



## ***U-Shaped Metal-Enclosed Switchgear Assembly Illustrates Design Flexibility That Produces Orders***



*Figure 1. A 19-bay switchgear assembly configured in a U-shaped arrangement is pictured above nearing completion. Open bays, which are incoming-termination compartments on each end and bus-transition sections on interior units, are closed off with cover plates. This indoor assembly matches to available room size at the installation and minimizes expense associated with capturing floor space from rental or production area for utility services at any facility.*

Federal Pacific Metal-Enclosed Switchgear offers both design flexibility and a broad choice of components that make it the preferred choice in many applications. In the switchgear assembly subject of this newsletter, Federal Pacific solved all the customer needs with a lineup that (1) has the bays arranged to match the installation physical limitations, (2) has the components and features necessary to provide the high-current ratings and essential switching and protection requirements and (3) has the switchgear bus connected in a main-tie-main circuit configuration making each half of the lineup capable of supplying power to at least the most critical load on both bus sections if the incoming power supply to one side is lost.

The indoor, 5kV, manually-operated 19-bay lineup of Federal Pacific Metal-Enclosed Switchgear is configured in a "U-shape" to minimize the footprint requirement for installation inside a building. Floor space and clearances within an indoor vault room is always at a premium. At this

installation, the proximity of adjacent circuits and equipment behind the switchgear assembly required that an insulating barrier had to be installed along the entire rear of the lineup. For this purpose, Federal Pacific installed red, sheet GPO-3 grade fiberglass along the entire rear of the longest run of bays.

Maximum Voltage, kV .....	5
Basic Insulation Level, kV .....	60
Continuous Current, Amperes	
Main Bus .....	1200
Incoming Switches .....	1200
Incoming Fuses .....	1100
Feeder & Bus-Tie Switches.....	600
Feeder Fuses .....	200, 300
Short-Circuit, Amperes, Sym.	
Withstand .....	25,000
Interrupting .....	25,000

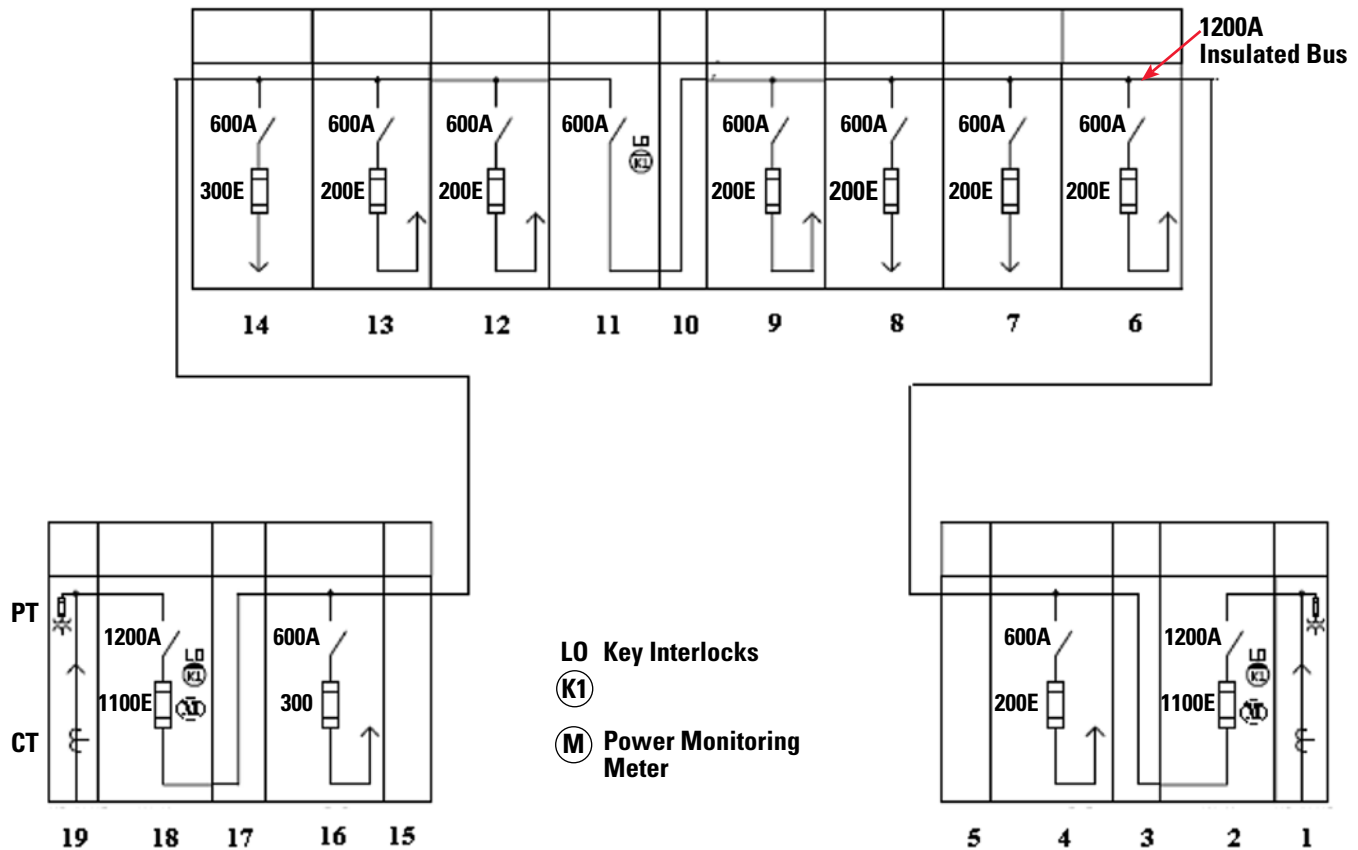


Figure 2. One-line diagram of 5kV, 19-bay Federal Pacific Metal-Enclosed Switchgear configured in a split-bus manual primary-selective arrangement: (a) with metering transformers on incoming termination bays, which are connected to power monitoring meters, (b) with fused incoming switches and (c) with key interlocks on each incoming switch and on the bus-tie switch to prevent paralleling incoming switches.

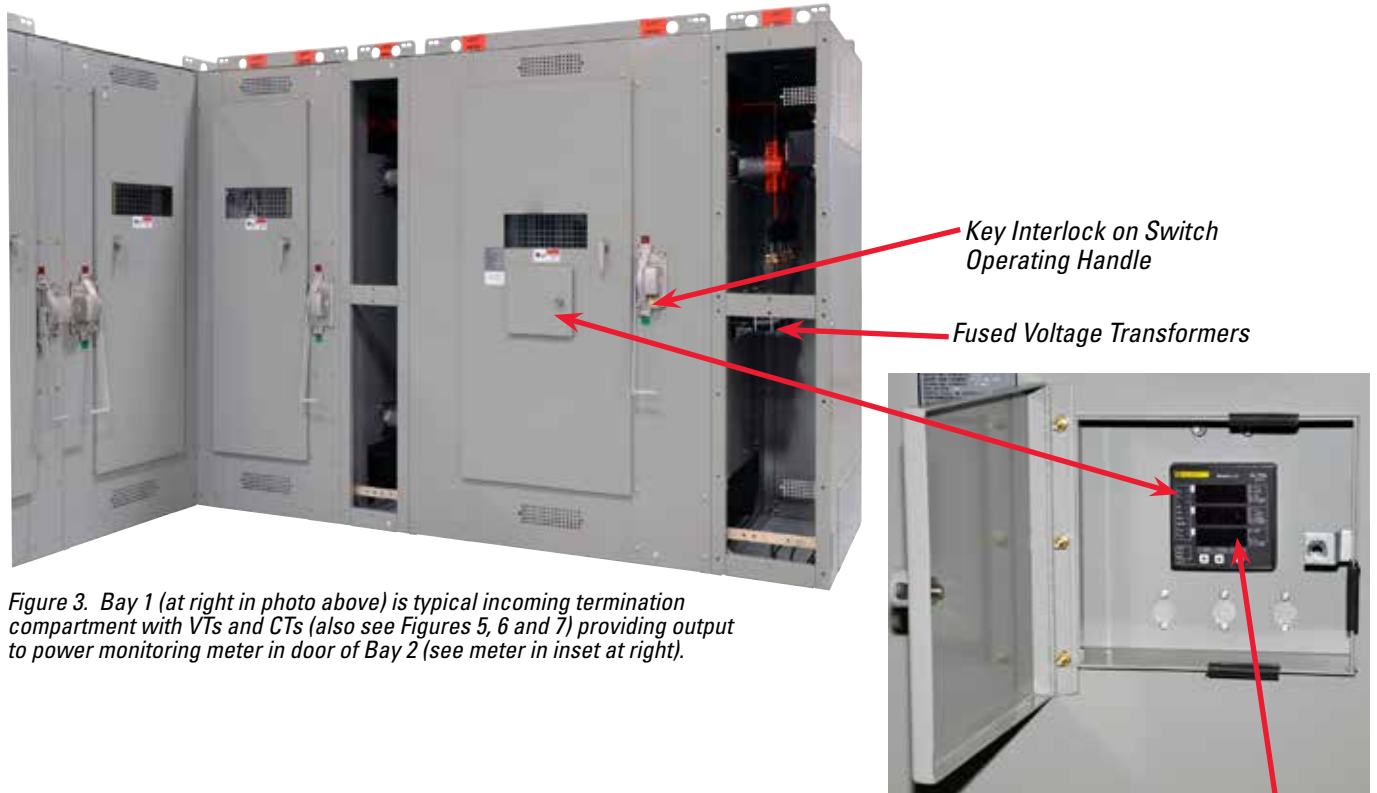
The incoming termination sections, which are the end compartments on the left and right wings of the switchgear assembly, include sensing current transformers and voltage transformers. These metering transformers provide input to the power monitoring meter included on the door of each second bay from the left and from the right. The main bus of the switchgear assembly is rated 1200-amperes continuous for which 1/2" x 2" silver-flashed copper bus is used. All of the bus throughout the switchgear assembly is insulated with bus connections and joints either booted or taped.

The increased level of fault current at the installation and the need to minimize the duration of such faults, made it desirable to utilize current-limiting fuses in the incoming line sections and in the outgoing feeder-bay sections. The anticipated high load current at the installation, and the desire for current limitation to minimize the effects of any short circuit, resulted in the use of incoming sections with parallel arrangements of the current-limiting fuses. The current-limiting fuses in the entrance compartments are paralleled to achieve the necessary 1100 amperes continuous-current rating and are

compatible with the Federal Pacific 1200 ampere Auto-jet® II Load-Interrupter Switches – both of these components match to the 1200-amp main bus. See Figure 5.

The main fused switch provides protection for the switchgear main bus and back-up protection for the feeder circuits. The manual switchgear assembly is configured in a split-bus primary-selective configuration. This configuration utilizes two bus sections with a normally open bus-tie switch between them. Each bus section is connected to its source by a main fused switch that is normally closed. Each main switch is normally closed and provides switching of the associated bus section. Similarly, the main set of fuses of each main switch provides overcurrent protection for the associated bus section and backup protection for the associated feeder circuits. If one source is lost, the affected source switch is opened and the switches associated with the designated less-critical loads on each bus section are opened. This load shedding is necessary because neither source can carry the total load of both bus sections simultaneously.

The incoming line sections and the bus-tie section include key interlocks. These key interlocks control switch sequencing. And, the sequencing allows only two of the three switches in the main-incoming and tie bays to be closed at the same time. Thus, the two sources supplying power to the switchgear cannot be tied together and will not be paralleled. In addition, the bus-tie switch is rated 600 amperes. Consequently, when the bus-tie switch is closed, some load shedding must occur.



*Figure 3. Bay 1 (at right in photo above) is typical incoming termination compartment with VTs and CTs (also see Figures 5, 6 and 7) providing output to power monitoring meter in door of Bay 2 (see meter in inset at right).*



*Figure 4. In certain situations, the incoming switch may be open and the circuit is served from the other source, but the fuses in this main compartment still remain energized. Consequently, separate screens are provided over the main switch and over the main fuses. This is done to prevent immediate direct access to the fuses and labels provide a reminder that the fuses may be energized.*

The 1200-ampere Auto-jet® II Load-Interrupter Switches on the incoming circuits have a short-circuit rating to 61,000 amperes, with a one-time fault-closing rating to that level. The main incoming fuses have a short-circuit interrupting rating to 31,000 amperes. The 600-ampere Auto-jet® II Load-Interrupter Switches in the feeder bays have a short-circuit rating to 25kA symmetrical, with a three-time duty-cycle fault-closing rating to that level. Therefore, the overall lineup is rated to 25kA symmetrical.

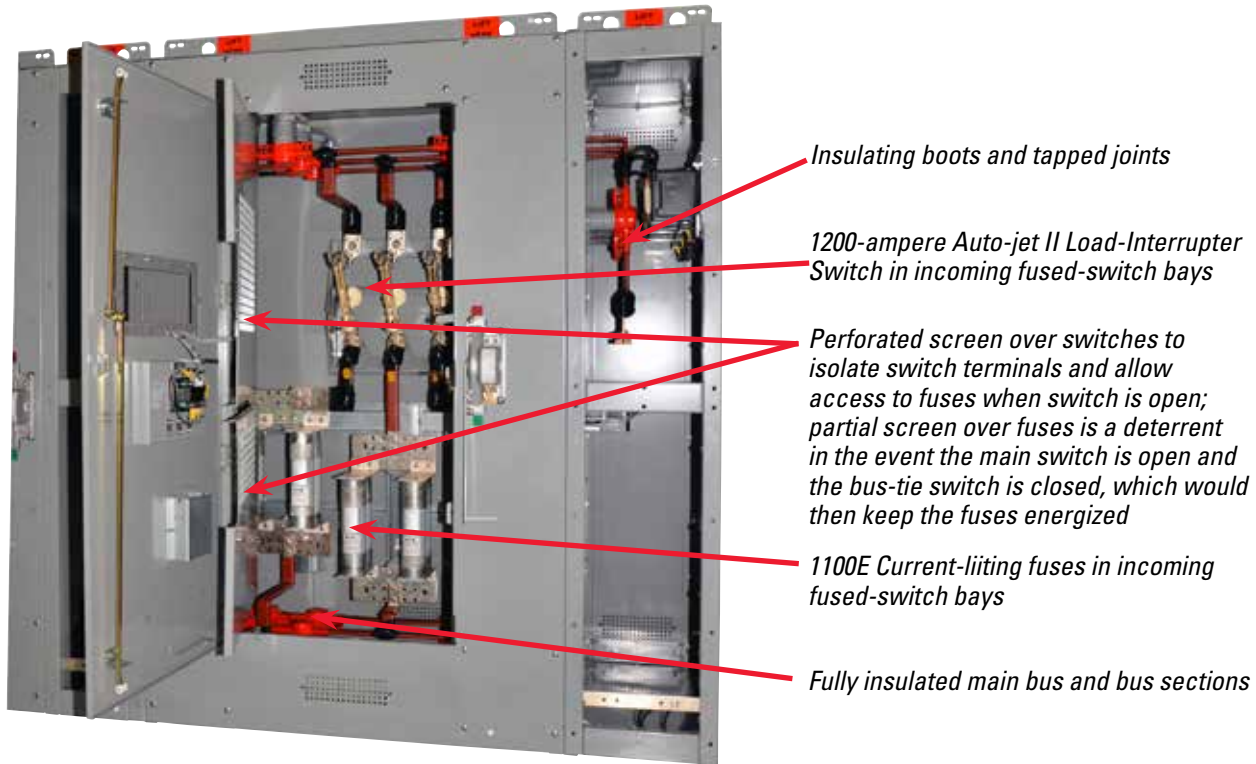


Figure 5. Bay 1 has a 1200-ampere load-interrupter switch and a set of three (3) paralleled current-limiting fuses rated to 1100E amperes.



Figure 6. Three (3) 4.16kV voltage transformers are furnished in each incoming termination compartment (Bay 1 and Bay 19). Each set of VTs provides voltage sensing input to the power monitoring unit in the associated main incoming fused switches, which are in Bay 2 and Bay 18. The voltage input combined with the current input allows the meter to produce all of the associated measurements: phase voltage, line-to-line voltage, average voltage, power factor, kW, kWh, etc.



Figure 7. Three (3) 1200:5 current transformers are furnished in each incoming termination compartment (Bay 1 and Bay 19). Each set of CTs provide current sensing input to the power monitoring unit in the associated main incoming fused switch, which are in Bay 2 and in Bay 18. The current input combined with the voltage input allows the meter to produce all of the associated measurements: phase current, average current, kW, kWh, etc.



The left bus section includes four (4) feeder bays and the right bus section (see Figure 8) includes five (5) feeder bays. Each feeder bay includes a 600-ampere Auto-jet® II Load-Interrupter Switch and a set of three (3) current-limiting fuses. In two of the bays on the left bus section, the fuses are rated to 300 amperes continuous and the remaining seven (7) feeder bays are rated to 200 amperes continuous. Thus, at maximum load current, some load shedding will have to take place before the two bus sections can be paralleled with only one incoming circuit supplying power to both bus sections. Six (6) of the feeder bays (three on the left bus section and three on the right bus section) have provisions for reverse-cable exit out the top. The other three (3) feeder bays (one on the left bus section and two on the right bus section) are arranged for cable exit out the bottom.



Figure 8. The five (5) feeder bays on the right side of the switchgear assembly are pictured at left. Doors of feeder bays include mechanical interlocks to prevent opening the door until the switch is open. With the doors open, access is possible to change fuses. While the door is open, the switch cannot be operated. Viewing window in each door allows inspection of the interior without requiring that the door be opened



Figure 9. The photo at left shows an open door view of four (4) of the feeder bays on the right side of the bus-tie switch. Perforated steel screens over switches of feeder bays limit exposure to energized bus at the top of the bay when the switch is open and access to the interior is necessary, such as to change fuses.

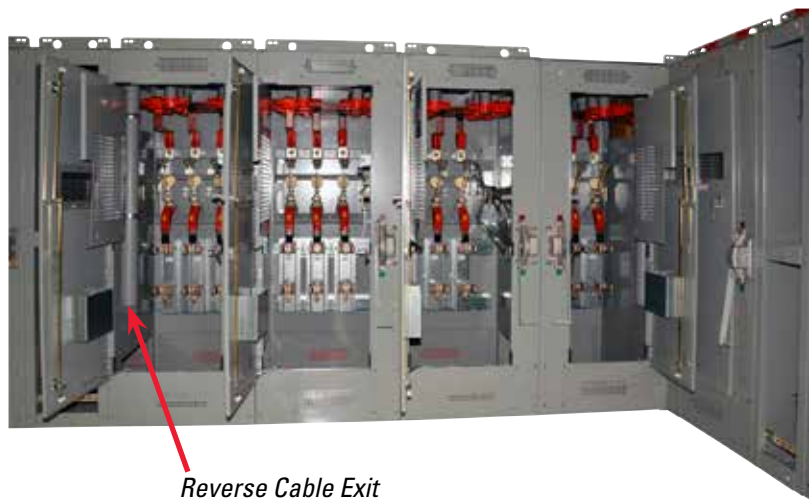


Figure 10. With the screens open, full access to the interior is attained. Storage of spare current-limiting fuse units is provided on the interior of each feeder bay. In bay at far left, grey PVC tube in left-front corner allows reverse cable exit out the top. Each door includes a self-latching door holder at the bottom adjacent to the door opening.

Reverse Cable Exit



*Blind-Tapped Threaded Inserts Above and Below Switch-Operating Handles are Mounting Provisions for the Federal Pacific Portable Remote Operating Mechanism (PROM), Which is Available as a Separately Purchased Accessory, to Allow Switches to be Operated from an Adjacent Location and Thereby Mitigate the Effects of any Potential Arc-Flash Hazard (see Page 8).*

*Figure 11. The Auto-jet® II Load-Interrupter Switch (rated 600-amperes continuous) in Bay 11 is the bus-tie switch between the two incoming sources that enter the switchgear through Bay 1 and Bay 19. If either source is lost, the associated main fused-switch is opened, non-critical loads are shed, and then the bus-tie switch can be closed to pick up the most critical loads on each bus section. Key interlocks among the switches in these three (3) bays insure that the sequencing of opening and closing the various switches is matched to the ability of the remaining circuit to carry the connected load.*



*Figure 12. Extending across the entire rear of the switchgear assembly are full-height sheets of GPO-3 grade red fiberglass. These insulating sheets, installed with non-metallic hardware, provide isolation of the metal switchgear surfaces from adjacent energized components that are located in the vault where the equipment is installed.*

# **Features on H2241A**

## **Standard Features**

- 11-gauge Steel Enclosure, Roof, Doors and Lifting Brackets
- Clear Polycarbonate Viewing Windows – Allow Inspection of Interior and Switch Position
- Heavy, Cast-Aluminum Housing over Switch-Handle Mechanism
- Cast-Aluminum, Padlockable Door Handles
- Air Vents (Indoor Type) at Top and Bottom at Front and Rear of Each Bay
- Removable Plates on Each End Bay Provide Provisions for Future Bus Extension
- Auto-jet® II Load-Interrupter Switches
- Current-Limiting Fuses
- Mechanical Interlocks Between Switch and Door to Prevent Opening the Door if the Switch is Closed and Closing the Switch if the Door is Open
- Interior Perforated-Steel Screens Over Switches
- Interior Perforated-Steel Screens Over Fuses Associated with Incoming Main Fused Switches
- Insulating Red GPO-3 Fiberglass Barriers Provide Phase-to-Ground and Phase-to-Phase Isolation for Switches and Fuses
- Copper, Silver-Flashed Ground Bus is Continuous Throughout all Bays
- Cycloaliphatic Epoxy Insulators
- Three-Point Door Latches
- Self-Latching Door Holders
- Bumper Gasket on Door-Opening Flanges Prevent Metal-to-Metal Impact with Doors to Protect Finish
- Three Stainless-Steel Hinges and Stainless-Steel Hinge Pins Per Door
- Storage Pocket for Spare Current-Limiting Fuses on Door of Each Bay Containing Fuses
- Provisions on Every Manual Switch-Operating Handle to Accommodate the Federal Pacific Portable Remote Operating Mechanism (PROM), see Page 8, Available as a Separately Purchased Accessory

## **Feature Unique to this Line-Up**

- U-Shaped 19-Bay Arrangement
- Split-Bus Primary-Selective Circuit Configuration
- Insulating Red GPO-3 Fiberglass Sheets Across Entire Rear of Switchgear Assembly
- Power Monitoring Meter on each Bus Section
- 1200-Ampere Silver-Flashed Copper Bus
- 1200-Ampere Main Auto-jet® II Load-Interrupter Switches
- 1100E Amperes Current-Limiting Fuses on Main Switches
- Key Interlocks on Main Switches and Bus-Tie Switch to Prevent Paralleling the Two Incoming Sources
- Fully Insulated Main and Tap Bus with Insulating Sleeving and with Insulating Boots or Insulating Tape on Bus Joints
- Corner Transition Bays
- PVC Tubes for Reverse Cable Exit on Some Bays

## Mitigate Exposure to Arc-Flash Hazards

Federal Pacific has developed a line of CO<sub>2</sub>-Actuated, Portable Remote Operating Mechanisms (PROM), which are purchased separately as an accessory. The PROM accessory permits operation of manual switches from an isolated location outside the Arc-Flash Boundary Zone. PROM units make it possible to bring arc-flash mitigation to every installation of Federal Pacific manually-operated switchgear. These PROM units are available for application on Metal-Enclosed Switchgear rated through 38kV and on Pad-Mounted Switchgear rated through 38kV.

Provisions to connect the PROM are already included on new switchgear assemblies. The provisions can also be retrofitted on installed units of Federal Pacific Metal-Enclosed Switchgear. The PROM for Federal Pacific Pad-Mounted Switchgear mounts directly over the switch operating-handle pocket without requiring any modifications and without requiring any tools.

Simply (1) install the air cylinder over the manual operating handle (provisions already provided on recently shipped switchgear and can be retrofitted onto any installed Federal Pacific unit), (2) connect the 50 feet of hose, which have quick-release connectors, to the air cylinder and the CO<sub>2</sub> tank, (3) roll the CO<sub>2</sub> tank (extending the hose) to an adjacent location and (4) open the valve. On release of the compressed air, the switch operates immediately and can be opened or closed.

Personnel no longer have to stand in front of the switchgear when opening and closing switches. Personnel are outside the arc-flash boundary and the PPE required is minimized.

Contact Federal Pacific to obtain a DVD video that shows how to connect and operate the PROM.



*Figure 13. Portable remote operating mechanism available from Federal Pacific can be mounted over handle on switchgear stile and operated from a distance of up to 50 feet to open and close the switch using compressed air or CO<sub>2</sub>. Similar arrangements are available for pad-mounted switchgear.*



*Figure 14. Metal-enclosed switchgear (and pad-mounted Switchgear not pictured) is shown equipped with a Federal Pacific portable remote operating mechanism on the bay at right to allow operation from a distance of up to 50 feet using compressed air or CO<sub>2</sub>.*

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