Cycle Time Reduction of D-301 Blender

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Abstract

The D-301 blender is the one that blends NC-701 with different products to produce various required compositions. NC-701 is unloaded from a truck to the blender manually and the blending process is intiated. This however has limited the availability of blender to a point where the blender can be used only if the truck is available, thus increasing the cycle time for an output from D-301. This paper proposes the introduction of a buffer storage tank D-12516 along with piping, valves, pumps and other instrumentation to reduce the cycle time of the D-301 blender.

1 Keywords

Cycle time, process optimization, instrumentation, controller, NC-701, unit based control

2 Introduction

It is proposed that the material (NC-701) from the truck be unloaded to a buffer storage tank D-12516. D-12516 will serve as a holding tank when the trucks are available to unload. The material can be transferred from D-12516 to D-301 as and when required. Material unloading from the truck will be effected by pump MP-516T. This pump could either transfer the material to D-12516 or to D-301 directly. The material stored in D-12516 can be transferred to D-301 using MP-516A pump.

The following are the two benefits that are expected out of this proposal:

- The cycle time of D-301 will be greatly reduced
- The truck waiting times can be drastically reduced resulting in lower cost
- The product stored in D-12516 can be stored and maintained at a temperature, most suited for blending

3 Overall Scheme

Below is the overall scheme for the project.

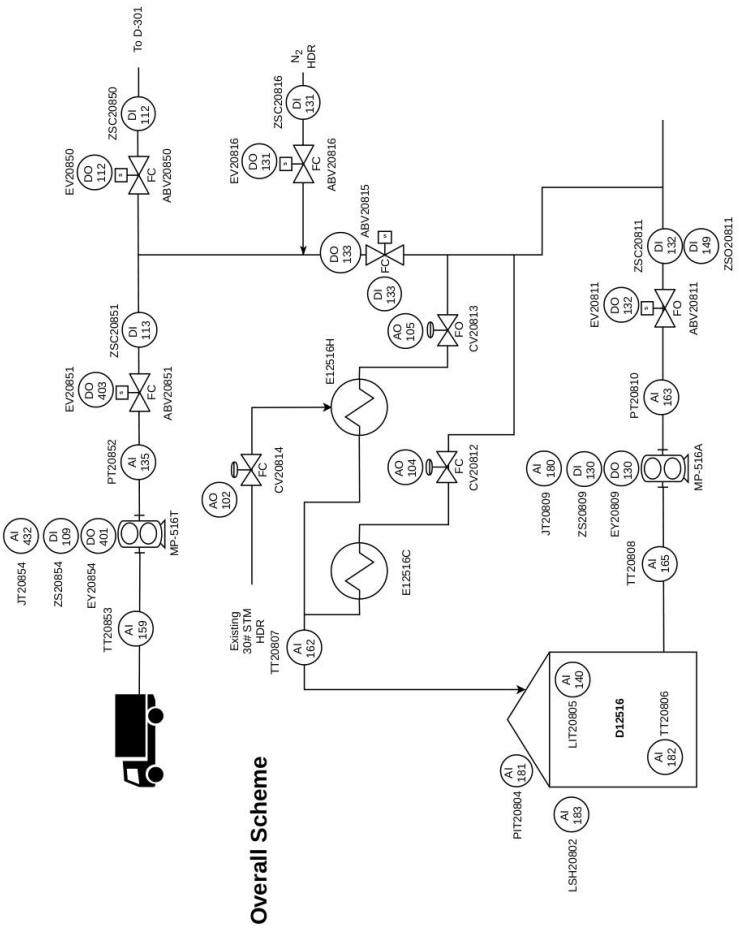

Figure 1: Schematic showing truck unloading, D-12516 tank and path to D-301

4 Process Narrative

The addition of a buffer storage tank calls for a operating procedure to unload from the truck, recycle the product (and regulate temperature, if required) and transfer to D-301 when required. It should also specify when a direct transfer from tank truck can be initiated toward the blender D-301. The following section details the process narrative using state based (or unit based control). :width 15cm

4.1 State based control

The following is the abstract from the white paper presented by David A.Huffman on benefits of State Based Control.

> State Based Control is a plant automation control design based on the principle that all process facilities operate in recognized, definable Process States that represent a variety of normal and abnormal conditions of the process. State Based Control, implemented with the latest developments in object-based technologies, delivers direct benefits to its adopters in a variety of Operational Excellence categories. It results in productivity increases, higher asset utilization of both people and process, automated responses and recovery for abnormal conditions and provides an environment for knowledge capture directly into the control design.

The proposal intends leverage the State Based Control scheme for this implementation. The various steps involved in control and operation of the plant are listed below:

1. Maintenance Wait
2. Process Wait
3. Recycle
4. Transfer
5. Unload
6. Direct Transfer
7. Line Clear

4.2 Steps

4.2.1 Maintenance Wait

In this step, the instruments and the control system are in maintenance.

All the process valves will assume thier safe state. The outputs from the control sytem will be in Fail-safe state. All (or most) of the instruments are in de-energized state. Most of (or all non-critical) the alarms are disabled in this step.

4.2.2 Process Wait

This is the step in which all the instruments, valves and the control system remain energized. The plant is preparing for start up.

The maintenance/operation team should ensure that all (or almost all) instruments and valves are in healthy condition. Most of the alarms are enabled in this step. Maintenance/operation would look of instrument out of service alarms. If any of the devices are in "out-of-service" state, they should be fixed and put in service for a effect a start up.

4.2.3 Recycle

During the recycle step, the temperature of the product can be controlled, if required. NC-701 is ideal for blending when its temperature is around 45 degree Celcius. NC-701 is a highly viscous liquid which needs to be agitated periodically to maintain consistency of the product.

During the winter months, the product temperature drops because of ambient tempertuare. In order to compensate and supplement heat to the product, NC-701 can be passed through a heat exchanger in order to raise its temperature. The NC-701 would pass through the tube side of the exchanger. The shell side would pass a 30 barg steam from the plants' existing steam header. The flow rate of NC-701 through the heat exchanger E-12516H can be effected by throttling the control valve CV-20813. If the product temperature drops, the steam control valve CV-20814 should approach 100% open position while the CV-20813 should approach around 50% of opening. The best ratio of opening the steam line vs opening the NC-701 line should be ascertained during operation / trail run for utmost efficiency

During the summer months, the product temperature could go way beyond the desired setpoint and might require cooling before being blended. For this case, we can close CV-20813 and also the steam valve CV-20814 and let the NC-701 to recycle through CV-20812. The tube side of the exchanger E-12516C would pass NC-701. The shell side would pass the cooling tower water to effect cooling of NC-701. The flow rate of NC-701 is adjusted using the control valve CV-20812 to effect the desired cooling. Note that, the cooling tower water does not have any controls on it which is unlike the steam control line which is used in the heating circuit.

4.2.4 Transfer

During this step, the material from D-12516 will be transferred to D-301 blender.

The pump MP-516A will be used to effect this transfer via the ON-OFF valves EV-20811, ABV-20815 and ABV-20850. During the transfer step, it should also be ensured that the control valves CV-20812 and CV-20813 remain completely closed to avoid any recirculation. The nitrogen purge line should also remain isolated (or closed) using EV-20816. Before a transfer is initiated, sufficient level in D-12516 must be ensured. This will prevent the dry running of MP-516A which might in turn damage the seal of the pump. D-12516 should be at least at 60% level (arbitrary value) to intiate a transfer.

4.2.5 Unload

During the unload step, NC-701 is unloaded from the truck to D-12516.

The pump MP-516T is utilized to pump the material from the truck to the tank. Since unloading requires manual connection of the unload hose to the tank truck, a signal to indicate ready-to-unload is provided by the operator. This signal will serve as a permissive to starting MP-516T pump. The material will flow via the pump MP-516T, ABV-20815 and CV-20813. Note that CV-20813 valve leads into the E-12516H heat exchanger. During unload, the steam supply to the E-12516H is shut off. The control valve CV-20813 is a fail-open valve. It should be ensured that EV-20811 and EV-20816 remain closed during the unload step.

4.2.6 Direct Transfer

During the Direct transfer step, the material from the truck is directly transferred to the D-301 blender. This is the present set up. Hence this functionality is being retained.

In order to effect a direct transfer, a signal from D-301 blender control system is required to inform that the material can be accepted by the D-301 blender. After reciept of this signal, the operator shall connect the hose to the tank truck and start the MP-516T pump for the direct transfer to happen. The NC-701 will flow through EV-20851 and EV-20850 to reach D-301. It should be ensured to close EV-20816 and ABV-20815 during the direct transfer step to avoid material flowing into the D-12516 circuit or into the N_2 line.

4.2.7 Line Clear

The purpose of line clear step is to ensure that NC-701 does not clog the line leading to the blender D-301.

The N_2 is purged by opening EV-20816 and EV-20850 valves. N_2 enters the D-301 carrying with it any residual NC-701 and leaves D-301 through a N_2 vent. Line clear operation should be carried out for a minimum of 30 minutes (arbitrary value) to ensure complete purging of the line leading to D-301. During this step, it should be ensured to close the EV-20851 and ABV-20815 to prevent N_2 from flowing elsewhere than desired.

5 Control Narrative

The control narrative will pictorically represent the process conditions that are required in each of the steps. There are no valve line up and vessel line up requirements for Maintenance Wait and Process Wait steps as there are no actions/functions.

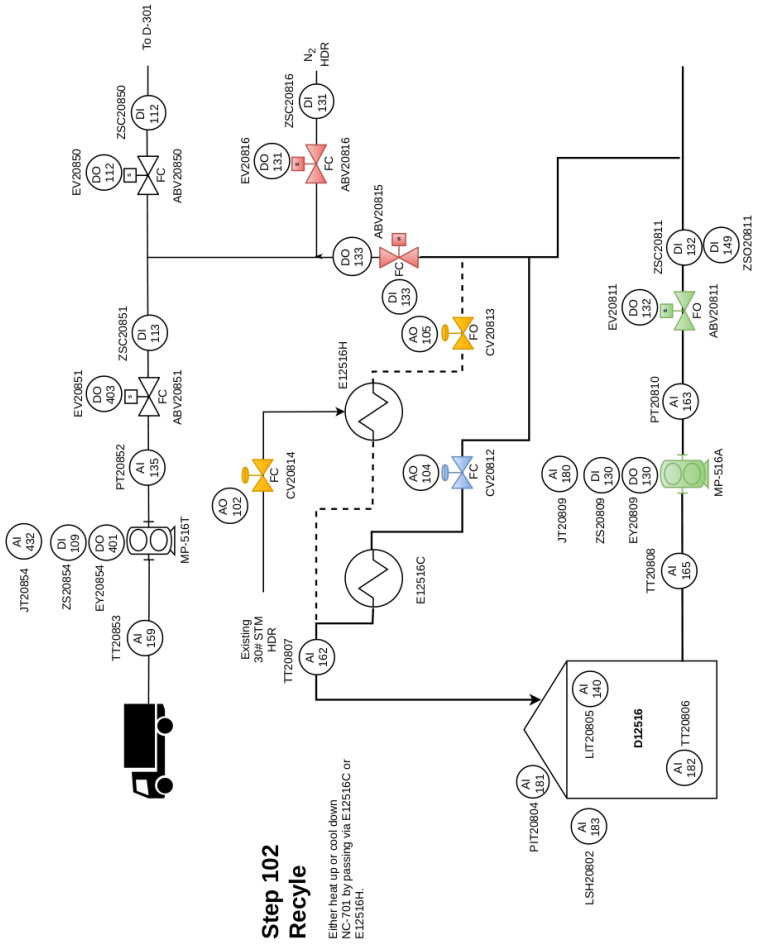

Figure 2: Recycle step

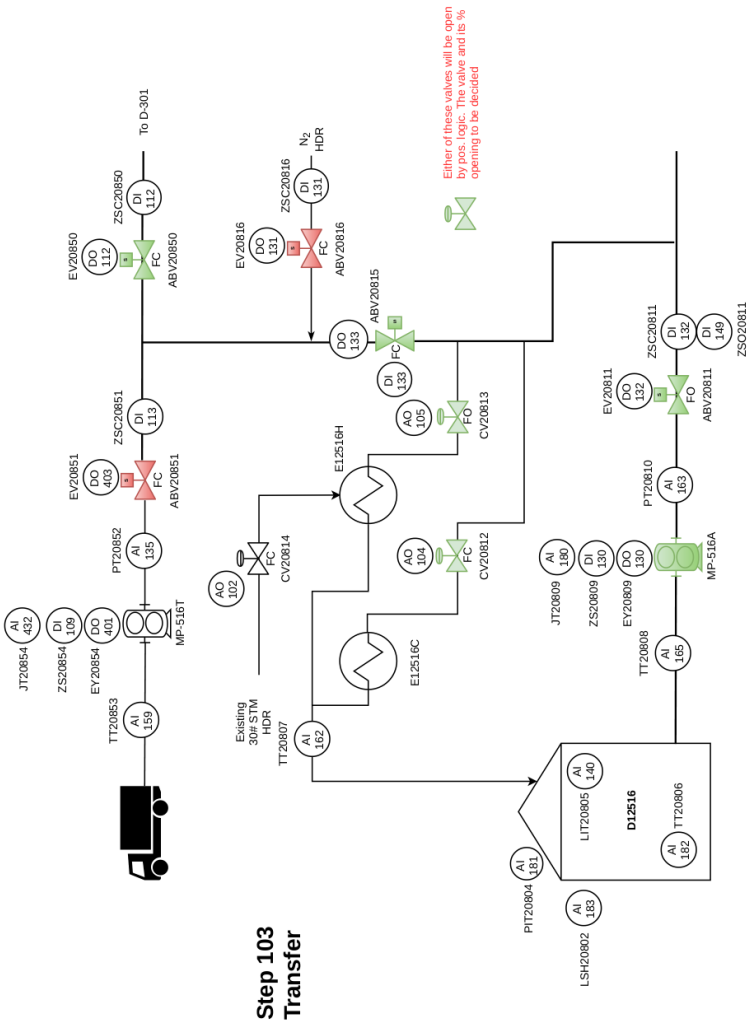

Figure 3: Transfer from D-12516 to D-301

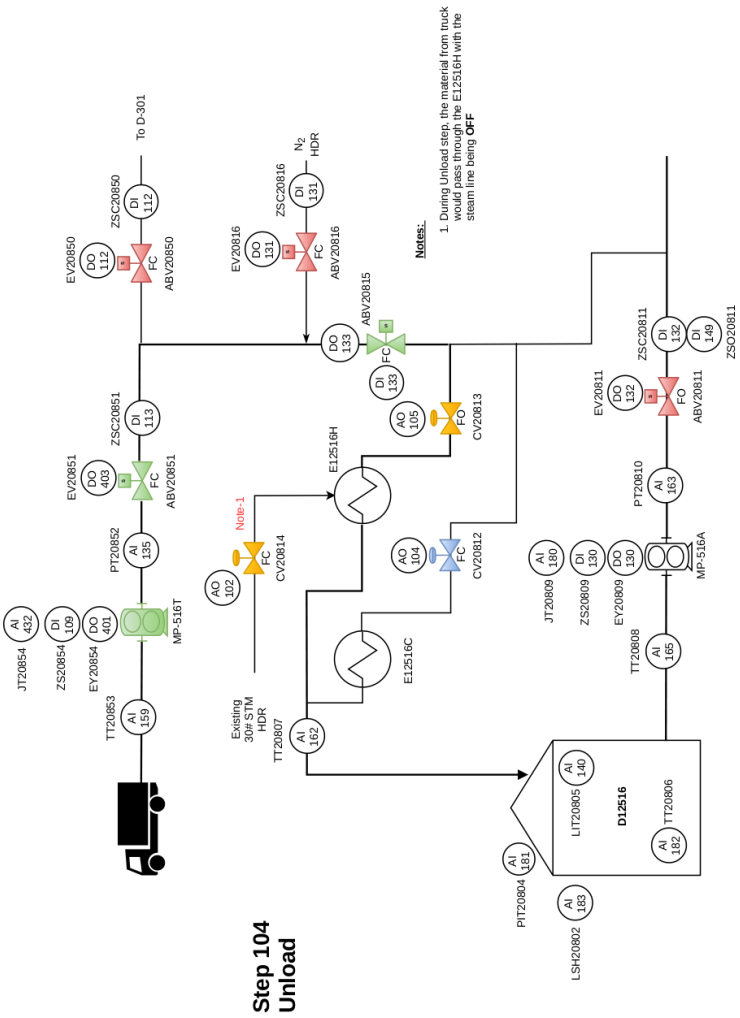

Figure 4: Unload from truck to D-12516

5.1 Recycle

5.2 Transfer

5.3 Unload

5.4 Direct Transfer

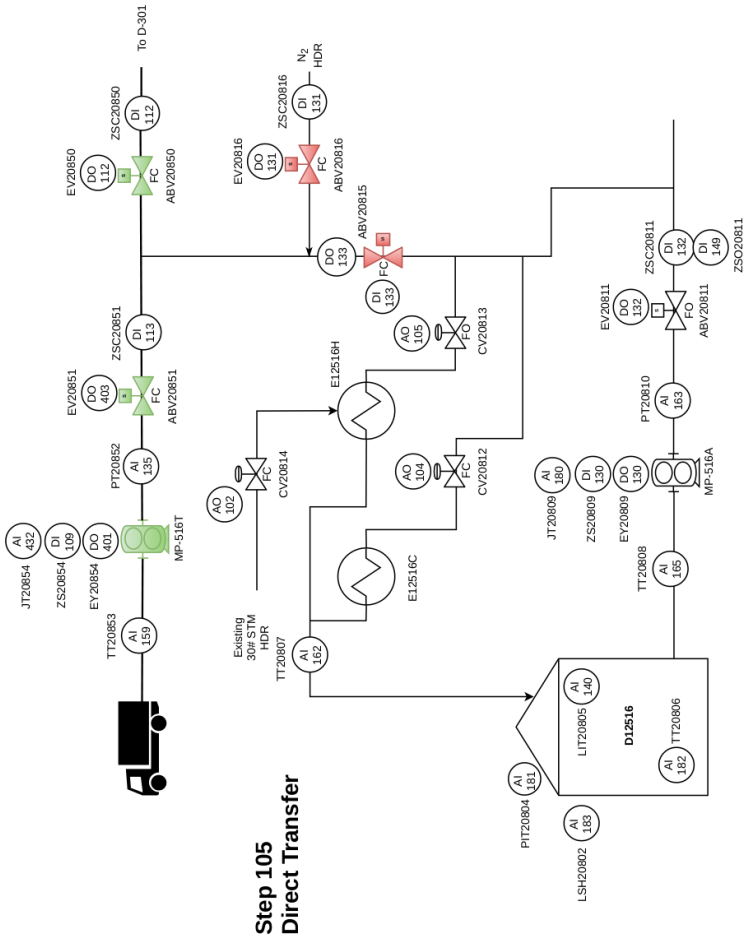

Figure 5: Unload from truck and Direct transfer to D-301

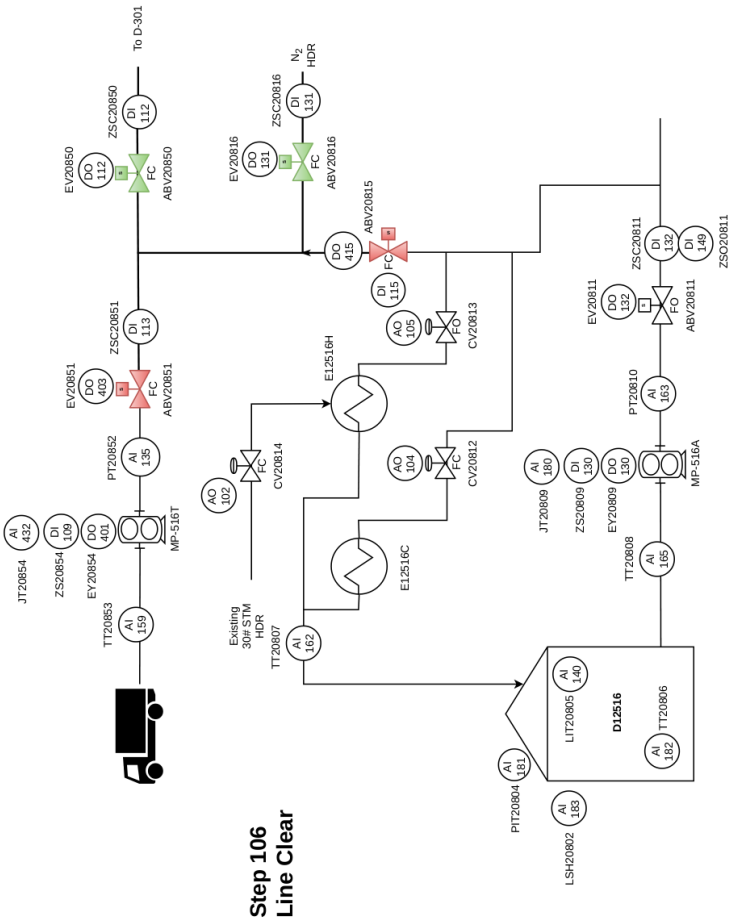

Figure 6: Line clear

5.5 Line Clear

6 Bill of Material

7 Conclusion

8 References

1. Benefits of State Based Control
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