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WHITE PAPER ON USE OF BEST-IN-CLASS EFFICIENCY MOTORS IN MECHANICAL PLANTS

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1.0 EXECUTIVE SUMMARY

The purpose of this paper is to assist in selection of best efficiency Motors for various applications in our commercial buildings, considering both capex and opex. This report mainly addresses the following:

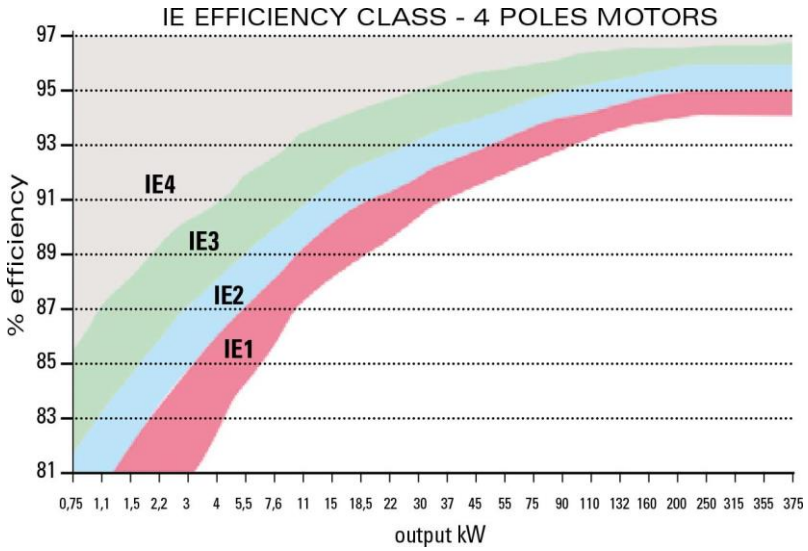
- differences in various motor efficiency ratings,
- considerations and benefits of high efficiency motors
- applications of premium efficiency motors in our context

This paper is based on a case study (Palava 1 - I think A), where existing IE2 High efficiency motors are compared with a scenario of using IE3 (Premium Efficiency) and IE4 (Super Premium Efficiency) motors. While IE3 motors are marginally (15%-30%) expensive than IE2 motors, it is observed that the ensuing energy savings recover the capex delta in close to 2 years, the same are recommended for further use in our projects.

The detailed analysis is given in the subsequent sections of this report.

2.0 INTRODUCTION

Electrical motors are one of the major energy consuming equipment in a building's mechanical plant, especially so in a commercial building. And a correct selection of motors can save significant energy in the overall lifecycle of the building.



The following table summarizes the energy efficiency classes defined in IEC 60034-30:-1-2014, aginst the current/proposed adoption status at our end:

Efficiency Class	Description	Remarks
IE1	Standard efficiency	Out of use. Banned in Oct 2017.
IE2	High efficiency	Minimum efficiency available in market, and currently purchased by us.
IE3	Premium efficiency	Popular higher efficiency option. Proposed for future purchases.
IE4	Super Premium efficiency	Highest efficiency option but supply chain, longer payback period issues.

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3.0 ANALYSIS

The analysis in this report is a comparison between the existing IE2 motors with scenarios of using IE3 and IE4 motors.

3.1 Capex

Motors are part of the pump, fan assemblies and are not procured directly by us. They are included in the packages by the relevant mechanical plant supplier. We took the costs from both the plant suppliers and motor manufacturers to ascertain the capex delta. A representative table with detailed costing is covered in Annexure 1. The summary of the cost differences is as follows:

Motor type	Absolute Supply Costs Rs.
IE2	1,200,000.00
IE3	1,400,000.00
IE4	2,400,000.00

3.2 Opex

Since we already have an energy model of the project, we ran the model with the separate efficiency ratings for each type of motor, and the operational benefits were registered as follows:

Description	kWh	Amount (@Rs.14/kWh)
Energy savings (IE3-IE2)	6725	94150
Energy savings (IE4-IE2)	13213	184982

AMC Costs (@5% of capex)	Rs.
IE2	60,000.00
IE3	70,000.00
IE4	120,000.00

3.3 Payback calculations

From the above data the payback and NPV calculations were estimated as follows:

Parameters	IE3 vs IE2	IE4 vs IE2
Incremental CAPEX	200,000	1,200,000
OPEX		
AMC Costs	10,000	60,000
Power Savings	96,000	186,000
Net Annual Savings	86,000	126,000
Payback (Years)	2.3	9.5

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NPV Calculations:

Description	Unit	IE2	IE3	IE4
Capex	Rs	1,200,000	1,400,000	2,400,000
Opex savings/month	Rs	-	8,000	15,500
AMC (annual)	Rs	60,000	70,000	120,000

Parameters	Value
AMC Cost Increase YoY	5%
Power Rate Increase YoY	3%
SBI MCLR - 3 Year rate	8.35%

IE3 vs IE2	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year6	Year 7	Year 8	Year 9	Year 10
CAPEX	(200,000)										
OPEX											
AMC Costs		(10,000)	(10,500)	(11,025)	(11,576)	(12,155)	(12,763)	(13,401)	(14,071)	(14,775)	(15,513)
Power Savings		96,000	98,880	101,846	104,902	108,049	111,290	114,629	118,068	121,610	125,258
Cash Flow	(200,000)	86,000	88,380	90,821	93,326	95,894	98,527	101,228	103,997	106,835	109,745
NPV	417,978										
Payback	2.3	-	-	1	1	1	1	1	1	1	1

IE4 vs IE2	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year6	Year 7	Year 8	Year 9	Year 10
CAPEX	(1,200,000)										
OPEX											
AMC Costs		(60,000)	(63,000)	(66,150)	(69,458)	(72,930)	(76,577)	(80,406)	(84,426)	(88,647)	(93,080)
Power Savings		186,000	191,580	197,327	203,247	209,345	215,625	222,094	228,757	235,619	242,688
Cash Flow	(1,200,000)	126,000	128,580	131,177	133,790	136,414	139,048	141,688	144,331	146,972	149,608
NPV	(321,754)	126,000	254,580	385,757	519,547	655,961	795,009	936,697	1,081,028	1,228,000	1,377,608
Payback	9.4	-	1	1	1	1	1	1	1	1	1

3.4 Supply chain

The other important feedback gathered from the suppliers, manufacturers and market in general is as follows:

1. While the suppliers have started using the IE3 motors in their system, the delivery of the IE3 motors takes 2-4 longer than a typical IE2 motors (10 Weeks)
2. IE4 motors are still not prevalent in the market and may take additional 6-8 weeks
3. Energy conscious clients especially commercial and hospitality sectors have significantly moved to IE3 motors with their systems

4.0 RECOMMENDATION

The above analysis, practical considerations and market discussions help us to recommend as follows:

1. All plumbing and hvac plant which runs on a daily basis shall always have an IE3 motor. Applicable for Commercial as well as Residential projects.
    a. Detailed discussions shall be carried out with the mechanical plant suppliers/manufacturers to reduce the delivery duration impact on the overall project schedules
    b. Procurement and GA approval of the applicable equipment shall be planned ahead so that the deliveries can happen at the same time as originally intended
2. IE2 motors shall be retained only in the fire emergency motors (fire pumps, pressurisation fans, etc.) which have no running cost consequence during the lifecycle. Applicable for Commercial as well as Residential projects.

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5.0 ANNEXURE 1

Description	Qty	Motor rating (Kw)	Absorbed Power (Kw)	RPM	IE2		IE3		IE4	
					Capital Cost (Rs)	Efficiency %	Capital Cost (Rs)	Efficiency %	Capital Cost (Rs)	Efficiency %
Primary Pump	1	5.5	4.8	1500	19117	87.7	21987	89.6	39577	91.9
Primary Pump	1	5.5	4.8	1500	19117	87.7	21987	89.6	39577	91.9
Primary Pump	1	5.5	4.8	1500	19117	87.7	21987	89.6	39577	91.9
Primary Pump	1	5.5	4.8	1500	19117	87.7	21987	89.6	39577	91.9
Secondary pump	1	11.0	8.3	1500	36015	89.8	41937	91.4	75500	93.3
Secondary pump	1	11.0	8.3	1500	36015	89.8	41937	91.4	75500	93.3
Secondary pump	1	11.0	8.3	1500	36015	89.8	41937	91.4	75500	93.3
Secondary pump	1	11.0	8.3	1500	36015	89.8	41937	91.4	75500	93.3
Condenser water pump	1	18.5	13.4	1500	56903	91.2	65798	92.6	118400	94.2
Condenser water pump	1	18.5	13.9	1500	56903	91.2	65798	92.6	118400	94.2
Condenser water pump	1	18.5	13.9	1500	56903	91.2	65798	92.6	118400	94.2
Condenser water pump	1	18.5	13.9	1500	56903	91.2	65798	92.6	118400	94.2
Filter Feed Pump	1	3.7	2.8	2900	11641	85.5	13825	87.7	24885	90
Chemical Dosing Pump	1	1.5	1.1	2900	7301	79.6	8393	82.7	15200	85.2
Pressurization Pump	1	1.5	1.1	2900	7301	79.6	8393	82.7	15200	85.2
Cooling Tower (IP55) (in IE1)	1	9.30	6.98	576	36015	89.8	41937	91.4	75500	93.3
Cooling Tower (IP55)	1	9.30	6.98	576	36015	89.8	41937	91.4	75500	93.3
Cooling Tower (IP55)	1	9.30	6.98	576	36015	89.8	41937	91.4	75500	93.3
Cooling Tower (IP55)	1	9.30	6.98	576	36015	89.8	41937	91.4	75500	93.3
TFA Unit	1	22.00	16.50	1500	62328	91.6	71680	93	129100	94.5
Ex.Air	1	5.5	4.1	1500	19117	87.7	21987	89.6	39577	91.9
Electrical room extract fan	1	1.1	0.7	1500	7504	81.4	8631	84.1	15538	87.2
Electrical room FA fan	1	1.1	0.7	1500	7504	81.4	8631	84.1	15538	87.2
Filter Feed Pump	2	3.7	2.8	2900	11641	85.8	13825	88.1	24885	90
AHU-GF-01	1	3.7	2.5	1440	13762	85.5	15834	87.5	28501	91.1
AHU-1F-01	1	7.5	5.4	1440	22603	88.7	25991	90.4	46790	92.6
AHU-1F-02	1	7.5	5.4	1440	22603	88.7	25991	90.4	46790	92.6
AHU-2F-01	1	7.5	5.4	1440	22603	88.7	25991	90.4	46790	92.6
AHU-2F-02	1	11.0	7.5	1440	36015	89.8	41937	91.4	75500	93.3
AHU-3F-01	1	7.5	5.4	1440	22603	88.7	25991	90.4	46790	92.6
AHU-3F-02	1	11.0	7.5	1440	36015	89.8	41937	91.4	75500	93.3
AHU-4F-01	1	7.5	5.4	1440	22603	88.7	25991	90.4	46790	92.6
AHU-4F-02	1	11.0	7.5	1440	36015	89.8	41937	91.4	75500	93.3
AHU-5F-01	1	7.5	5.4	1440	22603	88.7	25991	90.4	46790	92.6
AHU-5F-02	1	11.0	7.5	1440	36015	89.8	41937	91.4	75500	93.3
AHU-6F-01	1	7.5	5.4	1440	22603	88.7	25991	90.4	46790	92.6
AHU-6F-02	1	11.0	7.5	1440	36015	89.8	41937	91.4	75500	93.3
AHU-7F-01	1	7.5	5.8	1440	22603	88.7	25991	90.4	46790	92.6
AHU-7F-02	1	11.0	8.3	1440	36015	89.8	41937	91.4	75500	93.3
Terrace floor (11KW in IE4)	1	9.3	7.0	2900	35963	89.4	38115	91`.2	NA	NA
Terrace floor	1	1.12	0.6	2900	6363	79.6	7329	82.7	13200	85.2
		Total Cost			1,179,539.00		1,362,829.00		2,384,852.00	
				say	12,00,000		14,00,000		24,00,000	

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