

Danfoss VLT 6000 HVAC works 24 / 7 to maintain air conditioned cleanroom environment in a life savings drugs plant

When India's leading drug maker Cipla decided to build a world class drug manufacturing plant at Goa, it chose the Danfoss VLT 6000 HVAC drives to control around 350 AHUs and 20 Pumps to maintain inside conditions and differential pressure in the manufacturing areas.



Cipla, one of India's top five pharmaceutical companies created news, when in February 2003 it stunned global drug firms by offering to export a trio of AIDS drugs to the poor regions through the French Charity Medecins Sans Frontieres, at the lowest international price of \$ 350 per patient, annually.

Cipla had its beginning in 1935 as "Chemical, Industrial and Pharmaceutical Laboratories" and is today India's third largest drug maker by market share with a turnover of USD 325 million in 2002. Headquartered at Mumbai in India, its range of products are manufactured in 18 state of the art manufacturing facilities through out the country. Its product range consists of Tablets, Capsules, Liquids, Injections, Ophthalmic, Topical and Nasal preparations, Inhalers and Powders etc.

The Project:

Cipla broke ground for their new state of the art pharmaceutical manufacturing plant at Goa in 2001. Since the plant has to comply with US FDA, WHO, MCA, MCC, TGA and CGMP requirements, the emphasis was on quality. The Goa manufacturing plant consists of 8 independent manufacturing areas - Units I to VIII.

Cipla decided to use double skin air handling units (AHU) to maintain the required inside conditions. Different type of fan options such as belt driven, direct coupled centrifugal, plug fans etc., were considered. Finally they zeroed in on direct driven plug fans to avoid problems of contamination of the manufacturing area because of belt dust, energy losses due to slippage of belts and minimize the maintenance and down time.

However, plug fans need to be directly coupled to the motor and to achieve the design air flow (CFM) required, the fan has to run at speeds above or below the nominal speed of the motor. That was when Variable Frequency Drives (VFD) were thought of and Danfoss proposed a solution with VLT 6000 HVAC series drives, **specifically designed for HVAC applications**. Further more, VFDs gave them the flexibility to automatically maintain a constant CFM to the conditioned area irrespective of filter condition - without any user intervention (like manual operation of outlet dampers) - while at the same time providing them with high energy savings.

Selection of the right VFD:

Cipla was very particular in selection of the equipment for their new plant for approval from international regulatory authorities for exports, such as MCA, MCC, TGA and USFDA etc. When it came to VFDs, the criteria for selection was the following:

- Considering the fact that there were around 40-50 drives in each plant, harmonics was one big issue confronting them. As a knowledgeable customer, the project team were already aware that harmonics generated due to VFDs could affect the power quality and transformer loading.
- All the plants were planned to be eventually BMS monitored and controlled. Moreover, many machines in the manufacturing area were PLC controlled. Hence, it was a criteria that Radio Frequency Interference (RFI) emission by drives do not play havoc with the BMS or PLC systems.
- While investing in such sophisticated equipment like a VFD, they also wanted the maximum energy savings accruable out of its use.
- Minimum user intervention was envisaged in the operations and hence the VFD had to be suitable for such type of operating environment.
- The AHU motors shall not be subjected to over stress related to harmonics and peak voltage arising out of VFD applications.
- All the plants, were not planned to be on BMS operation immediately. So the customer wanted an in-built control system in the VFD which will automatically maintain the CFM being supplied to the conditioned area.
- Maximum flexibility in operations was the foremost requirement. To that effect the customer looked for the maximum availability of inputs and outputs so that he can configure them as per their site and individual plant requirement.

Fitting the Bill:

The following features offered by the Danfoss VLT 6000 HVAC appealed to the project team which was headed by Mr. BB Shah.



Mr. Shah says: "When we compared various makes of VFDs for the technical qualification, we found that Danfoss was offering their HVAC specific model – the VLT 6000 HVAC. Now, that made sense to us. All of our concerns towards applying

VFDs so extensively in the project were taken care of in this product. It had inbuilt harmonic filters and RFI filters. Usage of inverter grade motors were not required, which reduced our first cost. Further, it had also the provision to control the CFM output of the AHU in closed loop with a static pressure sensor, to be located in the duct. This was extremely useful for us in the plants, where we were not immediately implementing BMS."



AHU with Danfoss VLT 6000 in operation along side Mr. BB Shah. Inset shows the VLT 6000 inside the panel. Bottom picture shows their typical service floor layout





The electrical and instrumentation part of the project was lead by Mr. PG Patil, who appreciates the flexibility of the VLT 6000 HVAC drives. Mr. Patil, who currently is responsible for the Electrical and Instrumentation department says "When we commissioned the VLT 6000 HVAC drives in 2001 we were amazed at its flexibility in operation. We used the following features of the drives at our plant, while commissioning the system:

- **Closed loop operation** of the VFD with a static pressure transmitter to ensure that the design CFM is supplied to the conditioned area.
- Wherever BMS is installed the VFD is seamlessly **communicating with the BMS** for speed control signal, Auto/Manual status, AHU On/Off/Trip status, Speed and Energy consumption feedback.
- **Interlock of the VFD with smoke detector.** In case smoke is detected, the VFD will not start, even if there is a start command.
- The **supply to the fire damper** motor is routed through the VFD. Hence, the fire damper operates only if the VFD is ON. This ensures that the fire damper is always kept off in non-operating times.
- We have set the **display** of all the VFDs to **show the RPM**. This helps the operator to know what speed the motor is running.
- Further, we also get the **feedback** and **setpoint of pressure in Pascals**, which makes monitoring of the AHU filter status easy. We also know from the VFD the time to clean / change the filter.
- The **Auto / Manual switch** on the VFD helps us to access the operation of the VFD either from the BMS (in normal operation) and from the VFD panel (when user intervention is required for e.g. testing and maintenance).
- The **availability of energy meter** on the VFD gives us the flexibility to track the individual power consumption of the AHUs and Pumps and then transfer this data to the central BMS."



VLT 6100 (75 kW) for SCHW pumps installed in an MCC shown along side Mr. PG Patil. Picture below shows their pump layout.



Energy Savings:

Mr. Patil is upbeat about the energy savings achieved through the usage of VFDs. He shares his experience. "In most of the cases, the VFDs are operating 15 to 20 Hz below the design frequency. Now, without the VFD we would have naturally used a damper to maintain the constant CFM to the conditioned area and this would have saved no energy. This savings is very valuable to us and is helping to keep our operational costs under control. In Unit-I where we are logging the energy consumption on the BMS, we see that we are saving approximately 40% of the energy compared to full speed operation. **We have already recovered the cost of VFDs and BMS within a period of 2 years from the above energy savings.** "

Application on Pumps:

The VFDs were installed on the chilled water pumping system also. In line with the criteria to achieve maximum energy savings, primary – secondary system of chilled water pumping was adopted. The VFDs were installed on secondary pumps whose speeds are modulated to maintain a set differential pressure across the supply and return headers under all load conditions. The pump ratings vary from 11 kW to 75 kW and are working round the clock to ensure optimal energy consumption.

Reliability in Operation:

The VFDs have been in operation from December 2001. In fact, Mr. BB Shah and Mr. PG Patil are now happy with their selection of their VLT 6000 HVAC. Since the plant operates continuously, the engineering department normally keeps a stock of essential spares. In accordance with the above, when Danfoss submitted a proposal for essential spares and standby VFDs, the same was not approved by the Engineering In-Charge Mr. AV Mahajan citing the fact that there have not been a single instance of failure of the VFDs. We need not say more about the reliability of VLT 6000 HVAC.

Emulating the success in the company's other manufacturing locations:

The Goa plant has been a trend setter in the VFD applications in Cipla. Further to the satisfaction derived from the Goa application, VFDs for AHUs have been applied on their other plants at Daman, Patalganga and Satara. In some of these plants, the VFDs, in conjunction with a differential pressure transmitter, work as a dedicated controller to maintain the positive pressure to be maintained between different manufacturing areas and corridors.

At of March 2004, Cipla group had 374 VFDs for AHUs and 23 for Pumping Applications. Further more, as many as 27 other VFDs are working in other pharmaceutical machinery applications inside the manufacturing area. This makes the biggest installation of VFDs for HVAC applications in India, totaling to more than 400 drives at a single location.

AH - 18C FFS I MFG AREA

Cipla

21.65 °C, 10.61 °C, 76.09 mmWC, 63.45 mmWC

100.0 % OPEN, 100.0 % OPEN, 0.0 % OPEN, 73.9 % OPEN

FRESH AIR, CHILLED WATER RETURN, CHILLED WATER SUPPLY, Cooling Coil, DOOR POSITION STATUS: Close, FIRE DAMPER STATUS: Open

VFD DETAILS

AM STS	Auto
CONTROL	On
RESET	Normal
SPEED FEEDBACK	1808 RPM
SPEED CONTROL	1800 RPM
CURRENT FEEDBACK	12.5 A
TRIP STS	Normal
AHU FAIL STS	Normal
AHU FAIL RESET	Normal

04-Mar-04 10:26:41 Alarm localhost Strn01 Mngr

The actual BMS system screen showing an AHU with VFD running details. Note that the VFD is operating at 1800 rpm where the nominal speed of the motor is 2800 rpm.

