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# MTF Helium Compressor Operations Following the March 2005 Maintenance Shutdown

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## Abstract:

Improvements in MTF helium compressor operations resulting from work performed during the March 2005 maintenance shutdown are discussed. Important tasks completed were changing the slide valves on the in-service first stage and spare compressors and calibrating the gas management valves.

## 1. Introduction

Technical Division note TD-04-053 [1] proposed changing the slide valves installed in the MTF helium compressors based on several conclusions reached by comparing operating data and manufacturer's data:

- All MTF compressors had installed VI = 3.7 slide valves.
- Changing the first stage compressor to a VI = 2.6 slide valve would significantly reduce the motor current and allow the motor to run at a more constant current over the normal operating pressure range.
- The fully loaded position of the first stage compressor appeared to be set low in order to keep the motor current below its full-load value. This would also limit the compressor capacity.
- Changing the second stage compressor to a VI = 2.6 slide valve would reduce its motor current, but the benefit would not be as great as for first stage.

The proposal was presented to department management in November 2004, and slide valve changes for the in-service first stage and spare compressors were approved. The plant was shut down at the end of February 2005 for this work and other maintenance work to be completed.

After shutting down, the first stage compressor fully loaded position was checked and appeared to be normal. Changing the slide valve and setting the fully loaded position would therefore not affect the compressor capacity.

Dan Mroz of Mid-States Refrigeration Supply (LaPorte, IN), with assistance from MTF operators, changed the slide valves over a two-day period in early March 2005.

The compressor skid gas management valves were also calibrated during this maintenance period. This was prompted by an observed leakage problem while warming the cold box and storage dewar in July 2004. When operating in make-up mode, PCV210 (buffers to suction) was closed, but suction pressure was 19.6 psia. When operating in recirculation mode, PCV206 (discharge to suction) was 16% open, and suction pressure was 17.6 psia. This indicated that PCV210 was open when it should have been closed. Bench testing showed this to be true. Most of the gas management valves were then calibrated, and positioners were rebuilt as necessary.

Historical data collected by the FIX32 operator interface software was used to compare compressor operations before and after the slide valve change and the gas management valve work.

## 2. Comparison of MTF Compressor Operations

One reason for changing the slide valves in the in-service first stage and spare compressors was to reduce the motor current. FIX32 data shows that this was

accomplished. Figure 1 plots first stage motor current vs. suction pressure for four months prior to the modification and two months following.

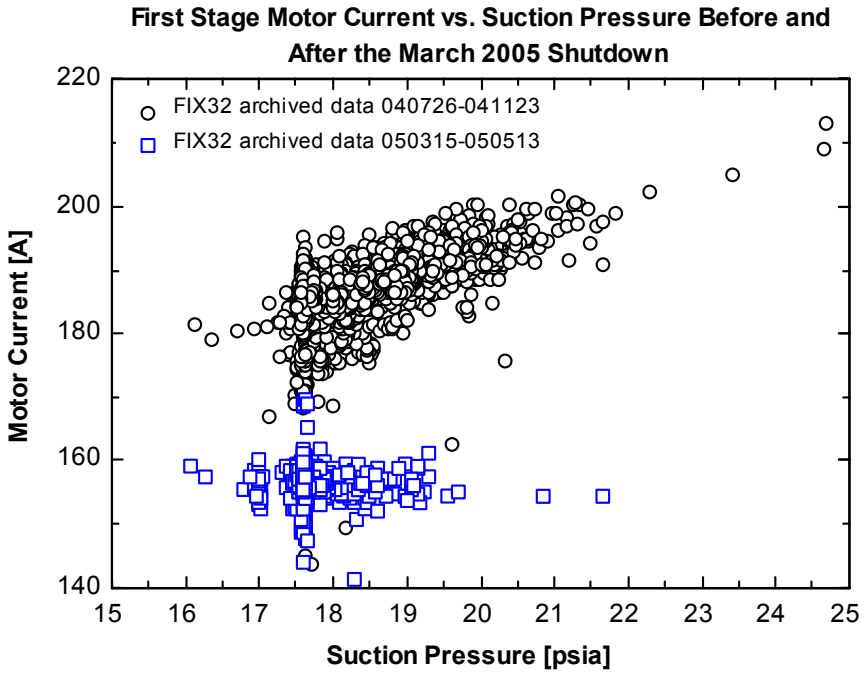


**Fig. 1** First stage motor current vs. suction pressure before and after the March 2005 shutdown.

The first stage motor current is reduced at all suction pressures. At normal suction pressure of 17.6 psia, the motor current is reduced by about 25 A. At a 22 psia suction pressure, the motor current is reduced by 40 A.

The motor current is also less dependent on suction pressure with the new slide valve, another anticipated benefit that was realized. The current increased by as much as 30 A with the VI = 3.7 slide valve as the suction pressure changed; with the VI = 2.6 slide valve the current is nearly constant.

In addition to lowering the motor current, the new slide valve allows the first stage compressor to be continuously run fully loaded. The first stage was previously run at 90-100% loaded. Maintaining a constant loading minimizes wear of the loading actuator and the moving parts associated with the slide valve. Figure 2 shows operating compressor loading positions before and after the slide valve change.

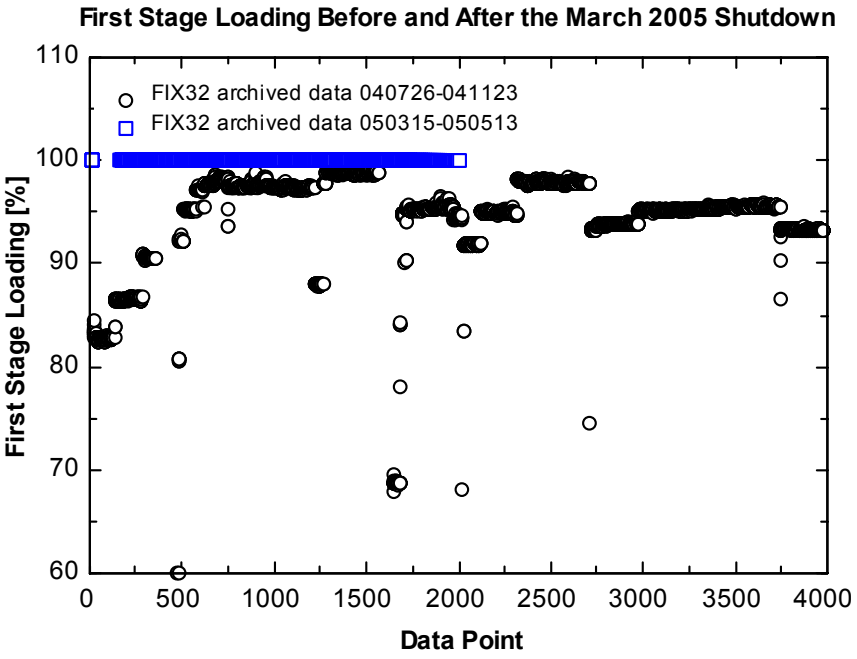


**Fig. 2** First stage loading before and after the March 2005 shutdown.

Recalibrating the gas management valves has resulted in a more stable suction pressure. Figures 3 and 4 plot the first stage compressor suction pressure vs. time before and after the maintenance shutdown, respectively. Periods of refrigerator support for the test stands are indicated on each plot. A stable suction pressure results in a more stable storage dewar pressure, maximizing the liquefaction rate. There is also less backpressure on the Kinney pumps and Tevatron cold pumps, maximizing the volumetric efficiency of these machines.

Similarly, Figures 5 and 6 plot the first stage motor current vs. time. The motor current has benefited from the decreased dependence on suction pressure as well as the stabilization of suction pressure.

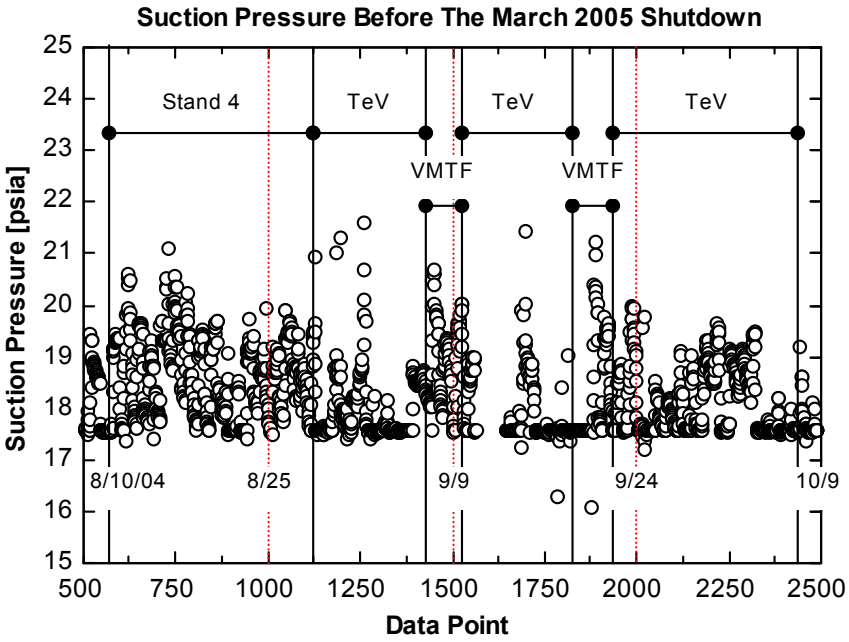


**Fig. 3** Suction pressure before the March 2005 shutdown.

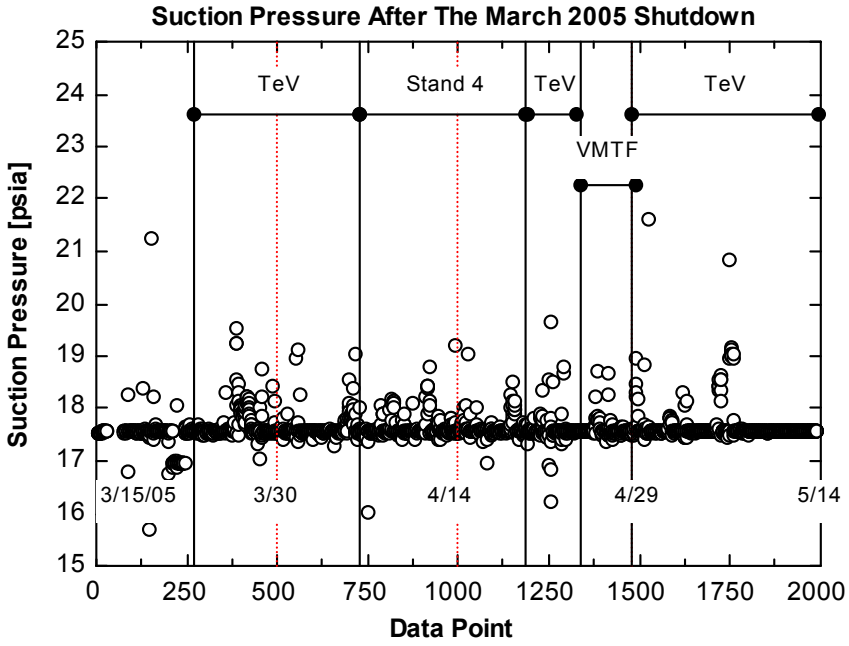


**Fig. 4** Suction pressure after the March 2005 shutdown.

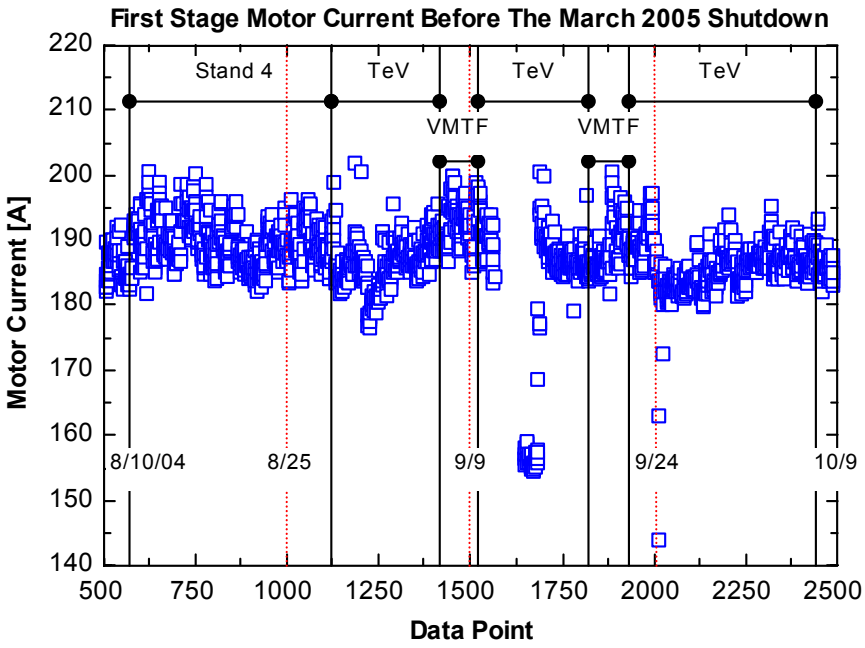


**Fig. 5** First stage motor current before the March 2005 shutdown.

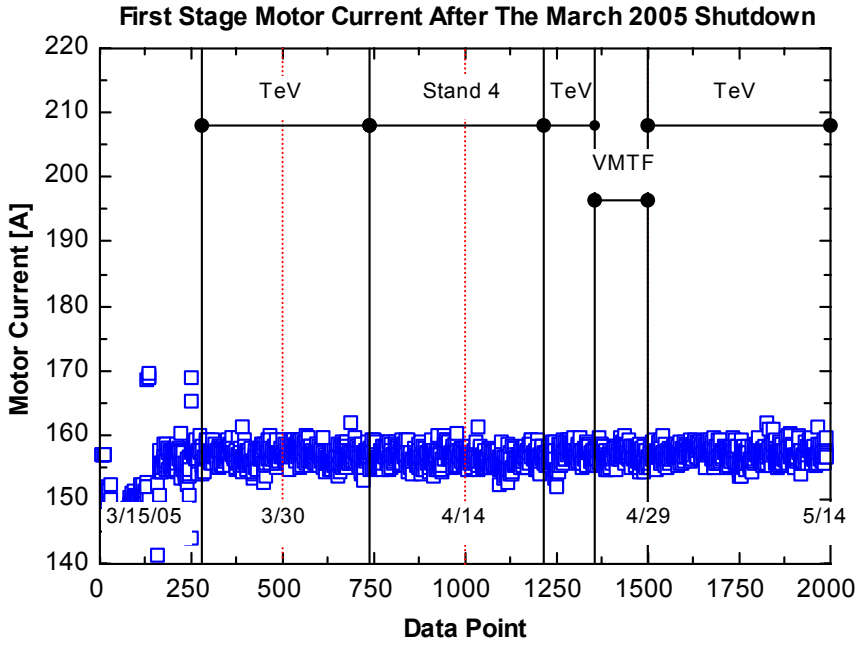


**Fig. 6** First stage motor current after the March 2005 shutdown.

## 3. Conclusion

Work completed during the March 2005 shutdown has had a significant impact on helium compressor operations.

Changing the slide valve has made the motor current much less dependent on suction pressure, and it has allowed the first stage compressor to continuously run fully loaded while reducing the motor current by an average of 30 A. At $0.052/kW-hr under the new Fermilab contract with ComEd [2] and assuming 11 months of running per year, the annual electricity cost to operate the MTF helium compressors is expected to decrease by approximately $10,000.

Recalibrating the gas management valves has stabilized suction pressure. This improves operation of the plant as well as the cold test systems.

Improving compressor operations is another step toward increasing the flexibility of the MTF cryogenics system.

## References

1. R. Rabehl, "Proposed Upgrade of the MTF Helium Compressor System," Technical Division Note TD-04-053, December 6, 2004.
2. J. Garvey, private communication.