LET'S BE PACIFIC™

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Lean Manufacturing and Kaizen Teams Increase Efficiency of Pad-Mounted Switchgear Assembly

Over the past several months, the pad-mounted switchgear assembly line at Federal Pacific has undergone a dramatic change in appearance, as shown by the "before" and "after" photos below (Figures 1 - 4). The assembly line has been re-engineered with a more efficient layout, improved inventory management system, an improved material handling process, improved work-flow, and improved factory lighting.

The change has been from a less structured environment with excess motion, to an efficient streamlined directly fed layout where parts are easy to find and excess motion is greatly reduced. The change is certainly more visually appealing, but the process changes have been much more than skin deep.

Before these improvements, the available switches (Figure 5) and the available switchgear enclosures (Figure 6) didn't always match up. Switch and enclosure production were based on separate schedules, not process demand. This lack of production coordination at Line Power led to mismatch rates as high as 50% when received at Federal Pacific, creating delays and losses in production efficiency.

Figure 1 Before *– The crowded main forklift aisle accommodated both vehicular and personnel traffic. Active material was stored, and subassemblies were built, at left, across the aisle from the assembly line (at right of picture).*

Figure 2 After *– The forklift aisle relocation is complete. Only slow-moving inventory remains on the left (background) with sub-assemblies now adjacent to the assembly line. Walkways are marked in blue and lined as separate from the forklift aisle.*

Figure 3 Before *– A view of the pad-mounted switchgear assembly line (to the right of the forklift aisle) is unmarked and without apparent order.*

Figure 4 After *– The work-station positions (stages) in the pad-mounted switchgear assembly line are clearly marked, with provisions to remove units from the line, if necessary, to avoid production bottlenecks.*

Figure 5

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Figure 6

Background

This change process in the Pad-Mounted Switchgear line at Federal Pacific began with an opportunity for improvement (sometimes known as a "problem") in the production flow. Federal Pacific was experiencing a mismatch between (1) the switches and fuse mounting parts when paired with (2) the required enclosures, all of which are supplied by our cross-town sister division, Line Power. The switchgear could not be assembled at Federal Pacific without these two key sets of components (as well as other required parts) meeting up, on time, at the correct assembly locations on the production line. The identified in-process mismatch rates occasionally reached as high as 50%, resulting in delays and production inefficiencies.

The method used to attack this issue was to utilize tools of lean manufacturing by way of cross-functional Kaizen teams of associates from the affected production areas, supporting departments, engineering, and other areas of the company, all overseen by Fred Holt, our internal expert in lean manufacturing processes.

The Lean Manufacturing Process Model

Lean manufacturing is a business process model that stresses the elimination of waste, which is defined as any activity that does not add value for the customer. The lean manufacturing system focuses on reducing the lead time to the customer through elimination of waste. Process, manpower and material stability are key to delivering a quality product to the customer on time.

A key improvement tool used at Federal Pacific and Line Power to achieve these process improvements is through the use of cross-functional ***"kaizen" teams*** in order to get a broader view of the existing situations and potential improvements. ***Kaizen*** (roughly translated as "good change") is often thought of as incremental process improvements, but it may also refer to more targeted, often time-bound, "kaizen events" to address specific process improvements.

The goal of the Federal Pacific (EMC) Pad-Mount Value Stream is to achieve the "lean manufacturing" objective of reducing the lead time to the Customer by eliminating waste. This goal was addressed through the following three key leverage points in the process:

Leverage Point		Opportunity for Improvement
Inventory	➔	Control and reduce the parts inventory Use pull vs push process Eliminate multiple schedules
Parts Availability	➔	Change the way parts are ordered Use Kanbans vs business operating system (defined on page 3)
Changeover Time	➔	Reduce batch sizes

The first step in the process was to address the switch assembly shop at Line Power, where the Auto-jet® switches and fuse mountings, along with the associated sub-assemblies and parts, are produced. A series of "kaizen events" were used to improve the process, reduce work in process, eliminate multiple schedules, and to kit parts.

In addition, one of the tools in transitioning from a scheduling-based production system (pushing the production) to a demand-based production system (where usage pulls production to support actual needs) is the use of a "Kanban" system. The Kanban approach is based on the model of a supermarket, where the shelves are restocked, based on customer usage, creating a demand on the supply chain. As stock of an item on the shop floor is depleted from its Kanban bin (literal or figurative), a Kanban card (physical or electronic) is generated which signals the need to replenish that item, creating a demand on the logistics system. Typically, there are one or two bins used as a buffer, depending on the lead time for that item.

Kaizen Events

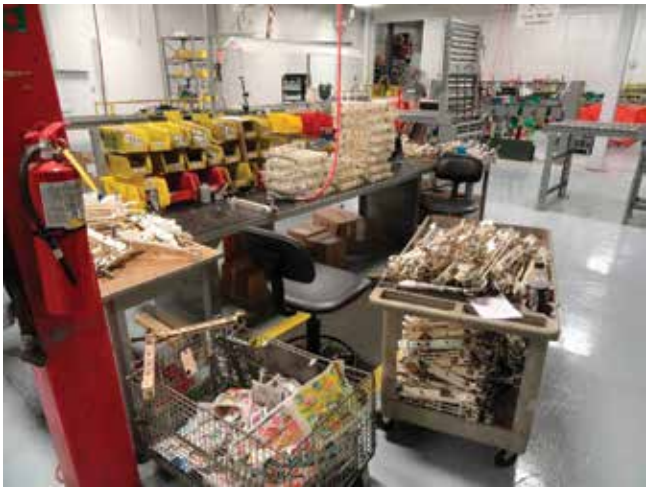

Figure 7 Before *– Push production in blade assembly area, resulting in an excess of and potential damage to, in-process material.*

Figure 8 After *– Production based on need ("pulled" by the next process), resulting in less in-process inventory while better meeting production needs.*

1) Reduce operational wastes at fuse-mount and contact-assembly production line at Line Power

Actions
Consolidated assembly from two physically separated locations to one streamlined work flow to reduce wasted motion

Results
61% footprint reduction of assembly area
83% inventory reduction
50% cycle time reduction

2) Reduce wastes involved with puffer, pump and blade assemblies at Line Power (Figures 7 and 8)

Actions
Reduced cycle time by eliminating various motion wastes

Eliminate scheduled production by switching from Push (arbitrary, schedule driven) to Pull (demand driven – "maintain a supermarket" / "stocked shelves")

Reduce Inventory through fixed inventory lanes (when the lane is full, stop producing

Improve process flow and work in process by moving puffer assembly next to pump assembly

Results
33% footprint reduction

36% inventory reduction

Cycle time reductions ranging from negligible to 60%, depending on item

Quality improvements due to reduced in-process (handling and storage) damage

Kaizen Events

3) Implemented "Signal Process" to coordinate production of Equipment Cases with associated internal components (switches, fuse mounts, and fuse contact assemblies) at Line Power (Figures 9 and 10)

Actions
Eliminated multiple schedules by using Google Docs.

Fabrication of an enclosure drives the production of switches, fuse mountings and fuse contacts needed to complete a particular unit of pad-mounted switchgear by serial number.

Completed switches, fuse mountings and contacts are transported together as a kit, by unit serial number, with the respective enclosures, from Line Power to Federal Pacific.

Results
30% Inventory Reduction

Motion wastes and assembly delays were virtually eliminated

Better coordinated production of components with actual process demand

Reduced in-process inventory of finished components

Figure 9 *– Fabrication personnel enter the serial number applicable to the enclosure, driving switch assembly to begin production of the required major components.*

Figure 10 *– Monitors in the switch assembly shop show the enclosures being completed. This provides the "schedule" for producing switch and fuse component assemblies that are to be installed in those specific enclosures.*

4) Implemented "Orange Carts" for kitting Switches, Fuse Mounts and Fuse Contacts by unit serial number for transportation from Line Power to Federal Pacific (Figures 11 and 12)

Actions
Switches, Fuse Mounts and Fuse Contacts are placed on custom-designed orange shipping carts at Line Power, matched to the switchgear serial number

Both the Orange Cart and the associated switchgear enclosure must be shipped together, by serial number, from Line Power to Federal Pacific

Results
Inventory reduced 50% at Federal Pacific

Motion Waste & Assembly Delays at Federal Pacific associated with missing or mismatched parts are virtually eliminated

Figure 11 Before *– The switches, fuse assemblies and contacts were produced in batches and stored accordingly*

Figure 12 After *– Switches and fuse components are produced as needed and are associated with a specific, serially numbered enclosure, by customer job order*

Kaizen Events

5) Implemented "parts kitting" of major components (other than switches and fuse components mountings) by the serial number of the pad-mounted switchgear to be built at Federal Pacific (Figures 13 -16)

Opportunities
Improve the average production rate

Inventory not properly allocated and sometimes difficult to locate when needed

Actions
Kitted parts by serial number to match up with specific enclosure

Instituted Kanban system to ensure adequate and appropriate inventory of required parts when needed

Expectations
Eliminate waste and balance line so that production throughput is improved by 20%

Improve inventory control and tracking

Results
This process change was recently implemented

Results are being accumulated

Figure 13 Before *– Loosely controlled randomly located parts inventory resulted in searching for needed parts.*

Figure 14 After *– Kitting area, using Kanban stocking system.*

Figure 15 After *– Area manager updates the system to display serial numbers of completed parts kit carts, which appear on the monitor.*

Figure 16 After *– Parts kit cart is matched to its associated enclosure on the assembly line.*

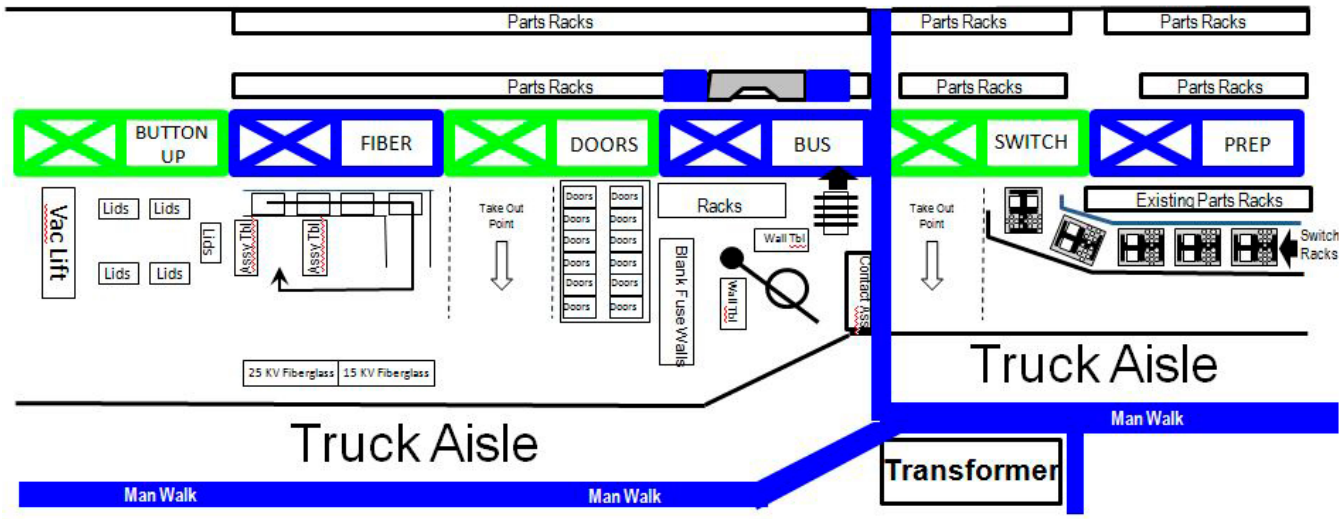

Figure 17 – New layout of the pad-mounted switchgear assembly line (units travel right to left) with components feeding into the six-stage assembly line (prep, switch, buss, doors, fiber, and button-up). After these assembly processes are completed, and the roof has been installed, the completed unit then moves into the test area.

Figure 18

After the Lean Manufacturing improvements, the orange carts (Figure 18) carrying the switches, fuse mounts and contacts are now aligned with the enclosures by serial number. As a result, there is a noticeable reduction of enclosure inventory at Federal Pacific (Figure 19), as well as an overall decrease of in-process stock, while achieving an overall increase in availability.

Figure 19

Kaizen Teams At Work

Figure 20 *– Kaizen programs are a true team effort. The collage above shows just a few of the team sessions that occurred while the pad-mounted switchgear line (and the component assembly lines) was thoroughly revamped.*

Through the ongoing process of continuous process improvement and lean manufacturing techniques, Federal Pacific expects to further increase the throughput capability of the pad-mounted switchgear line by an additional 30% over the 20% improvement already described in this newsletter. These process improvements will allow Federal Pacific to maintain the best lead times in the industry, while, at the same time, maintaining and improving the quality of our switchgear products.