



## **Lucas-TVS Limited**

### **Automobile Industry, Padi (Chennai)**

#### **UNIT PROFILE**

Lucas-TVS is a part of the TVS group. It was setup in 1961 as a joint venture of Lucas Industries plc, UK and T V Sundaram Iyengar and Sons at Chennai to manufacture automotive electrical systems.

Lucas-TVS has since inception has been maintaining its leadership as an automobile electrical systems supplier. Lucas-TVS manufactures a complete range of auto electrical products consisting of direct drive and gear reduction Starters, internal and external fan alternators, wipers, fan motors, blower motors, window lift motors, mechanical and electronic distributors, cam sensors, headlamps etc.

The Auto Electricals division now has three plants situated in Padi, Pondicherry and Rewari. The Padi plant, which is the mother plant, manufactures all range of electrical automobile products.

#### **“ENERGY MANAGEMENT POLICY”**

We are committed to minimize the Specific Energy consumption (Electrical units per Equivalent Starter Unit) for our products comparing to the previous year consumption.

#### **THROUGH**

1. Maximize the Capacity utilization.
2. Fine tuning our Operations and Maintenance continuously to achieve the above goal.
3. Technology up-gradation with energy efficient processes and equipments.
4. People involvement.
5. Waste elimination.
6. Improvement in Power and Air distribution.
7. Large cell formation.
8. Process changes.
9. Setting up a system to continuously monitor the progress.

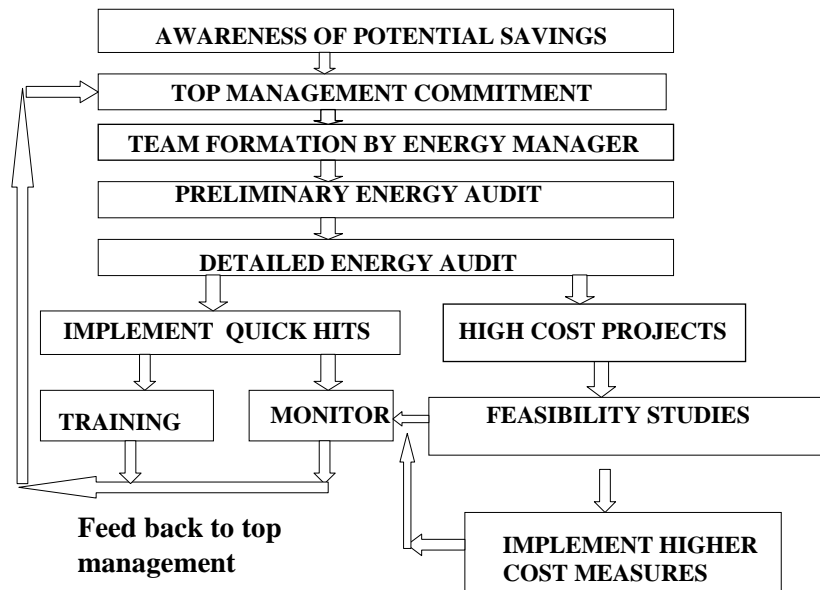
#### **APPROACH**

- Formation of Task force team
- Cross functional Team
- QC story
- Employees involvement through
- S.G.A. (Small Group Activities)
- Suggestion Scheme & Voluntary
- Work Teams (5S, TPM, ENVIRO, SAFETY)
- Energy Audits (Internal & External)

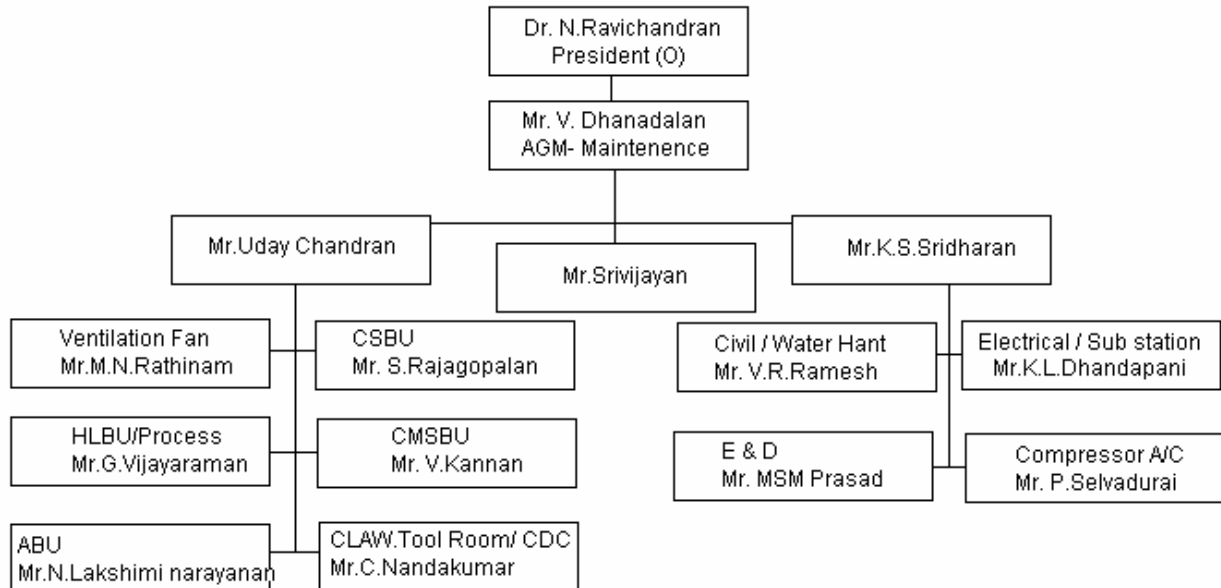
#### **ROLE OF ENERGY MANAGER**

- Prepares Annual Plan with Targets and Budget
- Acts as a Facilitator in implementing the Encon Projects
- Interacts with core team members / cross functional team periodically to review the progress
- Constitutes a team of Auditors to monitor the Retainment of Improvements
- Presents the achievements to Top Management

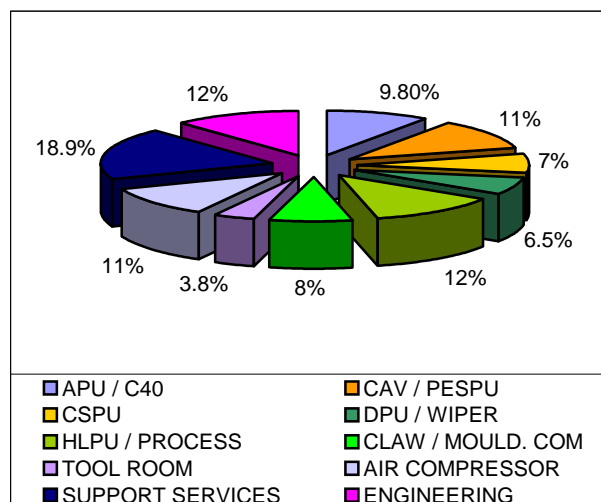
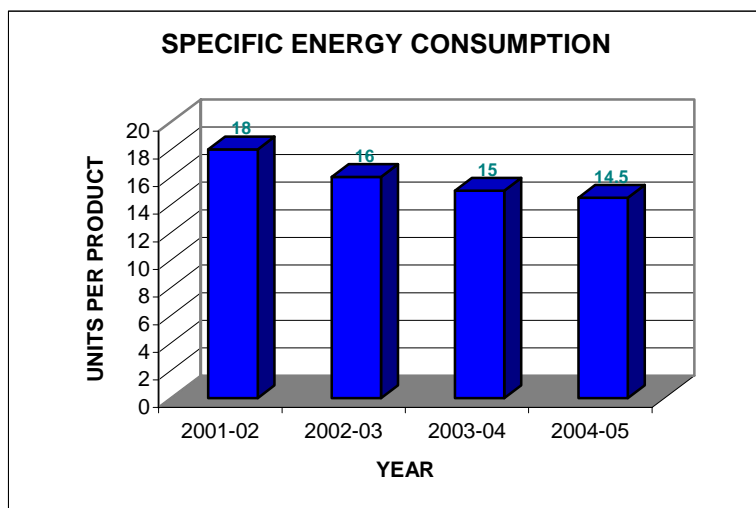
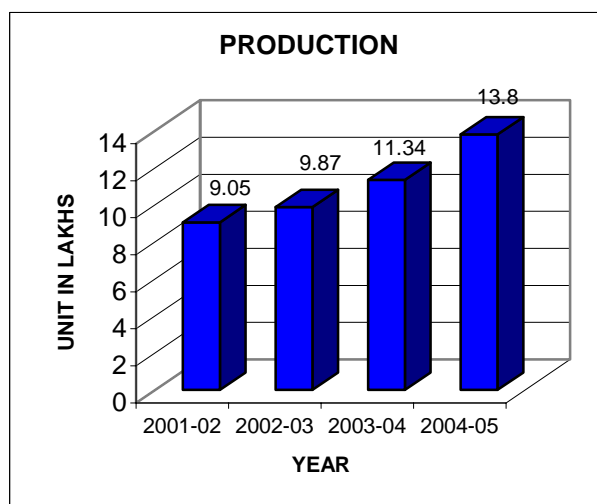
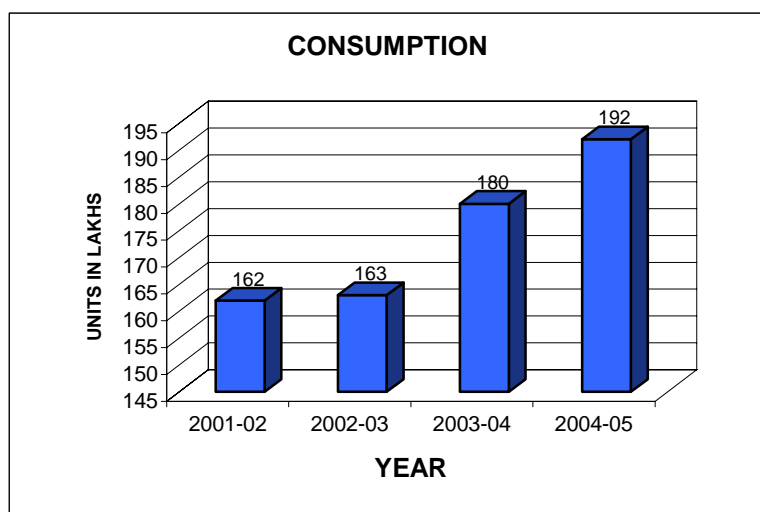
### MONITORING AND REPORTING SYSTEM



### Energy Conservation Organization - Structure



## GRAPHICAL REPRESENTATION OF ENERGY CONSUMPTION



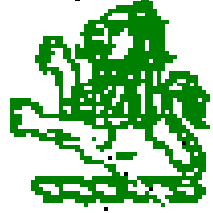
### ENCON PROJECTS IMPLEMENTED DURING 2004 –2005

- ELECTRONIC BALLAST FOR SHOP FLOOR LIGHT 200 NOS
- POWER FACTOR IMPROVEMENTS TO .99
- CORRECT SIZING OF MOTORS IN PROCESS AREA
- WATER PLANT ENERGY EFF. MOTORS
- FLAT BELT CONVERSION IN IKC 0063
- WINDOW A/C UNIT REPLACEMENT
- STANDARDS ROOM A/C UNIT REPLACEMENT
- PEAK HOUR MOTORS RUNNING IN OVERLAP SHIFT
- INDUCTION HARDENING M/C CHILLERS
- OPTIMIZING ENGINEERING CENTRE A/C UNITS
- ENERGY EFF. LIGHTINGS IN PERIPHERALS
- THRO' ANNEALING TEMP CONTROLLING
- ENGINEERING CENTRE A/C UNITS
- POWER MANAGEMENT IN OVERLAP SHIFT
- 2 STAGE AIR COMPRESSOR IN CLAW
- BLOWER LESS COOLING TOWER AT PROTOTYPE & CLAW AREAS
- SLEEP TIMERS IN ABU MACHINES
- SEVEN DAYS TIMER FOR SOLDERING POT
- INTRODUCTION OF A/C MOTORS WITH DRIVE
- INTRODUCTION OF SEVEN DAY TIMER FOR VENTILATION

- DOWN SIZING OF BLOWER EXHAUST MOTOR
- THRO' ANNEALING PLANT TEMP. TUNING
- THRO' ANNEALING CHILLER COMPRESSOR TEMP. CONTROL
- GAS CARBURISING FURNACE TEMPERATURE REVISION
- M/C NO: IKS 0005: SHOT BLASTING OPERATION
- M/C NO: IP 0080: POLISHING OPERATION
- LOW POWER DUST COLLECTOR IN UNDER CUTTING STAGE
- DEARATING OF HYDRAULIC MOTOR IN IPH 0112
- INTRODUCTION OF SEVEN DAY TIMER FOR SOAPING PLANT
- POWER CAPACITORS FOR TAIL END FEEDERS
- TEMPERATURE STUDY AND ENERGY EFF. PAINTING
- FOR THRO' ANNEALING PLANT
- V.S DRIVE FOR COMPRESSOR MOTOR
- CHILLERS CONVERTED INTO HEAT EXCHANGER CLEANING
- AIR COMPRESSOR AUTOMATION
- CENTRALIZED AIR CONDITIONER OPTIMIZATION IN TOOL ROOM

#### ENERGY CONSERVATION PLAN FOR THE YEAR 2005 -2006

Energy Saving Measure	Amount Saved (Rs.)	Investment (Rs. Lakhs)	Project *
Introduction of VFD for compressor	4.50 Lacs	12.00	2005-06
Replacement of in-efficient compressor	3.00	9.00	2005-06
Blower less cooling tower	1.00	2.00	2005-06
Replacement of in-efficient A/C units	1.00	2.00	2005-06
Solar water heater for canteen	1.50	4.00	2005-06
Replacement of in-efficient transformer	4.00	9.00	2005-06
Ring main system for compressed Air system	2.50	3.00	2005-06
Sleep timers for dust collectors	0.50	0.20	2005-06
Energy efficient motor for utilities	2.00	2.00	2005-06
Star Delta star converter for high power machine	2.00	1.00	2005-06
Introduction of AC drive motors in place of DC motors	1.00	2.0	2005-06
Power management during off peak hour and lunch hour	4.00	1.00	2005-06
TOTAL	27	47.2	



**Project title : Energy conservation and  
Improvement in quality of  
Compressed air.**



# Compressors at Lucas TVS. Ltd.

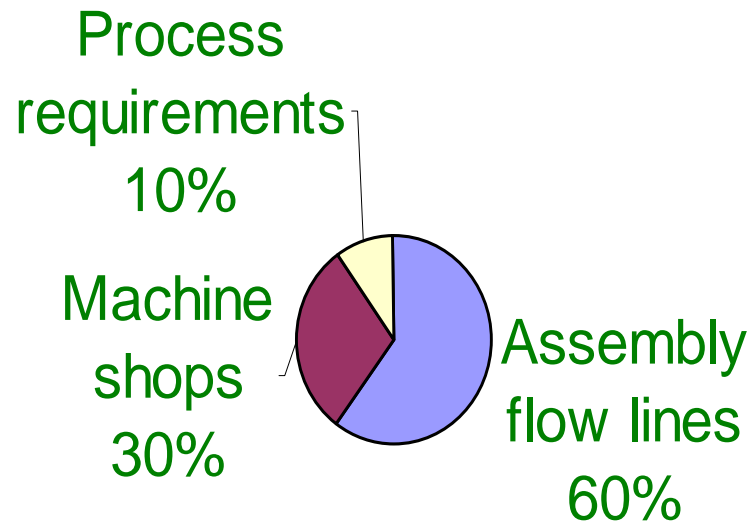
- Reciprocating 5 Nos
- Capacity 500 CFM X 5  
400 CFM X 2
- 6 Nos. Lubricated
- 1 No. non lubricated.
- All the above are electric motor driven.
- Screw compressor with engine driven 1 NO  
Capacity 300 CFM.



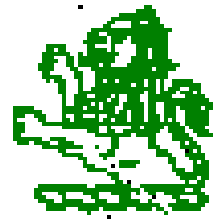


## 2.0. OBSERVATION.

### Usage of compressed air.



For Assembly lines - 1320 CFM  
For Machine shop - 660 CFM  
For Process - 220 CFM.



Number of occurrences

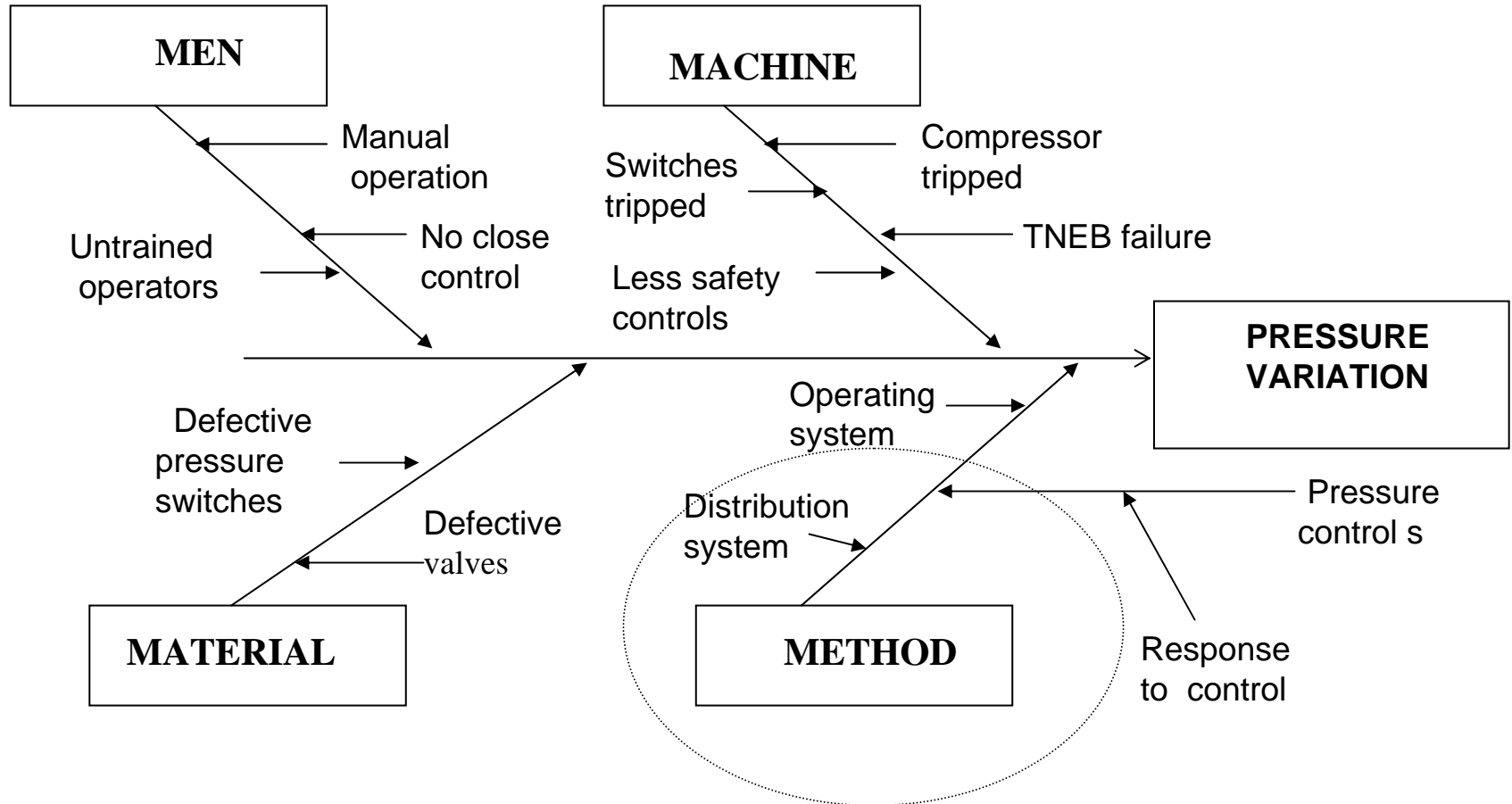
MONTH	No of complaints	Pressure variation
Jan-04	2	72,76,75
Feb-04	1	76,75,73
Mar-04	3	77,75
Apr-04	2	75,75,76
May-04	2	77,77,72



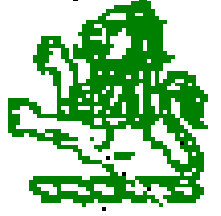
**Required air pressure is 80 PSI.**



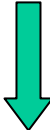
# CAUSE & EFFECT DIAGRAM



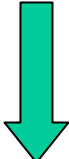
3.0 ANALYSIS



Cause validation :



Method



**Probable cause :** Manual compressor operation and Pressure control system.



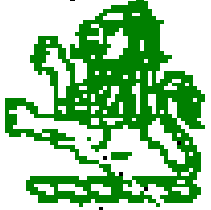
# COMPARISON OF PRESSURE CONTROL SYSTEMS

MECHANICAL PRESSURE CONTROL SYSTEM	ELECTRO PNEUMATIC PRESSURE CONTROL SYSTEM	ELECTRONIC PRESSURE CONTROL SYSTEM
Pressure setting is complicated	Pressure setting is easy	Pressure setting very easy & user friendly.
Maintenance prone system ( more moving parts )	Less maintenance	Maintenance free
Wider pressure band $80 \pm 5$ psi.	Wider pressure band $80 \pm 5$ psi.	Narrow pressure band $80 \pm 1$ psi. Hence energy saving and quality improvement.

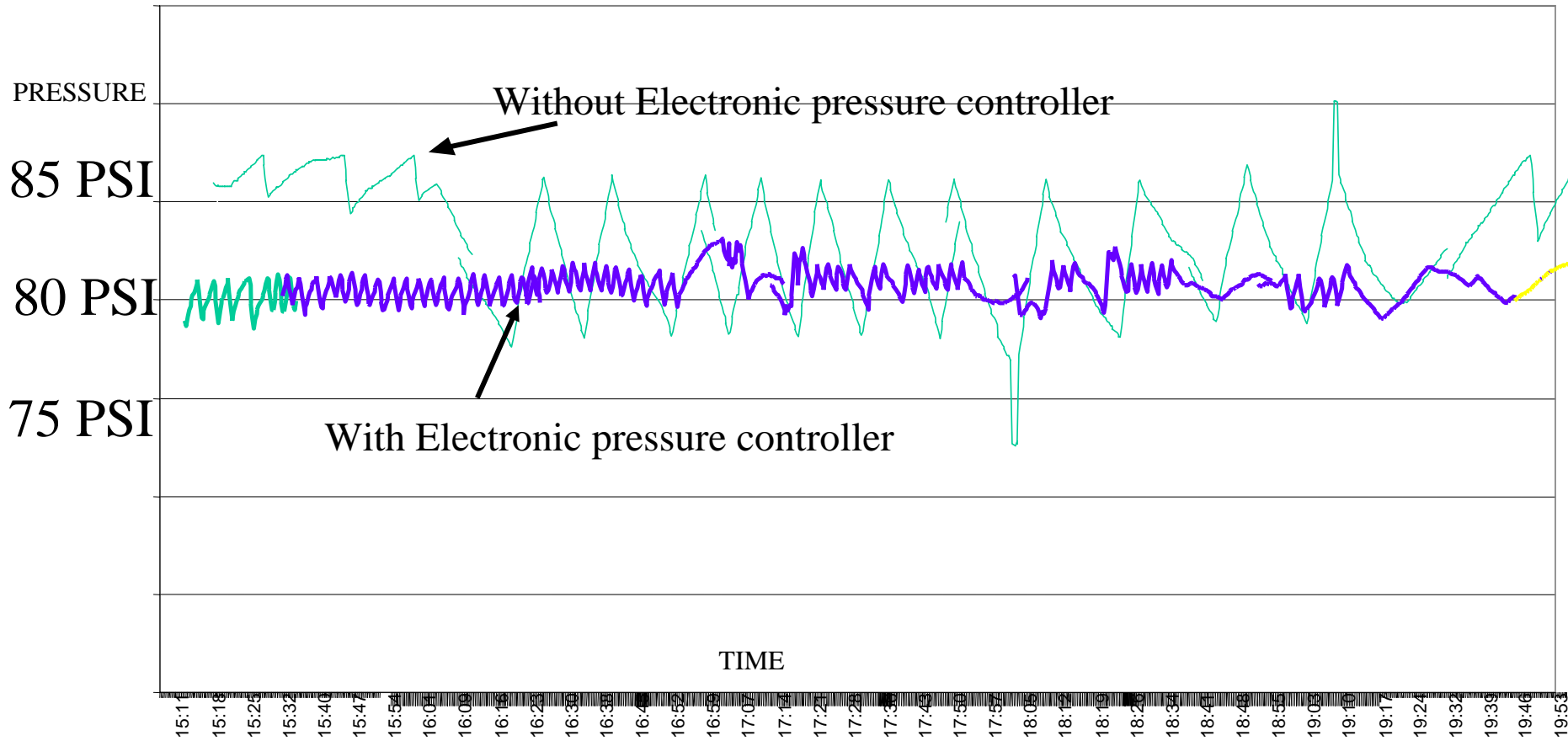


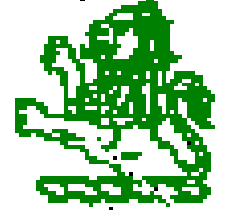
Root cause : The Electro pneumatic control system can control only  $\pm 5$  psi.

3.0 ACTION



PRESSURE OPTIMISATION - CONCEPT





# System design

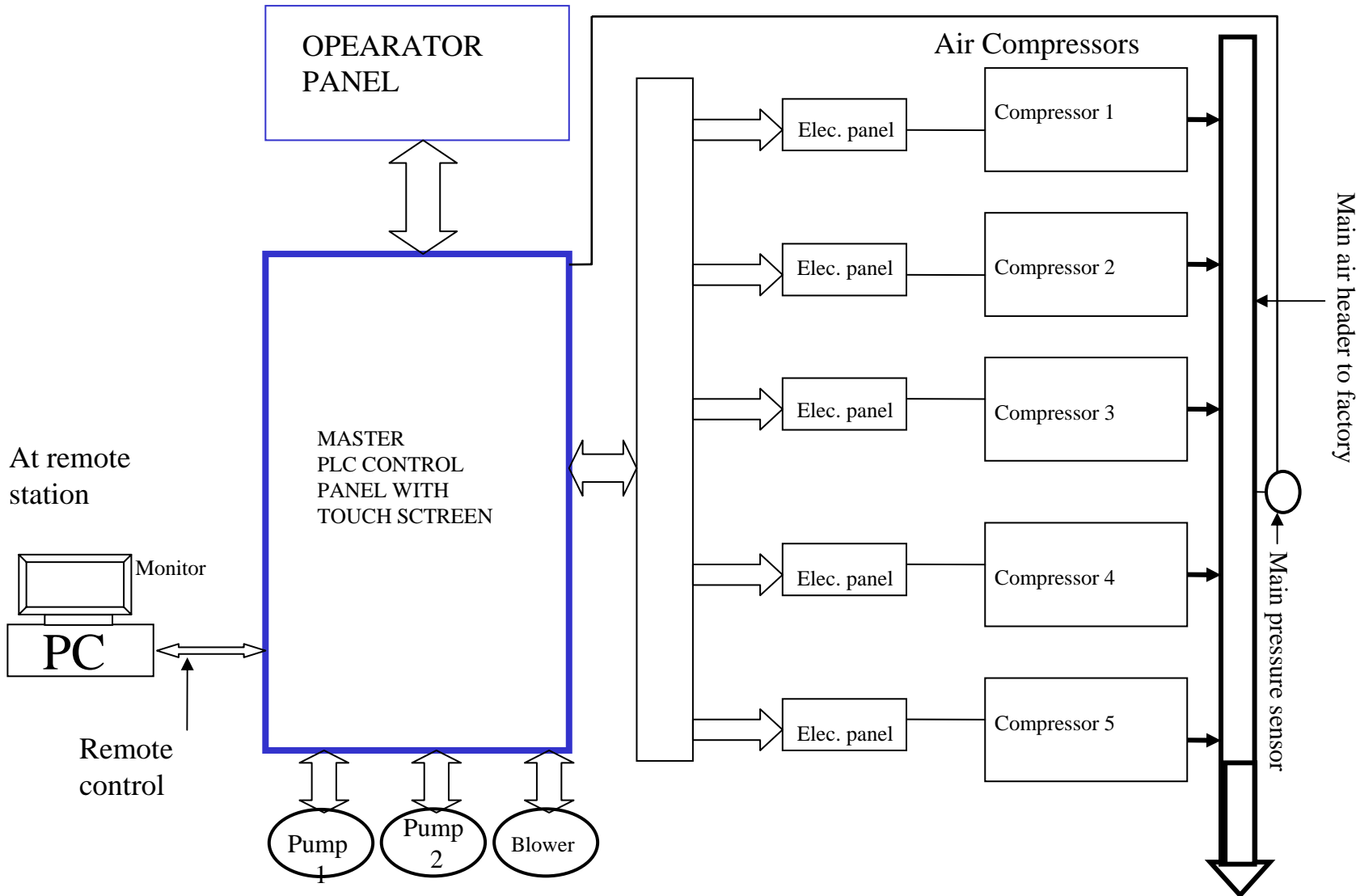
PLC based system with MMI & remote communication having following features

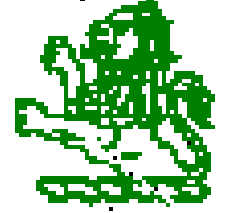
- Sequential starting & stopping of compressed air system.
- Automatic starting / stopping & loading / unloading based on air demand.
- Automatic starting / stopping of water pumps cooling tower fans .
- Data based maintenance for preventive maintenance schedule.
- Provision for monitoring from remote place.
- Interlocks for water flow failure/ lub oil pressure / discharge air pressure.



# 4.0 ACTION

## SCHEMATIC DIAGRAM FOR AUTOMATION

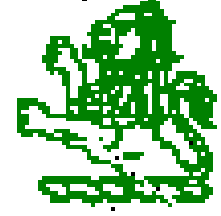




## Working principle

- The software maintains the system pressure at tightly set point.
- Achieved through time delays and continuous evaluation of the pressure signal from the main header pressure transducer.
- Continuously calculates the rate of pressure change and directs the PLC to add or delete the compressor accordingly.

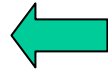
4.0 ACTION



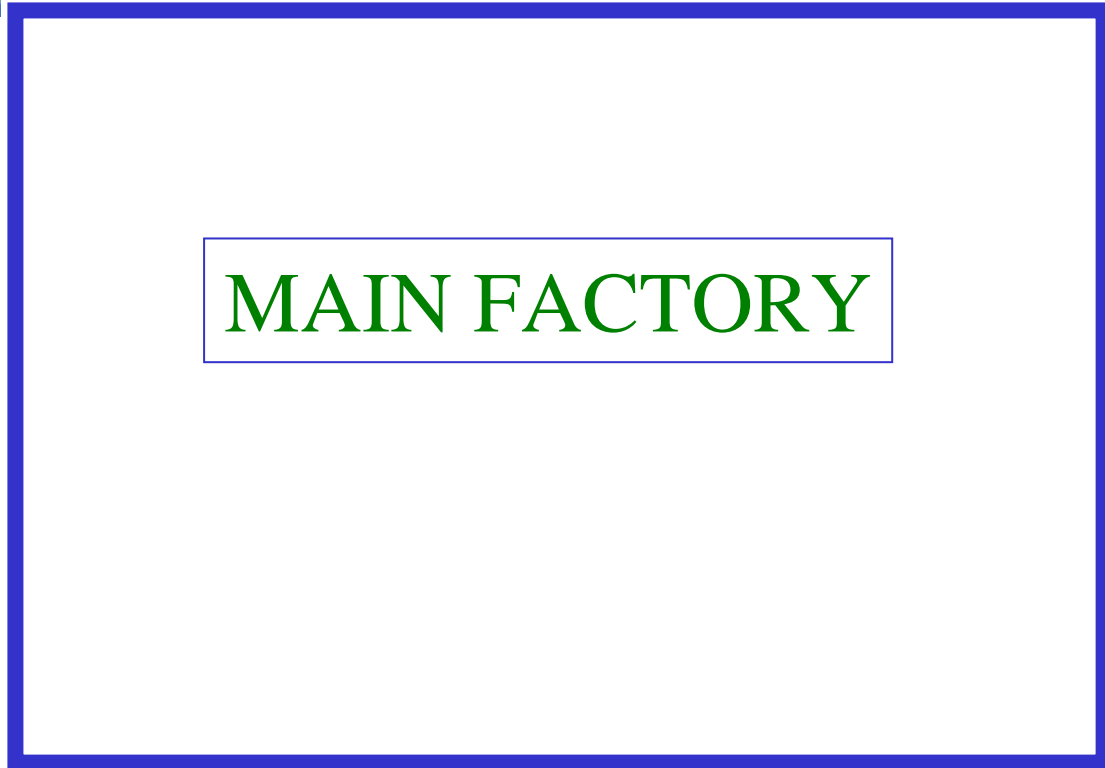
Substation 1000 ft away from compressor room.



Centralised PLC system at compressor room



Compressor Room



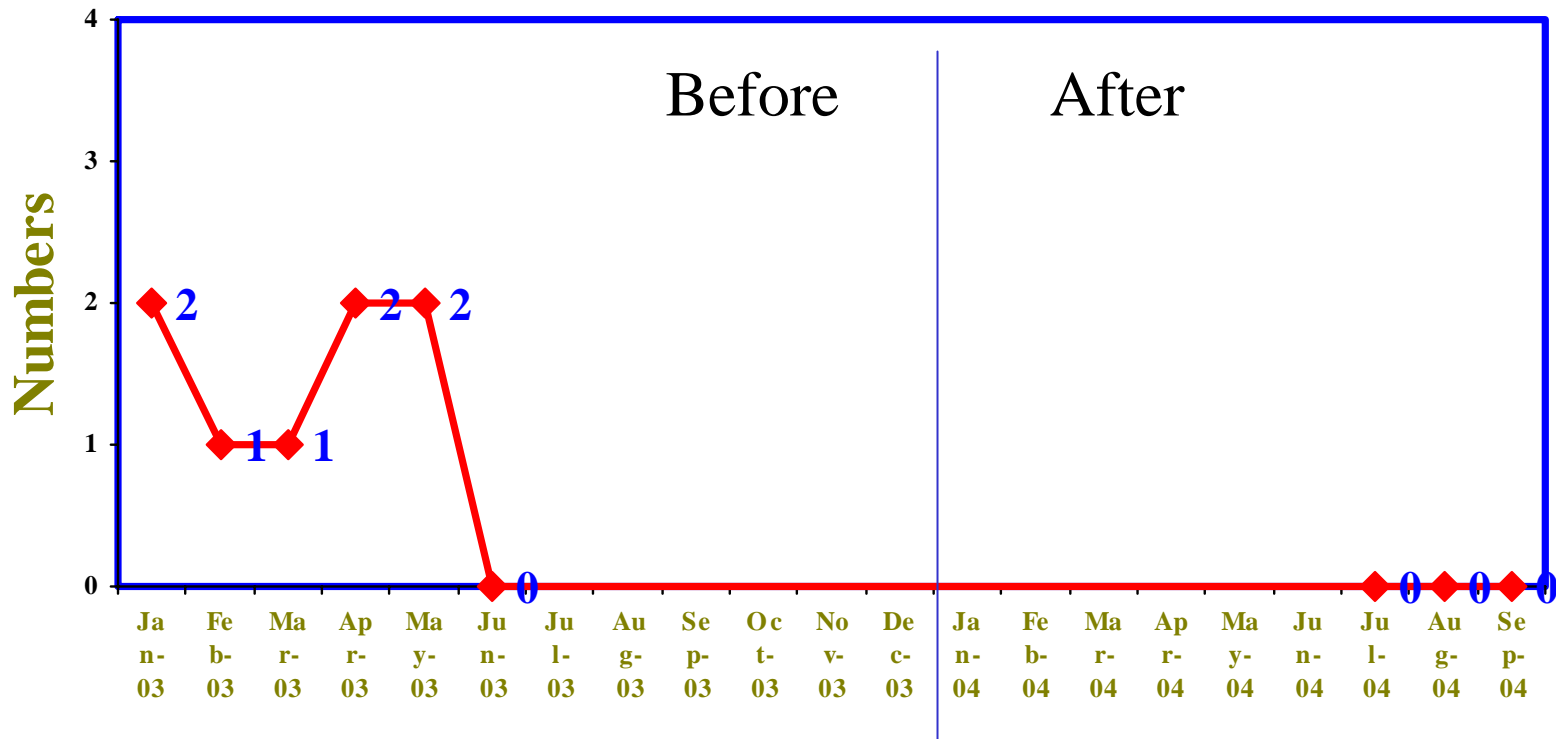
MAIN FACTORY

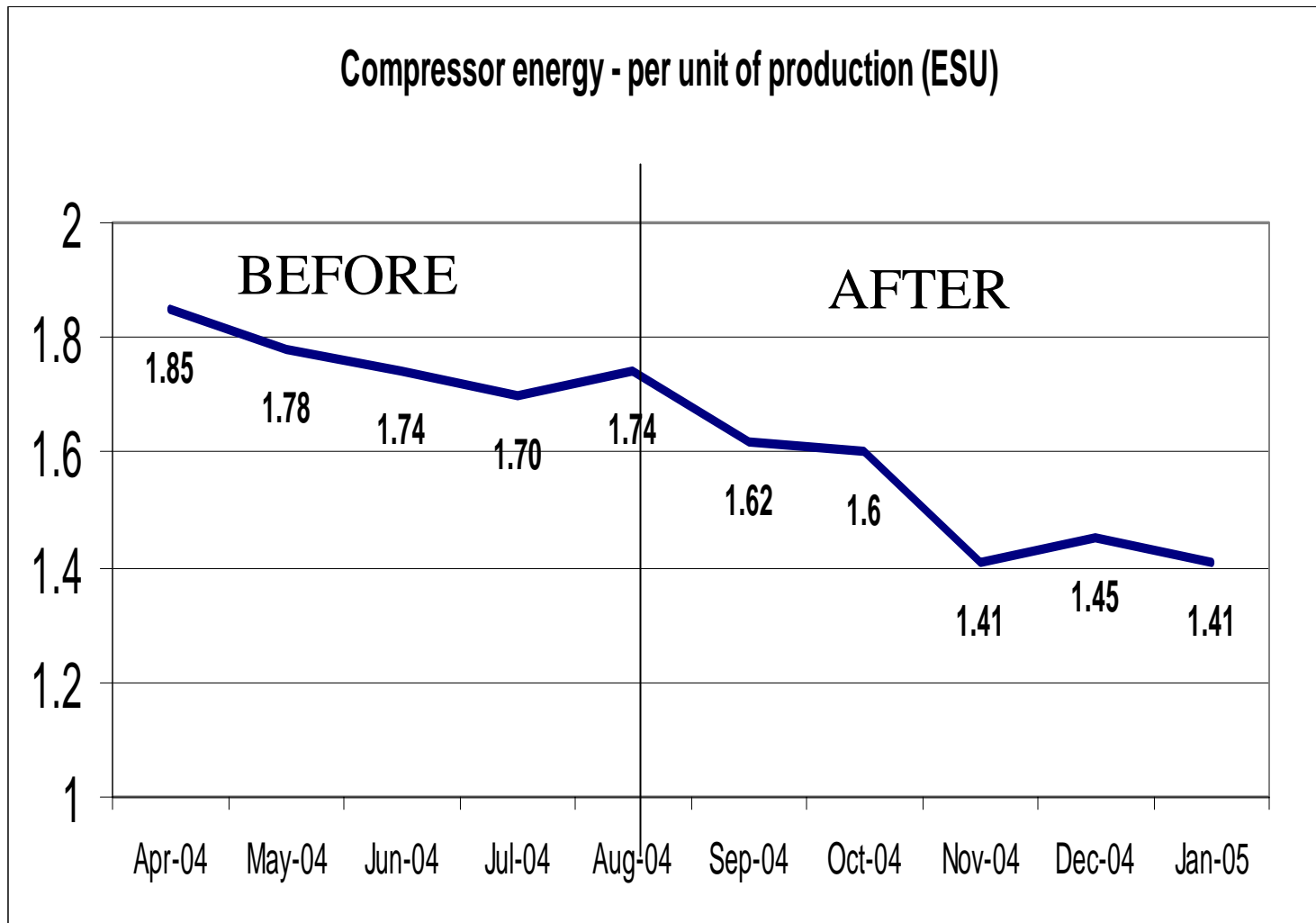
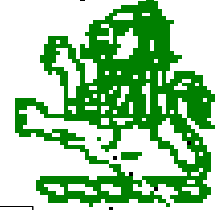
Substation





## Number of customer complaints on pressure variation







Sl.No.	What ( Activity)	Why ( Necessity )	Where	When	Who (Responsibility)	How ( Method )
1.	Introduction of electronic pressure control and automation.	To eliminate pressure variation in the header.	At compressor house.	In Aug 03	WED - QIT TEAM	Standard work procedure for air compressor operation is amended ( SWP I97 001) it is informed to process planning to standardise this for new projects in Pondy & Rewari.
1	Put compressor always in automatic mode.	The pressure will be consistently maintained .	In the user ends.	Always.	Sub station Operator.	By monitoring the P.C at substation.
2.	Calibrate the Pressure controller.	To ensure accuracy & repeatability.	Electronics lab.	Once in 2 years.	By electronic Lab.	By calibrating with external agency.
3.	Check all safety trips	For safety of the compressors.	Compressor room	Once in 3 months.	By maintenance engineer.	Stimulate abnormal conditions and check.



## 7.0 Conclusion

- Zero Customer complaints on compressed air interruptions is achieved.



## COST BENEFIT

### INVESTMENT

Total cost for the automation : RS. 6.50 LACS.

### COST BENEFIT

Average per day energy for compressor - before automation : 5375 KWHR.

Average per day energy for compressors - after automation : 5095 KWHR  
: ( 88000 uts)

Annual saving : Rs. 3.90 LACS.

Man power saved 2 : Rs. 3 lacs/annum

**PAY BACK : 11 MONTHS.**



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**Company Focus**

**OVER HEAD REDUCTION**

**Department  
Focus**

**Supply of utilities  
Improve quality of utilities  
Control cost on utilities**

**Team Focus / Objective**

**Energy conservation , Waste Elimination and  
Improving availability of utilities.**



1.1 Problem Statement

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# MORE ENERGY CONSUMPTION IN COOLING SYSTEMS

1.2 Why this Problem is Important?

- Increase in Over Head
- Resource Depletion
- Environmental Damage



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I 14	612	5

## ENERGY CONSERVATION

### To reduce 10% Energy in Our work area

STEP		JUNE				JULY					AUGUST				SEP		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
PROBLEM SELECTION	PL																
OBSERVATION	PL																
ANALYSIS	PL																
ACTION	PL																
CHECK	PL																
STANDARDIZATION	PL																
CONCLUSION	PL																
PRESENTATION	PL																



DEPT . CODE	PROJECT CODE	PAGE
I 14	612	6

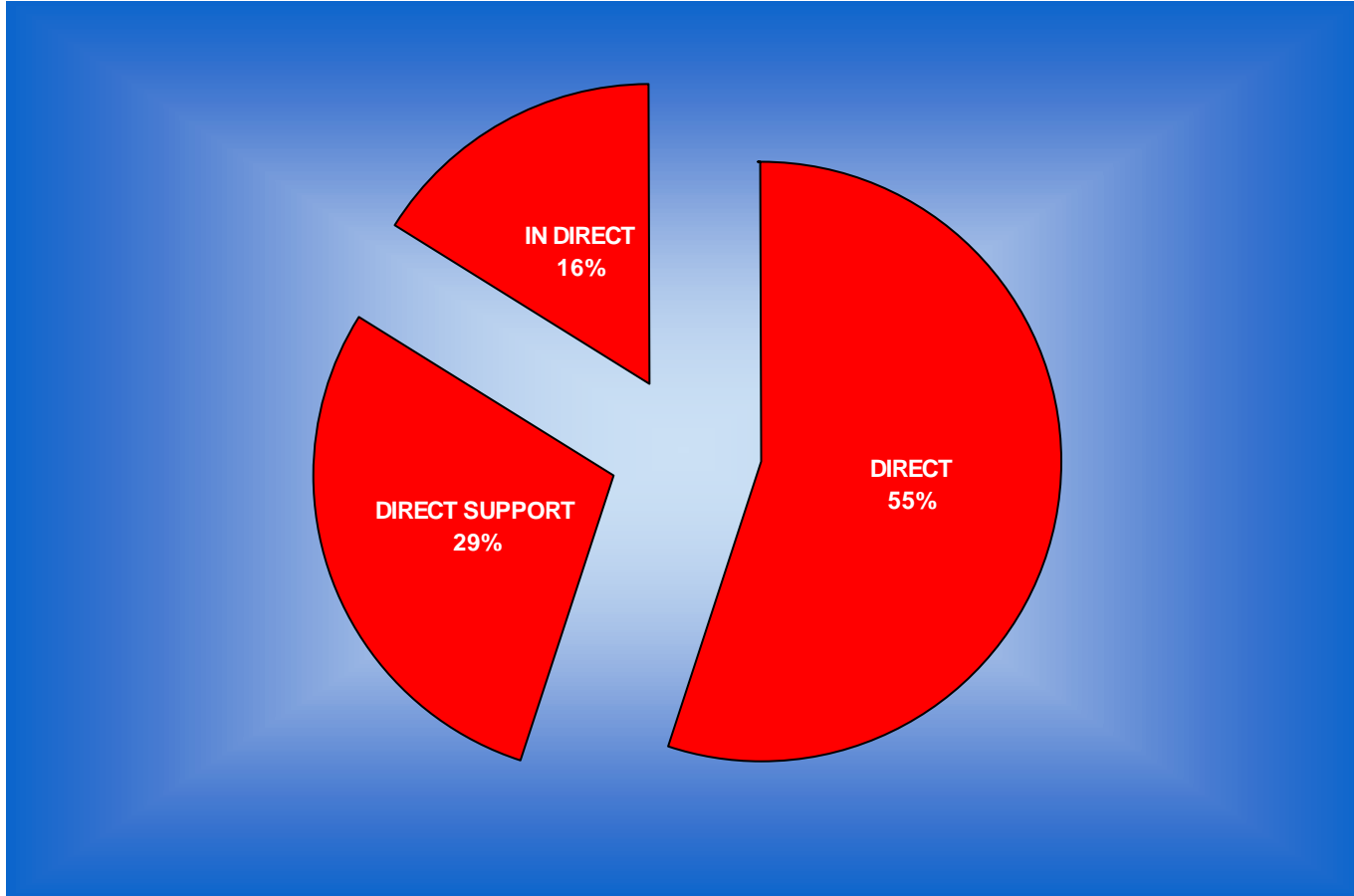
**ENERGY CONSUMPTION IN DIRECT & INDIRECT AREAS**  
**DATA COLLECTION IN DIRECT AND INDIRECT ENERGY**

Month	May-04	Jun-04	
Module	UNITS	UNITS	
APU / C40	189290	178050	} DIRECT 768705
CAV / PESPU	195250	199500	
CSPU	134500	132700	
DPU / WIPER	78000	82200	
HLPU / Process	174020	173900	
<b>TOTAL</b>	<b>771060</b>	<b>766350</b>	} DIRECTSUPPORT 399544
Air Compressor	136500	137500	
Cooling system	185060	194304	
Tet,Water & Sewage	71800	67740	
<b>TOTAL</b>	<b>393360</b>	<b>399544</b>	} IN DIRECT 220880
Canteen, DP, Accounts & Office areas	47600	47800	
Toolroom	59030	60080	
Engineering	113200	113000	
<b>TOTAL</b>	<b>219830</b>	<b>220880</b>	



2.1 Data collection W.R.T Time, Place, Type & Symptom

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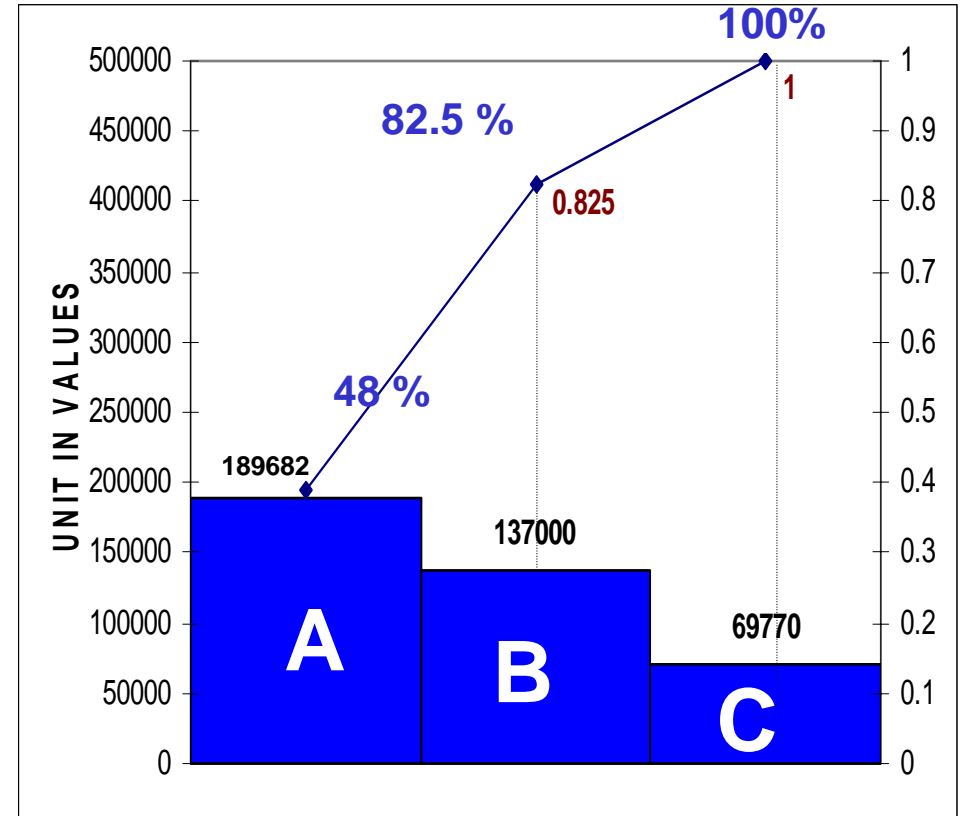
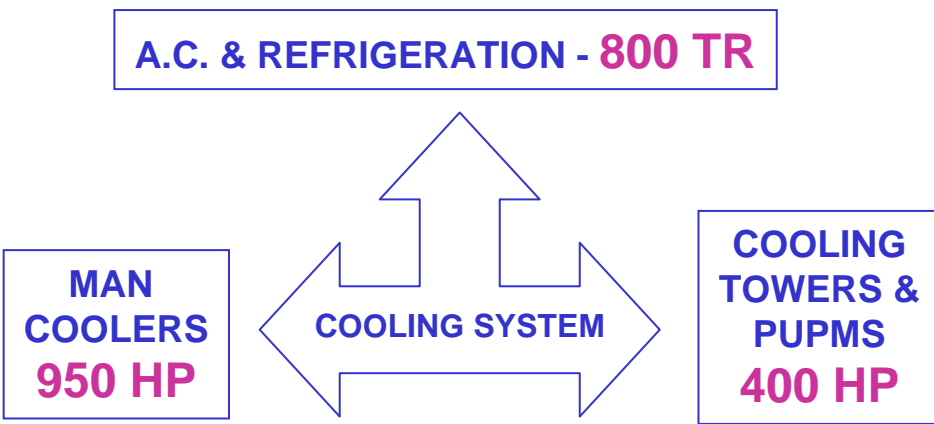
**ENERGY (DIRECT AREAS ) : 55 %**  
**ENERGY (DIRECT SUPPORT) : 29%**  
**ENERGY (INDIRECT AREAS) : 16 %**



PARETO ANALYSIS  
ENERGY CONSUMPTION IN

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DIRECT SUPPORT AREAS



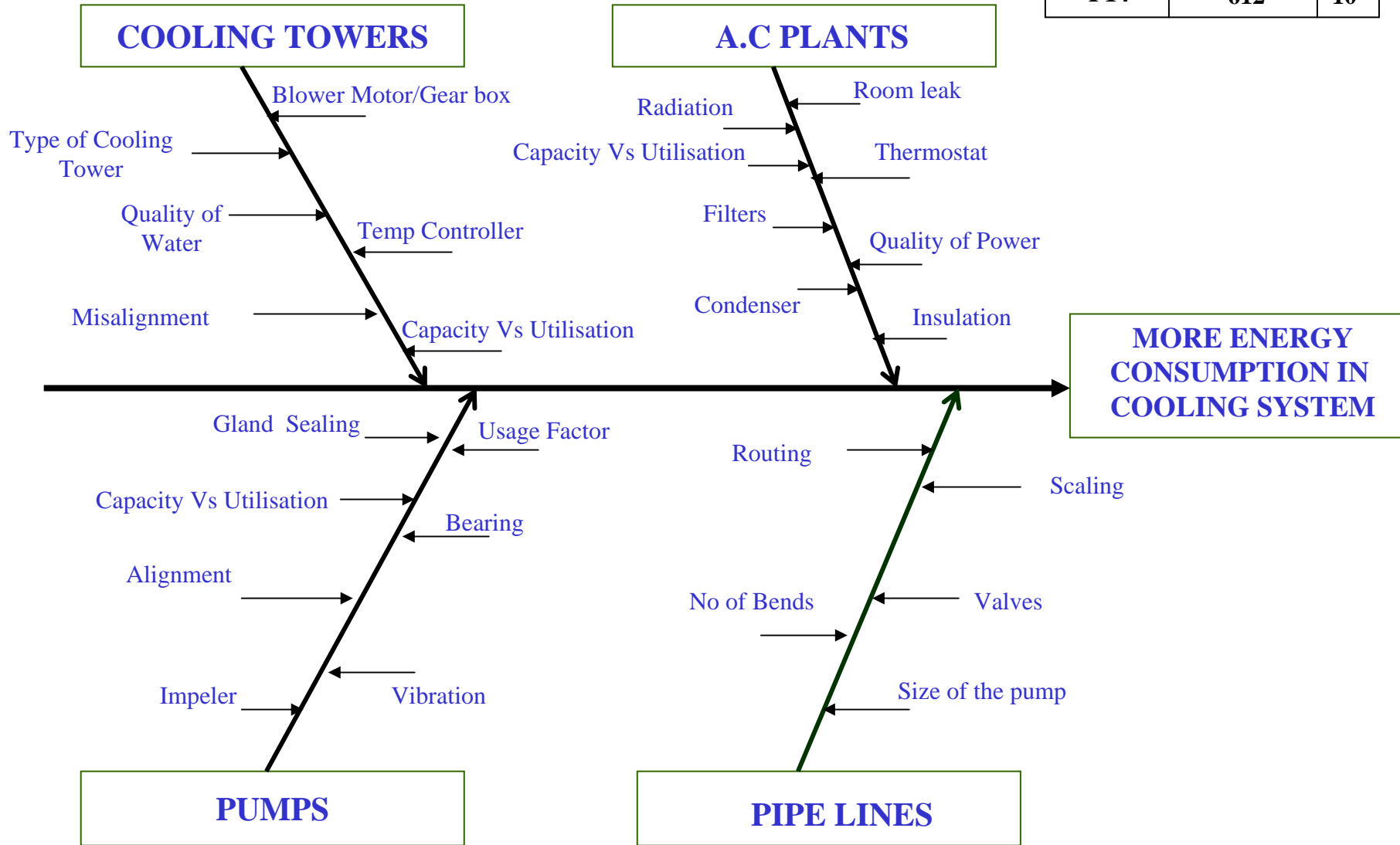
A - COOLING SYSTEM  
B - AIR COMPRESSORS  
C - WATER PLANT / TET / SEWAGE





3.2 CAUSE AND EFFECT DIAGRAM

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## 3.3 Cause Validation

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PIPE LINES			
SL NO	CAUSE	CHECKED BY	STATUS
1	ROUTING	TEAM	OK
2	SIZE OF THE PIPE	TEAM	OK
3	VALVES	TEAM	OK
4	NO. OF BENDS	TEAM	OK
5	SCALING	TEAM	OK



## 3.4 Cause Validation

DEPT . CODE	PROJECT CODE	PAGE
I 14	612	12

PUMP			
SL NO	CAUSE	CHECKED BY	STATUS
1	BEARING	TEAM	OK
2	CAPACITY Vs UTILISATION	TEAM	OK
3	GLAND SEAL	TEAM	OK
4	USAGE FACTOR	TEAM	OK
5	ALLIGNMENT	TEAM	OK
6	VIBRATION	TEAM	OK
7	IMPELLER	TEAM	OK



## 3.5 Cause Validation

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COOLING TOWER			
SL NO	CAUSE	CHECKED BY	STATUS
1	BLOWER - MOTOR/GEAR BOX	TEAM	OK
2	TEMPERATURE CONTROLLER	TEAM	OK
3	TYPE OF COOLING TOWERS	TEAM	OK
4	QUALITY OF WATER	TEAM	OK
5	MISALIGNMENT	TEAM	OK
6	CAPACITY Vs UTILISATION	TEAM	NOT OK



## 3.6 Cause Validation

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A.C PLANTS			
SL NO	CAUSE	CHECKED BY	STATUS
1	ROOM LEAK	TEAM	OK
2	QUALITY OF POWER	TEAM	OK
3	INSULATION	TEAM	OK
4	CONDENSER	TEAM	OK
5	FILTERS	TEAM	OK
6	GAS	TEAM	OK
7	RADIATION	TEAM	NOT OK
8	THERMOSTAT	TEAM	OK
9	TYPE OF COMPRESSOR	TEAM	OK
10	INSTALLED CAPACITY Vs UTILISATION	TEAM	NOT OK
11	DRIVE	TEAM	OK



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ROOF

ENERGY CONSUMPTION AS PER METER READING  
107 UTS PER DAY.

ELECTRONICS LAB

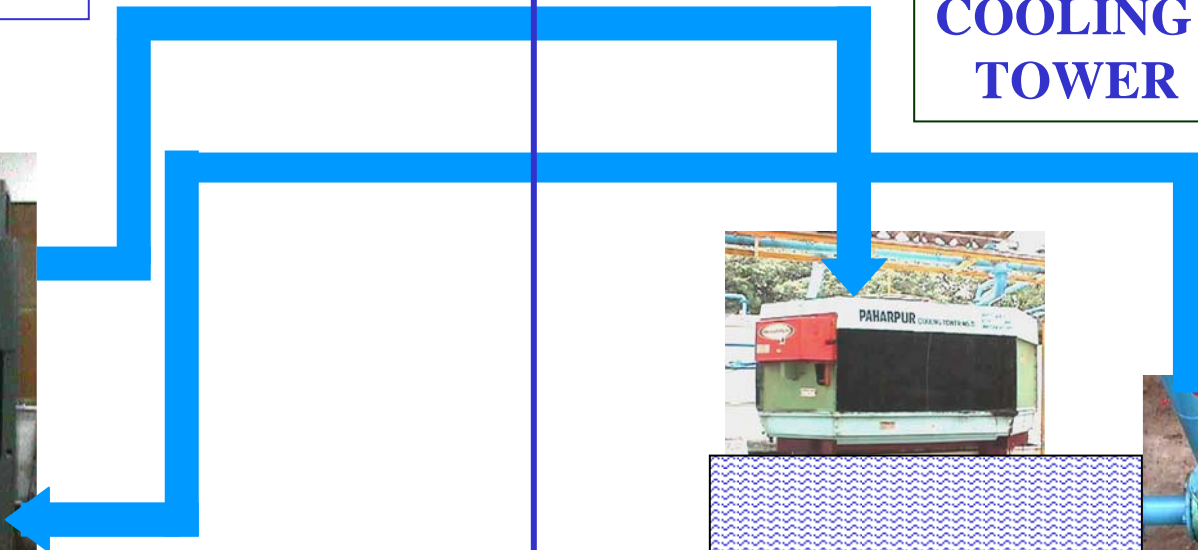
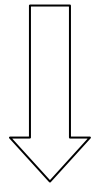
PACKAGE A.C. UNIT  
7.5 T.R



COOLING  
TOWER



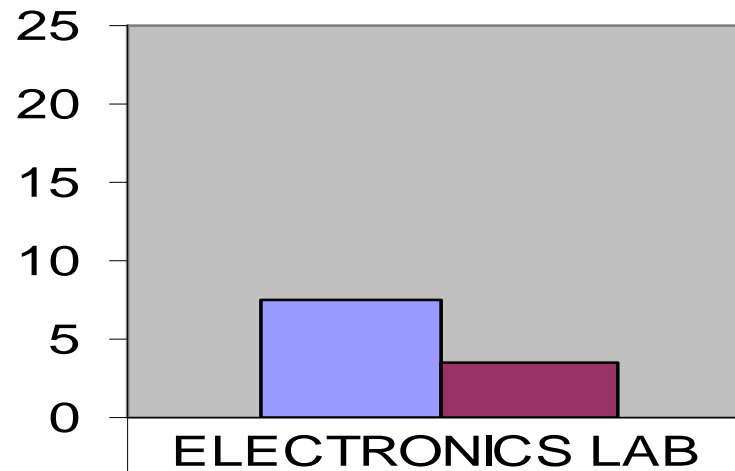
PUMP





SL.NO	LOCATION	CAPACITY	VOLUME	TYPE OF LOCATION	STANDARD	REMARKS
1	ELECTRONICS LAB	7.5 TR	10500 CFT	INSIDE ROOF	3000 CFT / TR	4.0 TR EXCESS

## INSTALLED CAPACITY Vs STANDARD



■ INSTALLED CAPACITY

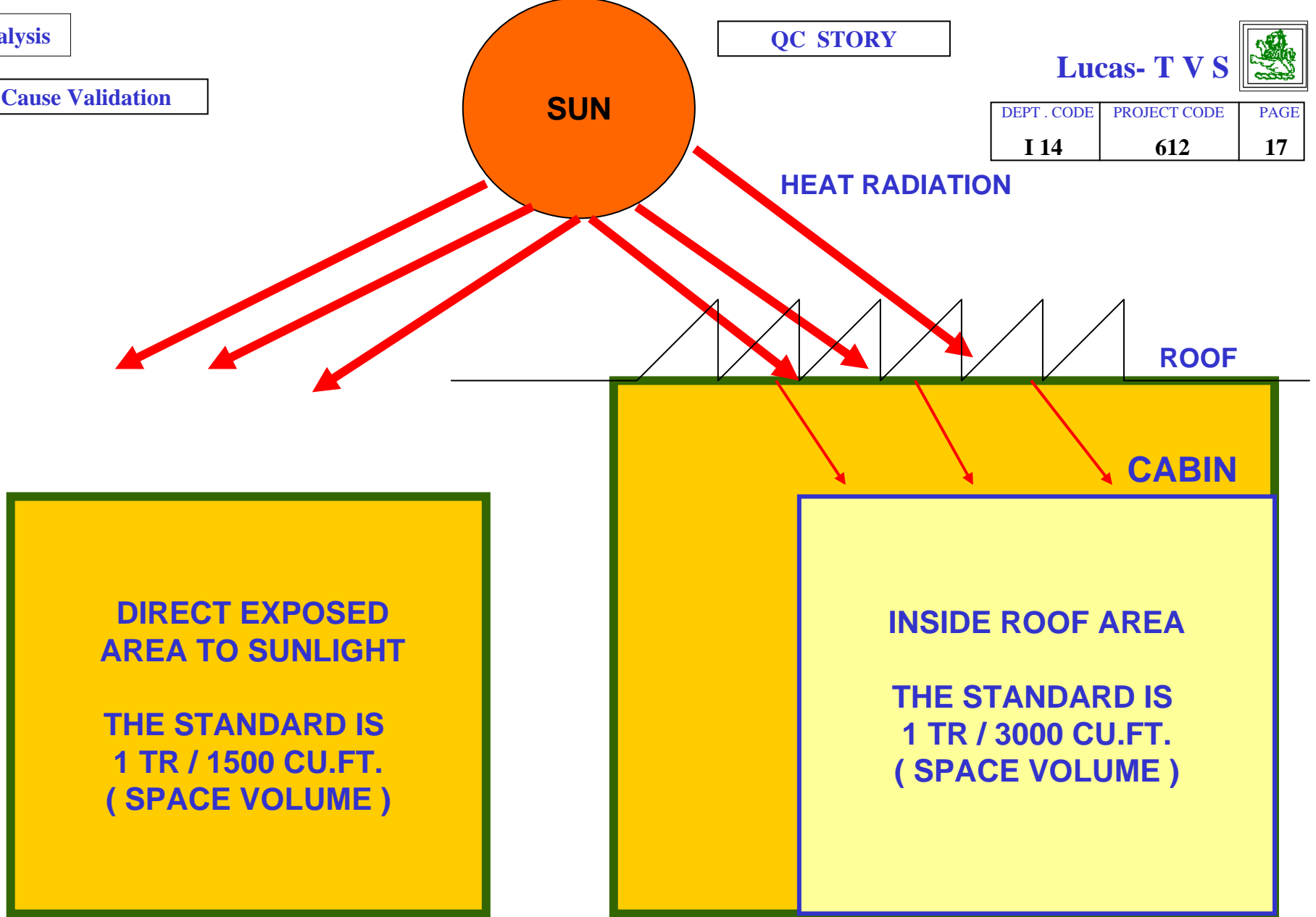
7.5TR

■ REQUIREMENT AS PER STD.

3.5TR



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3.10 Root Cause

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**T.R. VALUE PER VOLUME IS NOT AS PER STANDARD.**

4.1 Action Plan

**REDUCE THE CAPACITY AS PER STANDARD REQUIREMENT**



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1. In electronics Room the 7.5 ton package unit was replaced by 2 X 1.5 TON window units

## ELECTRONICS LAB



ENERGY CONSUMPTION AS PER METER READING  
39 UTS PER DAY



## 3.11 Cause Validation

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PAGE

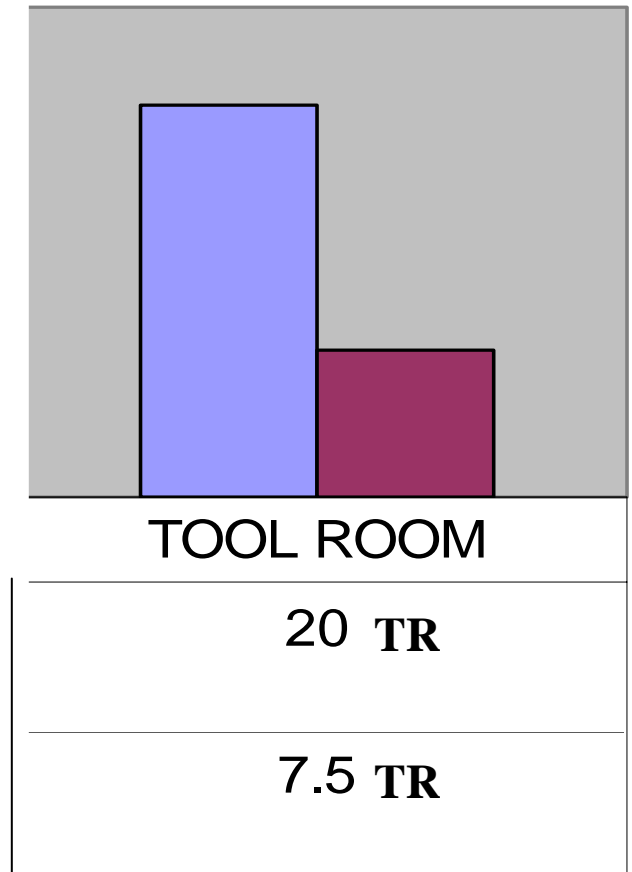
20

# INSTALLED CAPACITY Vs STANDARD

SL.NO	LOCATION	CAPACITY	VOLUME	TYPE OF LOCATION	STANDARD	REMARKS
1	TOOL ROOM	20 TR	13650 CFT.	INSIDE ROOF	3000 CFT / TR	12.5 EXCESS

**INSTALLED CAPACITY**

**REQUIREMENT AS PER  
STD.**

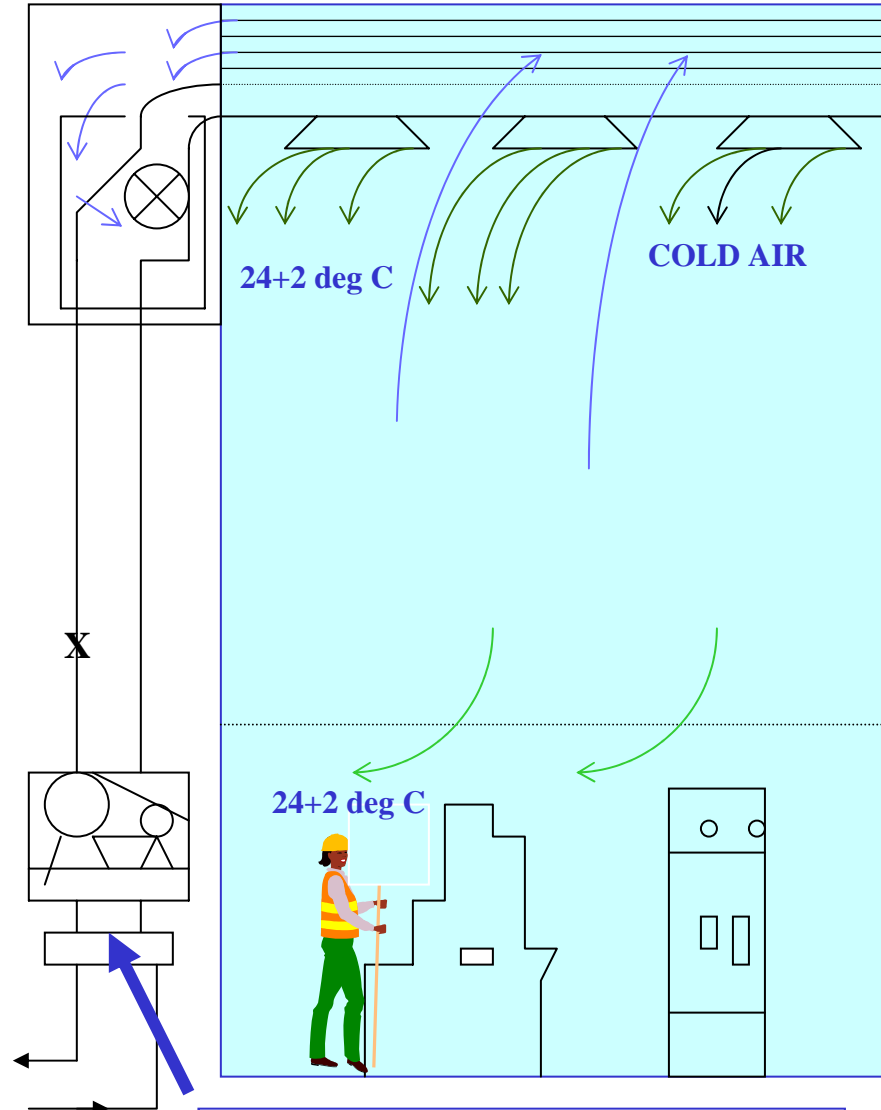




3.12 Cause Validation

Tool Room Central A.C. Plant

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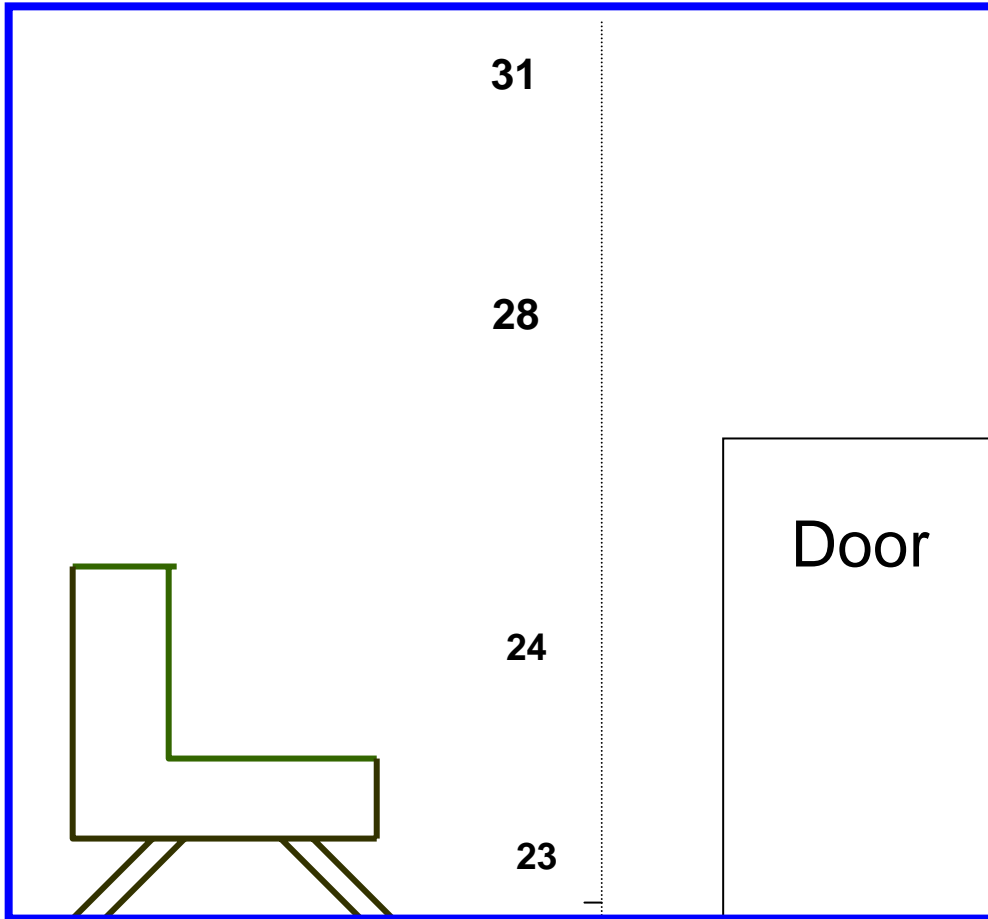


20 TR CENTRALISED A.C PLANT.



## 3.13 Cause Validation

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R.H. AT 25 DEG.C. IS 60 %

## Air Temp

25 Deg.C.

28 Deg.C.

31 Deg.C.

## Air Weight

1 Cu.m.of air = 1.04 kg.

1 Cu.m.of air = 0.936 kg.

1 Cu.m.of air = 0.842 kg.

- HOT AIR WILL BE RAISED TO HEIGHT DUE TO EXPANSION OF AIR
- BY MORE TEMPERATURE.
- COLD AIR WILL BE SETTLED AT BOTTOM DUE TO CONTRACTION OF AIR BY LESS TEMPERATURE.

4. Action

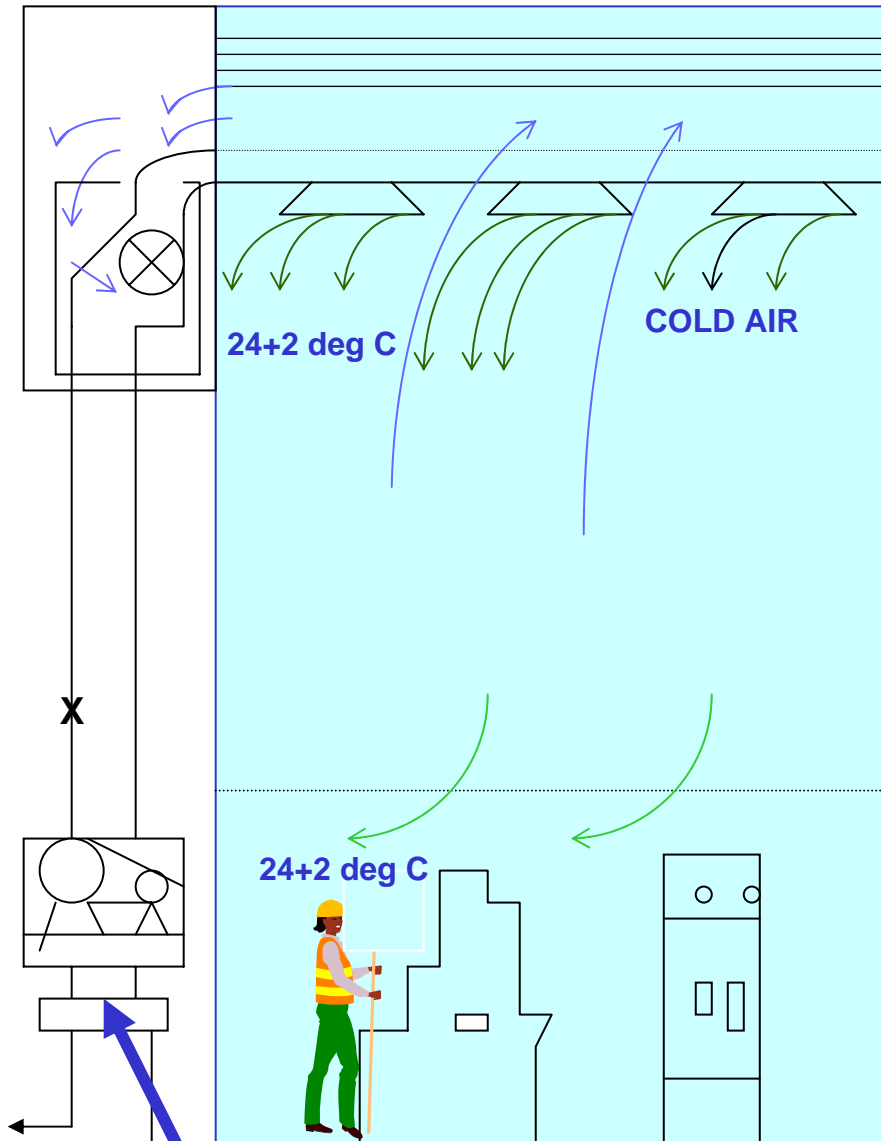
# TOOL ROOM EDM WIRE CUT MACHINE - ROOM

DEPT . CODE	PROJECT CODE	PAGE
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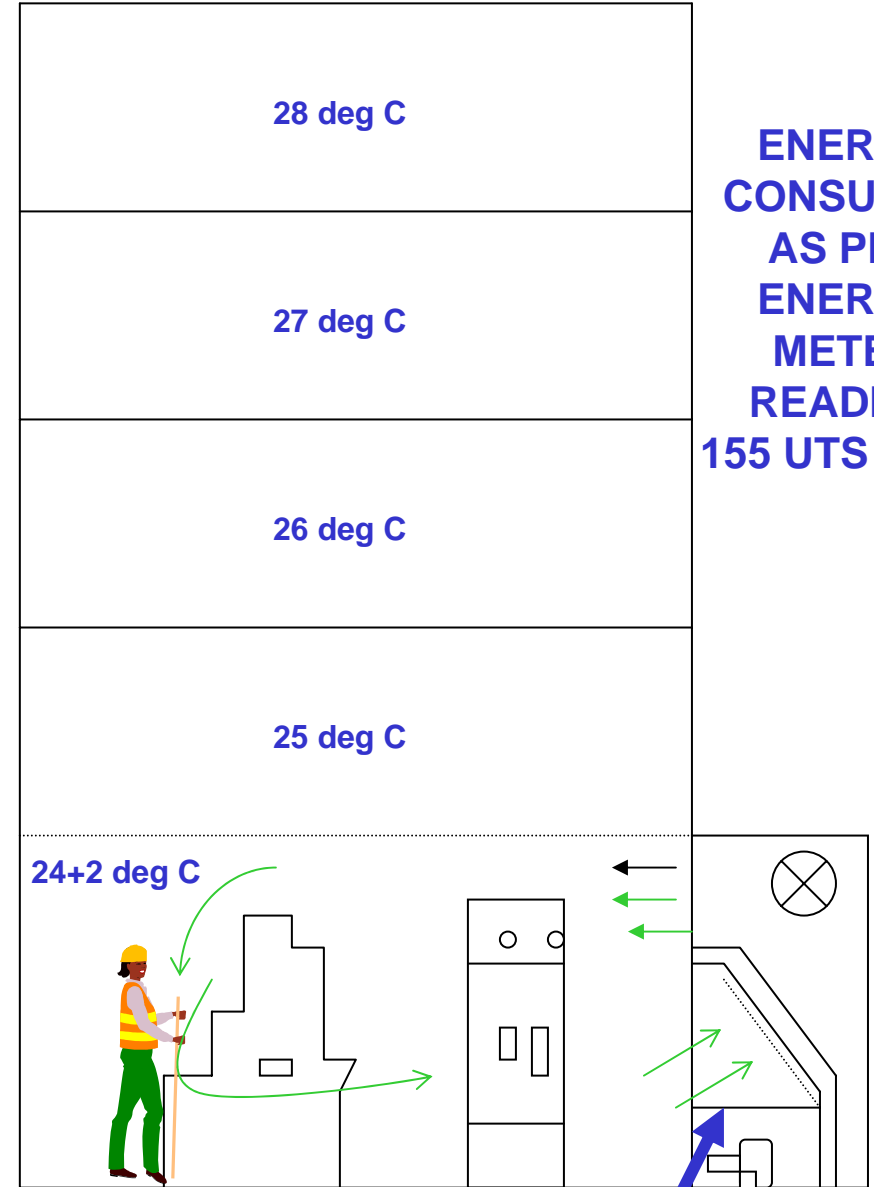
4.2 Counter Measures

BEFORE

AFTER



20 TR CENTRALISED A.C. PLANT.  
381 UTS / DAY



7.5 TR PACKAGE A.C. UNIT.

ENERGY  
CONSUMED  
AS PER  
ENERGY  
METER  
READING  
155 UTS / DAY

**WINDOW A.C. UNIT DOES NOT REQUIRE THE SECONDARY COOLING SYSTEM.**

3.14 Cause Validation

WINDOW A.C. UNIT



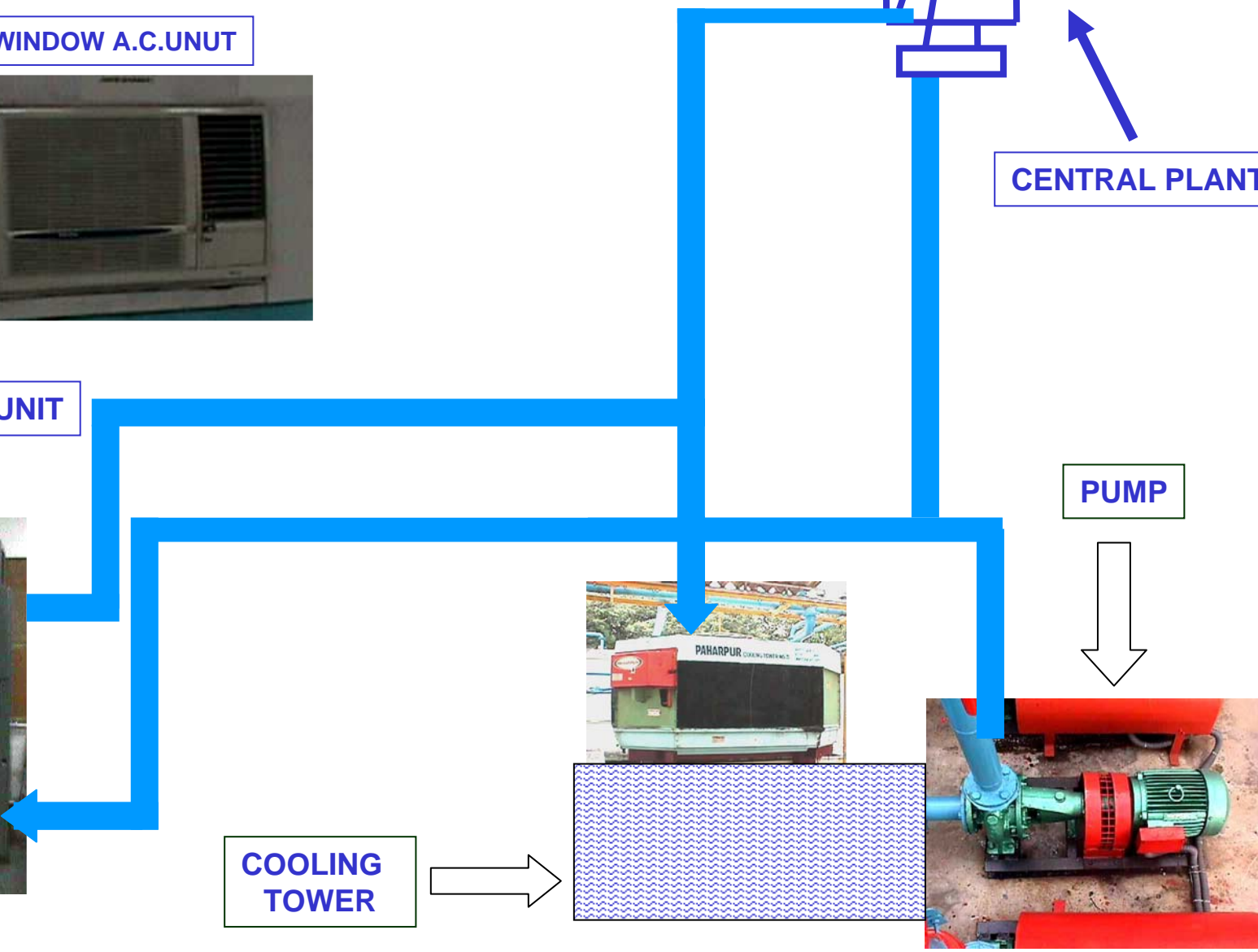
CENTRAL PLANT

PUMP

PACKAGE A.C. UNIT



COOLING TOWER



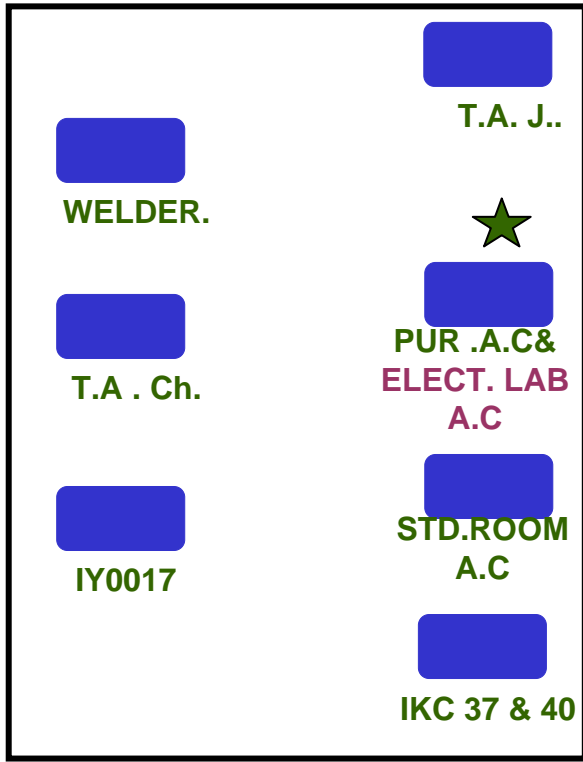


3.15 Cause Validation

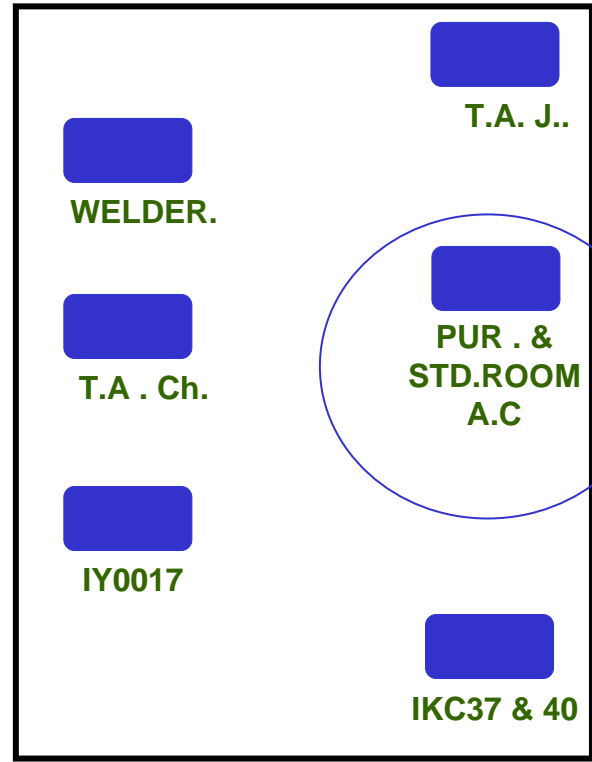
DEPT. CODE	PROJECT CODE	PAGE
I 14	612	25



**BEFORE**



**AFTER**



★ PUMP CAPACITY 10 HP , 1080 LPM  
 LOAD - PUR - 420 LPM + E.LAB 420 LPM

STD.ROOM. PUMP CAPACITY 7.5 HP , 810 LPM  
 LOAD - 420 LPM

PUMP CAPACITY 10 HP , 1080 LPM  
 LOAD - PUR - 420 LPM + STD.ROOM 420 LPM

ONE 7.5 HP PUMP TOTALLY REMOVED  
 FROM THE SYSTEM SINCE IN THE ELECTRONICS  
 LAB. A.C . WAS CONVERTED FROM WATER  
 COOLED SYSTEM TO AIR COOLED SYSTEM.

### 3. Analysis

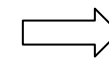
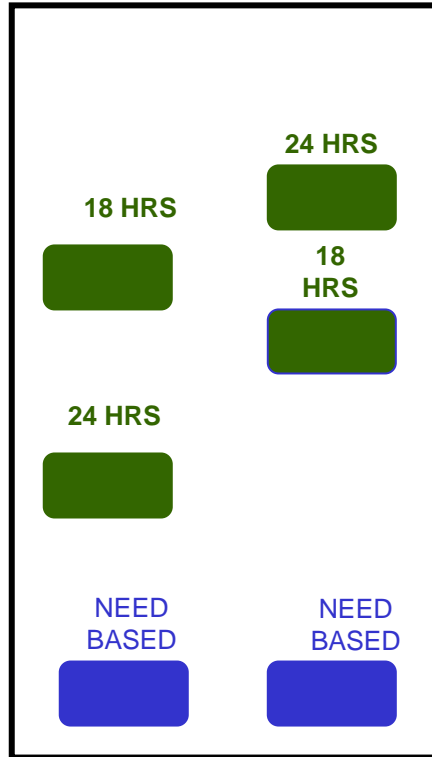
### QC STORY

Lucas-T V S

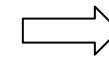


### 3.17 Cause Validation

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NEED BASED OPERATION



24 Hrs & 18 Hrs OPERATION

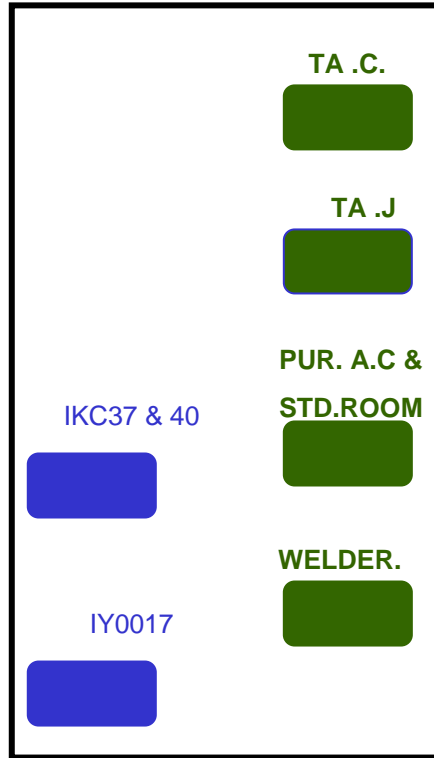


4. Action

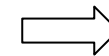
QC STORY

4.4 Counter Measures

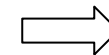
DEPT . CODE	PROJECT CODE	PAGE
I 14	612	28



AFTER THIS IMPROVEMENT THE BLOWER MOTORS OF COOLING TOWERS NEED NOT RUN ALL THE TIME



NEED BASED OPERATION



24 Hrs & 18 Hrs OPERATION

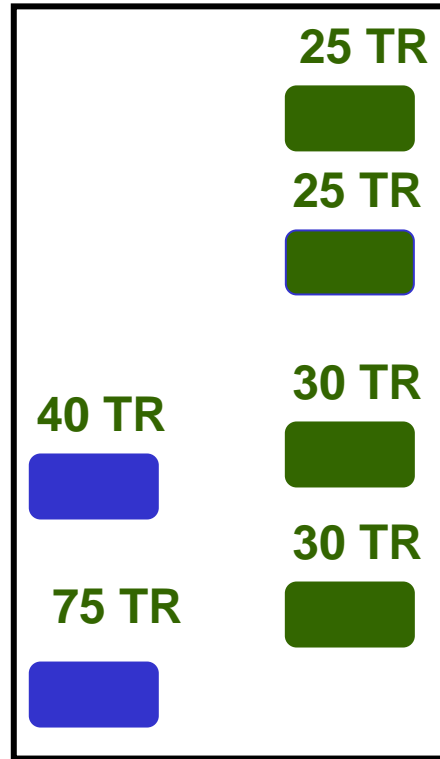
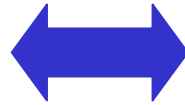


3.18 Cause Validation

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3

200 TR

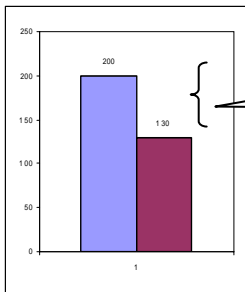


4

200 TR



CAPACITY VS. UTILISATION

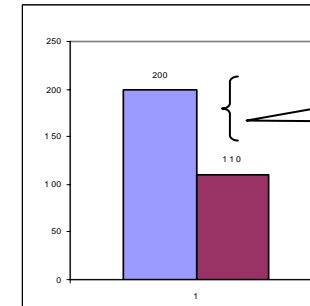


SPARE CAPACITY

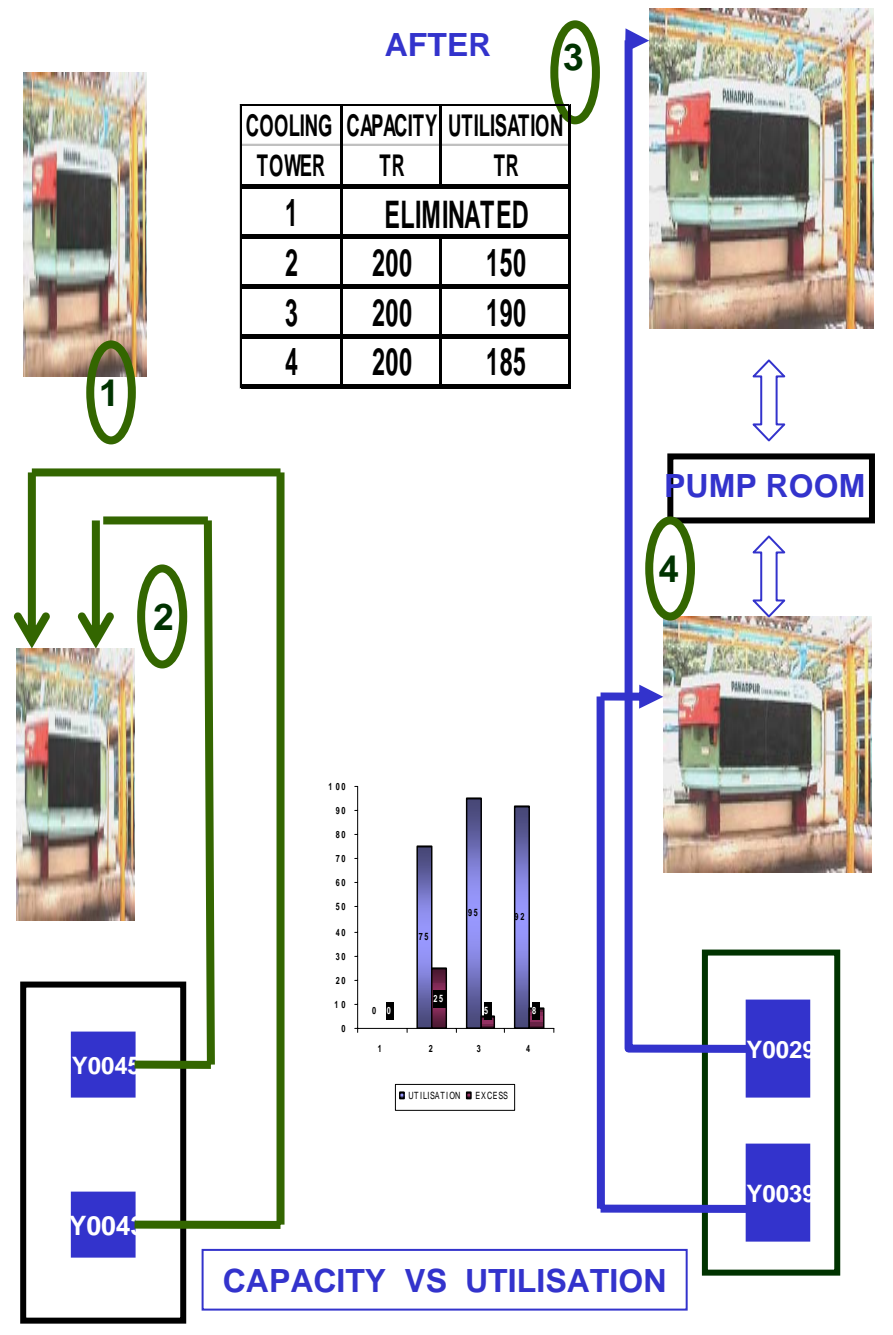
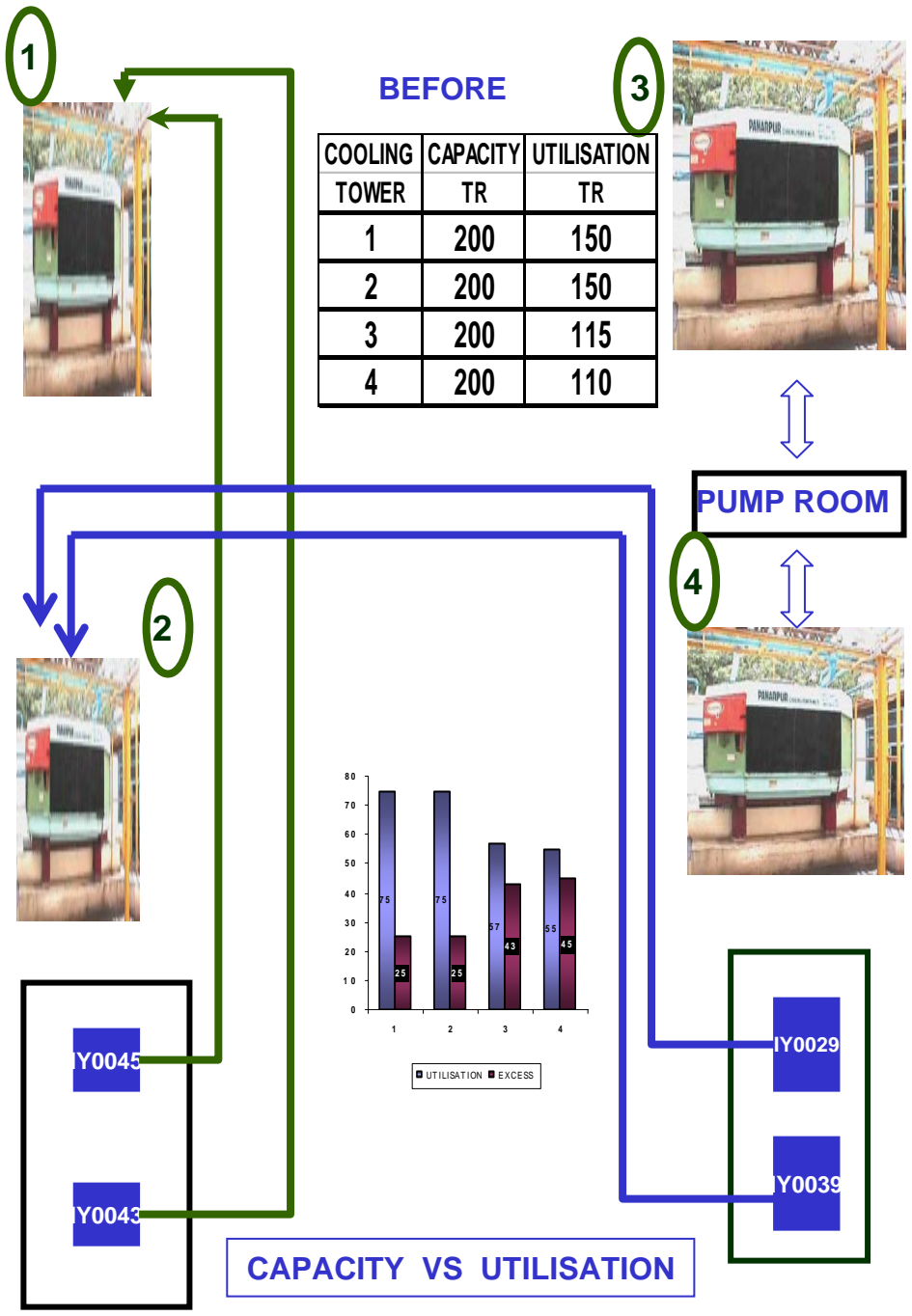
115 TR

110 TR

CAPACITY VS. UTILISATION



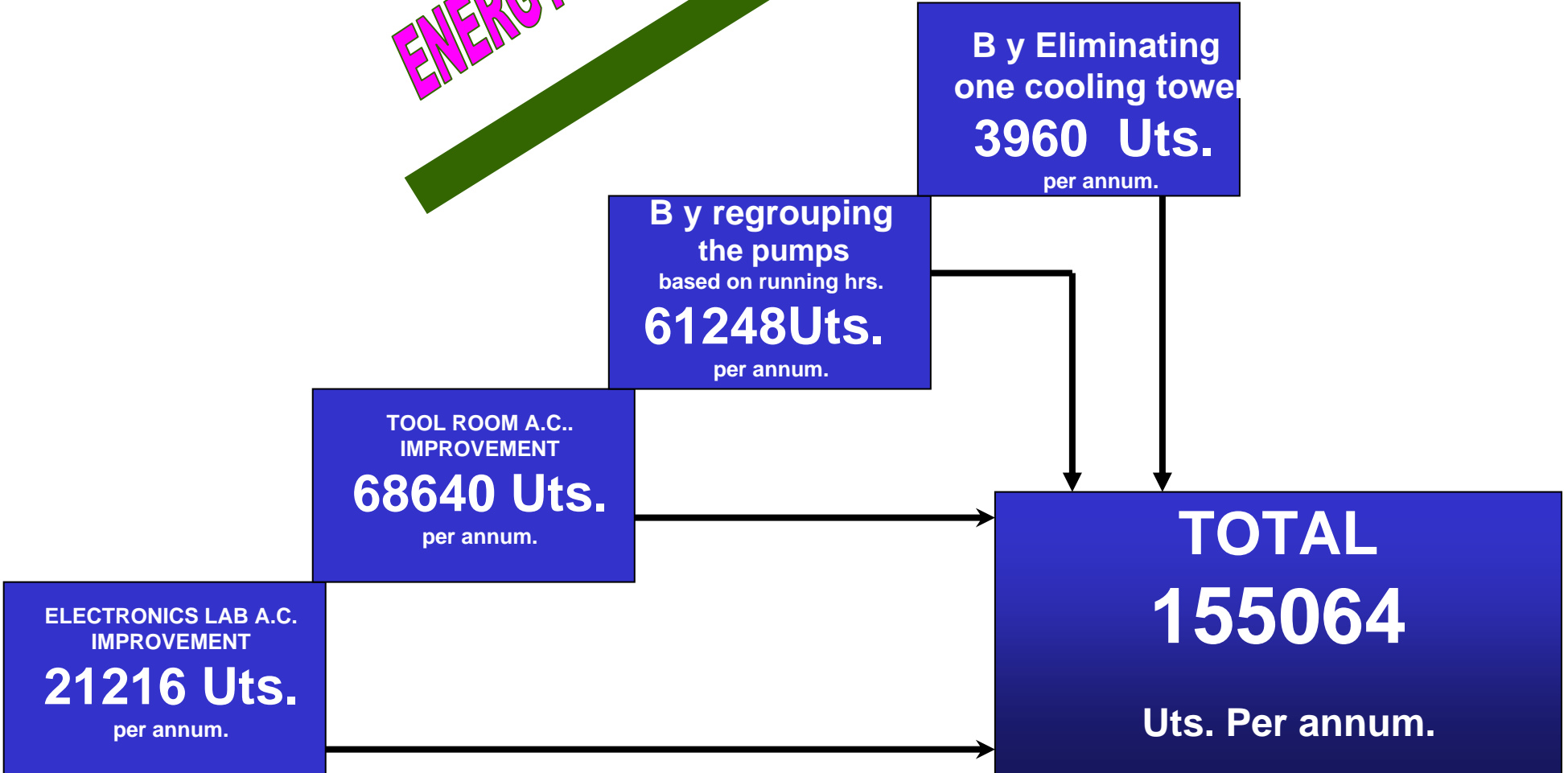
SPARE CAPACITY





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**ENERGY CONSERVATION**





## DATA COLLECTION AFTER IMPROVEMENT

DEPT . CODE

I 14

PROJECT CODE

612

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## ENERGY CONSUMPTION IN DIRECT &amp; INDIRECT AREAS

Month	May-02	Jun-02	Jul-02	Aug-02	Sep-02
Module	UNITS	UNITS	UNITS	UNITS	UNITS
APU / C40	189290	178050	171350	156960	148370
CAV / PESPU	195250	199500	193900	176950	161350
CSPU	134500	132700	132700	132304	131200
DPU / WIPER	78000	82200	83090	76230	71560
HLPU / Process	174020	173900	183790	178370	171250
<b>TOTAL</b>	<b>771060</b>	<b>766350</b>	<b>764830</b>	<b>720814</b>	<b>683730</b>
Toolroom	59030	60080	62200	61200	59060
Engineering	113200	113090	111070	102100	107312
Canteen	47600	47800	47800	35690	33762
Air Compressor	136500	137500	137504	132400	134400
Tet, Water & Sewage	71800	67740	74274	73450	76500
Cooling system	185060	194304	194300	179988	179900
<b>TOTAL</b>	<b>613190</b>	<b>620514</b>	<b>627148</b>	<b>584828</b>	<b>590934</b>

**TOTAL ENERGY SAVED IN**

**COOLING SYSTEM = 7 %**

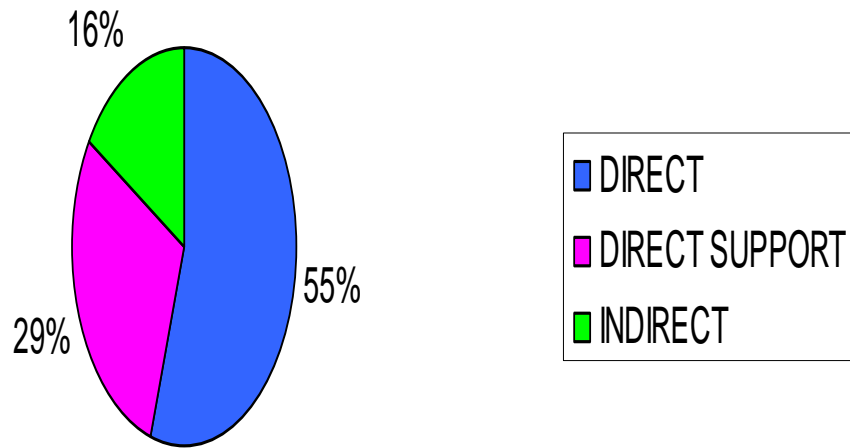
**(12922 uts per month.)**



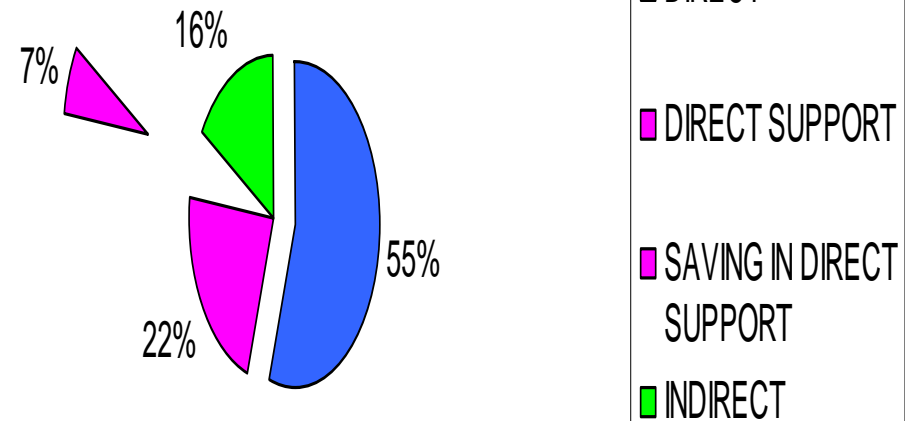
## DATA COLLECTION AFTER IMPROVEMENT

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### BEFORE Q.C



### AFTER Q.C



## 6. STANDARDISATION

## QC STORY

Lucas- T V S



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SL.No	What (Activity)	Why (Necessity)	Where	When	Who(Reps).	How (Method)
1	Capacity Vs.Utilisation of A.C. plants	For optimisation	Central plant & package units.	Once in 3 months.	TEAM	Check any relayout / or changes taken place in the locations / m/cs & match the capacity
2	Capacity Vs.Utilisation cooling towers & pumps	For optimisation	All cooling towers, & both pump houses.	Once in 3 months.	TEAM	Check any relayout / or changes taken place in the locations / m/cs & match the capacity
3	Check the condition of pressure switches	For effective controls	Central plant & package units.	Once in 6 months..	TEAM	Stimulate the system for the set condition and check.
4	Check the condition of Temp. controllers	For effective controls	In cooling towers.	Once in 3 months.	TEAM	Stimulate the system for the set condition and check.
5	Check the condensers & heat exchangers	For better heat transfer	In A.C.plants Gensets & air compressors.	Once in a month.	TEAM	Dismantle the unit & descale the bundle & shell.
6	Clean & descale the cooling tower - fills	For better heat transfer	In all cooling towers.	Once in 3 months.	TEAM	Clean all fills & louvers in a dry condition.



## 7.1 Result

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**ENERGY SAVING BY COUNTER MEASURES: 1,55,064 UTS PER ANNUM.**

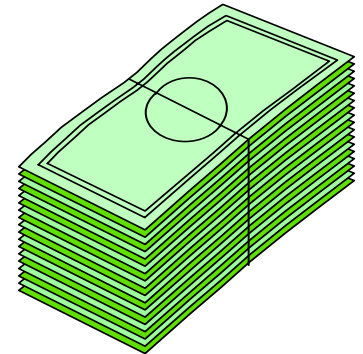
## 7.2 Benefits - Tangible

**RECURRING COST SAVING : RS. 7, 28, 800 PER ANNUM  
(1,55,064 UTS x Rs. 4.70 )**

**ONE TIME COST SAVING :**

- BY ELIMINATING ONE No. 200 TR FRP COOLING TOWER Rs.1,50,000
- BY ELIMINATING ONE 7.5 HP PUMP Rs. 15,000
- BY USING THE REMOVED PACKAGE UNIT AT TOOL ROOM Rs 80,000
  
- EXPENDITURE FOR THIS PROJECT
- 2Nos of 1.5 TR Window A.C unit for Electronics lab Rs. 40,000
- Cost towards modification of pipe lines Rs. 15,000
  
- NET ONE TIME COST SAVING Rs.1,90,000/-

**Noise level Reduced from 75db to 55db at Electronic lab**



## 7.3 Benefits - In Tangible

**Job Pride  
Team work  
Good House keeping**



7.5 PLAN VS ACHIEVEMENT

DEPT . CODE	PROJECT CODE	PAGE
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STEP		JUNE				JULY					AUGUST				SEP	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
PROBLEM SELECTION	PL	████████████████														
	A	████████████████														
OBSERVATION	PL			████████████████												
	A					████████████										
ANALYSIS	PL						████████████									
	A							██████████								
ACTION	PL									██████████						
	A									██████████						
CHECK	PL											██████				
	A															
STANDARDIZATION	PL												██████			
	A												██████			
CONCLUSION	PL													██████		
	A												██████			
PRESENTATION	PL														██████	
	A													██████		



## 7.4 Benefits - Learning Points

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**It is essential to have a periodical audit on capacity Vs. utilisation of any system , so that the optimisation can be achieved , which will result in energy saving & waste elimination.**

**While taking counter measures for above the best available energy efficient equipment is to be selected.**



- . BAR CHART
- . PIE CHART
- . PARETO DIAGRAM
- . CAUSE& EFFECT DIAGRAM

**ENERGY CONSERVATION ON STANDARDS  
ROOM A.C PLANTS**

**ENERGY CONSERVATION ON PURCHASE,  
IT & ENGINEERING CENTER A.C PLANTS**

**OUR THANKS TO**

**Manager (Maintenance)  
Electrical Engineers  
Training Center.**