OPTIMIZATION FOR EFFICIENT PUMPING MACHINERY

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OPTIMIZATION IS A STUDY AND ANALYSIS TO SPEND LITTLE MORE ON CAPITAL COST BUT SAVE SIGNIFICNT AMOUNT IN ENERGY AND GET LONGER LIFE DUE TO BETTER QUALITY. FOR THIS, CALCULATIONS OF L.C.C. (LIFE CYCLE COST) ARE AVAILABLE FOR ALMOST ALL ENERGY CONSUMING EQUIPMENTS.

OPTIMIZATION IS THE TOOL FOR MOVING FROM MINIMUM TO MAXIMUM AND STRIKES A BALANCE AFTER CONSIDERING EFFECT ON CAPITAL COST.

INCIDENTALY B.I.S SPECIFICATIONS ARE BASED ON MINIMUM ACCEPTABLE STANDARDS (M.A.S.) FOR GOOD PARAMETERS SAY EFFICIENCY IT IS MINIMUM FOR BAD PARAMETERS SAY LOAD LOSSES IN TRANSFORMERS IT IS MAXIMUM.

THEREFORE QUILITY AND COST CONSCIOUS ENGINEER IS SUPPOSED TO MOVE FROM MINIMUM TO MAXIMUM / MAXIMUM TO MINIMUM AND STRIKE A BENCH-MARK PARAMETER WHERE-BY IT IS ECONOMICAL IN LONG RUN.

IT IS ESTABLISHED FACT THAT ONE PERCENT EXTRA PUMP EFFICIENCY PAYS BACK ITS CAPITAL COST DURING ITS LIFE TIME (15 YEARS) IMAGINE WHERE SUBMERSIBLE PUMP FROM REPUTED MANUFACTURER QUOTED OVERALL EFFICIENCY OF 56% WHEREAS LOCAL MANUFACTURER SUPPLIED PUMPS OF THE SAME QxHxN PARAMETES OF WITH EFFICIENY OF 46% WHICH IS AS PER ISS HOWEVER WHICH CONSUME 10% EXTRA POWER THROUGHOUT LIFE AND HENCE MORE COST IN LONG RUN.

I OPTIMIZED PUMP EFFICIENCY AT 54% AND SUITABLE BONUS PER 1% EXTRA EFFICIENCY. FURTHER PROVISION WAS KEPT THAT THE PUMPS LESS THAN 54% EFFICIENCY WILL NOT BE ACCEPTED AND NO MINUS TOLERACES IN EFFICIENCY WILL BE ACCEPTED.

SIMILIARLY FOR ERW PIPES, WHICH WERE PURCHASED ACCORDING TO IS-3589 AND MANUFACTURERS SUPPLIED PIPES WITH -10% THICKNESS AGAINST PRESCRIBED PROVISION OF THE TENDER (IS-3589) AS ±10%

ACCEPTING PIPES OF -10% THINNER PIPES IS NOTHING BUT ACCEPTING MEDIUM DUTY PIPES INSTEAD OF HEAVY DUTY PIPES FOR WHICH PURCHASER PAYS MORE. MEDIUM DUTY PIPES ARE 10-12% CHEAPER THAN HEAVY DUTY PIPES OF SAME PARAMETERS.

I ARGUED WITH THE MANUFACTURERS, WHY ONLY FULL MINUS TOLERENCE AND NOT PLUS TOLERENCE. RERESENTATIVE OF S.A.I.L (STEEL AUTHORITY OF INDIA) AND TATA STEEL INFORMED THAT THEY

SUPPLY PIPES OF THICKNESS TOLERANCE OF ± 3% AND MAKE PIPES FROM THE PLATE/COIL OF PRESCRIBED TENDER THICKNESS AND NOT FROM LOWER THICKNESS.

I OPTIMIZED THICKNESS TOLERANCE AT ± 3% AND USE OF COIL/PLATE OF PRESCRIBEDTHICKNESS. THIS WAY DEPARTMENT GOT BEST QUALITY PIPES HAVING USEFULL LIFE OF 30 YEARS.

THEN PROBLEM OF EARLY (2-3 YEARS) RUSTING OF G.I. M.S. PIPES USED AS LINE PIPES AND COLUMN PIPES IN TUBEWELL WAS ALSO STUDIED.

HERE I REFERED IS -1239 WHICH PRESCRIBES ZINC COATING MINIMUM 230 GRAMS PER SQUARE METER OF PIPES. I CONTACTED TATA PIPES THEY SAID THEIR PIPES ARE COATED AT 460 GMS/M^2 SAY NEARLY DOUBLE.

I OPTIMIZED THE ZINC COATING AT 400 GMS/ M^2 ALONG WITH THICKNESS TOLERANCE OF ± 3% BY THIS WE STARTED GETTING QUALITY PIPES HAVING LONG LIFE OF ZINC COATING.

AFTER THESE EXERSISES I STARTED WORKING OF OPTIMIZING OF VARIOUS ELECTRIC AND MECHANICAL MACHINERY, ACCESSORIES AS MENTIONED BELOW:

1. **SIZE OF SUMP AS PER H.I.S NORMS ONLY.**
2. **SIZE OF SUCTION LINES**
3. **SIZE OF DELIVERY LINE**
4. **SIZING OF ELECTRIC MOTOR AS PER ACHIEVABLE PUMP EFFICIENCY.**
5. **SIZING OF CABLES.** AFTER CONSIDERING ALL THE THREE CONDITIONS (1) AS PER LOAD (2) AS PER VOLTAGE DROP (MAX 3%) (3) SHORT CIRCUIT CURRENT. THIS INCREASED SAFETY AGAINST FIRE, SAVING IN POWER DUE TO LESS RESISTANCE LONGER LIFE DUE TO LESS TEMP-RISE.
6. **<u>SIZING OF FLOW CAPACITY PUMPS</u>**

   FOR EXAMPLE FOR THE REQUIREMENT OF 460 M^3 /HR *32 M. HEAD 55KW MOTOR IS REQUIRED. GENERAL PRACTICE WAS TO SELECT THREE PUMPS OF 230 M^3 /HR*32MH AND 30KW. (2 WORKING + 1 AS STAND-BYE)

   I STUDIED SUCH CASES AND FOUND OUT THAT HIGHER THE FLOW CAPACITY MORE ENERGY EFFICIENT PUMP SETS ARE.

   I OPTIMIZED SUCH SYSTEM BY PROVIDING 2 PUMP SETS OF 460 M^3 /HR*32 M HEAD WITH 55 KW MOTOR. (1 WORKING + 1 STANDBYE)

THE CAPITAL COST FOR THIS TYPE OF OPTIMIZATION WAS FOUND 10-20% HIGHER INITIALLY BUT THAT COST WAS RECOVERED WITHIN 2-3 YEARS.
THIS WILL ALSO REDUCE O & M WORK FOR OPERATOR.

SIMILIARLY 8 PUMPSETS (6 Working + 2 Stand-by) WERE OPTIMIZED AND FOUND 4 PUMP SETS (3 Working + 1 Stand-by) OF 7200 $M^{3/}$ HR. OF SAME HEAD ARE MORE ENERGY EFFICIENT AND RELIABLE AND EASY FOR O & M.

7. OPTIMIZING R.P.M. OF PUMPSET.

WATER MANUAL PROVIDES A FORMULA OF SPECIFIC-SPEED WHICH HELPS IN OPTIMIZING ONE OF PARAMETER SUCH AS Q (FLOW RATE IN CUMECS), H (METER) AND R.P.M. ROTATION SPEED OF THE PUMPSET.
THE FORMULA IS AS UNDER.

$$\text{SPECIFIC SPEED} = \frac{3.65*N*\sqrt{Q}}{(H)^{0.75}}$$

THE GOOD OPERATING RANGE OF SPECIFIC SPEED IS 140-200 AND OPTIMUM EFFICIENCY IS AT 170.

I OPTIMISED THIS 170 IS THE RANGE OF 160-180. SO THAT SUPPLIER DOES NOT SUPPLY ELECTRIC MOTOR OF HIGHER SPEED (SAY L4 POLE-1500 INSTEAD OF 6 POLE (1000RPM) AS OTHER O&H PARAMETERS ARE FIXED IN TENDER.

HIGHER SPEED MOTOR ARE 10-20% CHEAPER AND ALSO EFFICIENT IS COMPARISON TO LOWER SPEED MOTOR BUT LIFE IS NEARLY HALVED DUE TO HEAVY WEAR & TEARS.

8. OPTIMIZING OF LOAD AND NO-LOAD LOSSES OF TRANSFORMERS.

THE LOSSES PER HOUR PROVIDED IN C.B.I.P. (CENTRAL BOARD OF IRRIGATION & POWER) - MANUAL ARE VERY HIGH (20 TO 30 % MORE)

REPUTED TRANSFORMER MANUFACTURERS ARE SUPPLYING AT 20 TO 30% LESS LOSSES. I CONTACTED REPUTED MANUFACTURES AND GOT INFORMATION REGARDING LOSSES WITHOUT MINUS TOLRANCES AND OPTIMIZED THOSE LOSSES FOR TENDERING THOUGH CAPITAL COST WAS 10-15% MORE BUT IT WAS RECOVERED WITHIN 2-3 YEARS.

9. OPTIMIZING OF SUCTION SPECIFIC SPEED (S)

AS SPECIFIC SPEED (140-200 RPM) IS FOR DELIVERY SIDE OF PUMP,SUCTION SP. SPEED IS FOR SUCTION SIDE OF PUMP.
THE FORMULA IS

$$S = \frac{3.65 * N * \sqrt{Q}}{(NDSHR)^{.75}}$$

FOR SMOOTH FUNCTIONING OF PUMP SETS THIS "S" SHOULD BE WITHIN 580 FOR FLOW RATE UPTO 3600M^3 /HR.

FOR BIGGER FLOW RATE IT SHOULD NOT BE MORE THAN 420 r.p.m

THIS OPTIMIZATION WAS DONE ON THE BASIS OF H.I.S.

10. OPTIMIZING HEAD LOSSES IN VALVES

INFORMATION WAS COLLECTED FROM REPUTED VALVE MANUFACTURERS REGARDING HEAD LOSSES IN THEIR VARIOUS SIZES OF VALVES AND THEN OPTIMIZED THE LOSSES PARAMETER.

BEFORE I JOINED GWSSB IN 1988, TENDERS FOR 150 MM BOREWELL SUBMERSIBLE PUMPS WERE INVITED FOR 265 SIZES WHICH WAS WITHOUT MUCH LOGIC. FLOW DIFFERENCE WAS TAKEN AT 10 L.P.M AND HEAD DIFFERANCE AT 5 METERS.

TECHNICALLY FLOW DIFFERENCE SHOULD BE 45 L.P.M AND HEAD DIFFERENCE OF 8 METERS FOR 150 MM SIZED PUMPS.

BY THIS WAY I STANDARDISED AND OPTIMISED 48 SIZES OF 150 MM PUMP SETS. THIS HELPED IN REDUCING INVENTORY OF PUMP SETS AND FACILITATED TENDER PROCEDURE.

SIMILIARLY FOR 200 MM SIZE PUMP SETS FLOW DIFFERENCE IS SAME i.e. 45 L.P.M BUT HEAD DIFFERENCE IS 18 METERS AND NOT 5 METERS.

LASTELY OPTIMIZATION WILL GIVE ENTRY TO REPUTED MANUFACTURERS AND KEEP AWAY UNSCRUPULOUS MANUFACTURERS.

CONCLUSION: -

LET US BE SMART AND SELECT SMART EQUIPMENTS ONLY, FOR OUR SMART PUMP- HOUSES.