OPTION CHECKLIST NO. 1: ELECTRIC MOTORS

• **Maintain supply voltage level**: Voltage at the motor should be kept as close to the nameplate value as possible, with a maximum deviation of 5%. Although motors are designed to operate within 10% of nameplate voltage, large variations significantly reduce efficiency, power factor, and service life
• **Minimize Phase Unbalance:** The voltage of each phase in a three-phase system should be of equal magnitude, symmetrical, and separated by 120°. Phase balance should be within 1% to avoid derating of the motor and voiding of manufacturers' warranties. Several factors can affect voltage balance: single-phase loads on any one phase, different cable sizing, or faulty circuits. An unbalanced system increases distribution system losses and reduces motor efficiency.
• **Maintain High Power factor:** Low power factor reduces the efficiency of the electrical distribution system both within and outside of your facility. Low power factor results when induction motors are operated at less than full load. Many utilities charge a penalty if power factor dips below 95%. Installing single capacitors or banks of capacitors either at the motor or the motor control centers addresses this problem.
• **Maintain Good Power Quality:** Motors are designed to operate using power with a frequency of 50 or 60 hertz and a sinusoidal wave form. Using power with distorted wave forms will degrade motor efficiency.
• **Select Proper Size of the Motor:** Under sizing of a motor will significantly reduce the efficiency and result in poor power factor. Ensure good loading i.e. more than 60% on the motor.
• **Adopt proper maintenance strategy:** Preventive and Predictive maintenance strategies should be adopted in order to have efficient operation.
• **Identify & Eliminate Distribution System Losses:** Regularly check for bad connections, poor grounding, and shorts to ground. Such problems are common sources of energy losses, hazardous, and reduce system reliability.
• **Minimize Distribution System Resistance**: Power cables that supply motors running near full load for many hours should be oversized in new construction or during rewiring. This practice minimizes line losses and voltage drops.
• **Use Variable Speed Drives(VSD) or Two Speed System wherever applicable :** When loads vary, VSDs or two-speed motors can reduce electrical energy consumption in centrifugal pumping and fan applications—often by 50% or more.
• **Choose a replacement before a motor fail:** Develop a replacement plan for all critical motors. Decide which motors should be replaced with an energy efficient or smaller sized model upon failure. Then, contact motor distributors to determine whether the energy efficient motor model you want will be available. If not, consider purchasing critical replacement motors now as backups.
• **Choose Energy Efficient Motors:** Select the most efficient motor possible within your price range. An energy-efficient motor that costs up to 20% more than a standard model is typically cost effective if used more than the number of annual hours.

• **Minimize Rewind Loss:** Always use a qualified rewind shop. Look for an ISO 9000 or Electrical Apparatus Service Association EASAQ based quality assurance program, cleanliness, good record keeping, and evidence of frequent equipment calibration. A quality rewind can maintain the original motor efficiency. However, if a motor core has been damaged or the rewind shop is careless, significant losses can occur.
• Motors less than 40 hp in size and more than 15 years old (especially previously rewound motors) often have efficiencies significantly lower than currently available energy-efficient models. It is usually best to replace them. It is almost always best to replace non-specialty motors under 15 hp.
• If the rewind cost exceeds 50% to 65% of a new energy-efficient motor price, buy the new motor. Increased reliability and efficiency should quickly recover the price premium.
• **Adopt Optimum Transmission Efficiency:** Transmission equipment including shafts, belts,chains, and gears should be properly installed and maintained.
• **Control Ambient Temperature:** Keep motors cool because high temperatures reduce insulation life and motor reliability. Make certain motors are shaded from the sun, located in well-ventilated areas, and kept clean, since dirt acts as an insulator.
• **Lubricate the motor properly:** Lubricate motors according to manufacturers' specifications. Apply high-quality greases or oils carefully to prevent contamination by dirt or water.

方案列表1: 电动机

• **维持电源电压水平**: 电动机的实际电压与铭牌额定电压应尽可能相等，最大偏差不能超过5%。尽管电动机的工作电压可以与额定电压偏差10%，但偏差过大会大大降低工作效率、功率系数和使用寿命。
• **最大限度减少不平衡相位:** 三项系统中各相电压应相等，并且呈120°均匀分布。不平衡相位应控制在1%的范围内，以避免电动机额定值降低，失去生产商质保。影响电压平衡的因素有：单相负荷，电缆粗细不均，或者电路故障。相位不平衡会增加配电系统损耗，降低电动机的效率。
• **维持高功率系数**：低功率系数会减降低设备内外配电系统的效率。当异步电机不是以满负荷运转时，就会造成功率系数偏低。如果电机的功率系数低于95%，很多用户都会对厂家进行罚款。给电动机或电机控制中心安装单个电容或电容器组都能解决这个问题。
• **维持好的电源质量**：电动机的设计使用电源为50或60赫兹正弦电。使用波形失真的电源会降低电动机的效率。
• **选择大小合适的电动机**：电动机大小不合适会大大降低效率和功率系数。电机大小应合适，从而以最佳荷载（60%以上）工作。
• **采用适当的维护方法**：为了使电动机运转维持高效率，需要采取一些预防性的维护方法。
• **确定并消除配电系统损耗**：要定期检查接触不良、接地不良和接地短路。这些问题是造成能源损失和危险情况最常见的原因，会降低系统的稳定性。
• **最大限度降低配电系统的电阻**：需要连续数小时接近满负荷工作的电动机配电电缆，在新建或重新布线时应选择加粗的电缆。这个办法能够最大限度的减少电路损耗和电压降。
• **在任何可行的地方使用变速驱动（VSD）或双速系统**：当荷载改变时，变速驱动或双速电机能够降低离心泵和风机的电能消耗——通常能够降低50%以上。
• **在1台电动机出现故障前，选择一个替代方案**：为所有关键部位的电动机设计一个替代方案，决定哪些电动机在出现故障时应该用能源效率更高或尺寸更小的电动机替代。然后，联系电动机经销商，确定您需要的节能型电动机是否有货，如果没有，那么最好现在就考虑为关键的电动机购置替代品。
• **选择节能型电动机**：在您的预算范围内，选择能源效率最高的电动机。一台比普通型电动机贵20%的节能型电动机，如果每年能够使用更长的时间，那么它的相对成本价就较低。
• **最大限度降低重新绕线的损失**：一定要选择一个有资质的绕线公司。可参考ISO9000或电器设备服务协会（EASAQ）提供的质量保证纲要，选择有良好维修记录，有丰富的设备校准经验的公司。高质量的绕线能够让电动机保持原有的效率。但是，如果电动机机芯已损坏，或绕线公司粗心大意，则会造成很大的损失。

• 40马力以下，使用时间15年以上的电动机（尤其是重新绕过线圈的电动机），其效率通常要比最新的节能型电动机低很多。最好的做法是换掉它们，而且最好把非专用的电动机都换成15马力以下的。
• 如果重新绕线的费用超过一台新的节能型电动机价格的50%－65%，那就买台新的。更高的稳定性和效率很快就能填补额外的那部分费用。
• **维持最佳的传输效率**：轴、皮带链、齿轮等传输设备应正确安装和维护。
• **控制环境温度**：做好电动机散热，因为高温会降低电动机的绝缘寿命和稳定性。有的电动机要安装在阴凉、通风好的地方，并且保持清洁，因为尘土会起到保温层的作用。
• **适当润滑电动机**：根据制造商提供的说明书为电动机加润滑剂。使用高品质的润滑膏或润滑油，以免受到污垢和水的污染。