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AUTOMATIC ELECTRIC DISTRIBUTION SYSTEM AT INDIAN ANTARCTIC STATION MAITRI; NEED OF THE DAY.

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Abstract:

This report contains the work carried out during the summer of XVIII Indian Antarctic Expedition. Various projects were undertaken by R & D E (Engrs), Pune, in the past and some modification was needed in maintenance and methodology from time to time. A special attention was paid for distribution of electrical loads in the station, balancing of these loads in different phases and designing of automatic alarm system in case of any eventuality.

Introduction:

The maintenance and upkeep of Maitri Station and its life support system is carried out by R & D E (Engrs), Pune from the time it was constructed. Various parameters were recorded for monitoring Generators, Maitri foundation. 28m mast etc. The data collected was analysed at R & D E (Engrs) and various measures suggested for the maintenance and upkeep of Station and its life support systems. As the Station and its life support systems are becoming older day by day, the chances of failure and break-downs are on the rise. A continuous and proper vigil needs to be maintained over these aging systems to avoid any major breakdown in future. Over the past few years, changes in the procedure of condition monitoring and methodology have been undertaken and adopted. A few more changes were carried out during this expedition and various suggestions put forward for future expeditions.

Wintering members monitor the generators and other life support systems round the clock, by taking hourly observations. Lots of changes can take place within these observation periods. A lot also depends on the timely systematic observations of the observer, who has to follow the routine seriously and religiously. The life of rest of the members sleeping during the nights is at stake, if the person on duty is not performing his duties carefully and systematically. The duty person has to be alert and attentive to any unfamiliar sounds, alarms or fluctuations in electrical loads. A little lapse on his part can have serious consequences and can result in fire, damage to station and systems and loss of life.

A computerized system with monitors, flashing and sounding alarms, auto trip-off of defective systems to avoid any further damage and automatic power distribution is the need of hour to overcome these problems and safeguard the life and property.

The various projects undertaken were as follows:

Project 1

Condition monitoring ofGcnerators At Antarctica:

The ongoing project by R & D E (Engrs) was established during XV Indian Antarctic Expedition. Fine-tuning was carried out from time to time. The requirement was to identify the-exact time of maintenance call, announced by an expert maintenance engineer, not present in Antarctica all the time.

For this job, the acquired data was to be sent to India over telephone lines and the analysis to be carried out by an expert at R & D E (Engrs), Pune. Limitations on Telephone line speed, connectivity problems. File size and environmental conditions have played an important role in deciding the project methodology.

We have adopted the following methodology:

1) Make the file size as small as possible
2) Send the required data only
3) Send the data over Email for larger time
4) Send the current operating generator data only.

To execute the above plan we had to make modifications in the following ways in earlier databases.

1) Each Generator was used as an independent entity and hence got independent database of its name.

2) The number of measuring points were reorganized and reshuffled to make minimum required measurements, thereby reducing file size from 6.3Mb to 1.32Mb.

3) The data files/database were split in smaller files for easy transfer and later joined at R & D E (Engrs), Pune, to make a single file. This was essential as the continuous e-mail connection for longer duration was not available.

The Data integrity, format, errors if any were tested first by sending the files over email to India and back to Maitri again and executing the exact steps at Maitri. All the data transfer was found to be error free.

After analyzing the data at R & D E (Engrs), necessary advice/suggestions were sent to Maitri For maintenance.

Project II

Electrical Power Distribution and Earth Potential Monitoring:

3 Phase generators provide the power to Maitri Station, and even power distribution in all three phases is very important. If the loads are not balanced in each phase, the neutral voltage changes, and can be very dangerous to the electrical instruments like Computers, Satellite communication terminal and other sensitive electronic instruments.

The electrical power distribution in Maitri Station takes place at three places i) A block, ii) Maitri station and iii) Boiler room.

'A' block takes care of Power distribution to following:

1) A block lighting,
2) Deep freezers in A block,
3) Summer Camp residential and laboratory blocks, and
4) Part of Maitri Station,

Total Load: (about 20 KVA)

Maitri Station distribution takes care of:

1) Station living rooms and laboratories,
2) Radio Room, .
3) Power to various equipments like computers and other unitsin Maitri, and
4) Deep freezers in loft

Total Load: (about 20 KVA)

Boiler House distribution takes care of:

1) Boiler Room,
2) Pumps & Heaters,
3) Water pipe line Trace heating,
4) Toilet block,
5) Laundry,
6) Kitchen, and

7) Lounge
Total Load: (about 40 to 50 KVA)

Observations:

During observations it was seen that the power distribution from the Generators in the three phases is not balanced most of the time. To overcome the same, a strategy was worked out in association with the Leader and Logistic team. The distribution from main power distribution point to major load points, which are major contributors in the load balancing tasks, were identified. All the major loads were isolated and reconnected for calculating the load values and its effect on the load balance. Identifications tags were given to each load and the power distribution to all these major loads balanced, so as to control the deviation between phase-to-phase current within 5A each. As some of the loads were changing and fluctuating, the extreme limits were assigned for any deviation. The data on fluctuating loads and different phases was collected for systematic analysis in India.

Suggestions and Remedy:

After returning from the expedition and analysis of the collected data, a computerized load balancing and distribution scheme for this operation has been suggested. This operation is less stressful, safe, simple' and can give more cost effective results in future. The system will help in power consumption analysis, provide load balancing charts and on-line view of all the loads connected to it. The system will be simple to operate, safe, reliable, and will have online status monitoring at any given time inside the Maitri station with distribution panels and LED indicators. Also some of the loads will be timed for operation, resulting in power saving.

The system being computerized, will store data on actual load distribution, and chalk out the Power distribution, Fuel consumption, Power usage, Statistical analysis of various power users and so on. A project report has been submitted to NCAOR in this connection.

This will be one of the major projects to be considered in future. A similar power distribution system is operational at South African SANAE - IV station, which we had a chance to visit during the expedition.Also we had discussion with the concerned person in SANAE - IV team member for the operation. One of the Italian station in Antarctica is also using similar electrical distribution system to minimize its operation costs.

Electrical Earth monitoring was also carried out at various points, maintenance of old points and installation of new points was undertaken and was completed in time to make working of electrical instruments safe and sound.

Health Monitoring of Maitri Foundation.

This project was taken up for the assessment of the stress on the Maitri foundation columns, As the Maitri station has completed more that 10 years of existence, It is necessary to assess the stress it experiences during changing seasons and Blizzards.

To perform the specified task, we have completed following:

1) Identification of Critical Structural columns,
2) Installation of Strain gauges on the columns,
3) Wiring of the strain gauges, and
4) Installation of computerized strain gauge scanner and data acquisition system.

A computerized data acquisition system was installed by me at my own cost which helped in data acquisition throughout the year for Stress monitoring.

Total 7 channels / columns were used for such monitoring. Channel No 8 was reserved for Wind direction and speed measurement. Additional parameters like Wind Chill factor, Ambient temperature were collected from 1 M D laboratory and were used by system as Keyboard entry. At the time of analysis of the stress conditions, these factors are also required.

The analysis of the acquired data is in progress. No major stress conditions were found during the term.

Health monitoring of 2 8 m mast:

This project was also ongoing project. We supported the team to execute the following tasks:

1) Re-install the strain gauges at respective heights on the mast.
2) Sealing of the Strain gauges against snow, water, winds and to protect them against corrosion.
3) Re-furnishing the cables for connectivity to Strain monitoring unit.

The above execution has given us the data for entire year after this maintenance.

Official Video Graphy

I also worked as an official video grapher for the XVIII ISEA. All the major events e.g. scientific experiments, presentations and other activities were recorded on

24 video cassettes. The entire recording has been handed over to the NCAOR for further processing.

Over and above I also provided the assistance to execute a number of tasks. The tasks undertaken were as follows:

1) Maintenance of power distribution, connections and load balancing at Pump House.
2) Maintenance of power distribution at Main station and A block
3) Maintenance of power points and load balancing in Boiler House
4) Maintenance of Audio/Video equipments at Maitri
5) Maintenance of Computers at Maitri
6) Maintenance of Controller for Walk in type Deep freezer.
7) Maintenance of electronic instruments of Pavan Hans.
8) Watch keeping duty for Ice bergs monitoring for GSI
9) Installation of Earth line connection for IMD lab.
10) Maintenance of Earth line distribution in Maitri station

Some modifications and suggestions for better operations of the life support systems:

1) The Electrical Distribution should be converted to Computerized system. As suggested earlier, this will save lots of tasks required by the personnel to execute manually. One can make necessary changes from the control room and remote operations of loads and its balancing will be automatically controlled.
2) The generator monitoring should have additional Video installation so as to have vigilance on the operation round the clock.
3) A small video surveillance system should be installed at all vital points. Now a days, thermally stable and small size video cameras with automatic scan controls are available in India. One can make the use of such cameras.
4) As observed at SANAE-IV station, all electrical distributions, maintenance units and other ancillaries should be operated from the control room.
5) At least one man should be trained to maintain and handle various electrical and electronic instruments used at Antarctica.
6) All the rooms must have electrical earthing properly connected and maintained.
7) For controlling Electro Static Charge, earth metal grids should be installed and connected to electrical earth in every laboratory, as provided in communication room.

If the above mentioned precautions are taken into consideration, the station operations will become safe, easy and efficient.

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