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Whether operational expenses weigh heavily on power plants' bottom line, regardless of whether they run on fossil fuels, nuclear or renewable sources, is an essential aspect of their business model. This expense, along with capital expenditures and fuel costs, needs to be carefully balanced against profitability, efficiency and availability over the plant's lifespan. These ongoing costs encompass day-to-day maintenance, labour expenses, asset management, health and safety protocols, and other crucial tasks. The O&M expenses for various power generation methods differ significantly, with some playing a more significant role in cost analysis than others. For instance, high maintenance costs may be offset by advantages in other areas. Here are the average O&M costs for six common power generation methods, along with explanations of these figures and how they fit into the broader landscape of power plant economics. Our data is based on information from the International Energy Agency's (IEA) World Energy Investment Outlook 2014, which includes raw information on average yearly O&M costs in the power industry, both currently and in the future. The IEA's predictions for future costs are based on its so-called New Policies Scenario (NPS), which incorporates countries' announced policy commitments and plans. Current costs are taken from 2012 data, with projections given for 2020 and 2035. As the IEA's O&M data is split between different countries and regions, we have used Europe as our default comparison point. Gas turbine (\$20 per kW) Gas-fired power generation has relatively low operational expenses when compared to other methods. According to the IEA, simple-cycle combustion turbines - the most common but least efficient gas-fired technology - have an average annual O&M cost of just \$20 per kilowatt produced, making this technology the cheapest option in terms of O&M costs. Combined-cycle gas turbine (CCGT) technology can boost efficiency from 39% to 60% at an average O&M cost of \$25 per kW, while cogeneration achieved by CCGT plants with combined heat and power (CHP) pushes efficiency to more than 80% for a similarly modest rise in O&M costs. The upkeep of an effective lubrication system for gas turbines is crucial for gas-fired plants as a preventative maintenance measure. As renewables become a larger part of developed economies' energy mix, gas-fired plants are becoming more important as a reliable and variable supplement to intermittent renewable supply. Flexible generation is now a paramount concern, and the strain caused by frequent starts and stops will likely drive gas-fired O&M costs as renewables take control of a growing portion of the energy supply mix. Large-scale solar photovoltaic (\$25 per kW) The ongoing development of solar photovoltaic (PV) technology has led to a significant decrease in operational expenses. According to our data, large-scale solar PV has an average annual O&M cost of \$25 per kilowatt produced. At \$25 per kilowatt, large-scale photovoltaic installations are among the most affordable power generation technologies for operation and maintenance (O&M). Solar PV's simplicity is key - regular cleaning of panels and monitoring inverter units and AC subsystems are primary tasks. The International Energy Agency (IEA) predicts steep declines in initial capital costs for solar PV projects until 2035, making it an attractive financial proposition as well as environmentally responsible option. Concentrated solar power (CSP), on the other hand, is a more advanced technology that hasn't benefited from the collective research and development driving down costs for solar PV. With high capital costs and \$290 per kilowatt O&M burden in Europe, CSP is currently expensive to run and maintain, but economies of scale, resilient materials, and declining component costs are expected to reduce O&M costs significantly by 2035, with IEA projecting \$183 per kilowatt. Subcritical coal power (\$43 per kilowatt) has long been the backbone of the power generation market, with strong financial characteristics that will keep it competitive in the absence of high carbon emissions or skyrocketing coal prices. While O&M costs aren't spectacularly low for coal, with cheapest subcritical plants at \$43 per kilowatt and rising to \$88 per kilowatt for more efficient technologies. Onshore wind power (\$46 per kilowatt) faces access challenges, with onshore sites rivaling simplest coal technologies in terms of O&M costs and expected to fall below coal by 2020. Offshore wind farms are currently at \$181, nearly four times the expense, highlighting the importance of automated off-site equipment monitoring methods for efficient maintenance, especially offshore where accessing turbines is an expensive operation. According to Siemens Energy's Diagnostic Centre head Merete Hoe, their specialists can remotely troubleshoot and resolve up to 80% of turbine events within ten minutes, without requiring a technician to physically visit the site. This efficient approach has reduced the need for on-site inspections. In terms of power generation costs, large-scale hydroelectric projects are currently more cost-effective than smaller-scale initiatives, with an average yearly O&M cost of \$53 per kW compared to \$70 for smaller-scale projects. However, the IEA predicts that maintenance costs for large installations like dams and barrages will gradually increase by 2035 due to ageing equipment and the complexity of integrating new components with older ones. Gerry Russell, chief hydraulic engineer at American Hydro Corporation, suggests that market conditions are testing the limits of operation for many hydroelectric facilities, leading to increased O&M capabilities and costs. Meanwhile, nuclear power plants require significant investments in both capital expenditures and ongoing maintenance costs. In Europe, for every kilowatt generated, an average of \$198 is spent on O&M, with other regions except China recording costs above \$100. Even China's relatively low cost of \$80 per kW is expected to rise to \$112 by 2020. The processing and disposal of uranium fuel elements, as well as equipment integrity management, are key factors contributing to these high costs. Despite the significant expenses involved, nuclear energy's advantages, including reliability, zero carbon emissions, and low fuel prices, will likely continue to play a major role in the global energy mix. As reactor technology improves and concerns over Fukushima-like incidents fade, nuclear power is expected to remain an important part of the energy landscape. The cost parameters are defined as follows: - A2 Rate: Cost per unit of fuel in Rs (Rupees) = A1 - A4 Raw water consumption: Cost per day in MT or M3 = A5 - A6 Rate: Cost per unit of river water in = A7 Operation costs are calculated on a head-wise basis, including: - Fuel cost: A3 X A4 (in Rs) - Raw water cost: A5 X A6 (in Rs) - Chemical consumption for water treatment: B3 - Fuel feeding cost: B4 - Raw water lifting charges from river to reservoir: B5 Total operation cost = B1 + B2 + B3 + B4 + B5 Maintenance costs are calculated on a head-wise basis, including: - Spares and consumables: C1 - Store inventory: C3 - Tools and tackles testing: C4 - Measuring instruments calibration: C5 Total maintenance cost = C1 + C2 + C3 + C4 + C5 Administration costs are calculated on a head-wise basis, including: - O&M manpower salary: D1 - Site expenditures: D2 - Gardening labor salary: D3 - Security guards salary: D4 - Transportation vehicles cost: D5 Total administration cost = D1 + D2 + D3 + D4 + D5 The total cost of production (E) is the sum of operation, maintenance, and administration costs. Power generation cost per unit = A1/E (in Rs/KWh or \$/Kwh) Power export cost per unit = A2/E (in Rs/KWh or \$/Kwh) Note: - In power plant calculations, auxiliary power consumption should not be considered. - For co-generation plants, the cost of power given to process plants and cost of process steam given should be considered for power generation cost calculation.

O&m cost of thermal power plant.