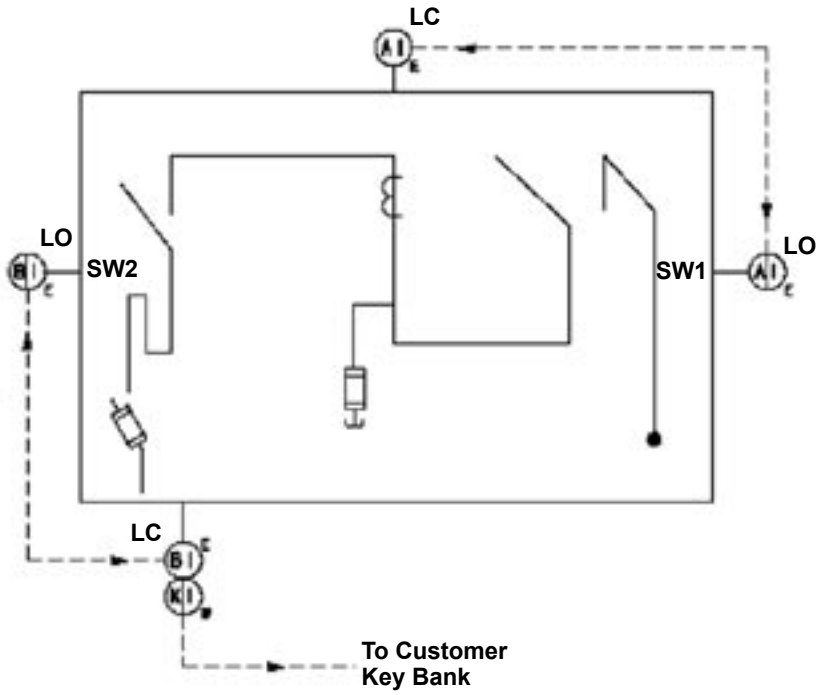

Figure 2. One-line diagram of Primary Metering assembly illustrating switches, orientation and sequencing of the switchgear, primary metering components, and protective devices. Metering components required space in the two center compartments of the unit. Key interlocks restrict access to the metering-transformer compartment unless the incoming switch is open and independent second set restricts access to fuses unless tap switch is open.

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Having equipment in the same enclosure owned or controlled by two organizations (the utility and the power consumer) brings challenges of developing methods to isolate and restrict access to each compartment. For example, certain components must be accessible only by the utility. And, it must also be possible for the utility to isolate the metering components when necessary to perform inspection, service and maintenance. Key interlocks discussed later are an important component in providing that access control. See Figures 1b and 1c.

On the other hand, the power consumer must have access to the switching and protection devices that connect to its transformer. Devices that the customeer needs to access are typically positioned immediately after the primary metering components. For Federal Pacific, these switching and protective devices include an Auto-jet® Switch for three-pole group-operated load switching and a three-phase set of fuses, either expulsion type or current limiting, for protecting the cable and transformers.

A one-line diagram representative of the foregoing arrangement is illustrated in Figure 2. The diagram shows that all components are in series. The key interlock transfer scheme is also illustrated.

Provisions for Metering Transformers

The electric power utility will want an incoming load-interrupter switch and the Auto-jet® switch is also provided for this function as shown in Figure 3. In addition, for revenue metering, the utility requires voltage transformers and current transformers with a high level of accuracy. And, the utility normally has a particular brand and type that are preferred.

FP will either provide mounting provisions only for the metering transformers (see Figure 4) or install and wire the components complete. If provisions only are included, FP still needs to know the particular brand and type that the utility plans on installing. With that brand/type information known, appropriate mounting holes will be drilled and interconnecting cable (or bus) will be cut and furnished.

Alternately, the customer can elect to have FP install the metering transformers. In such cases, the customer may prefer to ship its own components to FP for installation. Or, FP can purchase the customer's choice of components for installation.

Similarly, the customer may elect to have provisions only for a kilowatt hour meter or have FP install the meter complete. A choice here for the customer is whether the meter is to be surface mounted on the padmounted switchgear enclosure or enclosed in a separate housing mounted on the switchgear. Either choice is acceptable to FP.

Standard convention dictates the position sequence of the CTs and VTs. This convention has the VTs tapped from the bus and positioned on the incoming (line) side of the CTs. Thus, the CTs are always placed in the circuit after the VT points of connection.

Figure 3. Incoming (line-side) switch with top terminals connected to bus of incoming cable termination compartment and bottom terminals connected by bus to the CTs in adjacent compartment.

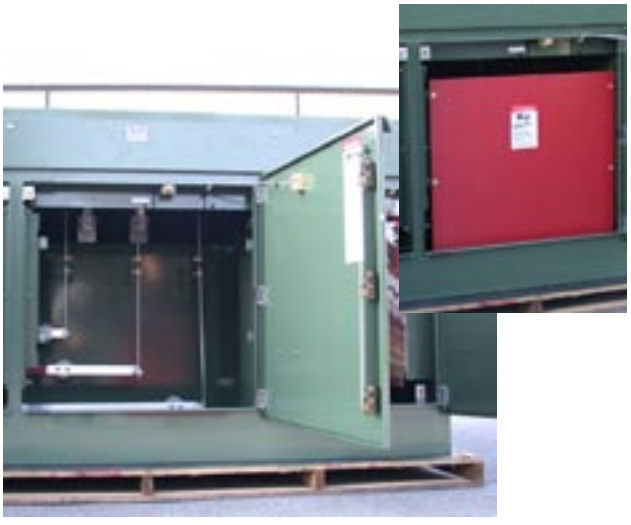

Figure 4. Primary metering compartment pictured above includes provisions for revenue metering components to be installed by utility and will include outdoor voltage transformers tapped to bus between bottom terminals of incoming switch in compartment to left and bar-type CTs to be installed by the utility in this compartment.

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Interlocks Limit Access and Allow Essential Sequencing

In this particular unit, the electric power utility requires the switch to be oriented so that when it is open the blade must be de-energized (i.e. on the load side of the circuit). Therefore, it is necessary to have an incoming termination compartment. This termination compartment (see Figure 5) permitts bus connections to the top of the incoming switch shown in Figure 3. In addition, the utility also wants to prevent access to the metering components unless the incoming switch is open. For this purpose, key interlocks are provided — one located on the incoming switch (and mounted within the switch-operating-handle pocket) and one located on the metering-transformer compartment door — to insure the necessary sequencing (see Figure 1b).

Correspondingly, there is a requirement that maintenance personnel of the end-user organization not be allowed access to the fuses unless the tap switch is open (see Figure 6). Maintenance personnel of the end-user organization may not be trained as "qualified" and, therefore, may not be aware of the dangers involved in accessing and handling components energized at medium voltage. Key interlocks on the switch-operating shaft of the tap switch and on the fuse-compartment door provide the necessary sequencing (see Figures 7 and 8).

Types of Metering Transformers

The electric power utility may select from a variety of voltage and current transformers. Fused indoor or unfused outdoor voltage transformers may be selected. Outdoor VTs take up the most space. Current transformers (CTs) for revenue metering are most often bar-type and of indoor construction, and also require considerable space. Furthermore, the bar-type CTs are positioned "in the bus" so that bus connections to the CTs and bus transitions from the CTs to the remainder of the circuit can be complex and may require the enclosure to grow in height or depth or both.

In addition to the standard four compartments of components (2 switches, one set of fuses, and a termination compartment), the primary metering unit pictured in this newsletter includes provisions for both outdoor VTs and bar-type CTs. Consequently, space requirements made it necessary to use an enclosure the size of a 6-compartment unit. The metering transformers required the space of two compartments. But, the 6-compartment sized-enclosure still requires less real estate than would have otherwise been required by separating utility and end-user components.

Figure 5. Open door view of incoming bus-termination compartment with bus connecting to top terminals of switch and allowing switchblades to be de-energized (if no backfeed from the load circuit) when the switch is open.

Figure 6. Tap switch pictured here is connected by bus (a) to CTs in compartment on left and (b) to top of fuse terminals in compartment on the opposite side of the switchgear.

Figure 7. Exterior view of FP Primary Metering padmounted switchgear with incoming cable termination compartment at right and fuse compartment at left. Key interlocks on fuse-compartment door prevent opening the door unless the tap switch is open. Associated key interlock on switch-operating shaft of tap switch is captive when switch is closed and can't be removed until switch is open.

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Project Involvement and Customer Acceptance

The resulting design has been well accepted by the customer involved. It is expected that this design will become the utility-wide standard where electric-power consumers are supplied power at medium voltages. For this application, FP's representative worked closely with the end-user consultant and the serving utility. Coordinating and communicating the requirements allowed FP to develop a design that met the utility requirements while also allowing the functionality and access necessary for day-to-day operations by the end-user.

Local codes required the unit to pass a field inspection performed by an authorized testing and inspection organization. The equipment passed all the requirements. The project also demonstrated FP's engineering capability to the utility, consultant and end-user personnel — a value added project that will result in future sales. Identifying potential opportunities early in the project development phase allows FP to gain an important position with consultants and demonstrates our capability to provide exceptionally featured equipment.

Figure 8. Open door view of fuse compartment containing fuse mountings accommodating current-limiting fuse assemblies. Fuse holders are pictured without fuse units.

Components and Ratings

Overall Unit Ratings

System Voltage	12.47kv
Maximum Design	15kv
BIL	95kv
AC Withstand	35kv
Main Bus Continuous	600 amperes
Short Circuit	40,000 amperes rms asymmetrical
MVA 3-Phase at 14.4kv Nominal	620 MVA (at nominal voltage and 25ka rms symmetrical)

Incoming and Tap Switch Ratings

Type	Federal Pacific Auto-jet® II
Continuous and Load Interrupting	600 amperes
Fault Closing 3-Time Duty Cycle	40,000 amperes
Momentary and 1-Second	25,000 amperes rms symmetrical

Fuse Mountings with Integral Load Interrupter

Type	Federal Pacific Auto-jet® - CL
Continuous and Load Interrupting	200 amperes
Fault Closing 3-Time Duty Cycle	22,400 amperes
Fuse Interrupting	50,000 amperes with current limiting fuses

Metering Transformers

Current Transformers	(3) KOR-11 (provisions only)
Voltage Transformers	(3) JVW-5 (provisions only)

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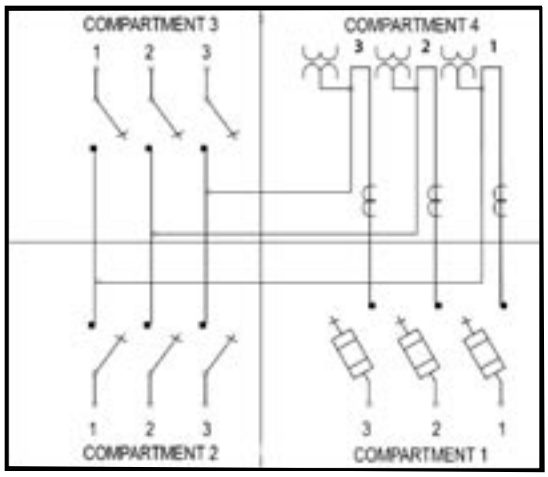

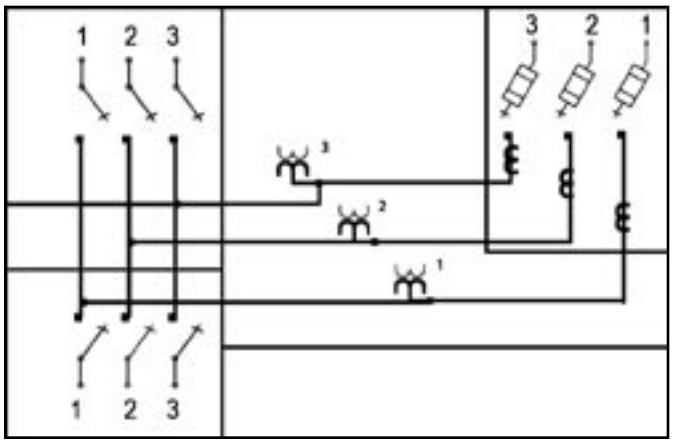

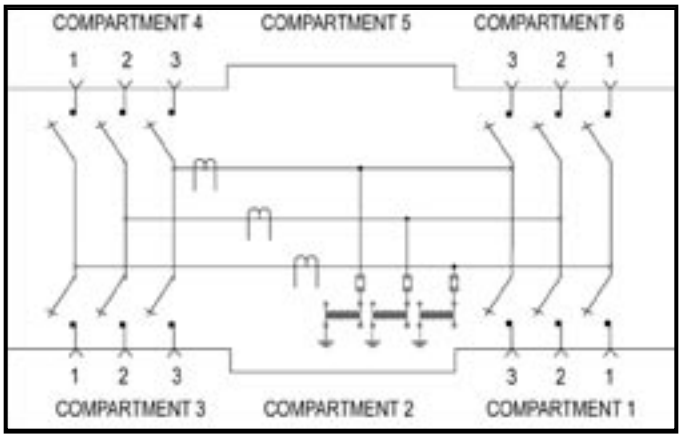

Federal Pacific offers a wide variety of unique metering configurations for the utility and commercial/industrial markets. Illustrated above are just a few of the configurations that have been built in addition to the unit featured in this newsletter. FP is prepared to develop additional units matched to the custommer's metering requirements.

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