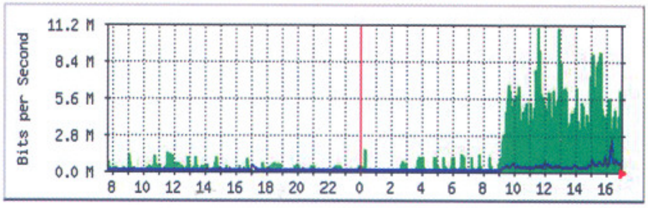

Fig.I.3.4: Graphical view of the 34 Mbps (1:2) Internet link utilization on a working day.

Enhancements to RRCAT Data Center

A new rack mount multiplexer of STM16 capacity was installed in the Data Center to terminate all current and future external data links from M/s BSNL to RRCAT. This facilitated RRCAT with enhanced provisions for terminating data links of up to 2.5Gbps capacity, from M/s BSNL to RRCAT network, which is an increase of up to 70 fold from the existing 34 Mbps network connectivity. Fig-I.3.5 shows the front view of the OptiMUX installed at our Data Center.

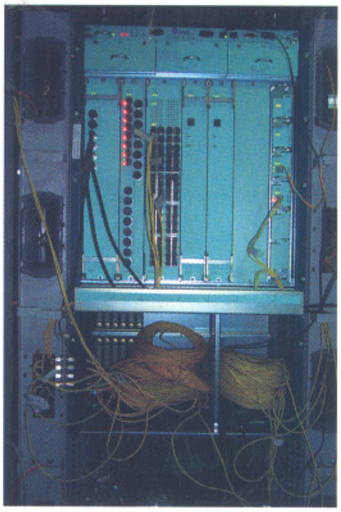

Fig.I.3.5: Rack view of the OptiMUX with STM16 bandwidth capacity

Expansion of communication Network

Telecommunication facilities were extended to Laser photo Cathode buildings, where 21 new telephone connections were provided. Mobile facilities were enabled on 13 extensions, 21 telephone connections were shifted, 28 new telephone connections were installed and 9 numbers of digital reflex phones were installed with voice mail facility in RRCAT campus. Seventeen numbers of TDPs, located in the colony area were revamped.

RRCATNet Planning, Expansion and Upgradation

Planning for Phase-V of the RRCATNet high speed OFC backbone network expansion, was carried out and work for "enhanced Phase-IV" was started.

The Phase-V of the networking will cover laying of ten OFC segments, which will benefit users of New Chemical, Old Chemical, Medical Centre, ID Card room, New CAP, H-Block and I & M building.

The "enhanced Phase-IV" of the network expansion includes replacement of the aging, unmanaged/managed network switches in various buildings with the new managed switches. About 12 numbers of switches will be replaced in this phase. The 120 port network of RF and the 40 port network of Photocathode buildings were included in one of the OFC rings of the RRCAT Net for providing physical level redundancy. Internal wiring of the 40 node network at Laser Photo Cathode building was also completed. A 20 node network was commissioned at new library building and was connected to RRCATNet. Internal network of ADL was upgraded by replacing the old 24 port unmanaged hub with the new 24 port managed switch. Both, AECS building (new and old) networks were connected to RRCATNet using OFC links. The internal networking of the two building was revamped by replacing old unmanaged switches with new managed switches. In all, two numbers of 24 port switches and one number of 48 port switch were installed. In all, 130 nodes were added to RRCATNet.

Reported by:
S. S. Tomar (tomar@rrcat.gov.in) and Anil Rawat

I.4: VRF based air Conditioning for temperature stability of $\pm 0.5^0$C at Calibration Facility

Survey and alignment of beam plays an important role in building and maintaining accelerator machines. Electromagnetic distance meters (EDM) and Distinvar™ are commonly used to meet the required accuracy over large distances. All such instruments need to be calibrated periodically and till recently, were calibrated at CERN. Recently, a new laser interferometer based calibration facility has been setup at RRCAT, near Indus building. This needs very precise temperature control throughout the year.

To maintain precise temperature control, within a range of $\pm 0.5^0$ C, along a 30 meters long calibration table, selection of a proper air conditioning system with high accuracy and precision was essential. Conventionally such systems are based on PID controllers and are costly.

In order to meet such stable environment conditions, within limited budgets and using standard, available air conditioning systems, the calibration facility was planned as 33 meters long and housed in a partially underground tunnel to minimize solar gains and to get good amount of north lighting.

The stringent temperature control requirement needed, design of a detailed flow dynamics system to ensure proper flow patterns, avoid dead air pockets and to maintain uniformity of the system throughout the year. The careful design of supply and return air profiles is also one of the keys.

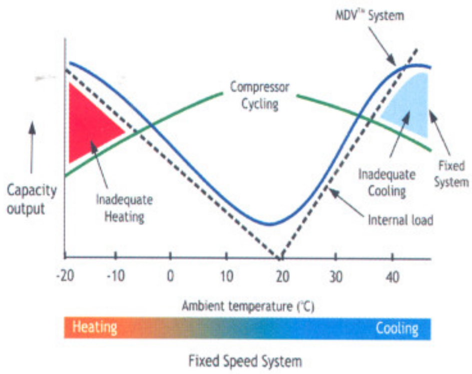

Fig.I.4.1 : Load matching curves for Conventional and Modulating Compressors

The detailed study revealed that such precise control of temperature was possible with either of the following:

1) Variable Air volume (VAV) System
2) Variable Refrigerant Volume (VRV) Systems

VAV systems are ducted systems with variable frequency driven motorized dampers to control the air flow as per algorithm, however, they need a lot of space for installation and have limitations in the form of EMI, minimum comfort velocities and reheating.

Thus Variable Refrigerant Flow (VRF) system was selected for the purpose. It is a No-Duct system, working on the principle of *varying refrigerant flow* to individual evaporative units through refrigerant piping, as per loads, and simultaneously varying the capacity of centrally installed digital compressor. The new age electronic refrigerant expansion valves modulate refrigerant flows through Ref-nuts and thus cooling/heating is achieved as per microprocessor inputs. The digital compressors with step-less capacity modulation make VRF suitable for such requirements. Instead of Inverter compressors, Digital Scroll compressors have been selected to avoid harmonic interference with sensitive Laser Interferometer. It has excellent part-loading capabilities (up to 10%). The VRF system has independent self-intelligent control for monitoring return air temperatures, continuously at three stages. Pt100 sensors with 0.15°C accuracy have been used. The system consists of 20.8 TR roof top outdoor units having digital compressors, 9 Nos. of 2TR four-way cassette indoor units, connecting refrigerant liquid/gas and condensate piping, electronic expansion valves, Ref-Nuts, fresh air modules and zonal control monitors (ZCM) along with control wiring. The complete system has been installed and commissioned.

Temperature stability of ± 0.5 deg C has been achieved successfully. The supervisory control system has been installed with BMS compatibility for controlling the system using a PC .

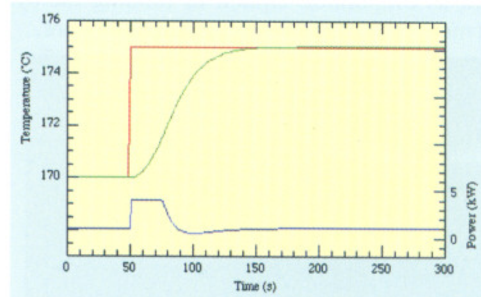

Fig. I.4.2: PID Temperature control

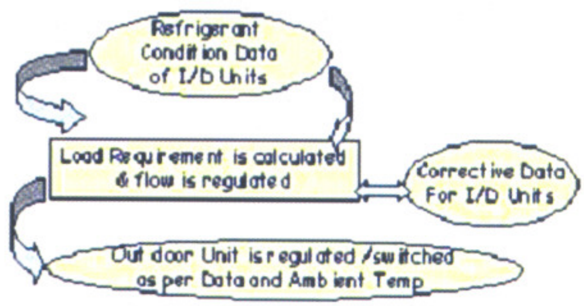

Fig. I.4.3: Working Principle of VRF

Energy Saving Feature :

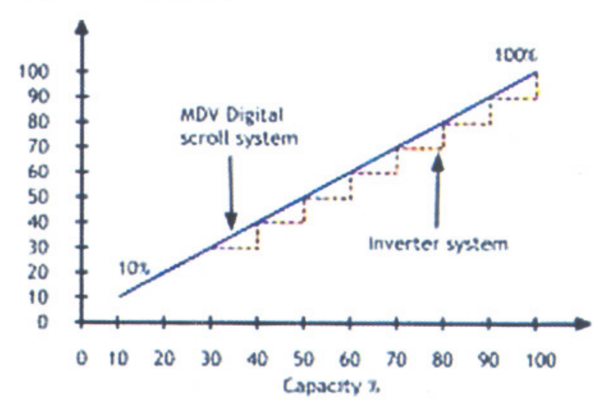

Fig.I.4.4 : Step-less Modulation of Digital Scroll Compressor

Due to step-less modulation, the installed VRF system has very good part-loading efficiencies which make it energy efficient.

AC system with Heat Mode :

The VRF system can be operated in cold mode as well as hot mode. The special feature of VRF systems for winter air conditioning lies in utilization of the air conditioning system as heat pump in winter. This has not only reduced the cost of resistive heating but has also enabled precise control of temperature. It also provides added benefit of energy saving. In hot mode the indoor units work as condensers and outdoor units work as evaporator. Option of running the system in Cold/Hot mode is available in the installed software.

Fig.I.4.5: Alignment Lab Calibration table

The complete system has been tested for hot mode as well as cold mode. The calibration facility is in use.

Reported by:
Deepak Arzare (arzare@rrcat.gov.in),
S. S. Kulkarni and A. M. Kekre

I.5: Clean Room for Laser Micro Machining Centre as per Class 8 of ISO 14644

A clean room has been made for the Laser Micro Machining Centre (built in the new Laser Work Centre Building Laser Systems Engineering Division) that will fabricate Fiber-Bragg Gratings using ultra violet laser from the second harmonic of Copper Vapor Lasers. The planning, design, execution and third party validation of the clean room has been completed in all respect.

The room is designed for 20 air changes per hour with 8.75 TR, 4400 cfm condensing units with fully ducted air supply and return. The duct losses, which account for 5-10% of total loss, have been reduced by using pre-fabricated ducts manufactured by lock-forming machine and special slip making tools. Terminal High efficiency particulate air filters (HEPA) with filtration efficiency of 99.97% @ 0.3 micron have been used with low grill velocity of 150-175 fpm. The clean room is designed to be maintained at 10 Pa of positive pressure and equipped with Magnahelic Gauges for online monitoring of positive pressure & HEPA filter status to ensure reliable operation of the system. The laser particle counts finally achieved and measured were found to be around 10000 which is one class better than the desired.

Reported by:
Deepak Arzare (arzare@rrcat.gov.in),
S. S. Kulkarni and A. M. Kekre

I.6 Erection of Experimental station platform for TIFR experiment on Cosmic Ray Measurement

In the wake of the solar eclipse on 22nd July 2009, Tata Institute of Fundamental Research had planned a month-long experiment for cosmic ray measurement to be carried out on top of the Accelerator Development Lab building of RRCAT. The experimental platform was a raised structure above the roof level of the building at a leveled floor free of vibration and radiation. The estimated loading on the platform was about one metric tonne.

Starting from the planning, structure design and the selection of materials, the work was executed within a week's time, complete in all respects, including the safety provisions of railings, approaches, ladders, illumination, grounding and lightning protection etc. A control room was set up just in vicinity of the platform, with complete power distribution, illumination and air-conditioning systems. Communication arrangements along with emergency power supply arrangements like UPS and generator back up were also made.

Technical summary of the work is as given below:
Size : 4m x 6 m
Level: 12.5 from the Finished ground level outside the building
Weight bearing capacity of the structure: 1.5 MT
Electrical loads in the control room: 5 kVA
Air-conditioning: 2 Nos of 1.5 TR Split type Air-conditioners.
Total Time from Concept to Completion: 10 days.

Reported by:
S. M. Jalali (sjalali@rrcat.gov.in),
Arti Shelke, P. C. Jain, S. S. Kulkarni and A. M. Kekre

I.7 Other Civil Works

Chemical treatment facility building with a provision for chemical treatment of large components, which can be handled by using the installed 5 MT EOT crane was completed and occupied. Chemical resistant epoxy flooring and provision of drainage pipe network and effluent treatment plant are special features of the facility. For the hazardous chemical rooms, indirect illumination scheme has been adopted. For flexible power distribution in the high bay area bus trunking system has been used.

Radiation shielded vault of R & D block 'G', meant for installation of Laser based accelerator set up, has been cast with stringent temperature control & joint preparation.

A lecture hall with a capacity of 110 seats has been setup in the RRCAT Training School Building. Special features include scene selection through illumination with intelligent luminaires and air-conditioning system.

About 25 % work of construction of 18 nos type IV-D houses has been completed. About 50% work of construction of PG Hostel building has also been completed.

Reported by:
G. Parchani (parchani@rrcat.gov.in), P. C. Jain, S. M. Jalali,
S. S. Kulkarni and A. M. Kekre