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PR Plant Online Finishing Design and Concept Study

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Summary of Improvements

The purpose of these upgrades is to increase product output while reducing the required manpower to process the additional load. The additional products will include all of the products from the TR plant and the addition of the Mine truck hood and fenders which will also receive a final basecoat processed through the same paint system as the current primer.

In order to achieve these goals, we propose to move all repairs, sanding, finesse, and touch up painting from segregated offline workstations located in the unload area to an online deck located after the paint system. The addition of online finesse will dramatically increase productivity by utilizing all available manpower on each product. This is in contrast to the existing system in which manpower is only utilized when a designated part enters a segregated workstation.

This section summarizes the process flow improvements and additions we propose to implement.

Inspect and Finesse Deck
All existing Inspection and Finesse operations are to be moved from the current unload area to the new Inspect and Finesse Deck located online immediately following the paint system. All parts exiting the paint system are processed in the new deck.

With the new location of these operations, parts will now follow a logical route through the facility. Parts will no longer be routed to unload stations only to be reloaded for further processing. Parts that require an additional coat of primer are routed back to the paint system, those that require further repairs are routed back to the Finesse deck, parts requiring basecoat paint are routed to the basecoat bank, and finally parts that are ready for shipping are routed to the unload area.

INSPECT FINESSE DECK HIGHLIGHTS

- Recirculating air handling unit with two stage filtration, cooling coils, fresh air intake, and an intake air heater to maintain a clean and comfortable work environment
- Multiple zones for dedicated operations
- Multi level and adjustable deck system to gain access to various areas of the part
- Filtered return air slots in the floor to capture sanding dust
- Lean rails for ergonomic access to various areas on the part
- High and low level lighting
- Ergo-Mat's throughout the Deck for a comfortable environment (Optional)
- Continuous tool rail which all tools (sanders, spot heaters, etc.) will be attached (Optional)
- Removable tool shelves at workstations for supplies and tools (Optional)
- Multiple compressed air drops throughout the length of the Deck for tools (Optional)
- Multiple electrical outlets for hand lighting and heat guns

Post Inspection Routing
After parts are processed through the Inspection and Finesse Deck, they are processed for further routing based on the part type and condition. Some parts will require a second coat of primer, while others will require final basecoat paint.

ROUTING OPTIONS

1. Back to the paint system for a second coat of primer: this is required for all CC hoods that have received one coat of primer and parts that received extensive repairs and require additional primer as determined by the final inspection in the Inspect Finesse Deck.
2. Unload area for packing: all parts that have received their final application (primer or basecoat) and passed the final inspection in the Inspect Finesse Deck are routed to the unload area for packaging.
3. Finesse Deck for further repairs: parts that require additional repairs that have not been completed in the Inspect Finesse Deck are routed back to the Finesse Deck.
4. Basecoat accumulation bank waiting for basecoat batch process.

Basecoat Accumulation Bank
In addition to the Online Finishing scope, further modifications to the Basecoat painting process are required; these are not covered in this scope.

New parts will be introduced in the paint system that requires both prime and basecoat paint (currently Mine truck hoods and fenders). This is accomplished by processing the part through the system for a prime coat, and then returning the part to the system for basecoat.

After a part is primed (including all prime repairs) it is routed to the basecoat accumulation bank awaiting basecoat paint. Once the accumulation bank is full, the system switches to basecoat mode and the parts are routed back to the paint system for a final basecoat. Before the parts can be routed out of the bank, new primed parts must stop entering the paint shop. Instead, they are routed to accumulate in the miscellaneous accumulation bank.

Miscellaneous Accumulation Bank
In addition to the Online Finishing scope, further modifications to the Basecoat painting process are required; these are not covered in this scope.

This accumulation bank will be used to queue parts awaiting prime paint while the system is running in basecoat mode. When parts are shuttled out of the basecoat accumulation bank, all parts awaiting primer must stop entering the system and instead will be routed to this accumulation bank.

In addition, we will use these lanes to accumulate carriers when a press operator releases empty carriers for various reasons including press operation equipment malfunction. Currently these carriers either backup at the press station causing delays at other press stations or travel through the paint shop before returning to the press operators. Empty carriers within the paint shop cause delays and excessive material waste – paint, heat losses in the ovens, etc.

Loading Stations
In addition to the Online Finishing scope, further review and modifications to the loading stations in the press areas may be justified in order to reduce double and triple handling of parts. Although this is not part of this scope of work, we believe a substantial savings may be realized by reviewing and modifying these processes.

- There are situations when an operator must release empty carriers belonging to a different load operator in order to access carriers belonging to their station.
- At times press operators release empty carriers for various reasons that are not related to equipment malfunctions. These empty carriers travel through the paint shop causing delays and material waste. We propose to install a bypass to re-route empty carriers back to the press stations.

Conveyor Scope and Design

This section summarizes the process flow logic and provides a detailed description of the modifications proposed in our scope.

Detailed Conveyor Sequence

Below we provide a list of each conveyor unit installed along with a detailed description of the rack sequence through the conveyor unit.

The sequence numbers provided refer to the sequence numbers provided on our conveyor layout (attached.)

01 – POP UP TRANSFER CONVEYOR

Provide (1) pop-up transfer conveyor to transfer a painted rack from Paint to the new accumulation conveyor Unit 02.

02 – NARROW ACCUMULATION CONVEYOR

Provide (1) 34 foot long accumulation conveyor. This conveyor will transport the rack from the paint unload pop-up transfer to the Unit 03.

03 – 90 DEGREE TURN TABLE CONVEYOR

Provide and install (1) 90 degree rotating conveyor. This conveyor will transport painted racks from Unit 02 to Unit 04 or it will act as a transfer to allow for a repaired rack to be transferred from Unit 24 back into the finesse line.

04 – TWO STRAND RACK TRANSFER CONVEYOR

Provide (1) 9 foot long transfer conveyor to conveyor a painted rack from Unit 03 turntable to Unit 05 turntable.

05 – 90 DEGREE TURN TABLE CONVEYOR

Provide (1) 90 degree rotating conveyor. This conveyor will transport painted racks from Unit 04 to Unit 08 to allow for entry into the west finesse deck, or it will act as a transfer to allow a rack to transfer to Unit 06 turntable.

06 – 90 DEGREE TURN TABLE CONVEYOR

Provide (1) 90 degree rotating conveyor. This conveyor will transport painted racks from Unit 05 turntable to Unit 07 to allow for entry into the east finesse deck

07 – TWO STRAND RACK TRANSFER CONVEYOR

Provide and install (1) 9'-6" two strand chain conveyor to transport a rack from Unit 06 turntable to Unit 09 east finesse deck production conveyor. This unit will require a VFD for a two speed transfer. Transferring a rack from Unit 06 will be fast speed while transferring a rack on Unit 09 will be slow speed at 8ft/min.

08 – TWO STRAND RACK TRANSFER CONVEYOR

Provide (1) 9'-6" two strand chain conveyor to transport a rack from Unit 05 turntable to Unit 10 west finesse deck production conveyor. This unit will require a VFD for a two speed transfer.

Transferring a rack from Unit 05 will be fast speed while transferring a rack on Unit 10 will be slow speed at 8ft/min.

09 – 8FT/MIN NARROW PRODUCTION CONVEYOR

Provide (1) 149 foot long production chain conveyor. This east finesse deck production conveyor will be speed set at 8ft/min. This unit will transfer a rack from Unit 07 to Unit 11. Prior to Unit 11 an operator pushbutton station will be included to select a routing to the heavy repair pull off spur Unit 19 or Re-route back to the Finesse Deck. We have included a run/stop pull cord the length of the booth for a controlled operator conveyor stop as well as an e-stop located every 50' along the booth. All controls are priced in Unit 17.

10 – 8FT/MIN NARROW PRODUCTION CONVEYOR

Provide (1) 149 foot long production chain conveyor. This west finesse deck production conveyor will be speed set at 8ft/min. This unit will transfer a rack from Unit 08 to Unit 12. Prior to Unit 13 an operator pushbutton station will be included to select a routing to the heavy repair pull off spur Unit 19 or Re-route back to the Finesse Deck. We have included a run/stop pull cord the length of the booth for a controlled operator conveyor stop as well as an e-stop located every 50' along the booth. All controls are priced in Unit 17

11 – TWO STRAND RACK TRANSFER CONVEYOR

Provide (1) 9'-6" two strand chain conveyor to transport a rack from Unit 09 east finesse deck to Unit 14 Pop-Up transfer conveyor. This unit will require a VFD for a two speed transfer. Transferring a rack from Unit 09 will be slow speed at 8ft/min while transferring a rack on Unit 14 will be high speed.

12 – TWO STRAND RACK TRANSFER CONVEYOR

Provide (1) 9'-6" two strand chain conveyor to transport a rack from Unit 01 west finesse deck to Unit 15 Pop-Up transfer conveyor. This unit will require a VFD for a two speed transfer. Transferring a rack from Unit 10 will be slow speed at 8ft/min while transferring a rack on Unit 15 will be high speed.

13 – WIDE CROSS TRANSFER CONVEYOR

Provide (1) 43'-6" long wide cross transfer conveyor. This conveyor will transport a finished rack from the finesse deck exit pop-up transfer Units 14 and 15 to Unit 16 Pop-Up transfer. This unit will be programmed with a FIFO stack logic (First In / First Out) to track racks that are required to be transferred to the Heavy Repair pull off station Unit 19.

14 – POP UP TRANSFER CONVEYOR

Provide (1) pop-up transfer conveyor to transfer a rack from Unit 11 to Unit 13 Cross transfer conveyor.

15 – POP UP TRANSFER CONVEYOR

Provide (1) pop-up transfer conveyor to transfer a rack from Unit 12 to Unit 13 Cross transfer conveyor.

16 – POP UP TRANSFER CONVEYOR
Provide (1) pop-up transfer conveyor to transfer a rack from Unit 13 cross transfer to Unit 18 accumulation conveyor. This unit will also act as a manual insertion point to allow for an operator to insert a rack back on the line from the manual heavy repair area. Included in this area is (1) operator pushbutton station for manual control as well as a small TouchScreen to allow for maintenance manipulation of the FIFO stack.

17 – PLC CONTROL PANEL (PROJECT CONTROLS)
This unit contains all controls engineering, material, and fabrication. This pricing should be considered budget while we negotiate final pricing from local Findlay contractors previous used at Whirlpool.

18 – NARROW ACCUMULATION CONVEYOR
Provide (1) 148' - 6" long accumulation conveyor with (1) rack hold back stop. This unit will transfer a rack from Unit 16 to Unit 19 Heavy repair pull off spur.

19 – POP UP TRANSFER CONVEYOR
Provide (1) pop-up transfer conveyor to transfer a rack from Unit 18 to Unit 21 Wide Cross transfer conveyor. If the rack is scheduled to return to the Finesse deck Unit 19 will transfer a rack from Unit 18 to Unit 23.

20 – HEAVY REPAIR RACK PULL OFF STATION
Provide (1) Pop-Up Transfers. This unit will accept a rack from Unit 21 cross transfer. If the rack is scheduled to exit to Heavy repair the rack will stop at Unit 20, raise and be transferred to a gravity decline section of conveyor for removal. If the rack is scheduled for the EMS load point it will bypass Unit 20 and continue to Unit 21 rack hold back.

21 – WIDE ACCUMULATION CONVEYOR
Provide (1) 25' lg wide cross transfer conveyor. This conveyor will transport a finished rack from Units 19 and 20 and transfer a rack to Unit 22 EMS Load Station. This conveyor will be equipped with (1) hold back stop to allow for rack to be held while waiting for Unit 22 ready to transfer.

22 – RELOCATED EMS LOAD STATION
Relocate (1) EMS Unload station from it current location to the new area as shown on the layout drawing. All controls and wiring will be maintained out of its current control panel.

23 – TWO STRAND RACK TRANSFER CONVEYOR
Provide (1) 9'-6" two strand chain conveyor to transport a rack from Unit 19 Pop-Up transfer to Unit 03 turntable. This conveyor will act as the path for a rack to be transferred back to the finesse deck.

24 – DATA COLLECTION PANEL (RELOCATED BY OTHERS) NO PRICING
This unit will be relocated by plant personnel.

25 – EMS Support Post Field Modification
Relocate Support post 7 feet north. We have provided labor and material for the relocation of (1) EMS support Post.

26 – Project Management and Layout / Detail Engineering
This pricing includes a conveyor project manager, layout engineering, and equipment detail engineering.

27 –Field Installation
We will provide all field labor and material for the installation of the above referenced scope of work items. All installation work will be performed on straight time. This pricing should be considered budget while we negotiate final pricing from local contractors.

28 – Field Wiring
This pricing should be considered budget while we negotiate final pricing from local contractors.

29 – Field Air Piping
This pricing should be considered budget while we negotiate final pricing from local contractors.

Conveyor Sequence Qualifications
The following further describes the type of equipment used and additional installation notes.

01 Pop-Up transfer conveyors
Pop-Up transfer conveyors will be a pneumatic lift.

02 Pallet stops
Pallet stops are pneumatically actuated.

03 Turntables
Turntables will be pneumatically actuated.

04 Pricing
This price is based on installing the complete system less Unit 01 and Unit 22 at one time. These units will be installed at a separate system tie-in timeframe.

05 Installation
Installation is based on a 5 day 40 hour workweek.

06 Other
We have not included building penetrations where needed.

Job Spacing and Process Time

Summary
In order to determine efficient job spacing and production hours, we have to evaluate the work areas around the part to insure we have sufficient space to perform inspection, finesse, and repair operations. In addition, production hours are reviewed for the number of straight time shifts vs. reducing shifts and adding overtime hours. Minimum job spacing will be selected along with the minimum number of weekly production hours; this allows future expansion by adding production hours.

In the following table, we determine the weekly production hours and job spacing based on data provided and the existing plant conditions.

The conveyor length of 2,000 feet and annual paint rack output data is provided by PR in document *08 Facility Optimization* along with annual operating days of 238 which is equivalent to 47.6 weeks per year. This data along with a constant conveyor speed of 16.7 feet per minute (to insure we do not change the wash, paint, and cure times) is used to calculate weekly production hours based on several job spacing's. The annual production *output as indicated in the tables takes into account rack load efficiency, first time throughput efficiency, and throughput for parts requiring two applications* – CC hoods and Mine hoods and fenders.

In order to reduce the shifts to a reasonable workweek, an eleven to twelve foot job spacing is required. This spacing however is too close for efficient operations. Assuming full paint shop operations without downtime, we could produce 75 jobs per hour at 13.36 foot job spacing. Using an uptime efficiency of 93% and two shifts per day, we can expect a weekly production of 75 hours per week (93% of 80 hours) which is equivalent to 59 jobs per hour at 16.6 foot job spacing. This provides ample access to the front and back side of a rack as it passes through the system.

In conclusion, we will design our system at 75 Jobs per hour with job spacing at 13.36 feet. However, the actual operating spacing and output will be 59 jobs per hour at 16.6 foot job spacing. ***These reductions will reduce the number of personnel required to man the new system which will be ignored in order to provide a conservative analysis***.

Job Spacing and Process Time Tables

Conveyor length (ft / revolution)	2,000	Time (hrs / revolution)	2.0
Conveyor speed (ft / min)	16.7	Production time (wks/yr)	47.6

	Paint Rack Annual Output (from 08 Facility Optimization)				
Rack Type	**2008**	**2009**	**2010**	**2011**	**2012**
PR Service Racks	1,366	1,366	1,366	1,366	1,366
PR Product Racks	71,984	74,083	106,545	112,902	75,800
Total PR Racks	73,350	75,449	107,911	114,267	77,166
TR Service Racks	1,659	1,659	2,218	2,143	2,031
TR Product Racks	140,139	142,490	100,764	86,733	61,858
Total TR Racks	141,798	144,148	102,982	88,876	63,889
Total Racks per Year	215,147	219,597	210,893	203,144	141,055

		Time (hours / week)				
Spacing (ft)	**Output** (rack/hr)	**2008**	**2009**	**2010**	**2011**	**2012**
10	100	45	46	44	43	30
11	91	50	51	49	47	33
12	84	54	55	53	51	35
13	77	59	60	57	55	38
13.36	75	60	62	59	57	40
14	72	63	64	62	60	41
15	67	68	69	66	64	44
16	63	72	74	71	68	47
16.6	60	75	76	73	71	49
17	59	77	78	75	72	50
18	56	81	83	80	77	53
19	53	86	87	84	81	56
20	50	90	92	88	85	59

Note:
Paint Rack Output is taken from *08 Facility Optimization* Data which accounts for rack load efficiency, first time throughput efficiency, and double run through for CC hoods, LiRi Hoods, and LiRi Fenders.

Highlighted job spacing of 13.36 feet equates to the paint shop current maximum production of 75 jobs per hour at 60 hours per week.

Using a two shift production and a paint shop uptime efficiency of 93%, our weekly production will be 75 hours (93% of 80 hours) which will produce 60 jobs per hour at 16.6 feet spacing.

Process Time Study

A time study was conducted on July 22, 2007 at which time the MMM500 Hood and CC hoods were being processed along with some grill opening panels and MMM500 cowls. The grill opening panels and cowls are fairly simple operations taking less than three minutes in all situations.

MMM500 F2 and RR Hoods

MMM500 hood operation is divided into seven separate operations with seven persons working the Inspect Finesse and two people working load and unload – *offline operation requires 9 persons*. The process times varied considerably from product to product – even for products with similar defects.

500 Hood Operation	Max Process Time
1) 1 person unload	1.25 minutes
2) 3 person repair	7 minutes
3) 1 person paint	1.5 minutes
4) 1 person pry test	0.25 minutes
5) 1 person audit	2 minutes
6) 1 person final repair	1.5 minutes
7) 1 person shipping	1.25 minutes

There is a considerable amount of time spent repairing press and bonding defects. For example, many parts require sanding of rough edges, pits, and removal of excess bonding. These repairs require lengthy sanding operations down to the substrate followed by the application of another coat of primer and drying time before the part can be inspected.

It was also noted that a considerable amount of time is spent waiting for a part to enter a workstation before any work can be completed. This is evident by comparing the total MMM500 hoods processed per day (23,000 per year / 238 days per year) which is 96 to the production output of 75 jobs per hour, which is easily accomplished within our proposed Deck. This is equivalent to less than one and a half hours of production per day on the new work Deck.

Also, we noted there is a fair amount of time spent changing tools (sanding, painting, adtech, etc) and handling the part. For example, in order to process this part, the operator repeatedly removed an air hose from their tools and attached it to a lift to raise and lower the part. This operation takes place in each of the five stations from repair to audit.

During our time study we were informed that the parts being processed were of poor quality due to press and bonding issues. Also during our observation period, all parts were repaired within the time noted – no parts were shipped to a separate repair station.

ZZ and CC Hoods

The ZZ and CC hoods are processed in seven separate stations (each containing one person) all performing the same operations on different hoods along with two auditors to cover all seven stations – this *offline operation requires 9 persons.*

Similar to the MMM500 hood operation, there is a considerable amount of time spent repairing press and bonding defects. Specifically, all of the repairs performed on the back side of the panel were due to bonding and press defects. The amount of time spent on the back side of the panel accounted for approximately twenty-five percent of the total process time.

Also, like the MMM500 hood, a significant amount of time is spent handling each part. Each operator must walk up to the line to retrieve a part and walk it back to their workstation prior to working (some stations are as far as forty feet from the part on the rack). This along with manually flipping the part over for back side inspection and repairs is time consuming.

Remainder of TR Plant Parts and Future Parts

The remainder of the products were not in production during our time study. However, the manpower required to process these parts can be estimated based on similar products in production at the TR plant. Also, since the process times for the MMM500 and CC hoods are the longest, we can use this data to design our system.

The following table tabulates manpower processing parts at the Inspect, Finesse, Load, and Unload stations. The first three products were in production and the manpower was counted; the remaining manpower data is estimated based on similar parts in production. Finally, given the low production of the Angme and Mine fender, we assume these two products would use the same production unload lane and manpower.

Future and Current Manpower with Offline Operation

Part Name	Production Range	Current Plant	Notes	Manpower	PPY 1,000
MMM500 Hood	2008 - 2011	PR	Actual	9	23
RRR and CC Hood	2008 - 2011	PR	Actual	9	37
MMM500 F2 and F3 Cowl	2008 - 2011	PR	Actual	2	26
Mine Hood	2009 - 2012	PR	Sim to MMM500 hood	6	12.7
Mine Fenders	2011 - 2012	PR	Sim to MMM500 cowl	2	10
Angme G350 Hood	2010 - 2012	PR	Sim to MMM500 hood	6	15
Angme G350 Fender	2010 - 2012	PR	Process w/ Mine fender	0	15
Truck X Fenders	2008 - 2009	TR	Actual	0	40
R555 Fenders	2008 - 2010	TR	Actual	4	
CC Rear Quarters	2008 - 2011	TR	Actual	6	72
CC Door Surround	2008 - 2011	TR	Actual	4	70
R555 Fender	2008 - 2012	TR	Actual	6	25
L350 Deck Lid	2009 - 2012	TR	Actual	5	49
Mine GOP	2008 - 2009	TR	Estimate	2	43
R300 Box	2008 - 2010	TR	Estimate	1	24
R300 Floor	2008 - 2010	TR	Estimate	1	24
R300 Headboard	2008 - 2010	TR	Estimate	1	24
R300 Frt Door	2008 - 2010	TR	Estimate	1	24
R300 Rr Door	2008 - 2010	TR	Estimate	1	24
R300 Tonneau	2008 - 2010	TR	Estimate	1	10
RRR Quarters & Surround	2008 - 2011	TR	Process w/ another part	0	3
ZZ Hood	2008 - 2011	TR	Process w/ Angme Hood	0	20
MM500 Fender	2010 - 2012	TR	Process w/ another part	0	4.3
L350 Hood	2009 - 2012	TR	Process w/ L350 Roof	0	6
L350 Fender	2009 - 2012	TR	Estimate	1	12
L500 Roof Filler Panel	2009 - 2012	TR	Estimate	2	30
Total				**70**	**643**

Notes:

Manpower identifies current and estimated manpower required at the processing lane for the given part.

PPY 1,000 is the approximate number of parts processed in thousands.

CC Includes two indirect auditors which will be used on our new new Finesse enclosure.

MMM500 and CC Hood Time Study Data

CRCR Hood

7 Person Operation (excluding unload and reload)

1.25 min Unload and Reload - 1 operator each operation with lift

Repair Station Totals - 3 Operators per Repair, 10 Samples

Operator	1	2	3	4	5	6	7	8	9	10	Avg	Max
Op 1	1.7	2.0	2.1	1.7	2.5	1.0	1.2	1.2	2.0	1.7		
Op 2	1.2	1.5	2.5	1.5	2.0	0.8	1.0	1.2	1.7	1.5		
Op 3	1.2	1.5	2.2	1.2	1.7	0.8	1.0	1.2	1.2	1.5		
Repair (total)	4.0	5.0	6.8	4.3	6.2	2.7	3.2	3.5	4.8	4.7	4.5	**6.8**
Spot Paint	0.9	0.8	1	0.9	0.9	1.2	1.4	1.3	0.7	1.1	1.0	**1.4**
Audit	2	1.7	2.1	1.8	2.1	1.8	1.5	2	1.9	1.8	1.9	**2.1**
Final Repair	1.1	1	0.5	1.1	1.1	1.5	1.2	1	1.1	1	1.1	**1.5**
Total											8.5	**11.8**

CC Hood

9 Person Operation - 7 workstations, 2 auditors

0.25 min Unload and Reload - 0 additional operators

Repair Station Totals - 1 Operator per Repair, 7 Independent Operators, 10 Samples each

Operator	1	2	3	4	5	6	7	8	9	10
op 1	2.0	3.9	5.3	6.5	4.0	4.0	6.0	5.3	4.7	4.5
op 2	5.3	7.6	9.5	10.5	5.3	9.7	6.3	5.0	7.5	7.3
op 3	4.2	4.5	2.5	1.9	2.2	7.6	6.0	2.2	4.1	3.8
op 4	3.4	0.7	3.2	2.7	2.3	5.0	3.1	4.5	3.3	3.0
op 5	3.3	6.8	5.2	4.9	5.8	4.4	4.5	1.9	4.7	4.5
op 6										
op 7										

CC Hood Operation Times

Operation	Avg	**Max**
Repair (total) - this time includes spot repair, paint, audit, and final repair	4.7	**10.5**
Spot Paint	1	**0.0**
Audit	1	**0.0**
Final Repair	1	**0.0**
Total	7.7	**10.5**

Conclusion

Production Rate and Spacing

We will design the new system using a conveyor speed of 16.7 feet per minute (to insure we do not change the wash, paint, and cure times), 75 Jobs per hour with job spacing at 13.36 feet; this will allow for maximum expansion with no plant down time and a weekly operating time of 62 hours. The actual operating conditions will be adjusted for an uptime efficiency of 93% and two shifts per day. This allows for weekly production of 75 hours (93% of 80 hours) which is equivalent to 59 jobs per hour at 16.6 foot job spacing. ***These reductions will reduce the number of personnel required to man the new system which will be ignored in order to provide a conservative analysis***.

As noted in "*Job Spacing and Process Times*", the production rates include *rack load efficiency, first time throughput efficiency, and throughput for parts requiring multiple applications*. In addition, as noted above, we have accounted for plant down time in our actual production setup of 59 jobs per hour.

Process Time and Deck Length

During our study we observed a maximum repair time of approximately 12 minutes on the MMM500 hoods with an average repair time of 8.5 minutes. This part requires the longest time to process and therefore we will base our process times on this product. In order to ensure future expansion and ensure that excessive part defects can be handled online, our new Inspect and Finesse Deck will be sized with approximately 50% of additional length with emphasis placed on the repair stations.

Manpower Reduction

Continuing to use an offline process will require approximately 70 persons to Inspect, Finesse, Unload, and pack parts. This does not account for hi-low operators, shipping and warehouse etc. as this process will not change. Conversion to an online system will use approximately 12 persons in the Inspect and Finesse Deck, and 6 persons in the unload and packing area for a total of 18 persons and a workforce reduction of 52 persons. As noted, these data do not account for several important factors which should reduce the required manpower and time required to process each part.

CONTRIBUTING FACTORS NOT ACCOUNTED FOR WITHIN OUR REPORT

1) Elimination of empty racks within the paint shop. Currently a significant portion of the racks processed within the paint shop are less than full or empty. These inefficiencies contribute to personnel hours by adding to delay times between part processing.

CONTRIBUTING FACTORS ACCOUNTED FOR WITHIN OUR REPORT

1) Rack load efficiency – currently racks are submitted to the paint shop empty which causes delays and gaps in the line. We propose to eliminate these which will increase paint shop efficiency.

2) Multiple paint application requirements (double prime, prime/paint, etc.) All data within this report includes process time for second coat primer applications and the addition of basecoat painting after primer.

New System Design Summary

- Conveyor Speed 16.7 feet per minute
- Job Spacing 16.6 feet
- Production rate 59 jobs per hour
- Production time 75 hours per week
- Existing Inspect/Finesse Time 12 minutes maximum
- New Inspect/Finesse Time 20 minutes (conservative deck length for excess capacity)

New System Process Highlights

- Cost savings due to fewer personnel due to the online method of production
- Free up additional floor space for future expansion
- Future expansion due to low production hours
- Cost savings from closing TR plant
- Utility savings due to not processing empty racks through washer, booth, ovens

Given these personnel reductions, quality improvements, and additional room for expansion, the proposed improvements will lead to considerable cost savings and could potentially free up a significant amount of floor space which can be used for future operations.