**ARAB REPUBLIC OF EGYPT**

**Ministry of Electricity and Renewable Energy (MoERE)**

**The Egyptian Electricity Holding Company (EEHC)**

# Power Sector Cooperation Planning Survey in Arab Republic of Egypt

# Final Report (Appendix)

**October 2018**

**Japan International Cooperation Agency (JICA)**

**Tokyo Electric Power Services Co., Ltd. (TEPSCO)**

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# Appendix

# Appendix 1 Financial analysis of Egyptian Government

(1) Financial position

Table 1　Transition of fiscal result

(LE Million)

| | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 | 増減 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Revenues | 151,266 | 180,215 | 221,404 | 282,505 | 268,114 | 265,286 | 303,622 | 350,322 | 456,788 | 465,241 | 308% |
| Tax Revenues | 97,778 | 114,326 | 137,195 | 163,222 | 170,494 | 192,072 | 207,410 | 251,118 | 260,289 | 305,957 | 313% |
| Taxes on Profits | 48,268 | 58,535 | 67,059 | 80,255 | 76,618 | 89,593 | 91,245 | 117,762 | 120,926 | 129,818 | 269% |
| Property Tax | 1,214 | 1,788 | 2,052 | 2,763 | 8,770 | 9,452 | 13,089 | 16,453 | 18,761 | 21,107 | 1739% |
| Goods & Services Tax | 34,699 | 39,436 | 49,747 | 62,650 | 67,095 | 76,068 | 84,594 | 92,924 | 91,867 | 122,930 | 354% |
| Customs | 9,654 | 10,370 | 14,020 | 14,091 | 14,702 | 13,858 | 14,788 | 16,771 | 17,673 | 21,867 | 227% |
| Other Taxes | 3,944 | 4,198 | 4,317 | 3,464 | 3,309 | 3,102 | 3,694 | 7,208 | 11,062 | 10,235 | 260% |
| Grants | 2,379 | 3,886 | 2,463 | 7,984 | 4,333 | 2,287 | 10,104 | 5,208 | 95,856 | 25,437 | 1069% |
| Other Revenues | 51,108 | 62,003 | 82,746 | 111,299 | 93,288 | 70,927 | 86,108 | 93,996 | 100,643 | 133,847 | 262% |
| Total Expenditures | 207,810 | 222,029 | 282,290 | 351,500 | 365,987 | 401,866 | 470,992 | 588,188 | 701,514 | 733,350 | 353% |
| Personel expenses | 46,719 | 52,153 | 62,839 | 76,147 | 85,369 | 96,271 | 122,818 | 142,956 | 178,589 | 198,468 | 425% |
| Goods & Services Costs | 14,429 | 17,028 | 18,470 | 25,072 | 28,059 | 26,148 | 26,826 | 26,652 | 27,248 | 31,276 | 217% |
| Interest | 36,814 | 47,700 | 51,528 | 52,810 | 72,333 | 85,077 | 104,441 | 146,995 | 173,150 | 193,008 | 524% |
| Subsidies, Grants and Soc | 68,897 | 58,442 | 92,371 | 127,033 | 102,974 | 123,125 | 150,193 | 197,093 | 228,578 | 198,569 | 288% |
| Other Expenditures | 19,739 | 21,208 | 23,892 | 27,007 | 28,901 | 31,364 | 30,796 | 34,976 | 41,067 | 50,279 | 255% |
| Investments | 21,212 | 25,498 | 34,191 | 43,430 | 48,350 | 39,881 | 35,918 | 39,516 | 52,882 | 61,750 | 291% |
| Cash Deficit | 56,544 | 41,815 | 60,886 | 68,995 | 97,872 | 136,580 | 167,370 | 237,866 | 244,726 | 268,109 | 474% |
| Financial Assets | -6,160 | 12,883 | 236 | 2,831 | 166 | -2,120 | -665 | 1,853 | 10,713 | 11,321 | |
| Overall Fiscal Balance | 50,385 | 54,697 | 61,122 | 71,826 | 98,038 | 134,460 | 166,705 | 239,719 | 255,439 | 279,430 | 555% |

Source: Central Bank of Egypt、Ministry of Finance

Above table show financial situation in the past 10 years, the financial situation has deteriorated in the last ten years. The revenue increased 308% over the past 10 years, while the expenditure increase rate is 353%. As a result, the budget deficit has increased significantly from LE 50 billion in 2005/2006 to LE 279 billion, and increased 5.5 times. The fiscal deficit against revenue ratio was 33% in FY2005 / 06, but it increased to 60% in FY2014 / FY2005. This means that it is necessary to increase revenues by 60% in order to balance finances with an increase in revenue, which is a very difficult. Fiscal deficits are fundamentally debt financed. As a result, liabilities increase, and liabilities expansion increases interest payments. An increase in interest payment will lead to an increase in expenditure and the budget deficit will expand in a chain reaction.

The table below shows the fiscal situation by ratio to GDP. From FY 2011/12 onwards, the fiscal situation has deteriorated seriously and it can be seen that the regression of the economy after the Arab Spring has a negative impact on the fiscal situation as well. Both revenues and expenditures are decreasing as a percentage of GDP, but the rate of decrease in revenue is large. While the decrease in revenue to GDP ratio is 4.4%, the decrease in income tax to GDP is 2.2%. Half of reduction is caused by income tax.

Total expenditures to GDP have been decreasing, but personnel expenses and interest to GDP are increasing. Interest is inevitable because of the increase in liabilities, but personnel expenses can be improved politically and it is a future task. Regarding subsidies, the subsidy reform was carried out by the El-Sisi administration, and subsidies were drastically

eliminated. Therefore, subsidies, aid and benefits have decreased from 11.4% in FY 2013/14 to 8.6% in FY 2014/15.

Table 2 Transition of fiscal result (ratio to GDP)

| | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 |
|---|---|---|---|---|---|---|---|---|---|---|
| Total Revenues | 24.5% | 24.2% | 24.7% | 27.1% | 22.2% | 19.3% | 19.3% | 20.0% | 22.9% | 20.1% |
| Tax Revenues | 15.8% | 15.3% | 15.3% | 15.7% | 14.1% | 14.0% | 13.2% | 14.3% | 13.0% | 13.2% |
| Income Tax | 7.8% | 7.9% | 7.5% | 7.7% | 6.3% | 6.5% | 5.8% | 6.7% | 6.1% | 5.6% |
| Property 'Tax | 0.2% | 0.2% | 0.2% | 0.3% | 0.7% | 0.7% | 0.8% | 0.9% | 0.9% | 0.9% |
| Goods & Services 'Tax | 5.6% | 5.3% | 5.6% | 6.0% | 5.6% | 5.5% | 5.4% | 5.3% | 4.6% | 5.3% |
| Customs | 1.6% | 1.4% | 1.6% | 1.4% | 1.2% | 1.0% | 0.9% | 1.0% | 0.9% | 0.9% |
| Grants | 0.4% | 0.5% | 0.3% | 0.8% | 0.4% | 0.2% | 0.6% | 0.3% | 4.8% | 1.1% |
| Other Revenues | 8.3% | 8.3% | 9.2% | 10.7% | 7.7% | 5.2% | 5.5% | 5.4% | 5.0% | 5.8% |
| Total Expenditures | 33.6% | 29.8% | 31.5% | 33.7% | 30.3% | 29.3% | 29.9% | 33.5% | 35.1% | 31.7% |
| Personel expenses | 7.6% | 7.0% | 7.0% | 7.3% | 7.1% | 7.0% | 7.8% | 8.2% | 8.9% | 8.6% |
| Goods & Services Costs | 2.3% | 2.3% | 2.1% | 2.4% | 2.3% | 1.9% | 1.7% | 1.5% | 1.4% | 1.4% |
| Interest | 6.0% | 6.4% | 5.8% | 5.1% | 6.0% | 6.2% | 6.6% | 8.4% | 8.7% | 8.4% |
| Subsidies, Grants and Soc | 11.2% | 7.8% | 10.3% | 12.2% | 8.5% | 9.0% | 9.5% | 11.2% | 11.4% | 8.6% |
| Other Expenditures | 3.2% | 2.8% | 2.7% | 2.6% | 2.4% | 2.3% | 2.0% | 2.0% | 2.1% | 2.2% |
| Investments | 3.4% | 3.4% | 3.8% | 4.2% | 4.0% | 2.9% | 2.3% | 2.3% | 2.6% | 2.7% |
| Cash Deficit | 9.2% | 5.6% | 6.8% | 6.6% | 8.1% | 10.0% | 10.6% | 13.6% | 12.3% | 11.6% |
| Financial Assets | -1.0% | 1.7% | 0.0% | 0.3% | 0.0% | -0.2% | 0.0% | 0.1% | 0.5% | 0.5% |
| Overall Fiscal Balance | 8.2% | 7.3% | 6.8% | 6.9% | 8.1% | 9.8% | 10.6% | 13.7% | 12.8% | 12.1% |

Source: Central Bank of Egypt、Ministry of Finance

As for revenue, tax revenue increase 3.13 times and it exceed average revenue increase of 3.08 times. However, increase of income tax (main tax resources) is 2.69 times and this rate is below average. Generally, if value added increase, income increase accordingly. Then, it leads to tax revenue increase. Income tax revenue increase is lower than GDP growth means that there may be a problem with either or all of tax system, assessment and collection.

In expenditure, amounts of Subsidies, Grants and Social Benefits are outstanding. Below list shows portion of 3 items in total expenditure. Portion increase every year and it reach to 82.7% in FY 2013/14. It decreases to 80.5% in FY 2014/15 because of subsidy reform. The higher the proportion, the more rigid the fiscal budget, the less budget is distributed to necessary fields such as civilian living. 80.5% in FY 2014/15 is high enough, so that reform will continue to be carrying out. Regarding subsidies, reductions are planned in the future, and expectations will also be given to public servant reform.

Table 3 Rate of 3 items in expenditure

| | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 |
|---|---|---|---|---|---|---|---|---|---|---|
| Personel expenses | 22.5% | 23.5% | 22.3% | 21.7% | 23.3% | 24.0% | 26.1% | 24.3% | 25.5% | 27.1% |
| Interest | 17.7% | 21.5% | 18.3% | 15.0% | 19.8% | 21.2% | 22.2% | 25.0% | 24.7% | 26.3% |
| Subsidies, Grants and Soc | 33.2% | 26.3% | 32.7% | 36.1% | 28.1% | 30.6% | 31.9% | 33.5% | 32.6% | 27.1% |
| Total | 73.4% | 71.3% | 73.2% | 72.8% | 71.2% | 75.8% | 80.1% | 82.8% | 82.7% | 80.5% |

Source: Central Bank of Egypt、Ministry of Finance

Below list describe total debts of the nation, as a result of the above financial situation, and it increases to 96.7% of GDP in 2016, almost equivalent to GDP. If the debt increases,

the repayment burden of interest increases, and it also affects the country's trust. In the case that the rating company drops the rate, it is necessary to issue the bond at a higher interest rate. The influence is serious.

Table 4 Total debt and ratio to GDP

(LE Million)

| | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|---|
| Total Debt | 1,044,898 | 1,238,137 | 1,527,378 | 1,816,582 | 2,116,345 | 2,619,594 |
| Ratio to GDP | 76.2% | 73.9% | 82.1% | 85.3% | 86.6% | 96.7% |

Source: Central Bank of Egypt

(2) Rating

Ratings by rating agencies are basically evaluations from the financial side, but they also have aspects of national economic evaluation, and their ratings are important in terms of international credibility.

The table below shows the trends in the rating of Egyptian government bonds by the three companies in the past 20 years. It can be seen that the ratings are falling from the Mubarak era of the late 1990s and the 2000s. At the end of the 1990s, when had the highest credit rating, S & P and Fitch ranked BBB-[1] at the marginal investment grade, but after that it has fallen into a category that is classified as speculative. After the Arab Spring, it has fallen to B except for one period. Currently B-, B3 and B-[2], the three companies rate the same rank. Every rating agency is judging that the worst conditions are over, but they are not at a level that can be trusted yet, considering fiscal deficits and high-level debts.

[1] Meaning of Rating “BBB” is as follows and mark “-“ means close to below rating. S&P: An obligation rated 'BBB' exhibits adequate protection parameters. However, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity of the obligor to meet its financial commitment on the obligation. Fitch: 'BBB' ratings indicate that expectations of default risk are currently low. The capacity for payment of financial commitments is considered adequate but adverse business or economic conditions are more likely to impair this capacity.

[2] Meaning of Rating “B” is as follows and mark “-“ means close to below rating. S&P: An obligation rated 'B' is more vulnerable to nonpayment than obligations rated 'BB', but the obligor currently has the capacity to meet its financial commitment on the obligation. Adverse business, financial, or economic conditions will likely impair theobligor's capacity or willingness to meet its financial commitment on the obligation. Moody’s: Obligations rated B are considered speculative and are subject to high credit risk Fitch: 'B' ratings indicate that material default risk is present, but a limited margin of safety remains. Financial commitments are currently being met; however, capacity for continued payment is vulnerable to deterioration in the business and economic environment.

Table 5 Rating of Egyptian national bonds by 3 major rating companies

| S&P | | | Moody's | | | Fitch | | |
|---|---|---|---|---|---|---|---|---|
| Date | Rate | Outlook | Date | Rate | Outlook | Date | Rate | Outlook |
| 2016/11 | B- | Stable | 2015/04 | B3 | Stable | 2014/12 | B | Stable |
| 2016/05 | B- | Negative | | | | | | |
| 2015/11 | B- | Stable | | | | 2014/12 | B | Stable |
| 2015/05 | B- | Positive | 2014/10 | Caa1 | Stable | 2014/01 | B- | Stable |
| 2013/11 | B- | Stable | 2013/05 | Caa1 | Negative | 2013/07 | B- | Negative |
| 2013/05 | CCC+ | Stable | 2013/01 | B2 | Negative Watch | 2013/01 | B | Negative |
| 2012/12 | B- | Negative | 2013/01 | B3 | Negative | | | |
| 2012/08 | B | Negative | | | | | | |
| 2012/06 | B | Negative Watch | | | | | | |
| 2012/02 | B | Negative | | | | 2012/06 | B+ | Negative |
| 2011/11 | B+ | Negative | 2011/12 | B2 | Negative Watch | 2011/12 | BB- | Negative |
| 2011/10 | BB- | Negative | 2011/10 | B1 | Negative | 2011/02 | BB | Negative Watch |
| 2011/05 | BB | Negative | 2011/05 | Ba3 | Negative | 2011/01 | BB+ | Negative |
| 2011/02 | BB | Negative Watch | 2011/01 | Ba2 | Negative | | | |
| | | | 2009/08 | Ba1 | Stable | 2008/08 | BB+ | Stable |
| 2005/03 | BB+ | Stable | 2008/06 | Ba1 | Negative | 2007/06 | BB+ | Positive |
| 2003/08 | BB+ | Negative | 2003/11 | Ba1 | Stable | 2002/08 | BB+ | Stable |
| 2002/05 | BB+ | Stable | | | | 2002/01 | BBB- | Negative |
| 2000/07 | BBB- | Negative | 2001/11 | Ba1 | Negative | 2000/09 | BBB- | Stable |
| | | | 1997/11 | Ba1 | Stable | | | |
| | | | 1997/10 | Ba2 | Positive Watch | | | |
| 1997/01 | BBB- | Stable | 1997/10 | Ba2 | Positive | 1997/08 | BBB- | N/A |
| | | | 1996/10 | Ba2 | Stable | | | |

Source: http://jp.tradingeconomics.com/egypt/rating

(3) Subsidy reform

As mentioned above, the national finances are in danger and urgent reform was required, but successive regimes were unable to take effective measures. In 2014 the El-Sisi administration embarked on subsidy reform and decided to drastically reduce fuel subsidies. As a result of this decision as shown in the table below, the regime succeeded in reducing the fuel subsidies for LE 126,180 million in FY 2013/14 to LE 73,951 million in 2014/15. Moreover, there was a second fuel price revision in November 2016.

✓ Transition of subsidy system

The history of Egypt's subsidy system is long. In 1941 during the wartime food distribution system was started, but at that time there was no price control, securing basal foods (sugar, kerosene, cooking oil, tea etc.) was the policy purpose in the era of food shortage[3].

Under the "Arab socialism" regime, the recognition that "it is a responsibility of the state to supply cheap goods and services to satisfy the people's lives" had become established, and the target items also expanded gradually (wheat, sugar, Rice, cooking oil, soap, kerosene,

[3] Policy advocacy research "social justice" and redistribution policy - issues and perspectives of reform of subsidy system in Egypt – IDE-JETRO, Yuko Ido

cotton products). After the war in 1967 when Egypt was defeated, prices soared and damaged the finances. President Sadat succeeded President Nasser, succeeded the subsidy system, and expenditure and items also increased dramatically (in addition to the items mentioned above, broad beans, lentils, fish, chicken meat, frozen meat, electricity, transportation, gasoline etc. 18 Items) [32].

In 1977, a nationwide riot was mounted against President Sadat's announcement on subsidy reduction corresponding to the recommendations of the IMF. This 77-year food riot has a decisive influence on policy makers in deciding about the development of the subsidy system thereafter, and it is often referred to as "uprising of bread" still now.

Based on the lessons learned in 1977, measures to curb expenditure were taken avoiding explicit reform. As a result, food subsidies expenditure equivalent to 14% of the national budget in 1980/81 had decreased to 5.6% in 1996/97[32].

Since the 2000s, fuel subsidies increased due to the soaring price of crude oil. The share of fuel subsidies in the national budget was 9% in the fiscal year 2001/02 and around 20% after 2004/05. The table below shows the trend of crude oil prices, and crude oil prices are sharply rising after 2004.

Table 6　Transition of oil price

(USD/Barrel)

| | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Brent | 28 | 24 | 25 | 29 | 38 | 54 | 65 | 73 | 98 | 62 | 80 | 111 | 112 | 109 | 99 |
| WTI | 30 | 26 | 26 | 31 | 41 | 56 | 66 | 72 | 100 | 62 | 79 | 95 | 94 | 98 | 93 |

Source: http://ecodb.net/pcp/imf_usd_poilwti.html

The table below shows the breakdown of subsidy over the past 10 years. It has increased drastically over the last ten years. It was nearly 3.5 times as much as the peak in 2013/14. In terms of ratio to the government expenditure, highest was 29% in 2012/13. In comparison with government expenditure, it was 26% already in 2005/06, which means that it gradually increased in 10 years. On the contrary, in 2014/15, it was 20% of government expenditure, which is the lowest in the past 10 years. Looking breakdown, the ratio of fuel subsidies is still the highest, but in the past, it was the highest in 2005/06 at 77%, gradually decreasing, 67% in 2013/14, and 49% in 2014/15.

Subsidies to non-finance public entities have increased rapidly after the Arab Spring. Subsidy to the EEHC group also falls into this category. It is speculated that the management of these companies is getting worse. There is also the possibility that the reduction of fuel subsidies in 2014 may also have an impact.

Table 7　Breakdown of subsidy

(LE million)

| | 2005/06 | 2006/07 | 2007/08 | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 | 2013/14 | 2014/15 |
|---|---|---|---|---|---|---|---|---|---|---|
| Fuel (EGPC) | 41,778 | 40,130 | 60,249 | 62,703 | 66,524 | 67,680 | 95,535 | 120,000 | 126,180 | 73,915 |
| Foods(GASC) | 9,407 | 9,406 | 16,445 | 21,072 | 16,819 | 32,743 | 30,282 | 32,551 | 35,493 | 39,395 |
| Non-financial public entity | 2,700 | 2,940 | 5,323 | 7,410 | 7,873 | 7,893 | 6,068 | 16,427 | 24,459 | 35,406 |
| Financial public entity | 360 | 1,483 | 2,188 | 2,645 | 2,354 | 2,895 | 3,078 | 1,822 | 1,527 | 1,482 |
| Total | 54,245 | 53,959 | 84,205 | 93,830 | 93,570 | 111,211 | 134,963 | 170,800 | 187,658 | 150,198 |

Source: Central Bank of Egypt、Ministry of Finance

Regarding these subsidies, many problems have been pointed out other than from the financial point of view. For example, all petroleum-related products are sold at subsidized prices. Anyone can purchase unlimited subsidized Bread accounting for over 70% of food subsidies. As a result, subsidies and benefits targeting specific layers are about 10 to 15% of total subsidy. The current Egyptian subsidy system is a price subsidy system for specific items. It is also speculated that price aid for specific items distorts the price mechanism, causing inefficiency of resource distribution[4].

✓ Subsidy reform

In early July, 2014, Egypt Government announced large scale subsidy reform which includes 40% to 80% price increase of fuel and 20% tariff increase for electricity. Although this policy content has been prepared since the cabinet before the revolution, in light of the social impact, the past cabinet could not be implemented. Regarding fuel subsidies, it is scheduled to gradually introduce smart cards, monitor both wholesale and retail, eradicate the black market and grasp information on the amount of transactions on the market[5]. The price revision at this time is as shown in the table below.

[4] "Developing countries and financial problems" Edited by Chie Kashiwabara, A survey research report IDE-JETRO 2008 Chapter 5 Egypt's Financial Situation, Kazuki Tsuchiya

[5] Policy advocacy research "social justice" and redistribution policy - issues and perspectives of reform of subsidy system in Egypt – IDE-JETRO, Yuko Ido

Table 8　Price revision of subsidized fuel

| | Old Price | | 2014 Price | | 2016 |
|---|---|---|---|---|---|
| Item | LE/L | | LE/L | | LE/L |
| Gasoline | Octane 80 | 0.9 | Octane 80 | 1.6 | 2.35 |
| | Octane 92 | 1.85 | Octane 92 | 2.6 | 3.5 |
| | Octane 95 | 5.85 | Octane 95 | 6.25 | 6.5 |
| Kerosene | All | 1.1 | All | 1.8 | 2.35 |
| Diezel | Brick & cement | 1.5 | Others | 1.8 | 2.35 |
| | Others | 1.1 | | | |
| Item | LE/Ton | | LE/Ton | | LE/Ton |
| Mazut | Bakery, Food | 1,000 | Food | 1,400 | 1,500 ~ 2,500 |
| | Generation | 2,300 | Generation | 2,300 | |
| | Cement | 1,500 | Cement | 2,250 | |
| | Brick | 1,500 | Brick | 1,950 | |
| | Others | 1,500 | Others | 1,950 | |
| Item | USD/Mil Btu | | USD/Mil Btu | | USD/Mil Btu |
| Natural Gas | Cement | 6 | Cement | 8 | |
| | Brick | 6 | Food, Spinning, Pharmaceutical, engineering, Brick | 5 | |
| | Steal, Copper, aluminum, Iron | 3 | Steal, Copper, aluminum, Iron | 7 | |
| | Manure, Petrochemical | 3 | Manure, Petrochemical | 4.5 | |
| | Glass, Ceramic | 2.3 | Glass, Ceramic | 7 | |
| | Others | 2 | Others | 5 | |
| | Generation | 1.77 | Generation | 3 | |
| | LE/$m^3$ | | LE/$m^3$ | | LE/m3 |
| | Bakery (subsidy) | 0.141 | Bakery (subsidy) | 0.141 | |
| | | | Automobile | 1.1 | 1.6 |
| | Residence | 0.2 | Residence | 0.4 | 0.75 |
| | | | | ~25 m³ | ~40 m³ |
| | | | | 1 | 1.5 |
| | | | | 25~50m³ | 40~75m³ |
| | | | | 1.5 | 2 |
| | | | | 50 m³~ | 75 m³~ |

Source: Policy advocacy research "social justice" and redistribution policy - issues and perspectives of reform of subsidy system in Egypt – IDE-JETRO, Yuko Ido
https://www.menas.co.uk/blog/egypt-next-fuel-subsidy-cut/

The El-Sisi regime began working on fiscal rebuilding by reducing subsidies. Further reduction of fuel subsidies is expected in the future. In particular, fuel subsidies for energy intensive industries such as steel and cement will be abolished at an early stage. It is expected that further subsidies will be cut by the administration, but because abrupt

reduction and abolition of subsidies will hit the lives of low-income groups (poverty rate of 2012/13 as 26.3%), the administration needs to be careful for handling[6].

The cuts in subsidy led to an increase in the prices of diesel (mainly used for electricity and transportation) by 64 percent, LPG by 37.5 percent, gasoline 80 (the most common fuel for the older taxis largely used in Egypt) by 78 percent, gasoline 92 (consumed by rich households for most domestic vehicles) by 41 percent, kerosene by 64 percent and gasoline 95 (luxury, diplomatic and high-level government vehicles) by 7 percent (Ministry of Petroleum, 2014). The share of the subsidy on diesel, LPG, gasoline (80, 92 and 95) and natural gas in total fuel subsidy in 2012/13 was 51 percent, 25 percent, 20 percent and 4 percent, respectively (Ministry of Finance, 2015) [7].

(4) Other fiscal reforms

✓ Tax system innovation

Fiscal reform requires efforts not only to reduce expenditure but also to increase revenues. In Egypt, the value-added tax bill passed through the Egyptian People's Assembly on August 29, 2016, and it will come into force. The new tax replaces the old general sales tax, which characteristics are that wide scope of tax and difficult for tax evasion[8]. From the fiscal year 2017, the tax rate will be 14%. Introduction of value added tax is a matter strongly requested from the IMF, and further increase of tax revenue is expected by this introduction.

The government introduced amendments to the tax code to widen the coverage of the tax system. This also included a measure to unify the highest income tax rate of 22.5%, which will now also apply to the special economic zones that were previously subject to 10% tax rate[9].

The next target of the tax reform shall be income tax. As analyzed above, income tax has not increased as much as GDP. Breakdown of income tax is as follows. 50-40% of tax revenue comes from oil, canal and central bank. Oil occupies 16.9% of GDP and Suez Canal 1.9%. It is thought that tax revenues from private companies and individuals are not sufficient. It is appointed that “Tax management systems are designed and managed in a way that facilitates tax evasion and tax avoidance, leading to collection rates that fall below what should be the case if tax systems were efficiently managed”[10]. The Government should implement what can be institutionally improved to measure income and to collect taxes.

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[6] Ministry of Foreign Affairs Diplomacy and Security Research Project in 2013 (Comprehensive Project) "Middle East as a Global Strategic Issue - Prospects and Responses in 2030" Chapter 6 Grant and Structural Reform
Takayuki Yokota, Assistant Prof. international relation research department NihonUniv, The Japan institute of international affairs

[7] Can Fuel Subsidy Reforms in Egypt Reduce Budget Deficit without Harming the Poor? Ahmed Fathy, Khalid Siddig, Naglaa El-sodany, Asmaa Samieh, Amani Shahin, Noura Abdelwahab April 2016

[8] https://www.eytax.jp/tax-library/newsletters/japan-tax-alert-20160926-2.html

[9] PANORAMA EGYPT: SLOW RECOVERY, STRUCTURAL CHALLENGES, SEITEM İYİGÜN Coface Economist for Middle East and North Africa

[10] Public Financial Management Status in Egypt Khaled Zakaria Amin, Ph.D. ENCC Senior PFM Consultant Public Financial Management Reform in Egypt Current Reforms, Best Practices, and Lesson Learned December 17th, 2015

Table 9 Details of income tax

(LE Million)

| | 2012/13 | 2013/14 | 2014/15 |
|---|---|---|---|
| EGPC | 45,816 | 46,060 | 36,000 |
| SCA | 12,150 | 14,312 | 13,400 |
| CBE | 8,290 | 4,042 | 3,691 |
| Other Legal body | 25,275 | 25,099 | 38,512 |
| Private | 26,231 | 31,413 | 38,215 |
| Total income tax | 117,762 | 120,926 | 129,818 |

Source: Central Bank of Egypt

✓ Public service reform

Civil service reform is a difficult problem for the administration. The public sector is one of the biggest hirer in Egypt. There is a possibility that the high unemployment rate will be increased if numbers of public servant are reduced. Securing employment in the public sector can be thought as a part of welfare policy. There is also analysis that "full-scale efforts will be postponed until subsidy reduction falls to a stage"[11].

Nonetheless, given the financial situation, as analyzed above, the regime should avoid increasing labor costs as it is. The government recently set a ceiling for public sector wages, subjected bonuses to income taxes and discontinued the automatic inclusion of bonuses in basic wages after five years. New hires have been centralized and require approval by the finance ministry, and the use of public entities' own resources for additional rewards to employees has been discontinued. The authorities are also working on a thorough revision of the public pay system and introducing an attrition scheme limiting the number of retirees to be replaced[12].

(5) Fiscal stability

✓ Structural reform required from IMF

On 11 August 2016, the Egyptian government and the IMF agreed on a USD 12 billion loan program for three years. Egypt hopes to raise foreign currency reserves, restore international credit of the Egyptian economy and realize growth by receiving support from a disciplined loan program by the IMF. This is beneficial in terms of improving the financial condition. The IMF financing terms include structural adjustment policies. Therefore, the Egyptian government needs to implement the structural adjustment programs described below.

- Improve function of foreign exchange market: Possibility of devaluation and transition to a floating exchange rate system

[11] Ministry of Foreign Affairs Diplomacy and Security Research Project in 2013 (Comprehensive Project) "Middle East as a Global Strategic Issue - Prospects and Responses in 2030" Chapter 6 Grant and Structural Reform
Takayuki Yokota, Assistant Prof. international relation research department NihonUniv, The Japan institute of international affairs

[12] IMF Country Report No. 15/33 ARAB REPUBLIC OF EGYPT February 2015

- Reduction of budget deficit: introduction of value added tax and subsidy reform
- Reduction of government debt outstanding: Reduced to 88% from present 98% of GDP. Prioritize public funds in areas such as infrastructure, health, education, social security
- Strengthen safety net to protect layer that is vulnerable to structural adjustment
- Promotion of employment: especially for the youth and women
- Increase in foreign exchange reserves
- Reduce inflation to less than 10%[13]

In response to these requests from IMF, the Egyptian Government corresponded quickly, including the decision to introduce value-added tax (August), the shift to the floating exchange rate system (November), the reduction of fuel subsidies (November).

The Egyptian government is carrying out structural adjustments under the promise with the IMF, and as a part of it, shifted to floating exchange rate system. As a result, the price of crude oil and other fuels soared. In addition, due to the impact of the rise in international oil prices, the fuel subsidy projected for 2016/17 will be increased from LE 35 billion to LE 64 billion. Since it was also included in the structural adjustment in November 2016 the second volume of fuel subsidy reduction was announced and it came into force[14]. The new price of each fuel is described in Table 1-1-13.

"We expect that the next cut in the fuel subsidy in Egypt will occur before the end of the 2016-2017 Financial Year on 30 June, in order to ensure that the government does everything it can to reduce the budget deficit to below 10% of GDP. There is an added urgency because the late October 2016 fuel subsidy cut was less than the fall in the value of the Egyptian Pound after the recent free float, and oil prices have risen since then"[15].

✓ Fiscal forecast

It is expected to improve future financial situation as follow, if the Egyptian Government has completed structural adjustments as promises with the IMF. Owing to the active economic policy of the El-Sisi regime, GDP will steadily increase and the unemployment rate halves. Revenue also increases accordingly, but it is considered to be nearly constant in ratio to GDP. On the contrary, expenditures to GDP are expected to gradually decrease from 32% to 25% due to the structural adjustment mentioned above. Therefore, the budget deficit is expected to decrease from 12% in 2016 to about 4% in 2021. In addition, it is assumed that the total debt is also about 95% in 2016 compared to GDP, it will decrease to 76% by 2021.

[13] https://www.meij.or.jp/kawara/2016_79.html
[14] http://www.dailynewsegypt.com/2016/11/06/fuel-subsidy-cost-increase-egp-64bn-following-pounds-flotation-petroleum-minister/
[15] https://www.menas.co.uk/blog/egypt-next-fuel-subsidy-cut/

Table 10　Fiscal forecast

(LE Million)

| Subject Descriptor | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 |
|---|---|---|---|---|---|---|
| Revenue (LE Bil) | 564.843 | 798.768 | 877.464 | 1,023.51 | 1,138.24 | 1,299.90 |
| Revenue (ratio to GDP) | 20.334 | 23.245 | 21.498 | 21.675 | 21.293 | 21.413 |
| Expenditure (LE Bil) | 898.625 | 1,131.86 | 1,208.82 | 1,301.10 | 1,377.08 | 1,537.84 |
| Expenditure (ratio to GDP) | 32.35 | 32.939 | 29.616 | 27.554 | 25.761 | 25.333 |
| Net lend/borrow (LE Bil) | -333.782 | -333.095 | -331.36 | -277.588 | -238.835 | -237.933 |
| Net lend/borrow (ratio to GDP) | -12.016 | -9.694 | -8.118 | -5.879 | -4.468 | -3.919 |
| Gross debt (LE Bil) | 2,628.72 | 3,208.56 | 3,616.44 | 4,023.37 | 4,378.28 | 4,704.72 |
| Gross debt (ratio to GDP) | 94.633 | 93.374 | 88.602 | 85.205 | 81.905 | 77.501 |
| GDP(LE Bil) | 2,777.81 | 3,436.24 | 4,081.68 | 4,721.99 | 5,345.56 | 6,070.53 |
| Unemployment rate (%) | 12.665 | 12.267 | 11.341 | 9.977 | 8.408 | 6.704 |

Source: International Monetary Fund, World Economic Outlook Database, October 2016

# Appendix 2 Outline of environmental standards necessary for project implementation

(1) Environment Law Number 4/1994

1) Discharge in Aquatic Environment

In accordance with the provisions of articles from 69 to 72 in Law 4/ 1994 (Environment Law) amended by Law 9 /2009, and annexes 1 and 10 in the executive regulations, the following must be ensured and taken in consideration:

No waste or untreated liquids or any objects that will cause pollution should be thrown or discharged in the water voluntarily or involuntarily, directly or indirectly. In case of the presence of any water pollution source, an environmental impact assessment study should be carried out and submitted to the Environmental Affairs Agency. Also a water treatment unit should be constructed for the polluted water.

The discharge levels for the elements stated in Table 2-7-2-6 must not exceed the amounts stated in the table, taking into consideration that no erosion should occur due to the speed of flow and no damage to the benthic environment in accordance to the rules set by the EEAA.

Discharge is not allowed in the areas designated for fishing, swimming or natural protectorates, to ensure the preservation of the economic and aesthetic value of the area.

In the cases that the Total Dissolved solids concentration increases or decreases be the limits specified in the below table, an Environmental Impact Assessment Study for the Aquatic environment surrounding the discharge location should be prepared in accordance with the requirements and guidelines that will be issued by the EEAA after the approval of the management board.

Table 1 The maximum allowable standards and specifications for discharge in aquatic environment

(Annex 1 of the Executive Regulations amended by Decree 964/2015)

| Item | Maximum standards and specifications mg /liter - unless otherwise stated |
|---|---|
| **Temperature** | Not to exceed 5 degrees above the standard temperature of 38 $^0$C |
| **pH** | 6-9 |
| **Color** | Free from colored materials |
| **BOD** | 60 |
| **COD** | 100 |
| **TDS** | ± 5% of the value of dissolved salts in the marine environment to which it is discharged |
| **Suspended Solids** | 60 |
| **Hydrogen sulfide** | 1 |
| **Grease and Oil** | 15 |
| **Total Phosphorus** | 2 |
| **Total Nitrogen** | 10 |
| **Phenols** | 0.015 |
| **Ammonia (nitrogen)** | 3 |
| **Vanadium** | 0.002 |
| **Selenium** | 0.001 |
| **Mercury** | 0.001 |
| **Lead** | 0.01 |
| **Cadmium** | 0.01 |
| **Arsenic** | 0.01 |
| **Chrome** | 0.01 |
| **Copper** | 1 |
| **Nickel** | 0.1 |
| **Iron** | 1.5 |
| **Manganese** | 0.1 |
| **Zinc** | 1 |
| **Silver** | 0.05 |
| **All types of Fertilizers (*)** | 0.2 |
| **Cyanide** | 0.01 |
| **Total Coliforms (in 100 cm$^3$)** | 1000 |
| **Boron** | 0.4 |

(*) The Fertilizers not mentioned in Annex 10 of the Executive regulations, for which the discharge to aquatic environment is prohibited

2) Discharge of water to Aquatic Environment

a) Cooling Water

With regard to cooling water, it is important that it is discharged into the aquatic environment according to the following requirements:

1. The cooling water should be discharged to the same source from which it is extracted
2. That the cooling cycle is completely separate from any other discharges
3. That the temperature does not exceed 10 degrees above the temperature of the inlet water with a maximum of 38 degrees Celsius.
4. That the concentration of oils and grease should not exceed 15 ppm.

b) Non-biodegradable materials

As stated in Annex 10 of the Executive regulations, non-biodegradable materials have certain specifications that make them poisonous and harmful to the health, safety and environment and to the biodiversity and to different ecosystems as a whole over prolonged time periods. These materials also get transferred through the air and water

and settles in places far from its source were it collects in the terrestrial and aquatic ecology.

The non-biodegradable materials that are prohibited from being discharged into the water environment are:

① Persistent Organic Pollutants (POPs)

- Toxaphene
- Mirex
- Aldrin
- DDT
- Chlordan
- Endrin
- Heptachlor
- Hexachlorobiphenyles
- Hexachlorobenzene
- Polychlorobiphenyles
- Dioxins
- Furans

② Organomercuric Compounds

③ Organolead Compounds

④ Polycyclic Aromatic Hydrocarbons (PAH)

Furthermore it is prohibited to dispose of solid wastes such as plastics in the environment.

3) Hazardous Waste

In accordance with the provisions of articles 29, 20, 31 or 33 in law 4/1994 which is equivalent to law 9/2009 and article 28 of the executive regulations, all hazardous waste is subject to the following laws and regulations.

a) Generation of hazardous wastes

The establishment that generates hazardous waste is committed to the following:

- Work on reducing the waste generation rates (both type and quantity) through developing the used technology and using clean technology alternatives and choosing the product or raw materials that are less harmful to the environment and public health.
- The waste generated should be characterized based on quantity and type and recorded.
- Construction and operation of waste treatment units at the source under the condition of acquiring the approval of the EEAA on the treatment method and the technical specifications of these units and their operational programs

- When the hazardous waste cannot be treated or disposed at source, the establishment generating the hazardous waste is committed to collect and transport the waste to designated disposal sites which were predetermined by the local authorities and the competent administrative authorities and the Egyptian Environmental Affairs Agency.

b) Collection and storage stage of the hazardous waste material

It is important to identify specific locations for the storage of hazardous waste and post clear warning signs, and a have all the available guidelines for safety conditions that prevent the occurrence of any damage generally or to people who get exposed to it.

Storage of hazardous waste should be in special containers made of non-porous material that is free of holes to prevent any fluid leakage from occurring. Furthermore it should be fitted with a tight lid and have the correct capacity to match the amount of hazardous waste or according to the regulations for storing this waste and according to its type.

Clear signage for the storage of the hazardous waste should be placed on the storage containers in order to know the contents of these containers and the potential risks of handling it inappropriately.

A timetable should be set for the hazardous waste collection, to ensure that it is not stored for long time periods.

The entity that generates Hazardous waste is required to provide waste containers that are washed after every use and, not to put them public places.

c) Transportation stage of the hazardous waste

It is prohibited to transfer hazardous waste without using the transportation entities that belong to entities licensed to manage hazardous waste and they have to abide by the following guidelines:

- That the transportation vehicles should be equipped with all the safety equipment and be in good working condition.
- The vehicles should have a capacity, and follows certain routes that are suitable to the amount of hazardous transported.
- The drivers of the vehicles should be trained to act professionally especially in cases of emergency.
- The vehicles should have appropriate and clear signs that determine the degree of severity for the cargo and the best way to deal with this cargo in the case of an emergency.
- A predetermined transportation route for the vehicles carrying the hazardous waste should be put in place, and the civil defense authorities should be notified

immediately if any change happens in route, in order to allow for a rapid and proper action to be taken in case of emergency.

- The hazardous waste transportation vehicles are prohibited from movement in residential, urban and downtown areas during the daytime.
- The responsible entity should be notified of the address of the garage that accommodates the hazardous waste collection trucks and their license plate number, and date of registration.
- The hazardous waste collection trucks must to be washed and disinfected on a regular basis after every use according to the instructions laid down by the Ministry of Health in coordination with the competent administrative authority provided for in Article 40 of the executive regulations, and the water resulting from the washing operations are considered to be hazardous waste.

4) Noise

During the operation of the project, the resulting noise levels must not exceed those given by Table 3 of Annex 7 of the Executive Regulations.

Table 2 Maximum permissible noise level limits for the project area

(From Annex 7 of the Executive Regulations, Table 3)

| AREA TYPE | MAXIMUM PERMISSIBLE EQUIVALENT NOISE LEVEL [dB($A_{eq}$)] | |
|---|---|---|
| | Day | Night |
| | 7 AM – 10 PM | 10 PM – 7 AM |
| Sensitive areas to noise exposure | 50 | 40 |
| Residential suburbs with low traffic flow | 55 | 45 |
| Commercial and administrative areas in city center | 60 | 50 |
| Residential areas with some workshops, administrative activities, or recreational and entertainment activities overlooking public roads less than 12 meters | 65 | 55 |
| Areas overlooking public roads more than or equal 12 meters, or industrial areas with light industries | 70 | 60 |
| Industrial Zone with heavy industries | 70 | 70 |

5) Provisions for the Occupational Health and Safety of Employees

a) Noise

Annex 7 of the Executive Regulations amended in 2012 stipulates the permissible limits for sound pressure and safe exposure times that must be observed by the power station management for the work areas and places within power plants.

Table 3 Permissible noise levels inside sites of productive activities

(Table 1, Annex 7 of the Executive Regulations)

| No. | TYPE OF PLACE AND ACTIVITY | MAXIMUM PERMISSIBLE EQUIVALENT NOISE LEVEL [dB(A)] | Exposure Duration |
|---|---|---|---|
| 1. | a) Work places (workshops and industries) with up to 8 hour shifts (licensed before 2014) | 90 | 8 |
| | b) Work places (workshops and industries) with up to 8 hour shifts (licensed since 2014) | 85 | 8 |
| 2. | Closed wedding and celebration halls (provided that this limit does not exceed the hall boundaries) | 95 | 4 |
| 3. | Work rooms for computers, typewriters or similar equipment | 65 | - |
| 4. | Work rooms for activities requiring routine mental concentration – Bank lobbies, control rooms for industrial activities, restaurants and cafeterias | 60 | - |
| 5. | Hospitals, clinics, public libraries, museums, post offices, courts, mosques and worships places. | 45 | - |
| 6. | Universities, schools, institutions, nursery, …etc. (inside classrooms) | 40 | - |
| | Universities, schools, institutions, nursery, ...etc. (building yards and gardens) | 55 | - |
| 7. | Residential buildings, hotels, …etc. (living rooms) | 50 | - |
| | Residential buildings, hotels, …etc. (bedrooms) | 35 | - |

For the first item (a, b) the exposure duration shall be decreased by half if the noise level increases by 3 dB (A) combined with using ear plugs. This is to avoid any impacts on the sense of hearing.

The instantaneous noise level shall not exceed 135 dB (A) during working period.

The noise level is measured inside working areas and closed areas in LAeq according to the international guidelines (Parts 1&2) ISO 9612/ ISO 1996 or the Egyptian specifications No. 2836 part 1 & 2 and No. 5525 concerning this matter.

Equivalent noise level LAeq is the average acoustic pressure at the level of measurement (A) during a specific time period, and expressed in dB.

Table 4 Maximum Permissible Exposure to Heavy Hammers (Table 2, Annex 7 of Executive Regulations)

| **Peak Noise Intensity Level [dB(A)] $L_{cPeak}$** | 135 | 130 | 125 | 120 | 115 |
|---|---|---|---|---|---|
| **Number of Allowable Strikes during Working Hours** | 300 | 1000 | 3000 | 10000 | 30000 |

The intermittent noise exposure depends on the noise level intensity presented in the previous table (number of strikes per shift).

The hammer strikes are considered intermittent if the duration between strikes 1 second or more. If the duration is less than 1 second, the strikes are considered continuous and the noise level shall comply with Table 1 of Annex 7 of the executive regulations.

b) Indoor Air Quality

Annex 8 of the Executive Regulations lists the maximum permissible limits for pollutants inside the work environment.

c) Temperature and Humidity

Article 44 of Law 4/1994 and 46 of its Amended Executive Regulations by ministerial decree No. 710 for year 2012 stipulate the conditions and requirements for work place temperature and humidity. Annex 9 of the Executive Regulations gives the maximum and minimum limits for temperature and humidity, the corresponding exposure times, and safety precautions.

Table 5 Safe Standards of Temperature Degrees in the Work Environment for Each Working Hour (Permissible Heat Stress Exposure) (Table 1, Annex 9 of the Executive Regulations)

| System of work and hourly rest | Light work | Medium work | Hard work |
|---|---|---|---|
| **Continuous work** | 30 °C | 26.7 °C | 25 °C |
| **75% work, 25% rest** | 30.6 °C | 28 °C | 25.9 °C |
| **50% work, 50% rest** | 31.4 °C | 29.4 °C | 27.9 °C |
| **25% work, 75% rest** | 32.2 °C | 31.1 °C | 30 °C |

d) Ventilation

Table 4 of Annex 8 of the Executive Regulations lists the amounts of air required to ventilate public spaces.

e) Municipal Solid Waste

Annex 11 of the executive regulations explains the specification and regulations of the means of collecting and transporting the municipal solid waste and the methods of recycling. It also explains the final disposal procedures and methods.

(2) Natural Protectorates Law Number 102/1983

Law 102 for the year 1983 defines the areas that are considered as natural protectorates and prohibits any actions or activities that can damage or deteriorate the natural environment or the marine and terrestrial ecology in these areas.

The protected areas are determined through a decree, based on the suggestion of the Environmental Affairs Agency, and the law prohibits the establishment of any activities such as buildings, roads or agricultural commercial and industrial activities in the protected areas unless an approval is acquired from the competent administrative authority.

(3) Protection of Nile River Water Law 48/1982

The protection of the Nile River and water was law number 48 for the year 1982 defines the water ways to which this law is applicable as Fresh water and non-fresh water sources. The fresh water sources are: the river Nile and its branches and bays, as well as the braches and canals of all sizes and the non-fresh water sources are: all types of drainages, lakes, ponds and enclosed water bodies and underground water reservoirs.

The law states that for all the stated water ways, it is prohibited to dispose or dump any solid, liquid or gaseous waste from all residential, commercial and industrial activities as

well as waste water unless an approval is obtained from the Ministry of Irrigation according to the regulations issued in this regard.

1) Standards and Specifications of fresh waterways

Article 49 of the executive regulations details the standards and specifications of the fresh waterways to which industrial waste water can be discharged as follows:

Table 6 standards and specifications of the fresh waterways to which industrial waste water can be discharged (Article 49 of the ER of Law 48/1982)

| Parameter | Limit (mg/liter) |
|---|---|
| Total dissolved solids | < 500 |
| dissolved Oxygen | > 6 |
| pH | 6.5 – 8.5 |
| Biological Oxygen Demand | < 6 |
| Chemical Oxygen Demand | < 10 |
| Organic nitrogen | < 1 |
| Ammonia ($NH_3$) | < 0.5 |
| Nitrates ($NO_3$) | < 2 |
| Total Nitrogen (TN) | < 3.5 |
| Total Phosphorous (TP) | < 0.5 |
| Oil and grease | < 1 |
| Sulphates | < 200 |
| Mercury | < 0.001 |
| Iron | < 0.5 |
| Manganese | < 0.5 |
| Cupper | < 0.01 |
| Zinc | < 0.01 |
| Fluorides | < 0.5 |
| Phenol | < 0.002 |
| Arsenic | < 0.01 |
| Cadmium | < 0.001 |
| Chromium | < 0.05 |
| Free Cyanide | < 0.005 |
| Lead | < 0.01 |
| Selenium | < 0.01 |
| Boron | < 0.5 |
| Molybdenum | < 0.07 |
| Nickel | < 0.02 |
| Aldrin, dialdrin | < 0.00003 |
| Achlor | < 0.02 |
| Decarb | < 0.01 |
| Atrazine | < 0.002 |
| Bentazon | < 0.03 |
| Carbofuran | < 0.007 |
| Chlordane | < 0.0002 |
| Dichlorobrote | < 0.03 |
| Phenobrote | < 0.009 |
| Mircrobrote | < 0.01 |
| T 2, 4, 5 | < 0.0009 |

2) Standards of wastewater discharged to river Nile and its branches

Article 50 of the executive regulations sets the standard that the waste water discharged to the river Nile and its branches should not be exceeded.

Table 7 standards and specifications of wastewater discharged to fresh water sources (Article 50 of the ER of Law 48/1982)

| Parameter | Limit of Wastewater Quality discharged on | |
|---|---|---|
| | **Rosetta and Damietta Branches Less than** | **River Nile to Delta Less than** |
| Temperature | Less than 3 ˚C increase over the recipient waterway | Less than 3 ˚C increase over the recipient waterway |
| pH | 6 - 9 | 6 - 9 |
| BOD | 30 | 20 |
| COD – dichromes | 40 | 30 |
| TDS | 1200 | 800 |
| suspended solids | 30 | 30 |
| Sulphides as ($H_2S$) | 1 | 1 |
| Oil, grease and resins | 5 | 5 |
| Total phosphorus | 1 | 1 |
| Ammonia ($NH_3$) | 1 | 1 |
| Total Nitrogen (TN) | 5 | 5 |
| Phenol | 0.001 | 0.002 |
| Fluorides | 0.5 | 0.5 |
| Residual Chlorine | 1 | 1 |
| Mercury | 0.001 | 0.001 |
| Lead | 0.01 | 0.01 |
| Cadmium | 0.03 | 0.03 |
| Arsenic | 0.1 | 0.1 |
| Chrome | 0.05 | 0.05 |
| Cupper | 1 | 1 |
| Nickel | 0.2 | 0.2 |
| Iron | 1 | 1 |
| Manganese | 0.5 | 0.5 |
| Zinc | 1 | 1 |
| Silver | 0.05 | 0.05 |
| Facial Colonial in 100 $cm^3$ | 1000 | 1000 |
| All kinds of pesticides | Pesticides free | Pesticides Free |

3) Standards of Wastewater disposed to non-fresh water sources

Article 52 of the executive regulations set the limits required for the treated and untreated wastewater disposed to non-fresh water sources.

Table 8 standards and specifications of treated and untreated wastewater discharged to non-fresh water sources (Article 52 of the ER of Law 48/1982)

| Parameter | Limit of Wastewater Quality discharged on | |
|---|---|---|
| | **Treated domestic wastewater** | **Treated industrial Wastewater** |
| Temperature | Less than 3 ˚C increase over the recipient waterway | Less than 3 ˚C increase over the recipient waterway |
| pH | 6 - 9 | 6 – 9 |
| BOD | 60 | 60 |
| COD – dichromes | 80 | 80 |
| Dissolved Oxygen | > 4 | > 4 |
| Oil and grease | 10 | 10 |
| TDS | < 2000<br>< 5000 At costal zones | < 2000 |
| suspended solids | 50 | 50 |
| Sulphides as ($H_2S$) | 1 | 1 |
| Free Cyanide | 0.1 | 0.1 |
| Total phosphorus (TP as P) | - | - |
| Ammonia ($NH_3$) | - | - |
| Total Nitrogen (TN as N) | - | - |
| Phenol | 0.05 | 0.05 |
| Mercury | 0.01 | 0.01 |
| Lead | 0.1 | 0.1 |
| Cadmium | 0.003 | 0.003 |
| Arsenic | 0.05 | 0.05 |
| Selenium | 0.1 | 0.1 |
| Chrome | 0.1 | 0.1 |
| Cupper | 0.5 | 0.5 |
| Nickel | 0.5 | 0.5 |
| Zinc | 2 | 2 |
| Iron | 3.5 | 3.5 |
| Facial Colonial in 100 $cm^3$ | 5000 | 1000 |
| Worm ova – Ascaris | - | - |
| Pesticides Types | | |
| Alderine di<br>Elderine | < 0.015 | < 0.015 |
| Alachlor | < 0.01 | < 0.01 |
| Aldecarb | < 0.5 | < 0.5 |
| Atrazine | < 0.1 | < 0.1 |
| Pentazone | < 0.15 | < 0.15 |
| Carbofuran | 0.35 | < 0.35 |
| Chlordan | 0.01 | < 0.01 |
| Dichlorobrote 2,4 | 0.5 | < 0.5 |
| Phenobrote | < 0.5 | < 0.5 |
| Microbrote | 0.45 | <0.45 |

(4) Industrial Wastewater disposal Law 93/1962

The industrial wastewater disposal into the drainage systems is regulated by law 93/1962 and its executive regulations amended by decree 44/2000. The law prohibits the disposal of domestic, industrial and commercial wastewater, treated or untreated, in public drainage system without obtaining a prior approval. Article 14 of the executive regulations set the parameters required regarding the quality of the wastewater discharged to the public sewage network.

Table9 standards and specifications of wastewater discharged to public sewage system (Article 14 of the ER of Law 93/1962)

| Parameter | Limit in the disposed wastewater |
|---|---|
| (pH) | 6-9.5 |
| Temperature | 43 |
| COD | 1100 ppm |
| Total suspended solids | 800/100l |
| Dissolved solids | 10 ppm |
| Oil and grease | 100 ppm |
| Total nitrogen | 100 ppm |
| Total phosphorous | 25 ppm |
| cyanide($CN^-$) | 0.02 |
| phenol | 0.05 |
| Deposited materials (after 10 minutes) | 8 cm/l |
| Deposited materials (after 30 minutes) | 15 cm/l |
| Total heavy metals | 5 mg/l |
| Chromium 6 | 0.5 mg/l |
| cadmium (Cd) | 0.2 mg/l |
| lead (Pb) | 1 mg/l |
| Mercury (Hg) | 0.2 mg/l |
| Silver (Ag) | 0.5 mg |
| Copper (Cu) | 1.5 mg |
| Nickel (Ni) | 1 mg/l |
| bioter | 2 mg/l |
| Arsenic (As) | 2 mg/l |
| Boron (B) | 1 mg/l |
| Mercury | 0.2 |
| Nickel | 0.1 |
| Silver | 0.5 |

(5) Fishing and Aquatic life law 124/1983

Fishing, aquatic life and regulation of fisheries are organized through law 124/1983, which designates the General Authority for Fish Resources Development (GAFRD) as the competent administrative authority. The law sets the fishing process regulations and prohibits the use of toxic of harmful materials in fishing.

The GAFRD was established through decree 190/1983 to oversee the execution of the law provisions and track and develop the fisheries and fishing process as well as keep a track record of the fish stock.

(6) Public Cleanliness Law Number 38/1967

Law 38 for the year 1967 amended by law 31/1976 and its Executive Regulations issued by decree 134/1968 prohibit the dumping of solid wastes in any location other than those designated by the municipal authorities. This includes solid waste treatment and disposal, in addition to the temporary storage in undesignated containers. Article 1 of the Ministry of Housing and Utilities decree 134/1968 defines solid waste as any waste generated by persons, residential units, non-residential constructions such as commercial establishments, camps, animal cages, slaughterhouses, markets, public spaces, parks, and transportation methods.

The Public Cleanliness Law and its Executive Regulations requires the municipal authority responsible for public cleanliness or the contracted entity assigned by it for the collection, transport, and disposal of solid wastes, to carry out these processes in accordance

with the specifications stipulated in the Executive Regulations and any other regulations by the municipal authority.

(7) Traffic Law Number 121/2008

The law prohibits vehicle drivers to cause any road pollution by dumping wastes, or construction wastes, or any other material. The law also prohibits driving vehicles emitting high levels of noise, heavy smoke, emissions that do not comply with environmental conditions, or foul odors. Moreover, it is not permitted to drive vehicles that leak flammable material, or material harmful to public health or road safety. It is not allowed to drop part of the cargo compromising the road safety or posing threats or harm to its users.

(8) Labor Law Number 137/1981 Modified by Decision 12/2003 (Unified Labor Law)

Law 137 for the year 1981 requires employers to provide a safe working environment to employees as well as inform employees of the hazards associated with handling substances and waste. Moreover, the same law requires employers to provide safety equipment and training to employees handling waste.

In addition to the health and safety the law also guarantees the gender equality for job opportunities and regulates the employer – employee relation to guarantee the rights and fair treatment of all parties.

(9) Renewable Energy Production Motivation Laws 203/2014

The New and Renewable Energy Authority (NREA) is the competent administrative authority regarding the use of renewable energy in Egypt. NREA was established by law 102 for the year 1986, which was amended by law 135/2014 which enables the authority to establish, operate and maintain renewable energy plants (Solar, wind and others) as a separate entity or in collaboration with other entities.

Law 203 for the year 2014 regarding the motivation of electricity production from renewable energy sources is concerned with the procedures that should be followed for investors to build renewable energy producing plants and selling the produced electricity to the electricity distribution companies.

(10) Expropriation of properties for Public Benefit Law 10/1990

Law number 10 for the year 1990 and its amendment Law 1/2015 sets the method of land and properties for public benefit and the method of compensation as per the law provisions. The law defines the public benefit cases where this law is applicable which includes energy projects, road works, irrigation, water and sewage.

According to the law provisions the land and properties that should be acquired for a certain project should be determined through a committee consisting of the authority doing the acquisition and a member of the local authority at the project location, the law also sets the compensation value to be based on the market value at the time of issuing of the acquisition decision and should be paid within 1 month from this decision date.

The owners and related parties have the right to file a complaint within 15 days from the date that the acquiring authority issues the list of lands and properties that will be acquired

for the project. The published list includes all the properties, their areas, locations, owners' names, benefactors, their residence and the compensations evaluated for them.

(11) Rental and Sales of Premises Law 49/1977

The Rental and Sale of private premises is regulated through law 49/1977 amended by law 6/1997. This law and its executive regulations organizes the relation between property owners and renters or buyers and is the base of dispute regulations between individuals over privately owned properties (land, real estates... etc.).

(12) Enforcement Agencies

The employees of the EEAA and its branches in the governorates designated by a decree of the Minister of Justice in agreement with the Minister of Environmental Affairs shall have the capacity of judicial officers. This gives them the power of seizures in proving the commission of crimes in violation of the provisions of Law 4/ 1994 or the decrees issued in implementation thereof. Inspectors of administrative authorities concerned as well as the inspectors of the EEAA who have the capacity of judicial officers shall report to the authority to which they belong to any violation of the provisions of the Law. The authorities concerned shall then take the necessary legal procedures. In addition, every citizen and organization concerned with the protection of the environment shall have the right to report any violation of the provisions of Law 4/ 1994.

Enforcement authority for Traffic Law 121/2008 is the traffic police in the Ministry of Interior.

(13) Penalties

1) Violations of Environmental Law 4/ 1994

Chapter 4 (Articles 84 through 101) define the penalties stipulated for the violations of the provisions of the various law articles.

Article 84: Without prejudice to any more severe penalty prescribed in another law, any person violating provisions of Article (28) of this law shall be subject to imprisonment and/or a fine of not less than five thousand EGP and not more than fifty thousand EGP. In all cases, the court shall order confiscation of seized birds, animals, living organisms, plants and fossils, as well as machinery , weapons, equipment , means of transportation used in committing the crime.

Article 84: Penalties for violating provisions of Articles 22 (Environmental Register), 37(clause a) (Open burning of wastes), 69 (discharging of untreated substance, wastes, or liquid) of this law shall be imprisonment for a period of not more than one year and/or a fine of not less than five thousand EGP and not more than. One hundred thousand EGP.

Whoever violates provisions of Articles 19, 23 (Environmental Permit of Expansions and Renovations of existing establishment) of this law shall be fined a sum of not less than fifty thousand EGP and not more than one million EGP.

In case of recidivism the minimum and maximum sum of the fine shall be doubled, and the maximum period of imprisonment shall be doubled.

In addition to the previous original penalties, there may be a sentence of closing down the establishment, cancellation of the issued license or suspension of the violating activity.

Article 86: Violation of the provisions of article 36 (equipment/machinery exceeding permissible air emission levels) is punishable by fine of a sum of not less than 200 EGP and not more than 300 EGP. As to violations of the provisions of article 39 of Law 4/ 1994 amended by 9/2009 (construction and demolition activities), these shall be punishable by a fine of not less than 500 EGP and not more than 1,000 EGP. The court may order the suspension of the license for a period of not less than one week and not more than six months, and in case of recidivism, the court may revoke the license.

Article 87: Whoever violates the provisions of article 42 by using loudspeakers with a volume exceeding the permissible levels of sound intensity shall be punished by a fine of not less than 500 EGP and not more than 2,000 EGP and the machines and equipment used in the violation shall be confiscated. Violators of the provisions of articles 35, 37, 40, 43, 44, 45, or 46 shall be subjected to fines not less 1,000 EGP and not more 20,000 EGP. In case of recidivism, the fine provided for in the preceding paragraphs shall be doubled.

Article 95: Intentional violation of the provisions of Law 4/1994 amended by law 9/2009 is punishable by imprisonment for a term of not more than 10 years if such violation results in causing a permanent incurable disability to an individual. The penalty shall be imprisonment if the violation results in causing this infirmity to three or more persons. If the violation results in the death of a person, the penalty shall be temporary hard labor, and if it results in the death of three persons or more the penalty shall be permanent hard labor.

2) Violation of Traffic Law Number 121/2008

Violators of Traffic Law Number 121/2008 shall be fined not less than 100 EGP and not more than 1,500 EGP. If the offense is repeated within three months of the previous violation, the said fine is doubled.

In case of recidivism, within six months of the second violation, the same fine is imposed and the driver’s license is suspended for one year.

# Appendix 3 Transmission related data

(1) List of existing 220 kV transmission lines

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Basos | Cairo West | 1 | 220 | 5.3 | 1,100 | 419 | 1,200 | 1*238/97 STACIR |
| Basos | Cairo West | 2 | 220 | 5.3 | 1,100 | 419 | 1,200 | 1*238/97 STACIR |
| Basos | Genration North | 1 | 220 | 8.85 | 994 | 379 | 1,000 | XLPE1200HDPECABLE |
| Basos | Genration North | 2 | 220 | 9.575 | 994 | 379 | 1,000 | XLPE1200HDPECABLE |
| Basos | Genration North | 3 | 220 | 10 | 650 | 248 | 670 | 1*380/88 ACSR |
| Basos | Shobra El kheama | 1 | 220 | 4 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| Basos | Shobra El kheama | 2 | 220 | 4 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| Basos | Shobra El kheama | 3 | 220 | 4 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| Basos | Shobra El kheama | 4 | 220 | 4 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| Basos | Helyoples | 1 | 220 | 12.6 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Basos | Helyoples | 2 | 220 | 12.6 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Basos | Helyoples | 3 | 220 | 9.2 | 600 | 229 | 850 | 2*240144 ACO |
| Basos | Helyoples | 4 | 220 | 9.2 | 600 | 229 | 850 | 2*240/44 ACO |
| Basos | Helyoples | 5 | 220 | 21.8 | 600 | 229 | 850 | Equivalent |
| Basos | Helyoples | 6 | 220 | 21.8 | 600 | 229 | 850 | Equivalent |
| Basos | Bahtem 1 | 1 | 220 | 7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Basos | Bahtem 1 | 2 | 220 | 7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Cairo 500 | Cairo West | 1 | 220 | 11 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Cairo 500 | Cairo West | 2 | 220 | 11 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Elmatimidia | Cairo West | 1 | 220 | 6 | 1,100 | 419 | 1,200 | 1*238/97 STACIR |
| Elmatimidia | Cairo West | 2 | 220 | 6 | 1,100 | 419 | 1,200 | 1*238/97 STACIR |
| Elmatimidia | Cairo West | 3 | 220 | 9 | 1,100 | 419 | 1,200 | 2*380/50 ACSR |
| Elmatimidia | Cairo West | 4 | 220 | 9 | 1,100 | 419 | 1,200 | 2*380/50 ACSR |
| Elmatimidia | Cairo West | 5 | 220 | 15 | 1,100 | 419 | 1,200 | Equivalent |
| Elmatimidia | Cairo West | 6 | 220 | 15 | 1,100 | 419 | 1,200 | Equivalent |
| ELHaram | Cairo 500 | 1 | 220 | 8 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| ELHaram | Cairo 500 | 2 | 220 | 30.2 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| ELHaram | Cairo 500 | 3 | 220 | 3.6 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| ELHaram | Cairo 500 | 4 | 220 | 41.8 | 950 | 362 | 1,000 | Equivalent |
| ELHaram | Cairo south | 1 | 220 | 10 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| ELHaram | Cairo south | 2 | 220 | 7 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| ELHaram | Cairo south | 3 | 220 | 3.5 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| ELHaram | Cairo south | 4 | 220 | 20.5 | 950 | 362 | 670 | Equivalent |
| El giza | Cairo 500 | 1 | 220 | 30.2 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El giza | Cairo 500 | 2 | 220 | 8 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El giza | Cairo 500 | 3 | 220 | 7 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| El giza | Cairo 500 | 4 | 220 | 45.2 | 950 | 362 | 1,000 | Equivalent |
| El giza | Cairo south | 1 | 220 | 10 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El giza | Cairo south | 2 | 220 | 7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El giza | Cairo south | 3 | 220 | 7 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| El giza | Cairo south | 4 | 220 | 24 | 950 | 362 | 670 | Equivalent |
| Elgiza | ELHaram | 1 | 220 | 6.2 | 948 | 361 | 1,200 | XLP 1200mm2 |
| Cairo south | Wadi hofe | 1 | 220 | 3 | 1,150 | 438 | 1,150 | 2*405 AAAC |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Cairo south | Wadi hofe | 2 | 220 | 3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cairo south | Elhadba | 1 | 220 | 30 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Cairo south | Elhadba | 2 | 220 | 30 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Cairo south | El maadisouth | 1 | 220 | 11 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Cairo south | El maadisouth | 2 | 220 | 11 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Cairo south | El maadi south | 3 | 220 | 0.188 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cairo south | El maadi south | 4 | 220 | 0.188 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cairo south | El maadi south | 5 | 220 | 11.1 | 1,150 | 438 | 1,200 | Equivalent |
| Cairo south | El maadisouth | 6 | 220 | 11.1 | 1,150 | 438 | 1,200 | Equivalent |
| El maadi south | Ein Elseera | 1 | 220 | 0.25 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El maadi south | Ein Elseera | 2 | 220 | 5.5 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| El maadi south | Ein Elseera | 3 | 220 | 7.5 | 1,600 | 610 | 1,600 | XLP 1600mm2 Elswedy |
| El maadi south | Ein Elseera | 4 | 220 | 0.25 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El maadi south | Ein Elseera | 5 | 220 | 5.5 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| El maadi south | Ein Elseera | 6 | 220 | 7.5 | 1,200 | 457 | 1,500 | Cable in parralel of Cable L-Pr E |
| El maadi south | Ein Elseera | 7 | 220 | 13.25 | 1,150 | 438 | 1,150 | Equivalent |
| El maadi south | Ein Elseera | 8 | 220 | 13.25 | 1,150 | 438 | 1,150 | Equivalent |
| 6-octobar | Cairo 500 | 1 | 220 | 28 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| 6-octobar | Cairo 500 | 2 | 220 | 28 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| 6-octobar | Elhadba | 1 | 220 | 25 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| 6-octobar | Elhadba | 2 | 220 | 25 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| 6-octobar | Octobar north | 1 | 220 | 11.6 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| 6-octobar | Octobar north | 2 | 220 | 11.6 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| octobar north | El sheikh zayid | 1 | 220 | 15.4 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| octobar north | El sheikh zayid | 2 | 220 | 15.4 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El tiben south | El tiben 500 | 1 | 220 | 7.4 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| El tiben south | El tiben 500 | 2 | 220 | 7.4 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| El basaten | Ein Elseera | 1 | 220 | 4.3 | 924 | 352 | 1,000 | XLPE1000mm2 |
| El basaten | Ein Elseera | 2 | 220 | 4.3 | 924 | 352 | 1,000 | XLPE1000mm2 |
| Elhadba | Elmatimidia | 1 | 220 | 18 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Elhadba | Elmatimidia | 2 | 220 | 18 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Elhadba | Elmatimidia | 3 | 220 | 9 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Elhadba | Elmatimidia | 4 | 220 | 9 | 120 | 46 | 1,200 | 2*380/50 ACSR |
| Elhadba | Elmatimidia | 5 | 220 | 27 | 1,200 | 457 | 670 | Equivalent |
| Elhadba | Elmatimidia | 6 | 220 | 27 | 1,200 | 457 | 670 | Equivalent |
| cairo north | El sabtia 1 | 1 | 220 | 8 | 750 | 286 | 800 | CableHi-Pr phlips 887 |
| cairo north | El sabtia 1 | 2 | 220 | 8 | 750 | 286 | 800 | CableHi-Pr phlips 887 |
| cairo north | Shobra El kheama | 1 | 220 | 4.5 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| cairo north | Genration North | 1 | 220 | 0.3 | 3,000 | 1,143 | 3,000 | XLP 3000mm2 |
| cairo north | Genration North | 2 | 220 | 0.3 | 3,000 | 1,143 | 3,000 | XLP 3000mm2 |
| Genration North | Helyoples | 1 | 220 | 15.8 | 600 | 229 | 850 | 2*240/44 ACO |
| Genration North | Helyoples | 2 | 220 | 0.35 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| Genration North | Helyoples | 3 | 220 | 7.4 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Genration North | Helyoples | 4 | 220 | 15.8 | 600 | 229 | 850 | 2*240/44 ACO |
| Genration North | Helyoples | 5 | 220 | 0.35 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| Genration North | Helyoples | 6 | 220 | 7.4 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Genration North | Helyoples | 7 | 220 | 23.55 | 600 | 229 | 850 | Equivalent |
| Genration North | Helyoples | 8 | 220 | 23.55 | 600 | 229 | 850 | Equivalent |
| El sabtia 1 | Shobra El kheama | 1 | 220 | 9 | 800 | 305 | 1,000 | CableHi-Pr kanda1267 |
| El sabtia 1 | Shobra El kheama | 2 | 220 | 9 | 800 | 305 | 1,000 | CableHi-Pr kanda1267 |
| El sabtia 1 | El sabtia 2 | 1 | 220 | 0.3 | 800 | 305 | 1,000 | CableHi-Pr kanda1267 |
| El sabtia 1 | El sabtia 2 | 2 | 220 | 0.3 | 800 | 305 | 1,000 | CableHi-Pr kanda1267 |
| El matro | El sabtia 2 | 3 | 220 | 1.6 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| El matro | El sabtia 2 | 4 | 220 | 1.6 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| El matro | EL estad | 1 | 220 | 8 | 1,000 | 381 | 1,000 | Cable Hi-Pr Dilion 1267 |
| El matro | Shobra El kheama | 1 | 220 | 12 | 1,000 | 381 | 1,000 | CableHi-Pr kanda1267 |
| Cairo west | EL estad | 1 | 220 | 7 | 800 | 305 | 1,000 | Cable Hi-Pr Dilion 1267 |
| Cairo west | Matro El abasia | 1 | 220 | 11.3 | 800 | 305 | 1,140 | Giza XLPE 1200 |
| Matro El abasia | EL estad | 1 | 220 | 3.3 | 948 | 361 | 1,140 | Giza XLPE 1200 |
| Matro El abasia | Ein Elseera | 1 | 220 | 9.5 | 948 | 361 | 1,140 | Giza XLPE 1200 |
| Matro El abasia | Ein Elseera | 2 | 220 | 9.5 | 948 | 361 | 1,140 | Giza XLPE 1200 |
| Cairo west | Helyoples | 1 | 220 | 12.6 | 800 | 305 | 1,200 | XLP 1200mm2 |
| Cairo west | Sakar korash | 1 | 220 | 10 | 650 | 248 | 670 | 1*380/88 ACSR |
| Cairo west | Sakar korash | 2 | 220 | 10 | 650 | 248 | 670 | 1*380/88 ACSR |
| Cairo west | Sakar korash | 3 | 220 | 10.5 | 950 | 362 | 1,200 | XLP 1200mm2 |
| Cairo west | El basaten | 1 | 220 | 16 | 650 | 248 | 670 | 1*380/88 ACSR |
| Cairo west | El basaten | 2 | 220 | 3.25 | 700 | 267 | 800 | Cable L-Pr Brilli800 |
| Cairo west | El basaten | 3 | 220 | 16 | 650 | 248 | 670 | 1*380/88 ACSR |
| Cairo west | El basaten | 4 | 220 | 3.25 | 700 | 267 | 800 | Cable L-Pr Brilli800 |
| Cairo west | El basaten | 5 | 220 | 19.25 | 650 | 248 | 670 | Equivalent |
| Cairo west | El basaten | 6 | 220 | 19.25 | 650 | 248 | 670 | Equivalent |
| Helyoples | Eloboor | 1 | 220 | 7.8 | 900 | 343 | 670 | 1*506 |
| Helyoples | Eloboor | 2 | 220 | 9 | 1,600 | 610 | 1,600 | XLP 1600mm2 Elswedy |
| Helyopies | Eloboor | 3 | 220 | 5.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Helyoples | Eloboor | 4 | 220 | 7.8 | 900 | 343 | 670 | 1*506 |
| Helyoples | Eloboor | 5 | 220 | 9 | 1,200 | 457 | 1,500 | lein parralel of Cable L-Pr E |
| Helyoples | Eloboor | 6 | 220 | 5.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Helyoples | Eloboor | 7 | 220 | 22.5 | 900 | 343 | | Equivalent |
| Helyoples | Eloboor | 8 | 220 | 22.5 | 900 | 343 | | Equivalent |
| El oboor | Abo zahble | 1 | 220 | 1.4 | 900 | 343 | 670 | 1*506 |
| El oboor | Abo zahble | 2 | 220 | 5.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Eloboor | Abo zahble | 3 | 220 | 1.4 | 900 | 343 | 670 | 1*506 |
| El oboor | Abo zahble | 4 | 220 | 5.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Eloboor | Abo zahble | 5 | 220 | 7.1 | 900 | 343 | | Equivalent |
| El oboor | Abo zahble | 6 | 220 | 7.1 | 900 | 343 | | Equivalent |
| AIR PORT | The new cairo | 1 | 220 | 7.8 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| AIR PORT | The new cairo | 2 | 220 | 7.8 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| AIR PORT | The new cairo | 3 | 220 | 1.1 | 1,200 | 457 | 1,200 | XLP 1200mm2 |
| AIR PORT | The new cairo | 4 | 220 | 1.1 | 1,200 | 457 | 1,200 | XLP 1200mm2 |
| AIR PORT | The new cairo | 5 | 220 | 8.9 | 1,200 | 457 | 950 | Equivalent |
| AIR PORT | The new cairo | 6 | 220 | 8.9 | 1,200 | 457 | 950 | Equivalent |
| Sakar korash | AIR PORT | 1 | 220 | 2.3 | 924 | 352 | 1,000 | XLPE1000mm2 |
| Sakar korash | AIR PORT | 2 | 220 | 2.3 | 924 | 352 | 1,000 | XLPE1000mm2 |
| El tiben south | Genration of tiben | 1 | 220 | 7.8 | 950 | 362 | 1,200 | XLP 1200mm2 |
| El tiben south | Genration of tiben | 2 | 220 | 7.8 | 948 | 361 | 1,200 | XLP 1200mm2 |
| Genration of tibe1 | Wadi hofe | 1 | 220 | 7.8 | 948 | 361 | 1,200 | XLP 1200mm2 |
| Genration of tibe1 | Wadi hofe | 2 | 220 | 27 | 1,200 | 457 | 1,200 | 1*439/46 TACSR |
| Genration of tibe1 | Wadi hofe | 3 | 220 | 0.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Genration of tibe1 | Wadi hofe | 4 | 220 | 7.8 | 950 | 362 | 1,200 | XLP 1200mm2 |
| Genration of tibe1 | Wadi hofe | 5 | 220 | 27 | 1,200 | 457 | 1,200 | 1*439/46 TACSR |
| Genration of tibe1 | Wadi hofe | 6 | 220 | 0.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Genration of tibe1 | Wadi hofe | 7 | 220 | 35.5 | 948 | 361 | 1,000 | Equivalent |
| Genration of tibe1 | Wadi hofe | 8 | 220 | 35.5 | 948 | 361 | 1,000 | Equivalent |
| Bahtem 2 | The North | 1 | 220 | 3.8 | 800 | 305 | 1,200 | XLP 1200mm2 |
| Bahtem 2 | The North | 2 | 220 | 3.8 | 800 | 305 | 1,200 | XLP 1200mm2 |
| Bahtem 1 | Bahtem2 | 1 | 220 | 0.135 | 948 | 361 | 1,200 | XLP 1200mm2 |
| Bahtem 1 | Bahtem2 | 2 | 220 | 0.135 | 948 | 361 | 1,200 | XLP 1200mm2 |
| El sheikh zayid | Genration ofoctobar | 1 | 220 | 13 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| El sheikh zayid | Genration of octobar | 2 | 220 | 13 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| TheEconomic | El tiben 500 | 1 | 220 | 90 | 650 | 248 | 670 | 1*380/88 ACSR |
| TheEconomic | El katamia | 1 | 220 | 62 | 650 | 248 | 670 | 1*380/88 ACSR |
| TheEconomic | El katamia | 2 | 220 | 14 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| TheEconomic | El katamia | 3 | 220 | 76 | 650 | 248 | 670 | Equivalent |
| El katamia | El tiben 500 | 1 | 220 | 28 | 1,200 | 457 | 1,200 | 1*255/88 |
| El katamia | El tiben 500 | 2 | 220 | 14 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El katamia | El tiben 500 | 3 | 220 | 42 | 1,200 | 457 | 1,200 | Equivalent |
| Elhadba | Genration of octobar2 | 1 | 220 | 12.5 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| Elhadba | Genration of octobar2 | 2 | 220 | 12.5 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| Genration of octobar2 | Genration of octobar1 | 1 | 220 | 0.28 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| Suez 500 | Eiyon mosa | 1 | 220 | 23.243 | 1,200 | 457 | 2,000 | 3*506 AAAC |
| Suez 500 | Suez 2 | 1 | 220 | 5 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Suez 500 | Suez 2 | 2 | 220 | 5 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Suez 500 | Abo soldan | 1 | 220 | 58.3 | 600 | 229 | 670 | 1*380/88 ACSR |
| Suez 500 | Abo soldan | 2 | 220 | 58.3 | 600 | 229 | 670 | 1*380/88 ACSR |
| Suez 500 | Abo soldan | 3 | 220 | 15.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Suez 500 | Abo soldan | 4 | 220 | 15.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Suez 500 | Abo soldan | 5 | 220 | 74 | 600 | 229 | 670 | Equivalent |
| Suez 500 | Abo soldan | 6 | 220 | 74 | 600 | 229 | 670 | Equivalent |
| Suez 500 | The new ataka | 1 | 220 | 13 | 1,150 | 438 | 1,150 | 2*405 AAAC |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Suez 500 | The new ataka | 2 | 220 | 13 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Suez 2 | The temrsher of Suez | 1 | 220 | 6 | 600 | 229 | 670 | 1*380/88 ACSR |
| Suez 2 | The temrsher of Suez | 2 | 220 | 6 | 600 | 229 | 670 | 1*380/88 ACSR |
| Suez 2 | Ataka | 1 | 220 | 10 | 800 | 305 | 850 | 2*236 AAAC |
| Suez 2 | Ataka | 2 | 220 | 10 | 800 | 305 | 850 | 2*236 AAAC |
| Suez 2 | Sakar korash | 1 | 220 | 103 | 550 | 210 | 670 | 1*380/88 ACSR |
| Suez 2 | Sakar korash | 2 | 220 | 103 | 550 | 210 | 670 | 1*380/88 ACSR |
| Ataka | Cement of Suez | 1 | 220 | 54 | 800 | 305 | 850 | 2*236 AAAC |
| Ataka | Cement of Suez | 2 | 220 | 54 | 800 | 305 | 850 | 2*236 AAAC |
| Ataka | Euruq El ssulb | 1 | 220 | 3 | 800 | 305 | 850 | CableHpofc 850 |
| Ataka | Euruq El ssulb | 2 | 220 | 1.25 | 800 | 305 | 850 | CableHpofc 850 |
| Ataka | The Eygption | 1 | 220 | 62 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Ataka | The Eygption | 2 | 220 | 62 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Abo soldan | El manaif | 1 | 220 | 40 | 600 | 229 | 670 | 1*380/88 ACSR |
| Abo soldan | El manaif | 2 | 220 | 40 | 600 | 229 | 670 | 1*380/88 ACSR |
| Abo soldan | The new ashar | 1 | 220 | 57.5 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Abo soldan | The new ashar | 2 | 220 | 57.5 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The Arabian cement | Eiz Suez | 1 | 220 | 23.92 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The Arabian cement | Eiz Suez | 2 | 220 | 0.67 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| The Arabian cement | Eiz Suez | 3 | 220 | 23.92 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The Arabian cement | Eiz Suez | 4 | 220 | 0.67 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| The Arabian cement | Eiz Suez | 5 | 220 | 24.6 | 1,150 | 438 | 1,150 | Equivalent |
| The Arabian cement | Eiz Suez | 6 | 220 | 24.6 | 1,150 | 438 | 1,150 | Equivalent |
| The Eygption | The Arabian cement | 1 | 220 | 6.61 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The Eygption | The Arabian cement | 2 | 220 | 0.69 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| The Eygption | The Arabian cement | 3 | 220 | 6.61 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The Eygption | The Arabian cement | 4 | 220 | 0.69 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| The Eygption | The Arabian cement | 5 | 220 | 7.3 | 1,150 | 438 | 1,150 | Equivalent |
| The Eygption | The Arabian cement | 6 | 220 | 7.3 | 1,150 | 438 | 1,150 | Equivalent |
| The Eygption | El katamia | 1 | 220 | 63 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| The Eygption | El katamia | 2 | 220 | 63 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El Zagazig | Bahtem | 1 | 220 | 59 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| El Zagazig | Bahtem | 2 | 220 | 59 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| The old ashar | Abo zahble | 1 | 220 | 52 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The old ashar | Abo zahble | 2 | 220 | 52 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The old ashar | The connection | 1 | 220 | 21.85 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The connection | The new ashar | 1 | 220 | 0.65 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| The old ashar | The new ashar | 2 | 220 | 22.5 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cement of Suez | Cement of Sweedy | 1 | 220 | 2.4 | 800 | 305 | 850 | 2*236 AAAC |
| Cement of Suez | Cement of Sweedy | 2 | 220 | 0.6 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cement of Suez | Cement of Sweedy | 3 | 220 | 2.4 | 800 | 305 | 850 | 2*236 AAAC |
| Cement of Suez | Cement of Sweedy | 4 | 220 | 0.6 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cement of Suez | Cement of Sweedy | 5 | 220 | 3 | 800 | 305 | 850 | Equivalent |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Cement of Suez | Cement of Sweedy | 6 | 220 | 3 | 800 | 305 | 850 | Equivalent |
| Cement of Suez | Eiz Suez | 1 | 220 | 1.57 | 850 | 324 | 850 | 2*236 AAAC |
| Cement of Suez | Eiz Suez | 2 | 220 | 9.43 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cement of Suez | Eiz Suez | 3 | 220 | 1.57 | 850 | 324 | 850 | 2*236 AAAC |
| Cement of Suez | Eiz Suez | 4 | 220 | 9.43 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Cement of Suez | Eiz Suez | 5 | 220 | 11 | 850 | 324 | 850 | Equivalent |
| Cement of Suez | Eiz Suez | 6 | 220 | 11 | 850 | 324 | 850 | Equivalent |
| El ein sakhna | Gulf of Suez | 1 | 220 | 1.76 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| El ein sakhna | Gulf of Suez | 2 | 220 | 4.24 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El ein sakhna | Gulf of Suez | 3 | 220 | 1.76 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| El ein sakhna | Gulf of Suez | 4 | 220 | 4.24 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El ein sakhna | Gulf of Suez | 5 | 220 | 6 | 1,150 | 438 | 1,150 | Equivalent |
| El ein sakhna | Gulf of Suez | 6 | 220 | 6 | 1,150 | 438 | 1,150 | Equivalent |
| El ein sakhna | El zafrana | 1 | 220 | 56 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El ein sakhna | El zafrana | 2 | 220 | 56 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El ein sakhna | TheEconomic | 1 | 220 | 4 | 1,150 | 438 | 1,150 | 1*238/97 AAAC |
| El ein sakhna | TheEconomic | 2 | 220 | 4 | 1,150 | 438 | 1,150 | 1*238/97 AAAC |
| TheEconomic | Gulf of Suez | 1 | 220 | 4.7 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| TheEconomic | Gulf of Suez | 2 | 220 | 4.7 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Abo kbear | El gammalia | 1 | 220 | 71 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Abo kbear | El gammalia | 2 | 220 | 71 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El sharqia | Abo kbear | 1 | 220 | 115 | 400 | 152 | 1,200 | 2*380/50 ACSR |
| El sharqia | Abo kbear | 2 | 220 | 115 | 400 | 152 | 1,200 | 2*380/50 ACSR |
| El sharqia | Genration of Elshaba | 1 | 220 | 16 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El sharqia | Genration of Elshaba | 2 | 220 | 16 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El sharqia | Genration of Elshaba | 3 | 220 | 16 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El sharqia | Genration of Elshaba | 4 | 220 | 16 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El sharqia | Genration of Elshaba | 5 | 220 | 32 | 1,150 | 438 | 1,150 | Equivalent |
| El sharqia | Genration of Elshaba | 6 | 220 | 32 | 1,150 | 438 | 1,150 | Equivalent |
| El shabab | El Zagazig | 1 | 220 | 44 | 650 | 248 | 670 | 1*380/88 ACSR |
| El shabab | El Zagazig | 2 | 220 | 44 | 650 | 248 | 670 | 1*380/88 ACSR |
| El shabab | El Zagazig | 3 | 220 | 3.3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El shabab | El Zagazig | 4 | 220 | 3.3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El shabab | El Zagazig | 5 | 220 | 47.3 | 650 | 248 | 650 | Equivalent |
| El shabab | El Zagazig | 6 | 220 | 47.3 | 650 | 248 | 650 | Equivalent |
| El shabab | El manaif | 1 | 220 | 1.875 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El shabab | El manaif | 2 | 220 | 1.875 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El shabab | El manaif | 3 | 220 | 28.125 | 650 | 248 | 670 | 1*380/88 ACSR |
| El shabab | El manaif | 4 | 220 | 28.125 | 650 | 248 | 670 | 1*380/88 ACSR |
| El shabab | El manaif | 5 | 220 | 30 | 650 | 248 | 670 | Equivalent |
| El shabab | El manaif | 6 | 220 | 30 | 650 | 248 | 670 | Equivalent |
| El shabab | The new ashar | 1 | 220 | 23.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El shabab | The new ashar | 2 | 220 | 23.7 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| El manaif | Porsaid | 1 | 220 | 40 | 625 | 238 | 670 | 1*380/88 ACSR |
| El manaif | Porsaid | 2 | 220 | 43 | 625 | 238 | 650 | 1*405 AAAC |
| El manaif | Porsaid | 3 | 220 | 40 | 625 | 238 | 670 | 1*380/88 ACSR |
| El manaif | Porsaid | 4 | 220 | 43 | 625 | 238 | 650 | 1*405 AAAC |
| El manaif | Porsaid | 5 | 220 | 83 | 625 | 238 | 670 | Equivalent |
| El manaif | Porsaid | 6 | 220 | 83 | 625 | 238 | 670 | Equivalent |
| El manaif | El sharqia | 1 | 220 | 46 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El manaif | El sharqia | 2 | 220 | 46 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Gulf of Suez | The new cairo | 1 | 220 | 105 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Gulf of Suez | The new cairo | 2 | 220 | 105 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Gulf of Suez | The new cairo | 3 | 220 | 9.1 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Gulf of Suez | The new cairo | 4 | 220 | 9.1 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Gulf of Suez | The new cairo | 5 | 220 | 38.9 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Gulf of Suez | The new cairo | 6 | 220 | 38.9 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Gulf of Suez | The new cairo | 7 | 220 | 153 | 1,150 | 438 | 1,150 | Equivalent |
| Gulf of Suez | The new cairo | 8 | 220 | 153 | 1,150 | 438 | 1,150 | Equivalent |
| Porsaid BOOT | El sharqia | 1 | 220 | 25 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Porsaid BOOT | El sharqia | 2 | 220 | 76.25 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Porsaid BOOT | El sharqia | 3 | 220 | 0.74 | 1,200 | 457 | 1,200 | XLP 1200mm2 |
| Porsaid BOOT | El sharqia | 4 | 220 | 25 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Porsaid BOOT | El sharqia | 5 | 220 | 76.25 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Porsaid BOOT | El sharqia | 6 | 220 | 0.74 | 1,200 | 457 | 1,200 | XLP 1200mm2 |
| Porsaid BOOT | El sharqia | 7 | 220 | 102 | 1,150 | 438 | 1,150 | Equivalent |
| Porsaid BOOT | El sharqia | 8 | 220 | 102 | 1,150 | 438 | 1,150 | Equivalent |
| Porsaid BOOT | Porsaid | 1 | 220 | 40.3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Porsaid BOOT | Porsaid | 2 | 220 | 0.74 | 1,200 | 457 | 1,200 | XLP 1200mm2 |
| Porsaid BOOT | Porsaid | 3 | 220 | 40.3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Porsaid BOOT | Porsaid | 4 | 220 | 0.74 | 1,200 | 457 | 1,200 | XLP 1200mm2 |
| Porsaid BOOT | Porsaid | 5 | 220 | 41 | 1,150 | 438 | 1,150 | Equivalent |
| Porsaid BOOT | Porsaid | 6 | 220 | 41 | 1,150 | 438 | 1,150 | Equivalent |
| Porsaid BOOT | Bar Elabd | 1 | 220 | 61.8 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Porsaid BOOT | Bar Elabd | 2 | 220 | 61.8 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Aolad hamam | EL broblien | 1 | 220 | 48 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| EL broblien | Porsaid | 1 | 220 | 21 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El trast | Aolad hamam | 1 | 220 | 69 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| porsaid | El trast | 1 | 220 | 3.3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Eiyon mosa | El kantra west | 1 | 220 | 130 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Eiyon mosa | El kantra west | 2 | 220 | 130 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Eiyon mosa | Ras sidr | 1 | 220 | 39.4 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Eiyon mosa | Ras sidr | 2 | 220 | 39.4 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Abo rdeas | Ras sidr | 3 | 220 | 125 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Abo rdeas | Ras sidr | 4 | 220 | 125 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Abo rdeas | El toor | 1 | 220 | 75 | 1,150 | 438 | 1,150 | 2*405 AAAC |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Abo rdeas | El toor | 2 | 220 | 75 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Sharm El sheakh | El toor | 3 | 220 | 107 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Sharm El sheakh | El toor | 4 | 220 | 107 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El kantra west | Bar Elabd | 1 | 220 | 68 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El kantra west | Bar Elabd | 2 | 220 | 68 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Bar Elabd | El masaiid | 1 | 220 | 60 | 750 | 286 | 1,150 | 2*405 AAAC |
| Bar Elabd | El masaiid | 2 | 220 | 60 | 750 | 286 | 1,150 | 2*405 AAAC |
| El masaiid | El Areash | 1 | 220 | 5 | 750 | 286 | 1,150 | 2*405 AAAC |
| El masaiid | El Areash | 2 | 220 | 5 | 750 | 286 | 1,150 | 2*40 AAAC |
| Bar Elabd | Bagdad | 1 | 220 | 105 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Bar Elabd | Bagdad | 2 | 220 | 105 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Taha | Niweba | 1 | 220 | 105 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Taha | Niweba | 2 | 220 | 105 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Niweba | Elnabq | 1 | 220 | 153 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Niweba | Elnabq | 2 | 220 | 153 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Safaga | Hergada | 1 | 220 | 43 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Safaga | Hergada | 2 | 220 | 43 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Genration of Hergada | Hergada | 1 | 220 | 3.5 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| Genration of Hergada | Hergada | 2 | 220 | 3.5 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| Gabl El zeat | Hergada | 1 | 220 | 158 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Gabl El zeat | Hergada | 2 | 220 | 158 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El zafrana 1 | El zafrana 2 | 1 | 220 | 3.3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| El zafrana 1 | El zafrana 2 | 2 | 220 | 3.3 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Gabl El zeat | El zafrana 2 | 3 | 220 | 147.8 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Gabl El zeat | El zafrana 2 | 4 | 220 | 147.8 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Elnabq | Sharm El sheakh | 1 | 220 | 19 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Generation of sharm El sheakh | Sharm El sheakh | 1 | 220 | 5.5 | 1,600 | 610 | 1,600 | XLP 1600mm2 Elswedy |
| West New Domiat | Connection El Asher1 | 1 | 220 | 11 | 2,000 | 762 | 2,000 | 2*238/97 STACIR |
| West New Domiat | Connection El Asher1 | 2 | 220 | 149.018 | 2,000 | 762 | 2,000 | 3*506 AAAC |
| West New Domiat | Connection El Asher1 | 3 | 220 | 160.018 | 2,000 | 762 | 2,000 | Equivalent |
| Connection El Aher1 | Elnabq | 1 | 220 | 5.5 | 1,600 | 610 | 1,600 | XLP 1600mm2 Elswedy |
| Connection El Aher1 | Elnabq | 2 | 220 | 19 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Connection El Aher1 | Elnabq | 3 | 220 | 24.5 | 1,150 | 438 | 1,150 | Equivalent |
| El zafrana 2 | Bni Sweef | 1 | 220 | 45 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Talkha | Conection Talkha/E | 1 | 220 | 22 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| Conection Talkha | El Mahala | 1 | 220 | 6.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Talkha | Meet gamr | 1 | 220 | 43.3 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| Conection Talkha | Meet gamr | 1 | 220 | 21.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tafkha | Kafr El sheakh | 1 | 220 | 52 | 450 | 171 | 670 | 1*380/88 ACSR |
| Talkha | Kafr El sheakh | 2 | 220 | 52 | 450 | 171 | 670 | 1*380/88 ACSR |
| Talkha | El Mansora | 1 | 220 | 12 | 1,500 | 572 | 1,500 | 2*500 ACSR |
| Talkha | El Mansora | 2 | 220 | 12 | 1,500 | 572 | 1,500 | 2*500 ACSR |
| West Domiat | El gammalia | 1 | 220 | 16 | 1,500 | 572 | 1,500 | 2*500 ACSR |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| West Domiat | El gammalia | 2 | 220 | 16 | 1,500 | 572 | 1,500 | 2*500 ACSR |
| West Domiat | El gammalia | 3 | 220 | 32 | 1,500 | 572 | 2,400 | 2*238/97 STACIR |
| West Domiat | El gammalia | 4 | 220 | 32 | 1,500 | 572 | 2,400 | 2*238/97 STACIR |
| West Domiat | El gammalia | 5 | 220 | 48 | 1,500 | 572 | 1,500 | Equivalent |
| West Domiat | El gammalia | 6 | 220 | 48 | 1,500 | 572 | 1,500 | Equivalent |
| Domiat | New Domiat | 1 | 220 | 1.2 | 2,000 | 762 | 2,400 | 2*238/97 STACIR |
| Domiat | New Domiat | 2 | 220 | 1.2 | 2,000 | 762 | 2,400 | 2*238/97 STACIR |
| New Domiat | Aolad hamam | 1 | 220 | 7.5 | 2,000 | 762 | 2,400 | 2*238/97 STACIR |
| New Domiat | Aolad hamam | 2 | 220 | 7.5 | 2,000 | 762 | 2,400 | 2*238/97 STACIR |
| Domiat | El Mahala | 1 | 220 | 80 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Domiat | El Mahala | 2 | 220 | 80 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El gammalia | Aolad hamam | 1 | 220 | 33 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| El gammalia | Aolad hamam | 2 | 220 | 33 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| El gammalia | El Mansora | 1 | 220 | 57 | 950 | 362 | 1,200 | 2*380/50 ACSR |
| El gammalia | El Mansora | 2 | 220 | 57 | 950 | 362 | 1,200 | 2*380/50 ACSR |
| Tanta | El Mahala | 1 | 220 | 34 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tanta | El Mahala | 2 | 220 | 34 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tanta | Qwesna | 1 | 220 | 37 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tanta | Qwesna | 2 | 220 | 37 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kafr El sheakh | Sedi Salm | 1 | 220 | 35 | 550 | 210 | 1,200 | 2*380/50 ACSR |
| Kafr El sheakh | Sedi Salm | 2 | 220 | 35 | 550 | 210 | 1,200 | 2*380/50 ACSR |
| Tanta | Kafr El zayat | 1 | 220 | 32 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tanta | Kafr El zayat | 2 | 220 | 32 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kafr El zayat | Eatai El barood | 1 | 220 | 30 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kafr El zayat | Eatai El barood | 2 | 220 | 30 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El Mansora | El Zagazig | 1 | 220 | 54 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El Mansora | El Zagazig | 2 | 220 | 54 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El qalyobia | Basos | 1 | 220 | 21 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El qalyobia | Basos | 2 | 220 | 21 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Banha west | Genration of Banha | 1 | 220 | 6.5 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Banha west | Genration of Banha | 2 | 220 | 6.5 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El qalyobia | Banha west | 1 | 220 | 27 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El qalyobia | Banha west | 2 | 220 | 27 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Banha west | Qwesna | 1 | 220 | 17 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Banha west | Qwesna | 2 | 220 | 17 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El qalyobia | Mnoof | 1 | 220 | 42 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| El qaiyobia | Mnoof | 2 | 220 | 42 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Mnoof | Basos | 1 | 220 | 17.5 | 650 | 248 | 1,200 | 2*380/50 ACSR |
| Mnoof | Basos | 2 | 220 | 17.5 | 650 | 248 | 1,200 | 2*380/50 ACSR |
| Mnoof | Basos | 3 | 220 | 57.5 | 650 | 248 | 670 | 1*380/88 ACSR |
| Mnoof | Basos | 4 | 220 | 57.5 | 650 | 248 | 670 | 1*380/88 ACSR |
| Mnoof | Basos | 5 | 220 | 75 | 650 | 248 | 670 | Equivalent |
| Mnoof | Basos | 6 | 220 | 75 | 650 | 248 | 670 | Equivalent |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| El Mahala | El Mahmoadia | 1 | 220 | 86 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El Mahala | El Mahmoadia | 2 | 220 | 86 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Ashmoon | North Giza | 1 | 220 | 9.6 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Ashmoon | North Giza | 2 | 220 | 9.6 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| West New Domia1 | West Domiat | 1 | 220 | 0.3 | 1,500 | 572 | 1,500 | 2*500 ACSR |
| West New Domia1 | West Domiat | 2 | 220 | 0.3 | 1,500 | 572 | 1,500 | 2*500 ACSR |
| El Amriaa | Kafr Al-Dawar | 1 | 220 | 37.5 | 500 | 191 | 700 | 1*454/50AAAC |
| El Amriaa | Kafr Al-Dawar | 2 | 220 | 37.5 | 500 | 191 | 700 | 1*454/50AAAC |
| El Amriaa | Sidi krier | 1 | 220 | 25 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| El Amriaa | Sidi krier | 2 | 220 | 25 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| El Amrfaa | El-Gazl | 1 | 220 | 5.9 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| El Amriaa | El-Gazl | 2 | 220 | 5.9 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| El Amriaa | The Free Zone | 1 | 220 | 30 | 570 | 217 | 1,200 | 2*380/50 ACSR |
| El Amriaa | The Free Zone | 2 | 220 | 30 | 570 | 217 | 1,200 | 2*380/50 ACSR |
| El Amriaa | Al-Dkhela | 1 | 220 | 5.8 | 750 | 286 | 1,150 | 2*405 AAAC |
| ElAmriaa | Al-Dkhela | 2 | 220 | 5.8 | 750 | 286 | 1,150 | 2*405 AAAC |
| The Free Zone | Somed | 1 | 220 | 9.3 | 400 | 152 | 670 | 1*405+1*380/88ACSR |
| The Free Zone | Somed | 2 | 220 | 9.3 | 400 | 152 | 670 | 1*405+1*380/88ACSR |
| The Free Zone | Somed | 3 | 220 | 0.5 | 800 | 305 | 850 | XLP1*400 cable |
| The Free Zone | Somed | 4 | 220 | 0.5 | 800 | 305 | 850 | XLP1*400 cable |
| The Free Zone | Somed | 5 | 220 | 9.8 | 400 | 152 | 850 | Equivalent |
| The Free Zone | Somed | 6 | 220 | 9.8 | 400 | 152 | 850 | Equivalent |
| The Free Zone | El-Arab Borag | 1 | 220 | 33.4 | 900 | 343 | 1,150 | 2*405 AAAC |
| The Free Zone | El-Arab Borag | 2 | 220 | 33.4 | 900 | 343 | 1,150 | 2*405 AAAC |
| El-Arab Borag | EL omaid | 1 | 220 | 37 | 600 | 229 | 1,150 | 2*405 AAAC |
| El-Arab Borag | EL omaid | 2 | 220 | 37 | 600 | 229 | 1,150 | 2*405 AAAC |
| EL omaid | Matrouh | 1 | 220 | 216 | 600 | 229 | 1,150 | 2*405 AAAC |
| EL omaid | Matrouh | 2 | 220 | 216 | 600 | 229 | 1,150 | 2*405 AAAC |
| Abu kir | Abees | 1 | 220 | 26 | 510 | 194 | 700 | 1*454/50AAAC |
| Smouha | Abees | 1 | 220 | 6 | 510 | 194 | 670 | 1*405+1*380/88ACSR |
| Smouha | Abees | 2 | 220 | 4.65 | 510 | 194 | 800 | CABLE 1*800 |
| Smouha | Abees | 3 | 220 | 10.65 | 510 | 194 | 670 | Equivalent |
| Smouha | Abu kir | 1 | 220 | 20 | 510 | 194 | 670 | 1*380/88 ACSR |
| Smouha | Abu kir | 2 | 220 | 4.6 | 510 | 194 | 800 | CABLE 1*800 |
| Smouha | Abu kir | 3 | 220 | 24.7 | 510 | 194 | 670 | Equivalent |
| Smouha | Karmouz | 1 | 220 | 6.9 | 650 | 248 | 670 | Cable cu oil f 1*800 |
| Smouha | Karmouz | 2 | 220 | 6.9 | 650 | 248 | 670 | Cable cu oil f 1*800 |
| El dekhela | Abu kir | 1 | 220 | 46 | 600 | 229 | 1,150 | 2*405 AAAC |
| El dekhela | Abu kir | 2 | 220 | 46 | 600 | 229 | 1,150 | 2*405 AAAC |
| El dekhela | Elhaded el esfengy | 1 | 220 | 0.7 | 975 | 372 | 1,000 | CABLE 1*1200 |
| El dekhela | Elhaded el esfenav | 2 | 220 | 0.7 | 975 | 372 | 1,000 | CABLE 1*1200 |
| El dekhela | Elhaded el esfengv | 3 | 220 | 0.67 | 975 | 372 | 1,000 | CABLE 1*1200 |
| El dekhela | Sidi krir | 1 | 220 | 25 | 1,100 | 419 | 1,150 | 2*405 AAAC |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| El dekhela | Sidi krir | 2 | 220 | 25 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Matrouh | El saloum | 1 | 220 | 198 | 600 | 229 | 1,150 | 2*405 AAAC |
| Matrouh | El saloum | 2 | 220 | 198 | 600 | 229 | 1,150 | 2*405 AAAC |
| El saloum | Tabrk | 1 | 220 | 170 | 800 | 305 | 1,150 | 2*405 AAAC |
| El saloum | Tabrk | 2 | 220 | 170 | 800 | 305 | 1,150 | 2*405 AAAC |
| Abees | El seouf | 1 | 220 | 6.7 | 800 | 305 | 1,150 | 2*405 AAAC |
| Abees | El seouf | 2 | 220 | 6.7 | 800 | 305 | 1,150 | 2*405 AAAC |
| Abees | Kafr el dwar | 1 | 220 | 23 | 500 | 191 | 670 | 1*380/88 ACSR |
| Abees | Kafr el dwar | 2 | 220 | 23 | 500 | 191 | 670 | 1*380/88 ACSR |
| Abu kir | El seouf | 1 | 220 | 23.2 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Abu kir | El seouf | 2 | 220 | 23.2 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Sidi krir | Karmouz | 1 | 220 | 37 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Sidi krir | Karmouz | 2 | 220 | 37 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Borg Elarab | Sidi krir | 1 | 220 | 25 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Borg Elarab | Sidi krir | 2 | 220 | 25 | 1,100 | 419 | 1,150 | 2*405 AAAC |
| Kafr el dwar | Damnhour GIS | 1 | 220 | 23.5 | 1,150 | 438 | 1,200 | 1*380/50 ACSR+ 2*405 AAAC |
| Kafr el dwar | Damnhour GIS | 2 | 220 | 235 | 1,150 | 438 | 1,200 | *380/50 ACSR+ 2*405 AAAC |
| Damnhour Gas | Eatai El barood | 1 | 220 | 32 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Damnhour Gas | Eatai El barood | 2 | 220 | 32 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Damnhour Gas | Eatai El barood | 3 | 220 | 12.5 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Damnhour Gas | Eatai El barood | 4 | 220 | 12.5 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Oamnhour GIS | Eatai El barood | 5 | 220 | 44.5 | 1,150 | 438 | 1,200 | Equivalent |
| Damnhour GIS | Eatai El barood | 6 | 220 | 44.5 | 1,150 | 438 | 1,200 | Equivalent |
| Damnhour Gas | Damnhour GIS | 1 | 220 | 2 | 1,200 | 457 | 1,500 | 2*500 ACSR |
| Damnhour Gas | Damnhour GIS | 2 | 220 | 2 | 1,200 | 457 | 1,500 | 2*500 ACSR |
| Damnhour Gas | Elmahmoudia | 1 | 220 | 15 | 500 | 191 | 670 | 1*380/88 ACSR |
| Damnhour Gas | Elmahmoudia | 2 | 220 | 15 | 500 | 191 | 670 | 1*380/88 ACSR |
| Tahrir Badr | Mnouf | 1 | 220 | 30 | 600 | 229 | 670 | 1*380/88 ACSR |
| Tahrir Badr | Mnouf | 2 | 220 | 17 | 600 | 229 | 1,200 | 2*380/50 ACSR |
| Tahrir Badr | Mnouf | 3 | 220 | 30 | 600 | 229 | 670 | 1*380/88 ACSR |
| Tahrir Sadr | Mnouf | 4 | 220 | 17 | 600 | 229 | 1,200 | 2*380/50 ACSR |
| Tahrir Sadr | Mnouf | 5 | 220 | 47 | 250 | 95 | 670 | Equivalent |
| Tahrir Badr | Mnouf | 6 | 220 | 47 | 250 | 95 | 670 | Equivalent |
| Tahrir Sadr | Eatai El barood | 1 | 220 | 13 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Tahrir Badr | Eatai El barood | 2 | 220 | 13 | 1,150 | 438 | 1,150 | 2*405 AAAC |
| Tahrir Sadr | Eatai El barood | 3 | 220 | 34 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Tahrir Badr | Eatai El barood | 4 | 220 | 34 | 1,200 | 457 | 1,200 | 1*238/97 STACIR |
| Tahrir Badr | Eatai El barood | 5 | 220 | 47 | 1,150 | 438 | 1,200 | Equivalent |
| Tahrir Badr | Eatai El barood | 6 | 220 | 47 | 1,150 | 438 | 1,200 | Equivalent |
| EL Bostan | EL Sadat | 1 | 220 | 32 | 1,200 | 457 | 1,200 | 1*255/88 INVAR |
| EL Bostan | EL Sadat | 2 | 220 | 32 | 1,200 | 457 | 1,200 | 1*255/88 INVAR |
| EL Bostan | EL Sadat | 3 | 220 | 3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| EL Bostan | EL Sadat | 4 | 220 | 3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| EL Bostan | EL Sadat | 5 | 220 | 35 | 1,100 | 419 | 1,200 | Equivalent |
| EL Bostan | EL Sadat | 6 | 220 | 35 | 1,100 | 419 | 1,200 | Equivalent |
| EL Bostan | Abu Elmatamir | 1 | 220 | 43 | 650 | 248 | 670 | 1*380/88 ACSR |
| EL Bostan | Abu Elmatamir | 2 | 220 | 43 | 650 | 248 | 670 | 1*380/88 ACSR |
| EL Bostan | Eatai El barood | 1 | 220 | 60 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| EL Bostan | Eatai El barood | 2 | 220 | 60 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El Nobaria | El Bostan | 1 | 220 | 56 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El Nobaria | El Bostan | 2 | 220 | 56 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Ezz Elsadat | El Sadat | 1 | 220 | 6 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| Ezz Elsadat | El Sadat | 2 | 220 | 6 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| Ezz Elsadat | Arkosteel | 1 | 220 | 4 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| Ezz Elsadat | Arkosteel | 2 | 220 | 4 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| American Egypt | Arkosteel | 3 | 220 | 1.4 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| American Egypt | Arkosteel | 4 | 220 | 1.4 | 1,000 | 381 | 1,200 | 2*380/50 ACSR |
| American Egypt | Elshekh Zaid | 1 | 220 | 64 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| American Egypt | Elshekh Zaid | 2 | 220 | 64 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| American Egypt | Bshay | 1 | 220 | 0.25 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| American Egypt | Bshay | 2 | 220 | 0.25 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Bshay | El Nobaria | 1 | 220 | 51.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Bshay | El Nobaria | 2 | 220 | 51.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Ety elbaroud | Abu kir | 1 | 220 | 39.4 | 800 | 305 | 850 | 2*236 AAAC |
| Ety elbaroud | Abu kir | 2 | 220 | 35.6 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Ety elbaroud | Abu kir | 3 | 220 | 39.4 | 800 | 305 | 850 | 2*236 AAAC |
| Ety elbaroud | Abu kir | 4 | 220 | 35.6 | 1,200 | 457 | 1,200 | 2*380150 ACSR |
| Ety elbaroud | Abu kir | 5 | 220 | 75 | 800 | 305 | 850 | Equivalent |
| Ety elbaroud | Abu kir | 6 | 220 | 75 | 800 | 305 | 850 | Equivalent |
| LGHAZL ,NASEE | Abu Elmatamir | 1 | 220 | 32.1 | 650 | 248 | 670 | 1*380188 ACSR |
| LGHAZL ,NASEE | Abu Elmatamir | 2 | 220 | 32.1 | 650 | 248 | 670 | 1*380/88 ACSR |
| Nobaria | Mnouf | 1 | 220 | 42.1 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Nobaria | Mnouf | 2 | 220 | 42.1 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Elmahmoudia | El atf | 1 | 220 | 1.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Elmahmoudia | El atf | 2 | 220 | 1.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Elatf | Sidi Salem | 1 | 220 | 42.8 | 900 | 343 | 1,200 | 2*380/50 ACSR |
| Elatf | Sidi Salem | 2 | 220 | 42.8 | 900 | 343 | 1,200 | 2*380/50 ACSR |
| El atf | Kafr elziat | 1 | 220 | 60 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El atf | Kafr elziat | 2 | 220 | 60 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tanta | El Nobaria | 1 | 220 | 59 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tanta | El Nobaria | 2 | 220 | 59 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| ABU Ghaleb | Giza North | 1 | 220 | 2.6 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| ABU Ghaleb | Giza North | 2 | 220 | 2.6 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| ABU Ghaleb | Giza North | 3 | 220 | 2.6 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| ABU Ghaleb | Giza North | 4 | 220 | 2.6 | 1,000 | 381 | 1,200 | XLP 1200mm2 |
| Cairo 500 | ABU Ghaleb | 1 | 220 | 18.5 | 1,200 | 457 | 1,200 | 1*255/88 INVAR |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Cairo 500 | ABU Ghaleb | 2 | 220 | 7.5 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Cairo 500 | ABU Ghaleb | 3 | 220 | 18.5 | 1,200 | 457 | 1,200 | 1*255/88 INVAR |
| Cairo 500 | ABU Ghaleb | 4 | 220 | 7.5 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Cairo 500 | ABU Ghaleb | 5 | 220 | 26 | 1,200 | 457 | 457 | Equivalent |
| Cairo 500 | ABU Ghaleb | 6 | 220 | 26 | 1,200 | 457 | 457 | Equivalent |
| ABU Ghaleb | El Sadat | 1 | 220 | 39.5 | 1,200 | 457 | 1,200 | 1*255/88 INVAR |
| ABU Ghaleb | El Sadat | 2 | 220 | 7.5 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| ABU Ghaleb | EL Sadat | 3 | 220 | 39.5 | 1,200 | 457 | 1,200 | 1*255/88 INVAR |
| ABU Ghaleb | EL Sadat | 4 | 220 | 7.5 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| ABU Ghaleb | EL Sadat | 5 | 220 | 47 | 1,200 | 457 | 457 | Equivalent |
| ABU Ghaleb | El Sadat | 6 | 220 | 47 | 1,200 | 457 | 457 | Equivalent |
| Nag-Hamady | Abu tartor | 1 | 220 | 290 | 400 | 152 | 1,520 | 2*400/108 ACSR |
| Nag-Hamady | Abu tartor | 2 | 220 | 290 | 400 | 152 | 1,520 | 2*400/108 ACSR |
| Elbalat | Abu tartor | 3 | 220 | 115 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Elbalat | Abu tartor | 4 | 220 | 115 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Qena South | 1 | 220 | 50.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Qena South | 2 | 220 | 50.3 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Gerga | 1 | 220 | 67 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Gerga | 2 | 220 | 67 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Aswan Dam | Selwa | 1 | 220 | 94 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Aswan Dam | El Nokra | 1 | 220 | 66 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| EL Nokra | Selwa | 1 | 220 | 75.8 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Selwa | Luxor East | 1 | 220 | 133.8 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Selwa | Arment | 1 | 220 | 66.9 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Arment | Luxor East | 1 | 220 | 66.9 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| South Qena | Luxor East | 2 | 220 | 55 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| South Qena | Luxor East | 3 | 220 | 55 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| South Qena | Safaga | 1 | 220 | 167 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| South Qena | Safaga | 2 | 220 | 167 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Toshka 2 | Toshka 1 | 1 | 220 | 55 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Toshka 2 | Toshka 1 | 2 | 220 | 55 | 800 | 304,832 | 1,200 | 2*380/50 ACSR |
| Terna | Gerga | 1 | 220 | 65 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Tema | Gerga | 2 | 220 | 65 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Nag- Hamadv Generation | 1 | 220 | 31.4 | 250 | 95 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Nag- Hamadv Generation | 2 | 220 | 31.4 | 250 | 95 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Aluminum | 1 | 220 | 2.5 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Nag-Hamady | Aluminum | 2 | 220 | 2.5 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| High Dam | Aswan dam | 1 | 220 | 11.55 | 1,600 | 610 | 1,200 | 2*380/SO ACSR |
| High Dam | Aswan dam | 2 | 220 | 11.55 | 1,600 | 610 | 1,200 | 2*380/50 ACSR |
| High Dam | Midkom Aswan for cement | 1 | 220 | 121 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Toshka 2 | Toshka 2 | 1 | 220 | 100 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| High Dam | Toshka 2 | 1 | 220 | 220 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Toshka 2 | Oynat East | 1 | 220 | 335 | 800 | 305 | 1,200 | 2*380/50 ACSR |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Toshka 2 | Oynat East | 2 | 220 | 335 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Samalout | MALAWI | 1 | 220 | 70 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Samalout | MALAWI | 2 | 220 | 70 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Samalout | Maghagha | 1 | 220 | 51 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Samalout | Maahaaha | 2 | 220 | 51 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | Demo | 1 | 220 | 41 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | Demo | 2 | 220 | 41 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| EL Masreen Stee | BNISweef East | 1 | 220 | 20 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| EL Masreen Stee | BNISweef East | 2 | 220 | 20 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | BNISweef East | 3 | 220 | 28 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | BNISweef East | 4 | 220 | 28 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| West Assut | Assut 500 | 1 | 220 | 2.2 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| West Assut | Assut | 1 | 220 | 3 | 1,200 | 457 | 2,400 | 2*255/88 STACIR |
| West Assut | Assut | 2 | 220 | 5.2 | 1,200 | 457 | 1,200 | Equivalent |
| West Assut | Assut | 3 | 220 | 2.2 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| West Assut | Assut | 4 | 220 | 3 | 1,200 | 457 | 2,400 | 2*255/88 STACIR |
| West Assut | Assut | 5 | 220 | 5.2 | 1,200 | 457 | 1,200 | Equivalent |
| West Assut | walidia | 1 | 220 | 28.5 | 1,200 | 457 | 2,400 | 2*255/88 STACIR |
| West Assut | walidia | 2 | 220 | 28.5 | 1,200 | 457 | 2,400 | 2*255/88 STACIR |
| West Assut | Reva | 1 | 220 | 32.5 | 1,600 | 610 | 2,400 | 2*255/88 STACIR |
| West Assut | Reva | 2 | 220 | 32.5 | 1,600 | 610 | 2,400 | 2*255/88 STACIR |
| Reva | Tema | 1 | 220 | 50 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Reva | Terna | 2 | 220 | 50 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El walidia | MALAWI | 1 | 220 | 110 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| El walidia | MALAWI | 2 | 220 | 110 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| BNI Sweef East | Faium West | 1 | 220 | 79 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| BNI Sweef East | Faium West | 2 | 220 | 79 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Maghagha | Faium West | 1 | 220 | 85 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Maghagha | Faium West | 2 | 220 | 85 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 1 | EL Gamal | 1 | 220 | 113 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| EL Gamal | Octobar-6 | 1 | 220 | 23 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 1 | Octobar-6 | 1 | 220 | 119 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 1 | Basaten | 1 | 220 | 118 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 1 | Basaten | 2 | 220 | 3.25 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| Kurimat 2 | Basaten | 1 | 220 | 118 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | Basaten | 2 | 220 | 3.25 | 1,200 | 457 | 1,600 | XLP 1600mm2 Elswedy |
| Kurimat 1 | Basaten | 1 | 220 | 121.25 | 1,080 | 412 | 1,200 | Equivalent |
| Kurimat 1 | Basaten | 2 | 220 | 121.25 | 1,080 | 412 | 1,200 | Equivalent |
| Kurimat 1 | Kurimat 2 | 1 | 220 | 0.15 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | Cairo East | 1 | 220 | 108 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | Cairo East | 2 | 220 | 9.5 | 800 | 305 | 1,200 | XLP 1200mm2 |
| Kurimat 2 | Cairo East | 3 | 220 | 108 | 800 | 305 | 1,200 | 2*380/50 ACSR |
| Kurimat 2 | Cairo East | 4 | 220 | 9.5 | 800 | 305 | 1,200 | XLP 1200mm2 |

| Transmission Name | | No | Voltage [kV] | Length [km] | Availability Current [A] | Availability Capacity [MVA] | Maximum Current [A] | Condactor Type |
|---|---|---|---|---|---|---|---|---|
| From | To | | | | | | | |
| Kurimat 2 | Cairo East | 5 | 220 | 117.5 | 800 | 305 | 1,200 | Equivalent |
| Kurimat 2 | Cairo East | 6 | 220 | 117.5 | 800 | 305 | 1,200 | Equivalent |
| Demo | West Faium | 1 | 220 | 35 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Demo | West Faium | 2 | 220 | 35 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Assut | Walidia | 1 | 220 | 17 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Assut | Walidia | 2 | 220 | 17 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |
| Assut | Walidia | 3 | 220 | 17 | 1,200 | 457 | 1,200 | 2*380/50 ACSR |

(2) Construction plan for 500 kV and 220 kV substations

Substation projects 2017

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| Hadaba 2 | Cairo | 220/66/11 | 2x175+4x40 |
| The investors | Cairo | 220/66/11 | 2x175+3x40 |
| Embaba | Cairo | 220/66/11 | 3x175+3x40 |
| Badr 500 | Cairo | 500/220/22 | 3x500 |
| Ext. Abo Zabel with 3rd Transformer | Cairo | 500/220/11 | 1x500 |
| Ext.Cairo West with 3rd Transformer | Cairo | 500/220 | 1x500 |
| Ext. Itay EIBarod | Delta | 500/220/66/11 | 2x500 |
| Ext. Free Zone with 3rd Transformer | Dalta | 220/66/11 | 1x125 |
| North Hurgada | Canal | 220/66/22 | 2x125+2x40 |
| Ext. Suez 500 with 2nd Transformer | Canal | 500/22/11 | 1x500 |
| Ras Gharib 500 | Canal | 500/220/11 | 2x500 |
| El Galala Touristic Resort | Canal | 220/22/22 | 2x175 |
| El Masreen Iron | Canal | 220/22/22 | 3x90 |
| Ext. El Kuriemat with 2nd Transformer | Upper Egypt | 500/220 | 1x500 |
| Ext. Maghagha West | Upper Egypt | 500/220 | 2x750 |
| Esna | Upper Egypt | 220/66/22 | 2x125 |

Substation projects 2018

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| EL Nargis (New Cairo) 2 | Cairo | 220/66/22 | 2x175+3x40 |
| El mantika El Mahsoura (6 October gardens) | Cairo | 220/66/22 | 2x175+3x40 |
| Zahraa El Maadi | Cairo | 500/220/22 | 4x500 |
| 6 October 500 | Cairo | 500/220/22 | 3x750 |
| El Promoter | Cairo | 220/22/22 | 3x175 |
| Zayed 3 | Cairo | 220/22/22 | 4x150 |
| Zahraa Nasr City | Cairo | 220/66/11 | 3x175+4x40 |
| South the Project 110 | Cairo | 220/22/22 | 2x175 |
| South the Capital SI | Cairo | 500/220/66/22 | 3x750 |
| El Mostakbel | Cairo | 220/22/22 | 2x150 |
| Gardenia | Cairo | 220/22/22 | 2x150 |
| Badr (2) | Cairo | 220/66/22 | 2x175+3x40 |
| El Shrouq West | Cairo | 220/22/22 | 2x175 |
| El Kilo 45 (Saray) | Cairo | 220/22/22 | 2x175 |
| Ext. Banha East | Delta & Alex | 500/220/66/22 | 2x500 |
| Samanood | Delta & Alex | 500/220/66/11 | 3x500 |
| Ext. Abu El Matameer | Delta & Alex | 500/220/11 | 3x500 |
| Wadi El Natron | Delta & Alex | 500/220/66/22 | 3x500+3x25+3x40 |
| Tami El amdid | Delta & Alex | 500/220/66/11 | 3x750+3+175+3x40 |
| El hay El Motamiz | Delta & Alex | 220/66/11 | 3x125+4x40 |
| Sidi Abd El Rahman | Delta & Alex | 220/66/11 | 2x75 |
| Damitta (1) | Delta & Alex | 220/66 | 2x175+3x40 |
| Damitta West 500 | Delta & Alex | 500/220/11 | 2x750 |
| Gamila Abu Hurid | Delta & Alex | 220/66/11 | 2x125+3 x 40 |
| Ext. El Ghagal Compound | Delta & Alex | 220/66/11 | 1x125 |
| Rehabilitate two Transformers in Matrouh | Delta & Alex | 220/66/11 | 2x125 |
| Assiut East | Upper Egypt | 500/220/66/11+66/22 | 2x500+3x125+2x40+2x40 |
| Sohag East | Upper Egypt | 500/220/66/22 | 2x750+3x175+2x40 |
| Qena East | Upper Egypt | 500/220 | 2x750 |
| Industrial Beni suef | Upper Egypt | 500/220/66/22 | 4x750+2x125+2x40 |
| Ext. the S/S of kuriemat p.s with 2nd Transformer | Upper Egypt | 500/220/11 | 1x500 |
| Ext. Assiut with 3rd Transformer | Upper Egypt | 500/20/11 | 1X375 |
| Tamia | Upper Egypt | 220/66/11 | 3x125+2x40 |

Substation projects 2018

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| El Koum El Ahmar | Upper Egypt | 220/66/11 | 3x175 |
| Zizinia | Canal | 220/66/11 | 3xl25+4x40 |
| East port Said | Canal | 220/22/22 | 2x125 |
| El Masseid | Canal | 220/66/22 | 2x125+2x40 |
| New Zagazig | Canal | 500/220/66/11 | 2x750+2x175+4x40 |

Substation projects 2019

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| Atfih | Cairo | 220/66/11 | 3x175+5x40 |
| Ext. Northen October | Cairo | 220/66/22 | 3x175+4x40 |
| Ext. Eastern October | Cairo | 220/22/22 | 3x125 |
| Completion of south capital ,Sl | Cairo | 220/66/22 | 2x175 |
| The CapitaI S/S ,52 | Cairo | 220/66/22 | 2X175+6x40 |
| The Capital S/S ,53 | Cairo | 220/22/22 | 3x175 |
| The Capital S/S ,54 | Cairo | 220/66/22 | 2x175+4x40 |
| The Capital S/S ,SS | Cairo | 220/66/22 | 2x175+4x40 |
| Ext. South project 110 | Cairo | 500/220/22 | 2x750 |
| North Project 110 | Cairo | 220/22/22 | 2x175 |
| El Hawamdia | Cairo | 220/66/11 | 3x175+Sx40 |
| El Metro 3 | Cairo | 220/22 | Under Study |
| 15 May | Cairo | 220/66 | 2x125 |
| Bianco | Cairo | 220/11/11 | 2x75 |
| Berwa & Damac (Watania) | Cairo | 220/66/22 | 3x125+4x40 |
| Ismailia East | Canal | 500/220/22 | 3x750+2x175 |
| Belbis | Canal | 220/66/11 | 3x125+4x40 |
| El Asher 500 | Canal | 500/220/11 | 2x750 |
| Economic 500 | Canal | 500/220/66/22 | Under Study |
| New Kafr Elshiekh | Delta | 220/66/11 | 2x175+4x40 |
| New Dabaa | Alex | 220/66 | 2x125 |
| Qena East | Upper Egypt | 500/220/66/11 | 2x750+2x175+2x40 |
| East Owinat | Upper Egypt | 220/66/22 | 3x75 |

Substation projects 2020

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| Ext. Hawamdia 500 | Ca iro | 500/220 | 3x750 |
| The ca pital ,57 | Cairo | 220/22/22 | 4x175 |
| Ext. Atfih 500 | Cairo | 500/220 | 3x750 |
| North Mehwar El - Musheer | Cairo | 220/22 | 2x125 |
| New Fustat | Cairo | 220/66 | 2x175 |
| Ext. New Kafr EIShiekh | Delta | 500/220/66/11 | 2x750 |
| Abies 500 | Alex | 500/220/11 | 3x750 |
| El Alamin | Alex | 200/66/11 | 3x175 |

Substation projects 2021

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| Ext. ,S7 | Cairo | 500/220/22 | 4x750 |
| Omrania | Cairo | 220/66 | Under Study |
| New Mutamadia | Cairo | 220/66 | Under Study |
| S/S ,S8 | Cairo | 220/22/22 | 4x175 |
| El Obour | Cairo | 220/66/22 | Under Study |

Substation projects 2022

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| The Capital ,S9 | Cairo | 220/22/22 | 4x175 |
| New Atfih | Cairo | 220/66/11 | 3x175 |
| New Hawamdia | Cairo | 220/66/ 11 | 3x175 |
| Zahraa mokattam | Cairo | 220/66/11 | 2x125 |
| Abu Talat | Alex | 220/66 | 2x125+3x40 |
| The industrial S/S (golden triangle) | Canal | 500/220/11 | 4x750 |
| The industry zone | Canal | 500/220/11 | 3x750 |
| Luxur 500 | Upper Egypt | 500/220/11 | 2x750 |

Substation projects 2023

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| Ehe capital ,S6 | Cairo | 220/22/22 | 4x175 |
| Manshia Nasr | Cairo | 220/66/11 | 3x125 |
| Borg El Arab | Alex | 220/66/11 | 3x125+3x40 |
| El sadat 500 | Delta | 500/220/11 | 3x750 |
| Abu khalifa | Canal | 220/66/11 | 2x125 |
| Ext. Malawy500 | Upper Egypt | 500/220/11 | 2x750 |

Substation projects 2024

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| Rashied | Alex | 220/66/11 | 4x125 |
| New Sadat | Delta | 220/66/11 | 4x125 |
| New Nag Hamadi | Upper Egypt | 500/220/11 | 2x750 |

Substation projects 2025

| Name | Zone | Voltage (kV) | Capacity (MVA) |
|---|---|---|---|
| New Heliopolis | Cairo | 220/66/22 | 2x175 |
| Ext. Borg El Arab | Alex | 500/220/11 | 3x750 |
| Ext. El Alamin | Alex | 500/220/11 | 2x750 |
| New Borg El Arab | Alex | 220/66/11 | 4x175 |
| Shebin ElKoum 500 | Delta | 500/220/11 | 3x750 |
| El qusier | Canal | 220/66/11 | 2x175 |

(3) Transmission Construction Plan

Cairo Zone 2017

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Hadaba 2 | 220 | Construct double circuit cable Hadaba 2/Cairo 500 type XLPE 2000mm2 with length 18km.<br>Disconnect the single circuit Haram/Giza XLPE 200mm2 from Harama S/S and extend to Hadaba2 with length about 10.5km.<br>Construct single circuit cable type XLPE 2000mm2 Hadaba2/Haram with length about 10.5km.<br>Construct double circuit cable Hadaba 2/Hadaba type XLPE 1600mm2 with length about 1km. |
| The investors | 220 | Open the double circuit T.L type ACSR x380/88mm 2 Cairo East/Basatin (in/out) with length about 300m on the investors 220kV S/S, to be Cairo East/investors 220 with total length of about 6.3km type ACSR 1x380/88mm2, the investors 220/Basatin with total length 10.3km type ASCR 1x380/88mm2 + 3.25km cable type L-Pr Brilli 800.<br>Construct double circuit T.L type ACSR 2x380/50mm2 Qatamia. The investors 220 with length about 20km + double circuit cable type XLPE 1600mm2 with total length 6km. |
| Embaba Airport | 220 | Open the double circuit T.L Muatamidia/Hadaba from Muatamidia S/S and extend it with cable type XLPE 1600mm2 with length 2x5.5km to Embaba Airport such that Embaba Airport /Hadaba cable XLPE 1600mm2 with length 5.5km + T.L with length 27km.<br>Connect Embaba S/S with double circuit 220kV T.L Cairo 500/Cairo West with T connection.<br>Unconnect to double circuit T.L 220kV Cairo 500/Embaba (Part T connection) such that the double circuit cable length Embaba/T connection type XLPE 2000mm2 with length 11km. |
| Badr | 500 | Open the single circuit T.L Abu Zaaba I/Suez 500 and extend it with length 3km (in/out) to Badr S/S.<br>Construct single circuit T.L Abu Kir/Badr type ACSR 3x490/65mm2 which will be opened in future on Tami El Amdid S/S.<br>Construct the double circuit T.L Badr/the Capital Power Station with total length 32km. |
| | 220 | Construct double circuit T.L Suez/Sakr Qurish type AAAC cross section 2x405mm2 which will be opened in future on Zizinia S/S<br>Open the double circuit T.L Suez/Sakr Qurish type ACSR 1x380/88mm2 and replace about 30km from Sakr Qurish direction with T.L higher capacity and extend it with 2x1.5km type AAAC 2x405 (in/out) on Badr S/S<br>Construct double circuit cable type XLPE 2000mm2 from Mostakbal S/S to switch S/S with 5.5km construct the double circuit T.L from the switch station to Badr S/S with 13.5km length |

Cairo Zone 2018

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Nargis | 220 | Open the double circuit T.L Kureimat/Basatin and extend it with cable type XLPE 1600mm2 with length 2x5km (in/out) on Nargis S/S (New Cairo 2). |
| October Gardens | 220 | Open the double circuit T.L Hadaba/October type ACSR 2x380/50mm2 and extend it with length 2x0.5km (in/out) on October Garden S/S<br>Open single circuit T.L type ACSR 2x380/50mm2 El Gammal/Kuriemat and extend it by 0.5km (in/out) on October Gardens<br>Open single circuit T.L type ACSR 2x380/50mm 2 Kuriemat/October and extend it by 0.5km (in/out) on October Gardens. |
| Zahraa Maadi | 500 | Construct double circuit T.L the capital power station/Zahraa Maadi with total length 40km.<br>Construct double circuit T.L Helwan South 500/Zahraa Maadi with length about 100km (on one tower). |
| | 220 | Open the double circuit T.L Ain El Sira/Maadi south and extend it by 2x7km (in/out) on Zahraa Maadi S/S, such that the double circuit T.L Ain Sira/Zahraa Maadi with length 14km XLPE 1600mm2 + 16km ACSR 3x380/50mm2.<br>Construct double circuit T.L Brwa and Damac/Zahraa Maadi with total length about 23km.<br>Open the double circuit Nargis/Kuriemat and extend it with length 2x7km (in/out) on Zahraa Maadi S/S.<br>Modify T.L Qatamia/Economic/Tebbin to be Economic/Tebbin double circuit.<br>Utilize the rest of the line from Qatamia direct ion and extend it by 15km such that Zahraa Maadi/Qatamia became double circuit by length about 25km. |
| October 500 | 500 | Construct double circuit T.L October 500/Wadi El Natron with length about 100km.<br>Construct double circuit T.L October 500/Maghagha 500 with length about 135km.<br>Open the single circuit Samalut/Giza North (in/out) on October 500 with length 2x20km. |
| | 220 | Disconnect the double circuit T/L 6 October/October North from October North S/S and extend it to October 500 S/S such that 6 October/October 500 with length 25.5km.<br>Construct double circuit T.L October North/October 500 with length 27.5km.<br>Construct double circuit T.L October 500/investors with length 16km type ACSR 2x380/50mm2. |
| Investors | 220 | Construct double circuit T.L October 500/investors with total length 16km type ACSR 2x380/50mm2. |
| Zayed 3 | 220 | Construct double circuit cable Zayed 3/Cairo 500 type XLPE 2000mm2 length 11km.<br>Open double circuit cable zayed 220/October Power Station type XLPE 1600mm2 and extend it with length 2xlkm (in/out) on Zayed 3 S/S. |

Cairo Zone 2018

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Zahraa Nasr City | 220 | Disconnect double circuit cable Cairo East/Kureimat cross section 1200mm2 from Cairo East and extend it to Zahraa Nasr City with length 5km cable type XLPE cross section 2500mm2 . Construct double circuit cable 220kV type XLPE cross section 2000mm2 Cairo East/Zahraa Nasr City with length 5km. |
| South Project 110 | 220 | Open double circuit T.L Katamia/the Masria Cement (in/out) with length 2x1.5km. Rehabilitate the double circuit T.L Qatamia/South Project 110 with thermal connectors length about 10km. |
| South Capital S | 500 | Construct double circuit T.L Capital Power Station/South Capital S, with length 10km. Open the single circuit Abu Zabal/Sokhna Power Station and extend it by 2km (in/out) on South Capital S/S to be:<br>- Single circuit T.L Abu Zabal/South Capital with length 60km.<br>- Single circuit T.L Sokhna Power Station/South Capital with length 75km. |
| Mostakbal | 220 | Construct double circuit cable Mostakbal Cityl/ switch station 220 type XLPE 2000mm 2 with length 5.5km. Construct double circuit T.L TASCR 330mm2 switch station/Badr 500 with length 13.5km. |
| Gardenia | 220 | Open double circuit T.L Sakr Qurish/Cairo East (in/out) on Gardinia S/S. Convert the double circuit T.L Sakr Qurish/Cairo East to be cable type XLPE 1600mm2 from Gardinia S/S to the project area with Ezba Hagana (switch station) length 2.8km. |
| Badr 2 | 220 | Open the double circuit T.L 220kV type AAAC 2x405mm2 Badr 500/Zizinia (in/out) on Badr 2 S/S to be:<br>- Double circuit T.L Badr 500/Badr2 220kV with length 5km.<br>- Double circuit T.L Zizinia/Badr2 220kV with length 15km. |
| Sherouk West | 220 | Construct double circuit T.L with length 19km + 3km cable type XLPE 2500mm2 to Badr2 S/S. |
| Kilo 45 | 220 | Open double circuit TL New Cairo/Suez Gulf(in/out) on Kilo 45 S/S with length 2x0.5km. |

Cairo Zone 2019

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Atfih | 220 | Open double circuit T.L Kuriemat/Nargis and extend it by 2xl.Skm, such that double circuit T.L Atfih/Kuriemat with length 8km, and the double circuit T.L Atfih/Nargis with length about 105km. |
| Ext. of Northen October | 220 | Open the double circuit T.L Sheikh Zayed/North October type ACSR 2x380/50mm2 (in/out) with length 0.5km on Ext. of Northen S/S such that the double circuit T.L Shiekh Zayed/Ext. of Northen S/S with length of 11km & double circuit T.L North October/Ext. of Northen with length of 5km.<br>Disconnect the doub le circuit T.L 6 October/North October type ACSR 2x380/50mm 2 with length 11.6km from North October S/S and extend it to October 500 S/S such that 6 October/October 500 with length 25.5km.<br>Construct the double circuit T.L 220kV October 500/North October type ACSR 3x380/50mm2 with length 27.5km. |
| Ext. of Eastern October | 220 | Construct doub le circuit cable October 2 Power Station/Ext. of Eastern S/S type XLPE 2000mm2 with length about 8km.<br>Disconnect single circuit cable October 2 Power Station/October 1 Power Station from the two sides.<br>Open the single circuit T.L 6 October/El Gammal type ACSR 2x380/50mm2 (in/out) with length 2km on Ext. of Eastern S/S,such that the single circuit T.L 6 October/Ext. of Eastern with length 11km & the single circuit T.L El Gammal/Ext. of Eastern with length 9km. |
| Capital South S1 | 220 | Construct double circuit cable Capital South Si/Capital S2 type XLPE 2000mm2 with length 5km.<br>Construct double circuit cable capital South S1/Capital S3 type XLPE 2000mm 2 with length 10km. |
| Capital S2 | 220 | Same interconnection as before. |
| Capital S3 | 220 | Same interconnection as before. |
| Capital S4 | 220 | Construct double circuit cable Capital S2/Capital S4 type XLPE 2000mm2 with length 5km.<br>Construct double circuit cable Capital S5/Capital S4 type XLPE 2000mm2 with length 6km. |
| Capital S5 | 220 | Construct double circuit cable Capital S5/Capital S3 type XLPE 2000mm2 with length 6km. |
| South Project 110 | 500 | Open the single circuit T.L Tebbin/Capital Power Station (in/out) on South Project 110 S/S with length about 2km,such that:<br>-Tebbin/South Project 110 with length 31.5km.<br>-Capital Power Station/South Project 110 with length 16km . |

Cairo Zone 2019

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Hawamdia | 220 | Open double circuit T.L El Mahssoura/Tam ia and extend it with 2x7km,such that:<br>-Hawamidia/EI Mahsosoura with length 43km.<br>-Hawamidia/Tamia with length 23km. |
| 15-May | 220 | Open double circuit T.L 220kV the Economic/Tebbin type AAAC 2x380/50mm2 and extend it by 2x 32 meters (in/out) on 15 May(2) S/S,such that:<br>-15 May(2)/Economic with length 76km.<br>-Tebbin/15 May(2) with length 15km. |
| Bianco | 220 | Construct double circuit T.L Tebbin 500/Bianco type ACSR 2x380/50mm2 with length 1km. |
| Barwa and Damac (Watania) | 220 | Construct double circuit TL type ACSR 3x380/50mm2 Barwa and Damac(Watania)/Zahraa Maadi with length 23km. |

Cairo Zone 2020

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Hawamidia 500 | 500 | Open the single circuit T.L October 500/Samalut and extend it by 2x7km, such that:<br>-Hawamidia/October 500 with length 88km.<br>-Hawamidia/Samalut with length 156km.<br>Open single circuit T.L Cairo 500/Kureimat and extend it by 2x7km such that :<br>-Hawamidia/Cairo 500 with length 53km.<br>-Hawamidia/Kuriemat with length 76km. |
| Capital S1 | 220 | Construct double circuit cable Capital S7/Capital S3 type XLPE 2000mmm2 with length 5km. |
| Atfih 500 | 500 | Open double circuit T.L Zahraa Maadi/Helwan South Power Station and extend it by 2xl.5km, such that:<br>-Atfih/Zahraa Maadi with length 87km.<br>-Atfih/Helwan South Power Station with length 13km. |
| North Mehwar El Musheer | 220 | Open Zahraa Nasr City/Kuriemat (in/out) type XLPE 200mm2, such that:<br>-Zahraa/Mehwar El Musheer with length 10km.<br>-Kuriemat/Mehwar El Musheer with length 108km T.L + 14km cable. |
| Fustat | 220 | Open double circuit T.L Basatin/Ain Sira (in/out) on Fustat S/S, such that:<br>-Fustat/Basatin with length 4.7km.<br>-Fustat/Ain Sira with length 3.7km. |

Cairo Zone 2021

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Capital S8 | 220 | Construct double circuit cable Capital S7/Capital S8 type XLPE 2000mm2 with length 8km. |
| Capital S7 | 500 | Open double circuit T.L Capital Power 5tation/Badr (in/out) on Capital 57 such that :<br>-Capital Power Station/S7 with length 14.5km .<br>-Badr/S7 with length 14.5km. |

Cairo Zone 2022

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| New Hawamidia | 220 | Construct double circuit TL Hawamidia 500/New Hawamidia with length 30km.<br>Open double circuit T.L Cairo South/Hadaba (in/out) on Hawamidia 500,such that:<br>-Cairo South/New Hawamidia with length 9km.<br>-Hadaba/New Hawamidia with length 21km. |
| Capital S9 | 220 | Construct double circuit cable Capital S8/Capital S9 type XLPE 2000mm2 with length 6km. |
| Zahraa Mokattam | 220 | Open one circuit from the double circuit T.L Cairo East/Investors type ACSR 380/88mm2 (in/out) on Zahraa Mukattam, such that:<br>-Cairo East/Zahra Mukattam with length 4.5km thermal conductor + 1.5km ACSR 2x380/50mm2.<br>-Investors/Zahraa Mukattam with length 1.8km thermal conductor + 1.5km ACSR 2x380/50mm2. |

Cairo Zone 2023

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Capital S6 | 220 | Construct double circuit cable Capital S6/Capital S9 type XLPE 2000mm2 with length 5km. |

Delta and Alex. 2017

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Itay El Bared | 500 | Construct double circuit T.L Itay El Bared/ Berlus West with length 100km .<br>Construct double circuit T.L Kafr El Zayat/ Itay El Bared with length 25km. |

Delta and Alex. 2018

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Samanood | 500 | Construct double circuit T.L Samanood/Banha East with length 70km.<br>Construct double circuit T.L Samanood/Berlus West with length 170km. |
| | 220 | Open double circuit T.L Mehala/Tanta and extend it by 2x10km (in/out) on Samanood S/S.<br>Construct double circuit T.L Samanood/Tami Elamdid with length about 40km.<br>Construct double circuit T.L Samanood/Kafr El Shiekh with length 55km. |
| Damietta 1 | 220 | Open double circuit T.L Damietta West/ El-Gamalia and extend it by 2x5km (in/out) on Damietta 1S/S.<br>Construct single circuit Damietta 1/West Damietta 1 with length 10km (0.5km cable + 1x9.5km T.L).<br>Construct single circuit Damietta 1/West Damietta 2 with length 10km (0.5km cable + 1x9.5km T.L). |
| Banha East | 500 | Construct double circuit T.L Banha East/Samanood with length 70km.<br>Construct double circuit T.L Banha East/El Asher with length 100km. |
| Damietta West | 500 | Open single circuit T.L Tami Elamdid/Abu Kir and extend it with x6km (in/out) on Damietta West. |
| | 220 | Open double circuit T.L West Damietta 2 /New Gamasa and extend it by 2x0.5km (in/out) on Damietta West S/S. |
| Tami Elamdid | 500 | Open single circuit T.L Badr/Abu Kir and extend it by 1x60km (in/out) on Tami Elamdid S/S. |
| Abu El Matamir | 500 | Construct double circuit T.L Abu El Matamir/Berlus West with length 130km.<br>Construct double circuit T.L Abu El Matamir/Wadi El Natron with length 80km.<br>Open single circuit T.L Sidi Krir/Nubaria and extend it by 1x6km (in/out) on Abu El Matamir S/S. |
| Wadi El Natron | 500 | Open single circuit T.L Nubaria/Cairo 500 and extend it by 1x20km (in/out) on Wadi El Natron S/S.<br>Construct double circuit T.L Wadi El Natron/October with length 60km.<br>Construct double circuit T.L Abu El Matamir/Wadi El Natron with length 80km. |
| | 220 | Disconnect double circuit T.L El Bistan/Wadi El Natron from El Bostan and exten it to El Motamiz S/S<br>Open double circuit T.L American/Shiekh Zayed and extend it by 2x2km (in/out) on Wadi El Natron S/S. |
| El Motamiz | 220 | Open double circuit T.L El Bostan/Wadi El Natron from Bostan and extend it to El Motamiz S/S<br>Construct double circuit T.L El Motamiz/Bostan with length 30km. |

Delta and Alex. 2018

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Sidi And El Rahman | 220 | Open double circuit T.L Marsa Matrouh/EI Omyed and extend it by 2x0.5km (in/out) on Sidi Abd El Rahman S/S,such that:<br>-Marsa Matrouh/Sidi Abd El Rahman 140km.<br>-Omyed/Sidi Abd El Rahman 80km. |
| Industrial Borg Ara b | 220 | Construct double circuit T.L industrial Borg Arab/Omayed with length 40km.<br>Construct double circuit industrial Borg Arab/Abu Matamir with length 40km. |
| Gamila Abu Hurid | 220 | Open double circuit T.L El Suif/Abu Kir (in/out) on Gamila Ab u Hurid S/S with 1km cables. |

Delta and Alex. 2019

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| New Kafr El Shiekh | 220 | Open double circuit T.L Kafr El Shiekh/Talkha and extend it by 2x5km (in/out) on New Kafr El Sheikh.<br>Construct double circuit New Kafr El Sheikh/Samanood with length 40km.<br>Construct double circuit New Kafr El Shiekh/ Dayrout with length 60km. |
| New Dabaa | 220 | Open double circuit T.L Marsa Matrouh/Sidi Abd El Rahman and extend it by 2x2km (in/out) on New Dabaa S/S,such that:<br>-Marsa Matrouh/Dabaa 70km.<br>-Sidi Abd El Rahman/Dabaa 70km.<br>Construct double circuit T.L Dabaa/Borg Arab Industrial with length 140km. |

Delta and Alex. 2020

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| New Kafr El Shiekh | 500 | Construct double circuit T.L Bew Kafr El Shiekh/Dayrout with length 60km. |
| | | Open single circuit T.L Abu Kir/Damietta West and extend it by 1x60km (in/out) on New Kafr El Shiekh 5/5. |
| Al A lamin | 220 | Open double circuit T.L Omayed/Sidi Abd El rahman (in/out) on Al Alamin 5/5, such that:<br>-Sidi Abd El Rahman/Alamin 40km.<br>-Omayed/Alamin 40km. |
| Abies | 500 | Open double circuit T.L Aby El Matamir/Berlus West (in/out) on Abies,such that:<br>-Berlus West/Abies 100km.<br>-Abu El Matamir/Abies 60km. |

Delta and Alex. 2022

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Abu Ta lat | 220 | Open double circuit T.L Sidi Krir Power Station/Dekhila {in/out) on Abu Talat S/S, such that:<br>-Sidi Krir Power Station/Abu Talat 15km.<br>-Dekhila/Abu Talat 15km. |

Delta and Alex. 2023

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Sadat 500 | 500 | Construct double circuit Abu El Matamir/Sadat 500 with length 60km. |
| Industrial Borg Arab | 220 | Open double circuit T.L Dabaa/Indsutrial Borg Arab (in/out) on Nuclear Dabaa,such that:<br>-Dabaa/ Nuclear Dabaa 15km.<br>-Industrial Borg Arab/Nuclear Dabaa 130km. |

Delta and Alex. 2024

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Rashid | 220 | Open double circuit T.L Abu Kir/Itay El Barod on Rashid,such that :<br>-Rashid/Itay El Barod 75km.<br>-Rashid/Abu Kir 60km. |
| New Sadat | 220 | Open double circuit T.L Bostan/Sadat (in/out) on New Sadat,such that:<br>-Bostan/New Sadat 32km.<br>-Sadat/New Sadat 32km. |

Delta and Alex. 2025

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Shebin El Korn 500 | 500 | Open single circuit T.L Kafr El Zayat/Basous (in/out) on Shebin El Korn 500, such that:<br>-Kafr El Zayat/Shebin El Korn 500 with length 40km<br>-Basous/Shebin El Korn 500 with length 60km.<br>Open single circuit T.L Kafr El Zayat/Abu Zabal (in/out) on Shebin El Korn 500, such that:<br>-Kafr El Zayat/Shebin El Korn 500 with length 40km.<br>-Abu Zabal/Shebin El KOm 500 with length 86km. |
| New Borg Arab | 220 | Open double circuit T.L Borg Arab/Sidi Krir Power station (in/out) on New Borg Arab S/S, such that:<br>-New Borg Arab/Borg Arab with length 12.5km.<br>-New Borg Arab/Sidi Krir Power Station with length 12.5km. |
| Ext. El Alamin | 500 | Construct double circuit T.L Al Alamin/Nuclear Dabaa with length 55km. |
| Ext. Industrial Borg Arab | 500 | Construct double circuit T.L industrial Borg Arab/El Alamin with length 70km. |

Canal Zone 2017

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Ras Gharib 500 | 500 | Construct double circuit TL 500kV<br>Ras Gharib 500/Samalout with length 280km. |
| | 220 | Open double crcuit TL 220kV Gabal El Zeit/Zafarana 2 (in/out) on Ras Gharib with length 2x9 km. |
| Hurgada North | 220 | Open double circuit TL 220kV Gabal El Zeit/Hurgada South (in/out) on Hurgada North S/S with length 2x2 km. |
| El Galala | 220 | Open double circuit TL 220kV Sokhna/Zafa ra na and extend it by 2x1km (in/out) on Galala S/S |
| El Masreen Iron | 220 | Open single circuit TL 220kV Economic/Tebb in and extend it by 300 meters (in/out) on the S/S.<br>Open single circuit TL 220kV Economic/Qatamia and extend it by 300 meters (in/out) on the S/S. |
| Masaeid | 220 | Open double circuit TL 220kV Arish/Beer Al Abd type AAAC 2x405mm2 and extend it by 2x1km (in/out) on Masaeid S/S. |
| Port Said Port | 220 | Open double circuit TL Port Said generator (BOOT) 220kV (in/out) and extend it by 2x7km, such that:<br>-Port Said Port/Raswa 34.74km.<br>-Port Said Port/Port Said generation (BOOT) 20km. |
| New Zagazig 500 | 500 | Open double circuit TL 500kV Asher 500/Ban ha East and extend it by 2x10km (in/out) on Zagazig 500.<br>Construct double circuit TL 500kV Asher 500/Zagazig 500 with length 50km. |
| | 220 | Open double circuit TL Zagazig 220/Bahteem 220 (in/out) with length 2x5 .5km on the proposed S/S. |
| Zizinia | 220 | Open double circuit TL old Asher/ Badr with length 2x1km (in/out) on the proposed S/S. |
| Asher 500 | 500 | Construct double circuit TL 500kV Asher 500/Banha East with length 100km.<br>Construct double circuit TL 500kV Asher 500/Ismailia East with length 150km. |
| | 220 | Construct double circuit TL Asher 500/Zizinia 220kV with length 50km.<br>Construct double circuit TL Asher 500/New Belbis 220kV length 40km. |
| Ismailia East | 500 | Construct double circuit TL 500kV Ismailia East/Ayun Mousa Coal with length 70km. |
| | 220 | Open double circuit TL Ayun Mousa/Qanatara East 220kV (in/out) with length 2x1km. |
| Belbis | 220 | Open double circuit old Asher/A bu Zabal 220kV with length 2x1km (in/out) on the proposed S/S. |

Canal Zone 2022

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Industrial Substation (Golden Triangle) | 500 | Construct double circuit TL Industrial Substation/Hamraween with length 90km.<br>Construct double circuit TL Industrial Substation/Luxor with length 90km |
| Industrial Zone | 500 | Construct double circuit TL Industrial Zone/Port Sa id generation 500kV with length 15km.<br>Construct double circuit TL Industrial Zone/Ismailia East 500kV with length 80km. |
| | 220 | Open double circuit TL Port Said Port/Raswa (in/out) on Industrial Zone S/S,such that:<br>-Port Said Port/Industrial Zone 20km.<br>-Raswa/ Industrial Zone 14.74km. |

Canal Zone 2023

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Abu Khalifa | 220 | Construct double circuit TL Shabab/Abu Khalifa 10km.<br>Construct double circuit TL Shabab/Sharqia with length ???km |

Canal Zone 2025

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Qusier | 220 | Convert double circuit TL Safaga/Qusier 66kV to operate on 220kV with length 105km . |

Upper Egypt Zone 2017

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Esna | 220 | Open double circuit TL Salwa West/Luxor East (in/out} and extend it by 2x2km. |
| Maghagha West | 500 | Construct double circuit TL October 500/Maghagha West with length 135km. |

Upper Egypt Zone 2018

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Industrial Beni Suef | 500 | Construct double circuit TL Ghiada/Industrial Beni Suef with length 30km. |
| | 220 | Disconnect double circuit TL El Korn Al Ahmar/ Beni Suef East and extend it to Industrial Beni Suef S/S, such that:<br>-El Korn Al Ahmar/Industr ial Beni Suef with length 20km.<br>Open double circuit Tl El Masreen Iron/Beni Suef East (in/out) and extend it by 3km to industrial Beni Suef, such that:<br>-Beni Suef East/Industrial Beni Suef 9km.<br>-El Masreen Iron/Industrial Beni Suef 10km.<br>Construct double circuit TL Arish Cement/Industrial Beni Suef with length 30km. |
| Tamia | 220 | Open double circuit TL Mahsoura/Kuriemat (in/out) on Tamia S/S, such that:<br>-Mahsoura/Tamia 52km.<br>-Kuriemat/Tamia 53km. |
| El Korn Al Ahmar | 220 | Open double circuit TL Beni Suef East/Fayoum West (in/out) on El Korn Al Ahmar S/S, such that:<br>-Beni Suef East/El Korn Al Ahmar 9km.<br>-Fayoum West/El Korn Al Ahmar 71km. |
| Assuit East | 500 | Construct double circuit Tl Ghiada Generation/Assuit East with length 190km.<br>Construct double circuit TL Assuit East/Sohag with length 160km. |
| | 220 | Open double circuit TL Waledia/Malawy West (in/out) and extend it by 12km. |
| Sohag East | 500 | Construct double circuit Tl Qena East/Sohag East with length 160km. |
| | 220 | Open double circuit TL Tema/Gerga (in/out) on Sohag East S/S and extend it by 2x21km, such that:<br>-Tema/Sohag East 38km.<br>-Gerga/Sohag East 89km. |
| Qena East | 500 | Construct double circuit TL Qena East/Nag Hamady 500 with length 50km |

Upper Egypt Zone 2019

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Qena East | 220 | Open double circuit TL Safaga/Qena South (in/out) on Qena East S/S, such that:<br>-Safaga/Qena East 50km.<br>-Qena South/Qena East 17km. |
| Owinat East | 220 | Construct double circuit TL New Owinat East/Balat with length 377km ACSR 2x380/50.<br>Construct double circuit TL New Owinat East/Owinat East with length 110Km ACSR 2x380/50 |

Upper Egypt Zone 2022

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Luxor 500 | 500 | Construct double circuit TL Industrial Substat ion/ Luxor 500 with length 90km.<br>Construct double circuit TL High Dam/Luxor 500 with length 90km. |

Upper Egypt Zone 2023

| Substation | Voltage (kV) | Proposed Interconnection |
|---|---|---|
| Malawy 500 | 500 | Open double circuit TL Assuit/Samalout (in/out) on Malaway 500 S/S, such that:<br>-Assuit/Malawy 500 with length 70.5km<br>-Samalout/Malway 500 with length 70.5km<br>Construct double circuit TL Malawi800/Nile West 2 with length 125km<br>Open double circuit TL Assuit/ Helwan South Generation (in/ out) on Malaway 500 such that Helwan South Generation / Malaway 500 |
| New Nag Hamadi | 500 | Open double circuit TL High Dam/Nag Hamadi (in/out) on New Nag Hamadi, such that:<br>-High Dam/New Nag Hamadi with length 219.5km.<br>-Nag Hamadi/New Nag Hamadi with length 16.5km<br>Construct double circuit TL New Nag Hamadi/Benban with length 180km. |

# Appendix 4 Human resource development materials

Source: Materials obtained from EEHC

(1) Outline of each training facility, facilities, training being implemented and training conducted by the EEHC head office

## Cairo North Power Plants Training Center

(Cairo Electricity Production Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1965 | • Balance and Vibration lab.<br>• Thermal treatment lab.<br>• Mechanical testing lab.<br>• Mechanical installation workshop.<br>• Power plant auxiliaries' workshop.<br>• Refrigeration and air conditioning workshop.<br>• Arc, gas and high pressure welding workshop.<br>• Logic circuits lab (PLC).<br>• Protection, control and instrumentation.<br>• Cable jointing workshop.<br>• Rewinding and repair of electrical machines workshop.<br>• Electrical installation workshop.<br>• Mechanical measurements lab.<br>• Hydraulics lab.<br>• Microprocessors lab.<br>• Boiler simulator.<br>• Refrigeration and air conditioning simulator.<br>• Hydraulic simulator.<br>• Training programs design and development lab.<br>• Audio/visual aids unit. |
| **Location** | 14 Teret El Ismailia St., Shobra, Cairo. | |
| **Function** | Technical training for engineers in the field of power plant operation, maintenance and control. | |
| **Activities** | • Training of engineers / chemists before receiving their jobs in EEHC power plants.<br>• Upgrading of engineers and technicians in the field of power plant operation and maintenance.<br>• Training of potential students from faculties of engineering during summer vacations.<br>• Vocational training for technical secondary school students in the field of power plant mechanics electricity control and instrumentation | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Operation and Control of Steam Power Plant | 2 |
| 2 | Maintenance of Boilers and Auxiliaries | 2 |
| 3 | Maintenance of Steam Turbine and Auxiliaries | 2 |
| 4 | Pumps and Valves Maintenance | 3 |
| 5 | Thermal Power Plants Auxiliaries | 3 |
| 6 | Operation and Control of Gas Power Plant | 3 |
| 7 | Combined Cycle Power Plant | 3 |
| 8 | Power Plant Water Treatment | 2 |
| 9 | Operation and Maintenance of Generator | 2 |
| 10 | Operation and Calibration of Hydraulic and Pneumatic Instruments | 1 |
| 11 | Power Plant Protection and Instruments | 3 |
| 12 | Vibration and Balancing of Rotating Machines | 1 |
| 13 | Metal Heat Treatment | 2 |
| 14 | Welding Technology and Non-Destructive Testing | 2 |
| 15 | Maintenance of Low Tension Substation Equipment | 3 |
| 16 | Joining of H.T Power Cables | 4 |
| 17 | Industrial Safety | 1 |

## Shoubra El – Kheima Training Center
### (Cairo Electricity Production Company)

| Training Center | Training Facilities |
|---|---|
| **Date of Operation** 1984<br><br>**Location** Shoubra El Kheima power plant, Cairo.<br><br>**Function** Technical training for engineers in the field of power plant operation and maintenance and control.<br><br>**Activities**<br>• Training newly graduated engineers and technicians and qualifying them for operation and maintenance work in power plants.<br>• Upskilling employees working in the field of power plants.<br>• Carrying out case studies in the field of power plant equipment for operation and maintenance.<br>• Conducting seminars and workshops in the field of management practices of modern power plants. | • Machining workshop.<br>• Welding workshop.<br>• Power plant auxiliaries' workshop.<br>• Boilers and turbines maintenance workshop.<br>• Refrigeration and air conditioning workshop.<br>• Electrical installation workshop.<br>• Repair and rewinding of electrical machines workshop.<br>• Thermal power plant simulator.<br>• Refrigeration and air conditioning simulator<br>• Hydraulic simulator.<br>• Diesel simulator.<br>• Training program design and development lab.<br>• Training program production unit.<br>• Audio/visual aids unit. |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Operation and Control of Steam Power Plant | 2 |
| 2 | Operation and Maintenance of Thermal Power Plant | 25 |
| 3 | Maintenance of Boiler and Auxiliaries | 2 |
| 4 | Maintenance of Steam Turbine and Auxiliaries | 2 |
| 5 | Thermal Power Plant Auxiliaries | 3 |
| 6 | Power Plant Water Treatment | 2 |
| 7 | Operation and Maintenance of Generator | 2 |
| 8 | Maintenance of Instrument and Control Systems | 2 |
| 9 | Vibration and Balancing of Rotating Machines | 1 |
| 10 | Welding Technology and Non- Destructive Testing | 2 |
| 11 | Effective Management of Power Plant | 2 |
| 12 | Utility Environment Management | 3 |
| 13 | Power Plant Pollution and Emission | 1 |
| 14 | Industrial Corrosion (Theoretical Aspects) | 2 |

## Abo – Qir Training Center
### (West Delta Electricity Production Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1994 | • Instrumentation and control lab.<br>• Thermodynamics lab.<br>• Thermal power plant lab.<br>• Working metals workshop.<br>• Welding workshop.<br>• PLC lab (basics).<br>• Mechanical machines workshop.<br>• Pumps and valves workshop.<br>• Transformers workshop.<br>• Cable workshop.<br>• Motors workshop.<br>• Electricity lab.<br>• Electronic lab.<br>• Thermal power plant simulator lab.<br>• Refrigeration and air condoning workshop.<br>• Computer lab.<br>• English language lab. |
| **Location** | Abo Qir power station, Alexandria. | |
| **Function** | Technical training for engineers in the field of power plant operation and maintenance. | |
| **Activities** | • Upgrading of engineers / technicians in the field of power plant operation and maintenance.<br>• Vocational training for technical secondary school students in the field of power plant operation and maintenance. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Operation of Steam Power Plants (3 levels) | 1-2 |
| 2 | Operation of Combined Cycle Units | 2 |
| 3 | Microprocessor (Basic /Applications) | 1 |
| 4 | Programmable Logic Control (PLC) | 2 |
| 5 | Printed Circuits (Design and Layout) | 2 |
| 6 | Industrial Electronics | 2 |
| 7 | Maintenance of Circuit Breakers | 2 |
| 8 | Maintenance of Power Transformer | 2 |
| 9 | Protection of Power Transformer | 2 |
| 10 | Protection of Generator | 2 |
| 11 | Mechanical Measurement | 1 |
| 12 | Cutting and Machining of Metals | 3 |
| 13 | Industrial Safety in Electricity Field | 3 |
| 14 | Industrial Safety in Chemical Fields | 1 |
| 15 | Working Injuries and First Aids | 1 |
| 16 | Safety and Fire Fighting | 2 |
| 17 | Risks Affecting Health | 1 |

# Fayed Training Center
## (East Delta Electricity Production Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1991 | • Electrical fundamentals lab.<br>• Electrical machines rewinding workshop<br>• Electrical Power lab.<br>• Electronics lab.<br>• PLC lab.<br>• Hydraulic and pneumatic lab.<br>• Manometers maintenance and calibration workshop.<br>• Mechanical fundamentals lab.<br>• Metal cutting and welding workshop.<br>• Machining workshop.<br>• Smithery and thermal treatment workshop.<br>• Sheet iron working workshop.<br>• Power plant mechanical equipment maintenance workshop.<br>• Electrical equipment maintenance workshop.<br>• Electrical machines rewinding workshop. |
| **Location** | Fayed, 47 km from Ismailia governorate. | |
| **Function** | Technical training for engineers in the field of power plants operation and maintenance. | |
| **Activities** | • Upskilling of engineers / technicians in the field of operation and maintenance of power plants (in cooperation with Abu Soltan power plant).<br>• Qualifying and preparing the technical cards in the frame of dual technical training. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Soft Soldering for Electronic Circuits | 1 |
| 2 | Standard Electrical Installation | 1 |
| 3 | Application on Electrical Measurement | 2 |
| 4 | Application on Digital Techniques | 2 |
| 5 | Electronic Elements and Applications | 2 |
| 6 | Power Plant Protection Devices | 2 |
| 7 | Theory and Application of Control Techniques related to Electrical Machines | 2 |
| 8 | Contactor Control Devices and Logic Gates | 2 |
| 9 | Single Phase Motors Rewinding (up to 220KV) | 3 |
| 10 | Three Phase Motors Rewinding (up to 400 KV) | 3 |
| 11 | Fine Finishing for Metal Product with Cutting machine Tools | 1 |
| 12 | Metallurgy and Thermal Treatment | 1 |
| 13 | Pipe Welding | 1 |
| 14 | Arc Welding | 1 |

# Kureimat Training Center
## (Upper Egypt Electricity Production Company)

| Training Center | Training Facilities |
|---|---|
| **Date of Operation** 2000<br><br>**Location** Cairo - Aswan way, eastern the Nile road.<br><br>**Function** Technical training for engineers in the field of power plants operation and maintenance and control.<br><br>**Activities**<br>• Upskilling of engineers working in the power plant operation and maintenance.<br>• Qualifying and preparing technical cadres in the field of power plant operation and maintenance. | • Electric machine workshop.<br>• Welding workshop.<br>• Valves and pumps maintenance workshop.<br>• Mechanical workshop.<br>• Rewinding machine workshop.<br>• Transformers and switchboards workshop.<br>• Vibration analysis and measurement lab.<br>• Vibration training simulator.<br>• Power plant training simulator (600mw unit).<br>• Diesel training simulator.<br>• Balancing training simulator.<br>• Computer training lab.<br>• English training lab. |

## Training Programs:

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Steam Generation (600 MW Steam Power Plant) | 4 |
| 2 | Turbine Operation (600 MW Steam Power Plant) | 5 |
| 3 | Power Plant Auxiliary System (Part-1)<br>Cooling Water, Compressors, Aux. Boiler, Services Water, Lubrication Oil ....etc. | 4 |
| 4 | Power Plant Auxiliary System (Part-2)<br>Fire Protection, Gases, Air – Condition, Switchyard.... etc. | 4 |
| 5 | Power Plant Operation and Control | 3 |
| 6 | Water Treatment | 2 |
| 7 | Expectative Maintenance | 2 |
| 8 | Vibration and Balancing of Rotating Machines | 2 |
| 9 | Maintenance Fundamentals | 2 |
| 10 | Maintenance of Equipment (Electrical /Mechanical) | 2 |
| 11 | Safety Rules and Electrical Safety | 3 |

# Aswan Training Center
## (Hydro Plants Generation Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1993 | • Automatic control lab.<br>• Pneumatic lab.<br>• Protection and power system lab.<br>• Testing lab.<br>• Electrical machines and transformers lab.<br>• Electronic lab.<br>• Welding workshop.<br>• Machining workshop.<br>• Metals tests workshop.<br>• Hydraulic lab.<br>• Air conditioning workshop.<br>• Electrical motor rewinding workshop.<br>• Computer lab.<br>• Hydro power plant simulator.<br>• English language lab. |
| **Location** | Aswan, Sahary, air port road. | |
| **Function** | Technical training for engineers in the field of hydro-power plant operation, maintenance and control. | |
| **Activities** | • Upskilling of engineers working on hydro- power generation.<br>• Qualifying and preparing technical cadres in the field of hydro-power plant operation and maintenance.<br>• Computer and languages training.<br>• Basic training for new engineers and technicians.<br>• Training of the students of high energy institute at Aswan. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Operation of Hydro-Power Plant (electrical/mechanical) | 2 |
| 2 | Troubleshooting of Power Plant (electrical/mechanical) | 2 |
| 3 | Rewinding and Repairing of Motors | 2 |
| 4 | Pneumatic Control Equipment | 2 |
| 5 | Power Network Operation | 2 |
| 6 | Electrical Equipment | 2 |
| 7 | Protection and Circuit Breakers | 2 |
| 8 | Automatic Control | 2 |
| 9 | Electronic Fundamentals Digital Circuits | 2 |
| 10 | Bearing | 2 |
| 11 | Valves Technology | 2 |
| 12 | Pumps | 2 |
| 13 | Electrical Welding | 2 |
| 14 | Air Conditioning | 2 |

# Networks Training Center
## (Egyptian Electricity Transmission Company)

| Training Center | Training Facilities |
|---|---|
| **Date of Operation** 1967<br><br>**Location** Corneish El-Nil, Helwan, Cairo.<br><br>**Function** Technical training for engineers in the field of operation, maintenance and control of electrical network.<br><br>**Activities**<br>• Training of newly graduated engineers before they have received their position at EETC networks.<br>• Preparing and qualifying newly graduated technicians in the field of electrical networks.<br>• Training the engineers and technicians working in the fields of operation maintenance and control of electrical networks.<br>• Train of trainers in the field of electrical networks.<br>• Training of students from faculties of engineering during summer vacation. | • Protection and instrumentation labs.<br>• Communication and electronics labs.<br>• Calibration equipment lab.<br>• Transformer operation and maintenance lab.<br>• Tab changer operation and maintenance lab.<br>• Circuit breakers operation and maintenance lab.<br>• High tension overhead lines maintenance workshop.<br>• Network training simulator (up to 220KV).<br>• Training programs design and development lab.<br>• Audio/visual aids and training program production lab. |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Instrument Transformer and Power Measurement | 3 |
| 2 | Protection Fundamentals | 3 |
| 3 | Substation Protection | 6 |
| 4 | High Voltage Line Protection | 8 |
| 5 | Digital Fault Recorder | 2 |
| 6 | Main Distribution Networks and its Protection | 2 |
| 7 | Supervision Control and Data Coordination (SCADA) | 2 |
| 8 | Installation and maintenance of Fiber Optic Cables | 2 |
| 9 | Gas Analysis of Transformer Oil | 1 |
| 10 | Maintenance of Transformer On-Load Tab Changer (ABB) | 1 |
| 11 | Maintenance of Transformer On-Load Tab Changer (MR) | 2 |
| 12 | Gas Insulated Switchgear | 2 |
| 13 | Power System Communication | 1 |
| 14 | Repair and Maintenance of Voltage Converter | 2 |
| 15 | Transformer Fire protection Systems | 2 |
| 16 | Instruction Techniques | 1 |
| 17 | Design and Development of Training Program | 3 |
| 18 | Effective Management of Networks | 2 |
| 19 | Economics Operation for Transmission and Distribution Systems | 4 |
| 20 | Energy Conservation | 2 |

# Live Line Maintenance Training Center
## (Egyptian Electricity Transmission Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1990 | • Isolation equipment 100 KV testing lab.<br>• Transmission line maintenance, tools and equipment (fixed / portable).<br>• 11 KV transmission line yard.<br>• 66 KV and 220 KV transmission line yard connected to company network.<br>• Network simulator.<br>• GIS lab for high voltage towers.<br>• Training program design and development lab.<br>• Audio/visual aids and programs production unit. |
| **Location** | Talkha- Dakahlya governorate. | |
| **Function** | Technical training for engineers training in the field of live line maintenance of high voltage transmission lines. | |
| **Activities** | • Training of engineers and technicians in the field of live line maintenance of high and extra high voltage transmission line and substation equipment (33, 66, 132, and 220 KV), also medium voltage transmission line (11and 22 KV)<br>• Training the engineers in the field of "GIS" for power plants, towers and transmission line layout and routing.<br>• Training of trainers in the field of modern training techniques.<br>• Training of technicians to be village or city electrician. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Basic Line Maintenance Extra High Voltage | 6 |
| 2 | Light Maintenance of Live Lines for Extra High Voltage | 9 |
| 3 | Heavy maintenance of Live Lines for Extra High Voltage | 9 |
| 4 | Training of Trainers | 3 |
| 5 | Basic Line Maintenance for Medium Voltage | 4 |
| 6 | Light and heavy Maintenance for Medium Voltage | 6 |
| 7 | Village Electrician | 12 |
| 8 | City Electrician | 12 |

# Talkha Training Center
## (Egyptian Electricity Transmission Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1990 | • Electricity fundamentals workshop.<br>• Electrical engineering lab.<br>• High voltage equipment testing lab.<br>• Measuring devices calibration and repair lab.<br>• Electronics lab.<br>• Electric motors rewinding workshop.<br>• Mechanical fundamentals workshop.<br>• Welding workshop.<br>• Sheet iron working workshop.<br>• Smithery and thermal treatment workshop.<br>• Metal cutting and machining workshop.<br>• Chemical testing workshop.<br>• Electrical network simulator.<br>• Training aid lab. |
| **Location** | Talkha, next to Talkha power station. | |
| **Function** | Technical training for engineers in the field of electrical power plant and networks. | |
| **Activities** | • The center performs basic and advanced training for the employee in the fields of power plants and networks.<br>• Training of engineers and technicians specialized in the field of electrical networks by using advanced training simulator.<br>• Training of technicians and craftsman according to the work requirement.<br>• Preparing future engineers through training students of the facilities of engineering during summer vacations.<br>• Provides the services and technical assistance needed in the field of the maintenance of power plants and networks equipment.<br>• Provide the technical assistant and researches needed for master's degree and doctorate studied. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Principle of Electricity and Magnetism | 3 |
| 2 | Refrigeration and Air Conditioning | 2 |
| 3 | Metal Welding | 3 |
| 4 | Electrical Machines and Their Automatic Control | 4 |
| 5 | Principles of Electronics and Applications | 4 |
| 6 | Digital Electronics and Applications | 4 |
| 7 | Analysis of Oil | 2 |
| 8 | Batteries (Charging and Maintenance) | 2 |
| 9 | Measuring of Electrical Power | 4 |

## Financial and Administrative Training Center
(Egyptian Electricity Transmission Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1988 | • Computer labs.<br>• English language labs.<br>• Training materials design and development lab.<br>• Audio/visual training aids lab.<br>• English language library for TOEFL.<br>• Tapes library for teaching English language.<br>• Financial and administration library. |
| **Location** | Teret El-Ismailia St. Shoubra, Cairo . | |
| **Function** | Finance, administration and middle management training. | |
| **Activities** | • Upskilling in the field of administrative, financial and managerial aspects, learning of computer and English language, secretarial and office management. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Development of Managerial Skills | 2 |
| 2 | Master Instructors Upskilling | 2 |
| 3 | Training Specialist Upskilling | 2 |
| 4 | Administrative Secretariat Upskilling | 2 |
| 5 | Procurement and Store Keeping Upskilling | 2 |
| 6 | Public Relations Specialist | 2 |
| 7 | Financial Affairs Specialist | 2 |
| 8 | Personnel Specialist | 2 |
| 9 | Preparation of Memorandum for Procurement and Contracting | 1 |
| 10 | Negotiation Upskilling | 1 |
| 11 | Project Feasibility Study | 2 |
| 12 | Crisis Management | 1 |
| 13 | Modern Office Work Management | 1 |
| 14 | Performance Appraisal | 1 |

# El - Mokatam Training Center
## (South Cairo Electricity Distribution Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1993 | • Operation and control systems lab.<br>• Transformers (operation and maintenance) lab.<br>• Underground cables lab.<br>• Distribution panels (operation, maintenance) lab.<br>• Energy meters (maintenance and testing) lab.<br>• Overhead lines network lab.<br>• Cable fault location and testing lab.<br>• Electricity engineering lab.<br>• Electricity distribution networks lab.<br>• Basic mechanics lab.<br>• Customers feeding lab. |
| **Location** | Street no. 9, Mokatam – Cairo. | |
| **Function** | Upskilling training in the field of electricity distribution networks. | |
| **Activities** | • Training of engineers, technician and foreman in the field of energy distribution networks.<br>• Provides financial, administrative and commercial training programs.<br>• Provides special programs for external customers according to their needs. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Control and Operation Systems | 2 |
| 2 | Cable Fault Location, Testing and Jointing | 2 |
| 3 | Energy Meters Calibration Maintenance and Testing | 2 |
| 4 | Power Transformers | 2 |
| 5 | Underground Cables | 2 |
| 6 | Transformer and Protection Technology | 2 |
| 7 | Electricity Distribution Networks | 2 |
| 8 | Customer Connections | 2 |

# El - Dokki Training Center
## (South Cairo Electricity Distribution Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1987 | • Distribution panels (operation and maintenance) lab.<br>• Transformers and distribution boards (operation and maintenance) lab.<br>• Energy meters (maintenance, testing and calibration) lab.<br>• Cable fault location and testing lab.<br>• Transformers and distribution boards protection and testing lab<br>• Overhead lines network lab. |
| **Location** | Nawal street – Elagouza – Cairo. | |
| **Function** | Up skilling training in the field of electricity distribution networks | |
| **Activities** | • Training of engineers, technicians and foremen for upgrading their capability in the field of energy distribution networks.<br>• Provides special training programs for external customers according to their needs. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Low and Medium Voltage Cable Technology | 2.5 |
| 2 | Cable Jointing (Medium Voltage) | 7 |
| 3 | Cable Jointing – MV (Refreshing Course) | 2 |
| 4 | Medium Voltage Cable Works | 1 |
| 5 | Installation of Electronic Energy Meters | 2 |
| 6 | Power Transformers (Operation and Maintenance) | 2 |
| 7 | Distribution Panels (Operation and Maintenance) | 2 |
| 8 | Customer Connections Technology | 2 |
| 9 | Electricity Distribution Networks | 2 |
| 10 | Customer Connections (Operation and Maintenance) | 2 |

# Tanta Training Center
## (South Delta Electricity Distribution Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1984 | • Basic skills workshop<br>• Transformers training workshop.<br>• Distribution panels training workshop<br>• Cable training workshop<br>• Customer networks training workshop<br>• Overhead lines (MV, LV) training workshop<br>• Training lab for basic electricity, electronics and communications. |
| **Location** | Tanta, (Tanta - Kafr el Sheikh subway). | |
| **Function** | Increasing the technical efficiency of employees in the company and training the new employees. | |
| **Activities** | • Provides financial, administrative and commercial training programs.<br>• Design and deliver training programs to satisfy the training needs of the employees and the external customer in the field of electricity distribution networks. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Operation and Maintenance (engineers) | 2 |
| 2 | Technical Affairs (engineers) | 3 |
| 3 | Protection and Testing (engineers) | 2 |
| 4 | Medium Voltage Networks (technicians) | 1.5 |
| 5 | Low Voltage Customer Networks (technicians) | 1.5 |
| 6 | Distribution Panels (technicians) | 1.5 |
| 7 | Calibration and Testing of Energy Meters (technicians) | 1.5 |
| 8 | Protection and Testing (technicians) | 1 |
| 9 | Projects Supervisory Skills (technicians) | 1 |
| 10 | Low Voltage Network (supervisors) | 2 |
| 11 | Commercial Accountants | 1 |
| 12 | Meter reader and Collector | 1 |
| 13 | Low Voltage Customer Networks (craftsman) | 11 |

## El - Fardos Training Center
### (North Delta Electricity Distribution Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1994 | • Measuring instruments training lab.<br>• Protection training lab.<br>• Cables and transformers training lab.<br>• Customer networks training lab.<br>• Overhead lines (MV, LV) training yard. |
| **Location** | El Mansora – El Fardos city, Elreda St. | |
| **Function** | Upskilling and upgrading of employees in the field of electricity distribution networks. | |
| **Activities** | • Design and deliver training programs to satisfy the training needs for the employees and the external customer in the field of electricity distribution networks. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Low Voltage Customer Networks (Technicians) | 1 |
| 2 | Medium Voltage Networks (Technicians) | 1 |
| 3 | Transformer Repair and Maintenance (Technicians) | 1 |
| 4 | Cable Jointing (Technicians) | 1 |
| 5 | Calibration and Testing of Energy Meters (Technicians) | 1 |
| 6 | Protection and Testing | 1 |
| 7 | Distribution Panels | 1 |
| 8 | Project Supervisory Skills | 1 |

# El - Canal Training Center
## (Canal Electricity Distribution Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1992 | • Distribution panels operation lab.<br>• Transformers and distribution board lab.<br>• Overhead lines (MV, LV) workshop.<br>• Measuring instruments (testing and calibration) lab.<br>• Protection and testing lab (for distribution networks and transformers).<br>• Cables (testing and fault location) lab.<br>• L.T customer connection lab.<br>• Principles of electricity and communication lab.<br>• Welding and iron forming workshop.<br>• Computer, language and internet lab. |
| **Location** | Industrial zone – Ismailia | |
| **Function** | Conduct training programs , seminars for employees and external customers in the fields of electricity distribution activities | |
| **Activities** | • Training of engineers, technicians and foremen in the field of electricity distribution networks.<br>• Provides financial, administrative and commercial training programs for the employees.<br>• Provides special training programs for external customers according to their needs.<br>• Provides computer, languages and internet training courses. | |

## Training Programs:

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Distribution Panel Operation and Maintenance | 2 |
| 2 | Maintenance of Transformers and Distribution Board | 2 |
| 3 | Cable Joining | 2 |
| 4 | Maintenance of Overhead Transmission Lines | 2 |
| 5 | Protection and Testing for Transformers and Distribution Board | 1 |
| 6 | Customer Connections | 2 |
| 7 | Energy Meter Maintenance and Repair | 1 |
| 8 | Protective Earthing | 1 |
| 9 | Electricity Risks and Precaution Methods | 1 |
| 10 | Quality of Electricity Feeding | 1 |
| 11 | Methods of Decreasing the Energy Losses | 1 |
| 12 | Distribution and Voltage Regulation Systems | 1 |

# Mid Egypt Training Center
## (Middle Egypt Electricity Distribution Company)

| About The training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1992 | • Electrical engineering fundamentals lab.<br>• Electrical transformers lab.<br>• Overhead transmission line workshop.<br>• Underground cables workshop.<br>• Distribution panels (operation, maintenance) workshop.<br>• Customer connection workshop.<br>• Protection and instrumentation workshop.<br>• Computer lab. |
| **Location** | Almenia city – Almenia governorate. | |
| **Function** | • Increasing the technical efficiency of employees and training the new employees, also providing special programs for external customers according to their needs. | |
| **Activities** | • Upskilling of employees in the fields of electrical distribution networks (operation, maintenance and installation of the network component for building and factories).<br>• Conduct training program in financial and commercial fields.<br>• Provides special training programs for external customers according to their needs. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Maintenance of Transformers | 2 |
| 2 | Distribution panels | 2 |
| 3 | Protection and Testing | 2 |
| 4 | Early Fault Detection through Thermal radiography | 1 |
| 5 | Distribution Network Control | 2 |
| 6 | Load Forecast Studies | 1 |
| 7 | Maintenance and Repair for Electronic Devices | 2 |
| 8 | Underground Cables | 2 |
| 9 | Customer Connections (Installation and maintenance) | 2 |
| 10 | Village / City Electrician | 2 |
| 11 | Overhead Line Electrician | 2 |
| 12 | Unified Accounting System | 1 |
| 13 | Stock Analysis and Control | 1 |

# Moharam Bek Training Center
## (Alexandria Electricity Distribution Company)

| About The training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1992 | • Power transformer and magnetic fundamentals lab.<br>• Distribution panels and protection workshop.<br>• Electrical engineers and electronics fundamentals lab.<br>• Low voltage networks and internal electrical connections workshop<br>• Power transformer workshop.<br>• Underground cables (medium voltage) workshop.<br>• Mechanical (pipes welding) workshop.<br>• Industrial safety and vocational health workshop.<br>• Vehicles maintenance and repair workshop. |
| **Location** | Moharam Bek St., Alexandria governorate. | |
| **Function** | Training of new engineers/technicians and craftsman in the field of distribution network up skilling of technicians and craftsman in the field of maintenance of distribution net work. | |
| **Activities** | • Design and deliver training programs to satisfy the training needs for the employees and the external customer in the field of electricity distribution networks. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Precaution from Electrical Charges Hazards (Eng./Tech.) | 1 |
| 2 | Maintenance and Testing of Transformers (Eng./Tech.) | 1 |
| 3 | Maintenance and Testing of Distribution Panels (Eng./Tech.) | 2 |
| 4 | Methods of Decreasing The Energy Losses (Eng./Tech.) | 1 |
| 5 | Design and Installation of Low Voltage Control Panels | 2 |

# Upper Egypt Training Center
## (Upper Egypt Electricity Distribution Company)

| Training Center | | Training Facilities |
|---|---|---|
| **Start of Operation** | 1992 | • Distribution panels protection workshop.<br>• Transformer repairing workshop.<br>• Overhead transmission lines workshop.<br>• Underground cables workshop.<br>• Distribution panels protection workshop.<br>• Customer connections workshop.<br>• Mechanical fundamentals workshop.<br>• Computer lab. |
| **Location** | High Dam – Sahary – Aswan governorate | |
| **Function** | Increasing the technical efficiency of the employees and training the new employees. | |
| **Activities** | • Upskilling of engineers, technicians, administrators, financials, commercials and labors who work on electrical distribution networks.<br>• Provides special training programs for external customers according to their needs. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Basis and Maintenance of Transformers | 2 |
| 2 | Distribution Panels | 2 |
| 3 | Protection | 2 |
| 4 | Medium Voltage Overhead Transmission Lines | 2 |
| 5 | Low Voltage Overhead Transmission Lines | 2 |
| 6 | Underground Cables | 2 |
| 7 | Customer Connections | 2 |
| 8 | Instrument Calibration | 1 |
| 9 | Estimation and survey | 2 |
| 10 | The Establishment Electricity | 3 |
| 11 | Electricity Bill Collector | 1 |
| 12 | Meters Reader | 1 |
| 13 | Contracts and Net Accounts of Customers | 1 |
| 14 | Computer Program in the field of "Customer Service" | 1 |

# Leadership Development Training Center
## (Egyptian Electricity Holding Company Headquarter)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1996 | • 4 Rooms fully equipped with audio - visual aids (30 – 50 trainees)<br>• Computer lab<br>• English language lab<br>• Library is equipped with various books in the fields of management, economics, computers, foreign language …. etc.<br>• Printing room for preparing and producing books. |
| **Location** | EEHC Headquarter - Abbassia - Cairo. | |
| **Function** | Developing a new generation of leaders capable through their knowledge, behaviors and experience to realize the mission of Ministry of Electricity and Energy (MOEE). | |
| **Activities** | • Conducts training program to develop new generation of leaders.<br>• Conducts short courses in management and leadership for middle managers and senior levels of employees in order to disseminate the new management technique and leadership skills.<br>• Conducts training program in the fields of English language and computer skills for middle managers and senior levels of employees.<br>• Provides services and assistance in the field of training program design and job analysis. | |

## Training Programs:

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Leadership Development Program | 36 |
| 2 | Top Management Skills | 5 |
| 3 | Effective and Interpersonal Communication | 1 |
| 4 | Basic and Skills of Management | 1 |
| 5 | Team Building | 1 |
| 6 | Motivation and Leadership | 1 |
| 7 | Personality Assessment and Development | 1 |
| 8 | Time Management and Dealing with Work Pressures | 1 |
| 9 | Negotiation Skills | 1 |
| 10 | Strategy Planning | 1 |
| 11 | Delegation and Enabling | 1 |
| 12 | Change Management | 1 |
| 13 | Decision Making Skills | 3 days |
| 14 | Leader Character | |
| 15 | English Language (Beginner - pre TOEFL Levels) | |
| 16 | Computer Programs | |

# Pyramid Extra High Voltage Research Center
## (Egyptian Electricity Holding Company Headquarter)

| Training Center | | Training Facilities |
|---|---|---|
| **Date of Operation** | 1969 | • Motor generator set.<br>• Cascade transformers (up to 2250 KV and 1 amp, single phase - up to 1300 KV and 2 Amp, 3 phases).<br>• Testing hall includes (single phase transformer 200 KV, 10 amp, pollution testing room, artificial rain equipment).<br>• Impulse generator 2400 KV, 180 KV.<br>• Partial discharge control room.<br>• Impulse generator 500 KV, 2.2 KV.<br>• Mobile GIS Testing facility (up to 800 KV) using resonant circuit.<br>• Partial discharge measuring lab.<br>• Transient overvoltage mobile measuring lab. |
| **Location** | 27 KM. Cairo Alex desert road | |
| **Function** | • Engineering, technical training testing, studies, research and network operation problems solving.<br>• Studies and researches to solve electrical network problems. | |
| **Activities** | • Types, routines and special tests for the electrical network equipment.<br>• Services for electrical industries sector.<br>• Experiments and researches to develop the electrical network.<br>• Studies on new technologies.<br>• Engineering and technical training. | |

**Training Programs:**

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Principles of Electrical Overhead Transmission Line | 1 |
| 2 | Design of the Overhead Transmission Lines | 1 |
| 3 | Electrical Insulators / Pollution | 1 |
| 4 | Electro – Magnetic Field Under O.H. Transmission Line | 2 |
| 5 | Live Washing | 1 |
| 6 | Electrical Transient Phenomenal | 1 |
| 7 | Electrical Tests (basic Leve) | 1 |
| 8 | Electrical Tests (Advanced Level) | 1 |
| 9 | Power Factor (P.F) Improvement | 1 |

EEHC 本社が実施している研修

| No. | Course Title | Duration (Week) |
|---|---|---|
| 1 | Auditing of Electrical Energy | 2 |
| 2 | B.O.O.T Projects | 2 |
| 3 | Demand Side Management | 2 |
| 4 | Design and Planning of High Voltage Networks | 2 |
| 5 | Economic Operation for Transmission and Distribution Networks | 2 |
| 6 | Electric Energy Rationalization and Efficiency Improvement | 2 |
| 7 | Electric Energy System Economics | 2 |
| 8 | Electric Tariff Study | 2 |
| 9 | Energy Analyzing and losses Decreasing | 2 |
| 10 | Financing Methods and Lending Agreements | 2 |
| 11 | Geographical Information System (GIS) | 2 |
| 12 | Load Forecasting and Generation Expansion planning | 2 |
| 13 | Power Planning and Stability | 2 |
| 14 | Power Quality | 2 |
| 15 | Power Trade | 2 |
| 16 | Project Feasibility Study | 2 |
| 17 | Project Management | 2 |
| 18 | Protection System and Coordination Between Transmission and Distribution network | 2 |
| 19 | Public Management | 2 |
| 20 | Quality of Supply, Customer Need in Distribution Networks | 2 |
| 21 | Reduction of Harmonics in Distribution System | 2 |
| 22 | Reliability | 1 |
| 23 | Stability | 1 |
| 24 | Energy Management | 3 |

(2) Training on Renewable Energy

Ministry of Electricity & Renewable Energy
Egyptian Electricity Holding Company

## Solar Energy Technology and Energy Conservation

**Participants:** Engineers and technicians working in the fields of Solar Energy and Energy Conservation.

**Duration:** 2 weeks

**Objectives:** Familiarizing the participants with:

- Being aware of the solar thermal technology.
- To provide an opportunity to the participants for sharing their ideas and experiences with Egyptian experts in the field of solar energy.
- Gain knowledge of PV systems and their applications.
- Testing, Evaluation, follow up & carry out solar energy systems.

**Contents:**

- Solar Energy (principles- resource- geometry).
- Technologies and applications of Solar Energy.
- Solar flat plate collector heating systems.
- C S P Technologies.
- Basic components of PV Systems, principles and operations.
- PV applications.
- Fuel cell.
- Introduction to energy conservation (Principles- technologies- applications).
- Energy efficiency labeling for home appliances.
- Passive solar building

## Wind Energy Technology

**Participants:** Engineers and technicians working in the fields of wind energy technology.

**Duration:** 2 weeks

**Objectives:** Familiarizing the participants with:

- Gain knowledge on wind turbine Technology.
- Being aware of environmental impacts of wind farms.
- Understanding the operation and maintenance of the wind farms.
- Building skills in preparing wind farm projects tender document.
- To be able to prepare wind farm projects.
- To provide an opportunity to the participants for sharing their ideas and experiences with Egyptian experts in the field of wind energy.

**Contents:-**

- **Theoretical Training**
  - Wind turbine technology.
  - Wind resource assessment.
  - Clean Development Mechanism (CDM).
  - Grid connection for wind farm.
  - Phases of wind farm projects.
  - Tender document preparation.
  - Energy Economics.
- **On Site Training**
  - Zafarana wind farm.
  - Wind turbine components.
  - Operation of wind turbine.
  - Control system.
  - Mechanical components (low speed shaft – gearbox – generator- blades).
  - Predictive & corrective maintenance (Vibration, Alignment, balance,. etc).

## Electricity Production from Renewable Sources (Wind, Solar & Biomass)

**Participants**: Engineers & technicians working in the field of Renewable Energy.

**Duration**: 2 weeks.

**Objectives:**

- Learning how wind turbine work & gaining a thorough understanding of wind power system
- To be able to prepare wind farm projects.
- To gain knowledge on wind turbine technology, PV systems and C.S.P.
- To provide an opportunity to the participants for sharing their ideas and experiences with Egyptian experts in the field of wind energy.
- Understanding the operation and maintenance of the wind farm.

**Contents**:

**Theoretical Training**

- Wind turbine technology
- Wind resource assessment
- Grid connection for wind farm
- Phase of wind farm projects
- PV systems
- Energy Economics
- Electricity production from biomass
- Concentrating solar power (CSP) technologies
- Carbon new market mechanism

**On site Training**

- Zafarana wind farm
- Operation of wind turbine and connection to electrical grid
- Control system
- Mechanical components (low speed shaft – gearbox – generator – blades)
- Predictive & corrective maintenance (Vibration, Alignment, Balance, …etc)

**Training Institute:** New & Renewable Energy Authority Headquarter.

## Renewable Energy Technology & their Uses

**Participants:** Engineers & technicians working in the field of Renewable Energy Resources & Energy Conservation.

**Duration:** 2 weeks.

**Objectives:**

- To be aware of the state of the art in different RE&EC technologies.
- To gain knowledge on the environmental impacts of renewable energy applications.
- To be able to apply RE&EC concepts in industry, electricity and residential sectors.
- To make an informed decision on which RE Technologies will meet their own needs of their countries.

**Contents:**

- Renewable energy activities in Egypt
- Solar Energy (principles- resources- geometry)
- Wind energy (resource assessment, wind turbine tech., operation & maintenance)
- Biomass Technology.
- Photovoltaic technology & applications.
- C.S. P technology.
- Carbon new market mechanism

**Training Institute:** New & Renewable Energy Authority.

## Solar Energy Technology & Energy Efficiency

**Participants:** Engineers and technicians working in the fields of Solar Energy & Energy Conservation.

**Duration:** 2 weeks.

**Objectives:**

- Being aware of the solar thermal technology.
- To provide an opportunity to the participants for sharing their ideas and experiences with Egyptian ex
- perts in the field of solar energy.
- To gain knowledge of PV systems and their applications.
- To gain knowledge on energy efficiency techniques.

**Contents:**

- Solar Energy (principles- resource- geometry).
- Technologies and applications of Solar Energy.
- Solar flat plate collector heating systems.
- Concentrating solar power (CSP) technologies.
- Basic components of PV Systems, principles and operations.
- PV applications.
- Fuel cell.
- Introduction to energy conservation (principles- technologies- applications).
- Energy efficiency labeling for home appliances.
- Passive solar building.
- Carbon new market mechanism

**Field Visits:** Solar thermal plant - Kurymat.

**Training Institution:** New & Renewable Energy Technology

## Solar Energy and Photovoltaic Panels

**Participants**: Engineers working in the field of renewable energy.

**Duration**: one week.

**Objectives**: Familiarizing the participants with the following:

- Renewable energies.
- Photovoltaic panels Components
- P V System Criteria
- Commissioning tests.
- Maintenance Procedures systems.

**Contents**:

- Traditional energy resources and the reasons for the search for alternative
- Renewable energies, Solar energy and its uses
- Solar cell types
- Photovoltaic panels Components (cells - charger - battery - reflector).
- Electrical representation of the photovoltaic cell
- Types of photovoltaic panels (off grid – on grid)

**P V System Criteria**

- Solar radiation
- temperature.
- Shadow and cell incompatibility.
- Tilt angle of panels.
- Cleaning panels
- Standard specifications for PV IEC61727,60904,61215,6123
- System tests (panels - voltage Regulator.....)
- Common faults.
- Design Principle and site measurements.
- Design of off and on grid system.
- A practical example design calculations.
- Commissioning tests.
- The factors upon which the system is connected to the network.
- Procedures and Regulations of PV systems in Egypt (role of the distribution company - role of the supplier company - the role of the customer - the tariff)
- Maintenance Procedures systems.
- Lightning protection. Grounding of PV system.

(3) Training results to other countries (2003 - 2017)

| No. | Country | Client | Training Fields | No. of Trainees | Duration (Week) | Place |
|---|---|---|---|---|---|---|
| 1 | Jordan | Central Company for Electricity Production | ▪ Natural Gas Firing<br>▪ Vibration Analysis for Rotating Machines | 50 | 2 | Cairo |
| 2 | Saudi Arabia | Ministry For Industry and Electricity | ▪ Power Saving<br>▪ Gas Turbine<br>▪ ABB LV MV Circuit Breaker<br>▪ Mark IV control System<br>▪ Welding<br>▪ Vibration Analysis<br>▪ Digital and Numerical Protective Relays<br>▪ Testing, Setting and Applications,<br>▪ Combined Cycle Power Plant Operation and Plant System. | 83 | 1-2 | Cairo |
| | | Saudi Electricity Company | ▪ Effective Communication Skills | 45 | 3 days | Riyadh |
| 3 | Kuwait | Ministry Of Electricity | ▪ Gas Turbine<br>▪ ABB LV MV Circuit Breaker<br>▪ Mark IV Control System<br>▪ Welding<br>▪ Vibration Analysis | 10 | 1 | Cairo |
| 4 | Jordan | National Company for Electricity | ▪ Maintaining SF6 Gas Barker | 20 | 1 | Amman |
| 5 | Comoros Islands | Egyptian Ministry of Foreign Affairs | ▪ Maintaining Transmission Networks | 6 | 8 | Cairo |
| 6 | Sudan | National Authority for Electricity | ▪ Electricity Production, Transmission and Distribution<br>▪ BOOT<br>▪ Financial<br>▪ Administrative<br>▪ IT | 4527 | 1 – 5 | Cairo<br>Aswan<br>Alex.<br>Talkha |

| No. | Country | | Client | Training Fields | No. of Trainees | Duration (Week) | Place |
|---|---|---|---|---|---|---|---|
| 7 | Iraq | In cooperation, with | JICA | ▪ O& M of Thermal PP<br>▪ Economical Operation for Distribution Networks<br>▪ New and Renewable energy<br>▪ TOT | 281 | 4-6 | Cairo |
| | | | GTZ | ▪ Electricity Production and Transmission | 183 | 2 - 4 | |
| | | | Washington International Co. | ▪ O & M of 33/11 KV Substation | 20 | 4<br>(80) | |
| | | | Bearing Point Co. | ▪ Financial and Accounting | 41 | 6 | |
| | | | UNDP | ▪ Planning and Operation of Elec. Power System<br>▪ I & C Main. for thermal PP<br>▪ Mech. Maintenance for Thermal PP | 33 | 3 | |
| | | | Egyptian Ministry of Electricity and Energy | ▪ On Job Training | 5 | 2 | |
| 8 | Nile Basin Countries | | Egyptian Ministry of Electricity and Renewable Energy | ▪ Electricity Production, Transmission and Distribution<br>▪ BOOT<br>▪ Financial | 1323 | 2-3 | Cairo Aswan Alex |
| | | | JICA | ▪ Operation and Maintenance of Transmission Network<br>▪ Advanced Power System Protection and SCADA<br>▪ Power System Control | 129 | 3-6 | Cairo |
| 9 | Palestine | | JICA | ▪ Operation & Maint. Of Substation<br>▪ SCADA<br>▪ Human Resources Management<br>▪ Time Management | 95 | 1-5-11 | Cairo |
| 10 | Yemen | | Yemen Electricity General Authority | ▪ WASP<br>▪ Wind Energy<br>▪ Rural Electricity Project Preparation Feasibility Study | 13 | 1-2 | Cairo |
| 11 | Libya | | Daewoo | ▪ Trainee Selection | 171 | 1 | Beni Ghazi |
| | | | | ▪ O & M of CC | 85 | 5-9 | Cairo |
| | | | Gesco | ▪ Basic Training | 80 | 3 | Beni Ghazi |
| | | | | ▪ O & M of GT | 92 | 6-10 | Cairo |
| | | | Egyptian Ministry of Electricity and Energy | ▪ Electricity Production, Transmission and Distribution | 28 | 1-3 | Cairo |
| | | | MAS Trading | ▪ On Job Training | 16 | 8 | Cairo |
| | | | PCT | ▪ Maintenance of 10 KV Protection Relay<br>▪ Tests for Electrical Transformers and Motors<br>▪ Maintenance of 30 KV Circuit Breaker | 10 | 1-2 | Cairo |

| No. | Country | Client | Training Fields | No. of Trainees | Duration (Week) | Place |
|---|---|---|---|---|---|---|
| 12 | Oman | Oman Electricity Transmission Co. | ▪ Jointing of HTP power cables | 2 | 4 | Cairo |
| 13 | Qatar | Ministry of Electricity | ▪ Gas Turbine | 2 | 1 | Cairo |
| 14 | African Countries | African Union | ▪ Hydro-Power Training Workshop<br>▪ Small Hydro power<br>▪ Advanced Small Hydro power | 68 | 1 | Aswan<br>Cairo |
| | | Ministry of Foreign Affairs | ▪ Power Sys. Studies & Protection Relay Coordination & Tests | 25 | 2 | Cairo |
| | | African Energy Committee | ▪ Grid Connected Wind Farm, PV and CSP power Plant | 11 | 1 | Cairo |

## Appendix 5 Seminar Materials

# Speech of

# H.E. Dr. Mohamed Shaker Markabi

## Egyptian
## Minister of Electricity and Renewable Energy

In the

**Seminar on Results of Power Sector Cooperation Planning Survey in the Arab Republic of Egypt**

**July ١٣th, ٢٠١٧**

**Intercontinental City Star Hotel**

**Cairo - Egypt**

**Excellencies,**

## Ladies and Gentlemen

It is a pleasure to welcome you all and share this important event with your honorable selves. I view this seminar as a chance for us to revisit the future plans of the electricity sector from a different perspective that reflects the uniqueness of the Egyptian-Japanese relations and the effective Japanese contribution in our projects that have emerged several decades ago.

The Japanese International Cooperation Agency (JICA) has been a trustable partner for the support of Egyptian people, and its collaboration to the Power Sector in Egypt dates back to ١٩٨٣. I hope this Seminar marks a new milestone in our way to boost the cooperation between JICA and the Egyptian electricity sector and introduce a common vision for future assistance.

**To continue this fruitful cooperation, this seminar will introduce the results of Power Sector Cooperation Planning Survey.**

**The scope of work of cooperation will cover all aspects of electricity including generation, transmission & distribution networks, renewable energy and energy efficiency.**

**Excellences,**

**Ladies and Gentlemen**

Japanese energy sector is among the most innovative and successful worldwide. Japan has a great expertise in the field of

electricity and renewable energies. Active steps have been taken in this area, Egyptian electricity sector build several projects and programs of cooperation with the Japanese side to take advantage of its experience. In this context, I would like to highlight our cooperation with JICA for example:

١. Rehabilitation of ٦ GTs in Cairo North, Atef, and Sidi krir power plants.
٢. Construction of a large-scale solar PV and storage project near to the city of Hurghada the estimated cost of $ ٩٢ million.
٣. Wind power plant project of capacity ٢٢٠ MW At Jebel el ziet , it was funded by a soft loan of about ٣٨ billion yen.
٤. Upgrading energy efficiency systems in distribution companies (Cairo North, Alexandria, Delta North).
٥. Japan is involved in collaboration with Egypt through trilateral cooperation mechanism where the Japanese International Cooperation Agency (JICA) funded the training of a number of Arab and African human resources in the electricity sector training centers in the field of operation and maintenance of power plants and based on Egyptian technical experience to perform this training.

**Excellencies,**

**Ladies and Gentlemen**

Egypt is working hard to secure a sustainable and efficient power system to match its ambitious goals of development.

The power sector in Egypt suffered in the recent past years several challenges including; shortage of supply of fuel, insufficient

infrastructure including power plants and transmission facilities as well as decelerated flow of investments.

In summer ٢٠١٤, the electric power cuts reach a peak of ٥٣٠٠ MW, **The President Abdel Fatah Al Sisi mentioned that the continuity of electric power supply is considered a matter of National Security, and he promised to take the energy challenge seriously, because without electricity there would be no economic growth.**

Depending on these instructions, many corrective measures were taken **to bridge the gap between the production and the demand of electricity**:

**First**: An accelerated plan was considered by which Egypt could contract the installation of different simple cycle power plants with an overall capacity of ٣٦٣٢ MW using EPC, The installation was completed in a world record time of ٦ – ٨ months. The installation was completed before summer ٢٠١٥. Since then, there was no power cut. The continuity of supply is ١٠٠٪ since June ٢٠١٥ till to date.

**Also**, by end ٢٠١٥ additional ٣٢٥٠ MWs of electricity power generation has been injected to the network due to a very close follow-up, supervision and project management to complete the commission of some power stations under construction.

**Second**: Coordination with Ministry of Petroleum resulted in securing gas supply to fully utilize electricity generation capacity.

**Third: Review of the efficiency of conventional power plants.**

By providing, the necessary investments required for maintenance and rehabilitation of electricity production units to enable them to participate in covering ٢٠١٥ summer loads.

**Currently the installed capacity provides comfortable margin and there is no power shortage.**

**Excellencies,**

## Ladies and Gentlemen

**In March ٢٠١٥, During the Egypt Economic Development Conference "EEDC", that was held in Sharm El-Sheikh. Some of the biggest investment deals at the conference were in the electricity sector, including projects to build power plants fueled by coal, gas and renewables.**

Important step in this direction came three months after the conference, during President Abdel-Fattah Al-Sisi's visit to Germany. It was there that he witnessed the signing of an €٦ billion contract with Siemens for the construction and turnkey delivery of three mega power plant projects of ١٤,٤ GW high-efficiency Combined Cycle Power Plants using Siemens power generation technology. These projects are currently being implemented in three regions (Beni Suef – Burullus - New capital).

The added power generation capacity will boost Egypt's current installed electricity capacity by ٥٠ percent. These power plants will play a key role in providing powerful and reliable energy supplies to

support the long-term economic development in Egypt especially upper Egypt and meet its growing population's electricity demand.

Nearly ٤٠٪ of these units have already joined service and the fuel savings from this project are expected to result in outstanding payback periods.

We also appreciate the great effort of the responsible companies that make a rapid progress according to a tight schedule.

Electricity sector follows up the progress of implementation on weekly basis, doing field visits and works for removing all difficulties that face Siemens and its local partners.

**The outcome of these efforts is evident. The previous shortage in supply turned to be a surplus more than ٥ GW.**

**Excellences,**

**Ladies and Gentlemen**

As our emergency phase is concluded, we moved to a new sustainable development phase. This includes; ensuring security of supply, sustainability, improving power sector institutional setup and developing the electricity as well as regulations.

Egypt is rich in natural resources that qualify it to be one of the major renewable energy producers. Egypt has the highest wind Energy potential in the Middle East and North Africa amounting to approximately ٣٠ GW. Also Egypt has highest intensity of direct Solar radiation ranging between ٢٠٠٠-٣٢٠٠ kwh/m٢/year from north to south, with expected potential of ٦٠ GW Solar power.

A full-scale program has been adopted to encourage private sector participation in the energy sector projects.

**The first component of these actions was a tariff reform program.** This program was adopted and announced in July ٢٠١٤.

**The second component, New and Renewable Energy Authority (NREA) establishing Law which** has been amended allowing NREA to establish companies by itself or in partnership with the private sector to build and operate renewable energy projects.

**The third component, A Renewable Energy Law was issued,** in December ٢٠١٤, to encourage generating the electricity from RE sources through ٤ development schemes as follows:

١- Governmental Projects scheme: by NREA via EPC contracts.

٢- The competitive bids scheme: Under the framework of "Build, Own and Operate" (BOO).

٣- Third Party Access IPP scheme: This mechanism allows the investor to sell the electricity generated from his project directly to the end user through using the national grid with a wheeling charge.

٤- Feed in Tariff scheme (FIT): Government of Egypt has announced target of ٤٣٠٠ MW of both solar and wind energy with attractive prices as **a phase** ١. Limited number of companies succeeded to fulfill the financial closure in specified period.

A **Phase** ٢ of the feed-in tariff (FIT) program has been commenced on ٢٨ October ٢٠١٦.

**Also a new Electricity law** was issued in July ٢٠١٥ to allow liberalizing of the market that enable investors to build and operate his own plant and sell the generated electricity directly to the consumers.

**As a result of the above-mentioned actions a great number of investors became confident in the Egyptian electricity and renewable energy sector, a foreign and domestic private sector investors have been encouraged to invest in the sector projects through different contractual schemes such as EPC+ Finance, BOO, IPP, Competitive Bidding and FIT.**

## Excellences,
## Ladies and Gentlemen

**Energy transformation means for us in Egypt major changes in the current structure of electricity sector.**

**Egypt is committed to a decisive, comprehensive and holistic treatment of the Energy security challenge.**

**Achieving power security rests on a foundation of sound sector governance and financial sustainability.**

**The supreme council of energy approved in October ٢٠١٦ "the integrated sustainable energy strategy for ٢٠٣٥", which depends on the optimal scenario that achieves the required energy balance including ٣٧,٢٪ Renewable Energy share till ٢٠٣٥. (Coal ٣٤٪ - Natural gas and Dual fuel ٢٠٪ – Nuclear ٨,٨٪ )**

**To adjust the distorted current Energy mix**, Electricity sector strategy is depending on securing electricity supply by using new technology for electricity generation such as (Nuclear, Coal, pump storage…etc)

- Egypt has developed a power generation plan till the year ٢٠٢٢ the installed capacities will reach about ٥٦ GW.
- Egypt set a target of ٢٠٪ of its electricity generating capacity

coming from renewable sources by ٢٠٢٢, Private sector investments will play a critical role in achieving the target.

- Now, we are in the phase of preparation of pump storage project in Attaka of ٢٤٠٠ MW that will be integrated with renewable energy projects.
- Currently, intensive cooperation with the Russian company Rosatom to build ٤ Nuclear power reactors for electric power generation of ٤٨٠٠ MW in El Dabaa.
- The Oyoun Moussa Coal Power Project (٢٦٤٠ MW) will be developed in phases with each phase sized at ٢ x ٦٦٠MW, Also under preparation for financial and technical bidding for ٦٠٠٠ MW of coal fired power stations to be built in EL-Hamrawien on the red sea. Companies from: China, Korea & Japan are participating.

  we will committed to environmental standards for emissions from coal plants that issued by the Egyptian Ministry of Environment, which conforms to international standards. In addition to, coal power plants will be established near coal import ports to overcome any concerns about coal handling processes.
- Regional integration could play a significant role in strengthening power security over the medium and long-term.
  - Egypt has a significant role for grid interconnection of Arab Mashreq with North African countries.
  - Additionally, Egypt and Saudi Arabia in the way to finalize their electrical interconnection through a DC lines of ٣٠٠٠ MW to be in operation in ٢٠٢١. The planned ٣٠٠٠ MW Egypt Saudi

Arabia interconnection would allow mutually beneficial exchange between the two countries on a Zero-net trade basis due to the fact that Saudi power demand peaks during the middle of the day, while Egypt demand peaks in the evening.

- MoU was signed to study electrical interconnection between Egypt, Cyprus and Greece.

**After finishing these projects, Egypt will be an energy Hub as a nodal point between Europe, Arab and African countries.**

## Excellences,

## Ladies and Gentlemen

Since the early 1980's, JICA has offered several assistance tools to the power sector in Egypt, that was manifested in power plants projects, rehabilitation for distribution grids, rural electrification and capacity building, and this is supported by creative solutions, patent technologies and wide experience in the electric power field.

Today, we are joined to have a general perspective of the upcoming projects that can be financed by JICA to assist the development of the Egyptian electricity sector and to enrich our utilities with reliable Japanese products, experiences and knowledge.

We are keen to bring cooperation with JICA into higher levels; especially in making use of JICA's competitive financing schemes and Official Development Assistance.

Finally, I cordially thank JICA and their partner TEPSCO for the exploited efforts in the Power Sector Survey, and wish this output to help all stakeholders to reach a concrete projects for future cooperation that realizes cover all aspects of electricity including generation,

transmission & distribution networks, renewable energy and energy efficiency.

**Thank you**

# Egyptian Electricity Sector

## Current Situation and Future plans

## Ministry of Electricity & Renewable Energy

## Main Objectives of Electricity Sector Strategy

EGYPT

- Utilization of all available resources.
- Promoting utilization of renewable energy.
- Promoting electricity interconnection.
- Improving energy Efficiency through adopting Energy Efficiency strategies.
- Environment conservation by adopting necessary measures on the supply side.
- Future planning to face the increasing demand.

**The political leadership considered that the energy supply is a matter of National Security.**

3

# Important Indicators

| | 2017 |
|---|---|
| Installed Capacity (MW) | 43870 |
| Max Load (MW) | 30400 |
| No.of Consumers (million) | 32.4 |
| Electricity Share per Capita (kwh) | 1950 |

# WHAT HAS BEEN ACHIEVED in Electricity Sector FROM JUNE 2014 UNTIL NOW



## 1-Short term plan

- This plane is based on 7% growth rate for demand, taking into consideration that the estimation of economic index performance enhancement in different fields (industrial, tourist, agricultural, residential).
- Accordingly, the expected maximum demand will be about 31450MW.

# Added Capacities in year 2016

| Item | | Power (MW) |
|---|---|---|
| Maximum available power in August 2015 | | 29550 |
| Completion of fast track projects | Mahmoudia | 160 |
| | LM units at ( sharm al shekh, Port Said, Hurghada) | 420 |
| | New Atakka | 160 |
| | Assuit West | 250 |
| Reoperation of some units (major accidents) | Tiben (out of Service since 26/10/2012) | 300 |
| | Cairo North (out of service since 16/10/2014) | 250 |
| | Korimat CSP (out of service since 6/9/2013) | 120 |
| Completion of the under construction power Plants | Giza North Power Station | 750 |
| | Suez Thermal Power Station | 650 |
| New mobile units | (10*5) | 50 |
| **Total Available Power** | | **32660** |
| **Load demand in 2016** | | **29400** |

# Added Capacities in year 2016

| Item | | Power (MW) |
|---|---|---|
| Maximum available power in August 2015 | | 29550 |
| Completion of fast track projects | Mahmoudia | 160 |
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| | Cairo North (out of service since 16/10/2014) | 250 |
| | Korimat CSP (out of service since 6/9/2013) | 120 |
| Completion of the under construction power Plants | Giza North Power Station | 750 |
| | Suez Thermal Power Station | 650 |
| New mobile units | (10*5) | 50 |
| **Total Available Power** | | **32660** |
| **Load demand in 2016** | | **29400** |

# 3-Success Story of Mega Power Plant Projects

- One of success stories was the cooperation between Electricity sector and Siemens In March 2015, During the Egypt Economic Development Conference "EEDC".

- President Abdel-Fattah Al-Sisi witnessed the signing of an €8 billion contract with Siemens for the construction and turnkey delivery of three 4.8 GW combined cycle power plants and 2 GW from wind energy.



# Success Story of Mega Power Plant Projects

- Building three mega power plant projects of 14.4 GW high-efficiency Combined Cycle Power Plants (60.5%), the contract worth € 6 billion.

- These projects are currently being implemented in three region (Beni-suef – Burulls - New capital).

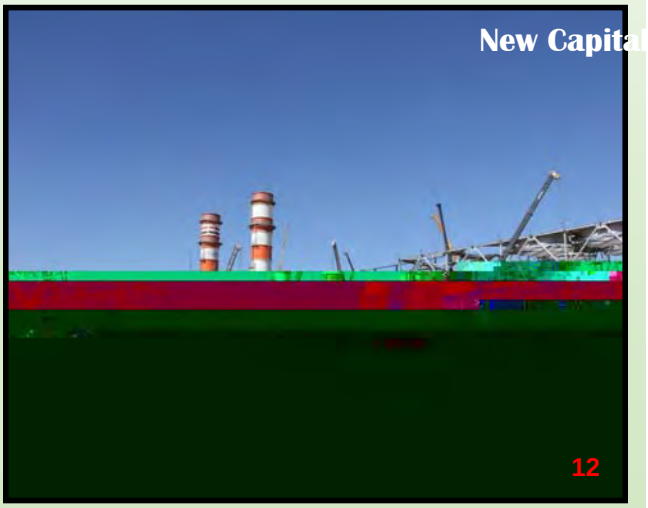
- Siemens and Local partners El Sewedy and Orascom are working around the clock,

# Success Story of Mega Power Plant Projects

- The full capacity of 14400 MW will be By connected to the network May 2018.
- These Mega Projects will save 1.3 Billion $ yearly from fuel saving.

| | | |
|---|---|---|
| TOTAL WORKING HOURS | : | 66 million hours |
| TOTAL NUMBER OF EMPLOYEES | : | 20 thousand workers |
| TOTAL NUMBER OF COMPANIES | : | 256 international and local companies. |




**Sustainable Development Strategy: Egypt vision 2030**

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## Strategic vision for energy to 2030


An energy sector meeting national sustainable development requirements and maximizing the efficient use of various resources contributing to economic growth, competitiveness, achieving social justice, and preserving the environment.

A renewable energy and efficient resource management leader, and an innovative sector capable of forecasting and adapting to local, regional, and international developments and complying with SDGs.


There is coherent among the strategic vision for energy 2030 , National SDGs and UN SDGs. And the energy strategy 2035


# Energy Strategy until 2035

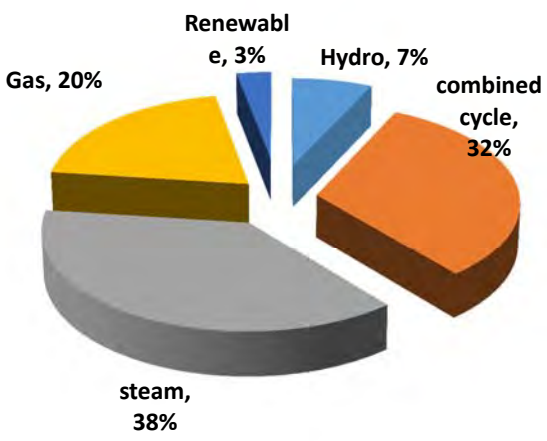
Energy Strategy until 2035

- **A new strategy of electricity Sector was updated in cooperation with EU in the framework of Energy Sector Policy Support Program (ESPSP) up to 2035 to ensure diversify of energy mix from all resources (Wind – Solar PV – Solar CSP - Coal – Nuclear – oil & gas).**
- **In this strategy, all energy scenarios in Egypt has been studied by focusing on renewable energies and Energy Efficiency.**

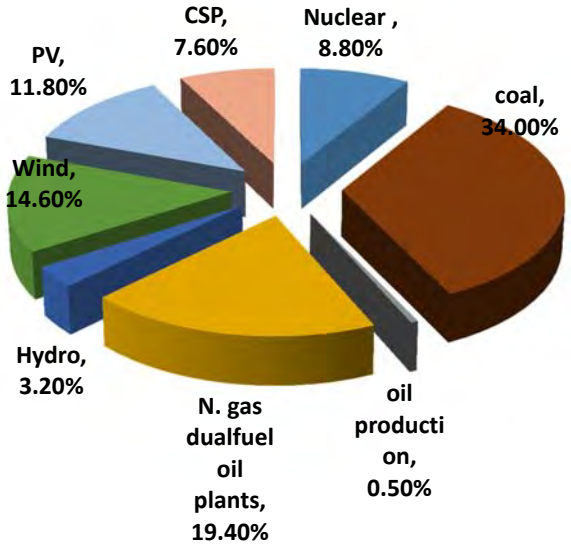
# Energy Strategy until 2035

- In 18/10/2016 The supreme council chose the optimal scenario for Egypt.
- In this Scenario, the renewable energies share in energy mix planned to reach more than 37% by 2035, taking into consideration energy efficiency measures . the target will be 18 %

**Power Mix 2015/2016**




**Power Mix 2034/ 2035**

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# Electricity Law

**Electricity law has been issued on 7/7/2015 to reflect a liberalized market reform as well as to strengthen the regulatory framework and also the bylaw has been issued on march 2016.**

**The main features of the new law:**

- Establishment of competitive electricity market which is based on bilateral contracts and adoption of the concept of eligible customers.
- Third Party Access (TPA).
- Establishment of Transmission System Operator (TSO) and provide assurances for its independence and full unbundling from other sector participants.
- Tariffs to be ratified by the regulatory agency
- Supporting renewable energies, cogeneration and power generated from secondary resources
- Supporting integrated resources planning including: energy efficiency and demand side management.

# Renewable Energy

**Hydro Energy**

**Wind Energy**

**Solar Energy**

# Hydro Power

Installed capacity from hydro is 2843 MW

Hydro power represents 9% from the generated electrical energy.



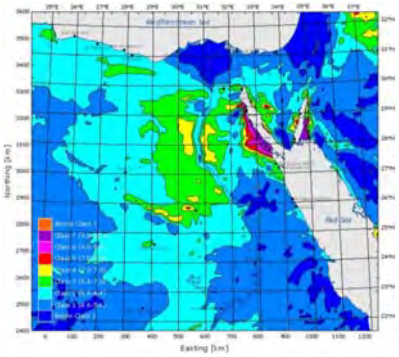
**Currently, Assuit Hydro Power Project with 32 MW is under implementation and it is planned to be operated by 2018**

It's planed to establish pumping & storage plant with 2400 MW in Attaqa - Suez to be operated by 2022

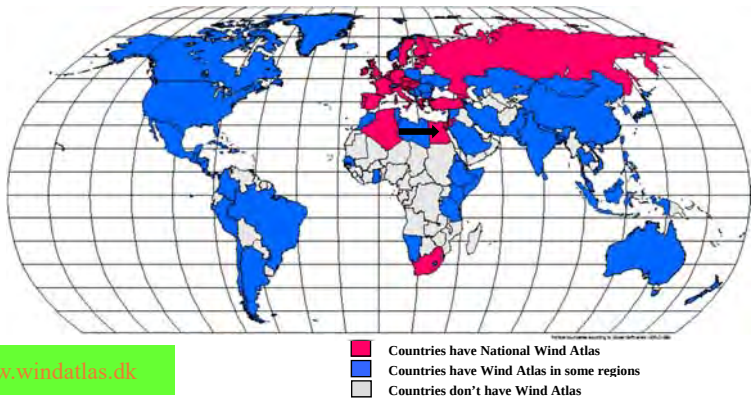
# Wind Energy

# Wind Atlas

- Egypt enjoys an excellent wind regime, particularly along the Suez Gulf where the average wind speed reaches about 10.5 m/sec.

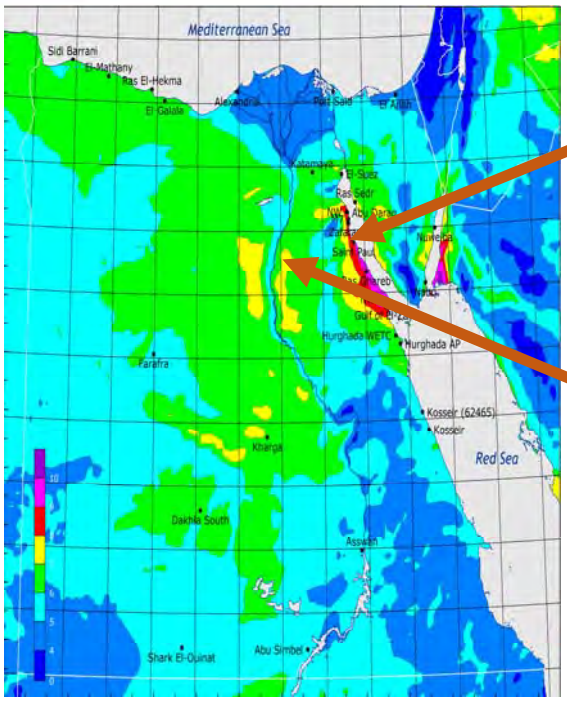


- Egypt is one of 38 countries in the world that published a National Wind Atlas




Source: www.windatlas.dk

# High Resources Wind Atlas of Egypt 1996, 2003 & 2005




Average wind speed reaches: 10.5 m/sec at 50 m height.

Average wind speed reaches: 7.5 m/s at 80 m height.

Potential Capacities: More than 30000 MW Produced Power

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# Large Scale Wind Farms

Installed capacity : 750 MW

Generated Energy 12.6 Billion KWh

fuel savings 2.7 mteo

CO2 reductions 6.8 million ton

# Large Scale Wind Farms

Governmental Projects:

- 220 MW of wind farm projects have been funded and are under implementation.
- 2400 MW of New wind farms currently are being securing fund.

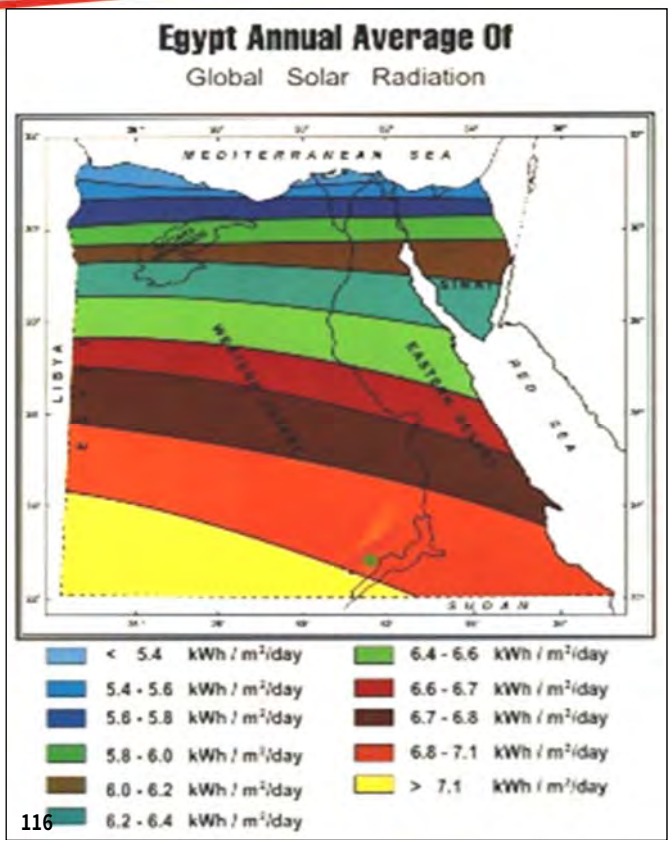
Private Sector Projects:

- 320MW (BOO) in Gulf of Suez (Italgen).
- 250 MW (BOO) in Gulf of Suez.
- 250 MW (BOO) in West of Nile.
- 2000 MW (Feed in Tariff).

# Solar Energy

# Solar Atlas

- **The Solar Atlas was issued, and indicated that Egypt is considered as one of the sun belt countries where it is endowed with high intensity of direct solar radiation**



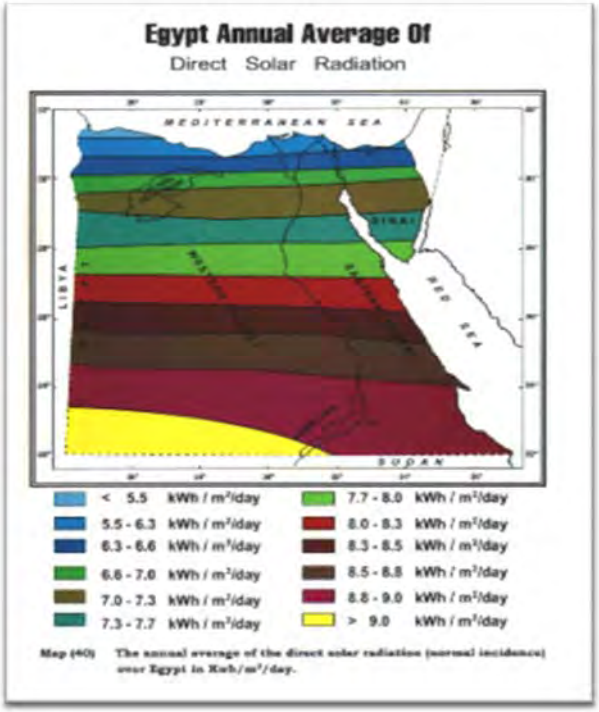
# Solar Atlas of Egypt

**Direct solar radiation ranging: 2000 – 3200 kWh/m²/year**

**Sun shine duration: 9-11 h/day**

**Potential Capacities: More than 50000 MW**

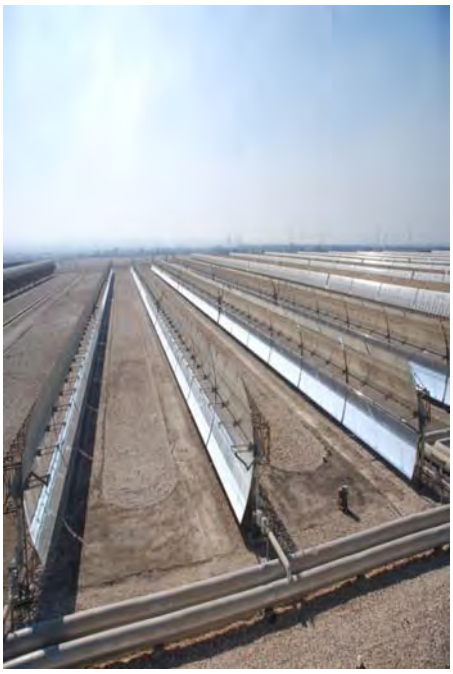
**Produced Power**




## Solar Thermal Electricity Generation

140 MW Solar thermal power plant at kuraymat

- The 1st CSP plant is 140 MW including solar field of 20 MW
- The total investment is about 340 millions US$ .
- The project started operation commercially in July 2011.



# Solar Energy

## Ongoing and upstream projects:

### Governmental Projects:

- 2×20 MW PV will be developed until 2017.

### Private Sector Projects:

- 200 MW of PV (BOO) in West of Nile.
- 100 MW of CSP (BOO) in West of Nile.
- 200 MW (10 × 20) of PV (BOO) in Kom Ombo.
- 2300 MW Solar (PV) Feed in Tariff.

# Solar Photovoltaic Systems

- The Total Installed Capacity of PV Systems in Egypt is more than 50 MW for different purposes (remote areas, governmental buildings, ….).
- The Cabinet has approved to disseminate the initiative to include 1000 building.
- the Governorates Council has approved to utilize the Solar Energy in streets and public buildings lighting.

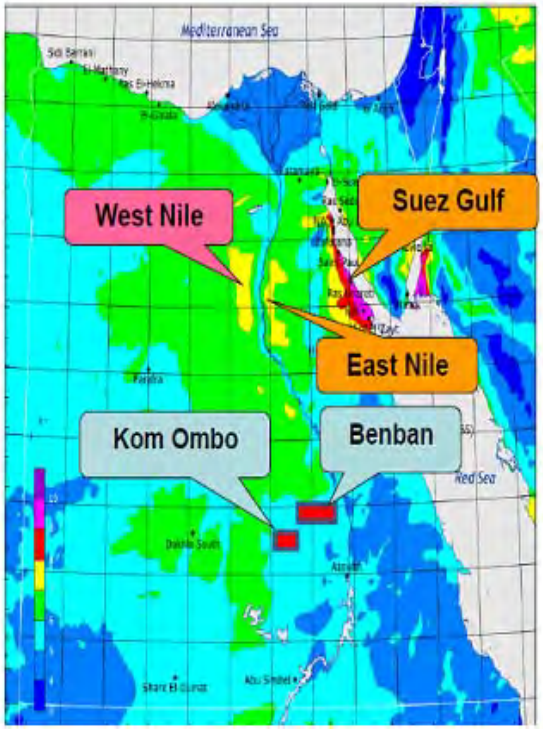
## The Egyptian Government role in supporting the renewable energy includes:

- Land allocation and permits, (7650 km2 are already allocated)
- Availability of the related information,
- Long-term PPA,
- Governmental guarantees,
- Custom duties are 2%.
- The investors will enjoy benefiting from carbon credits.
- Environmental Impact Assessment studies and others.
- The governmental Guarantee of financial obligations has been issued.

# Land allocated for renewable energy

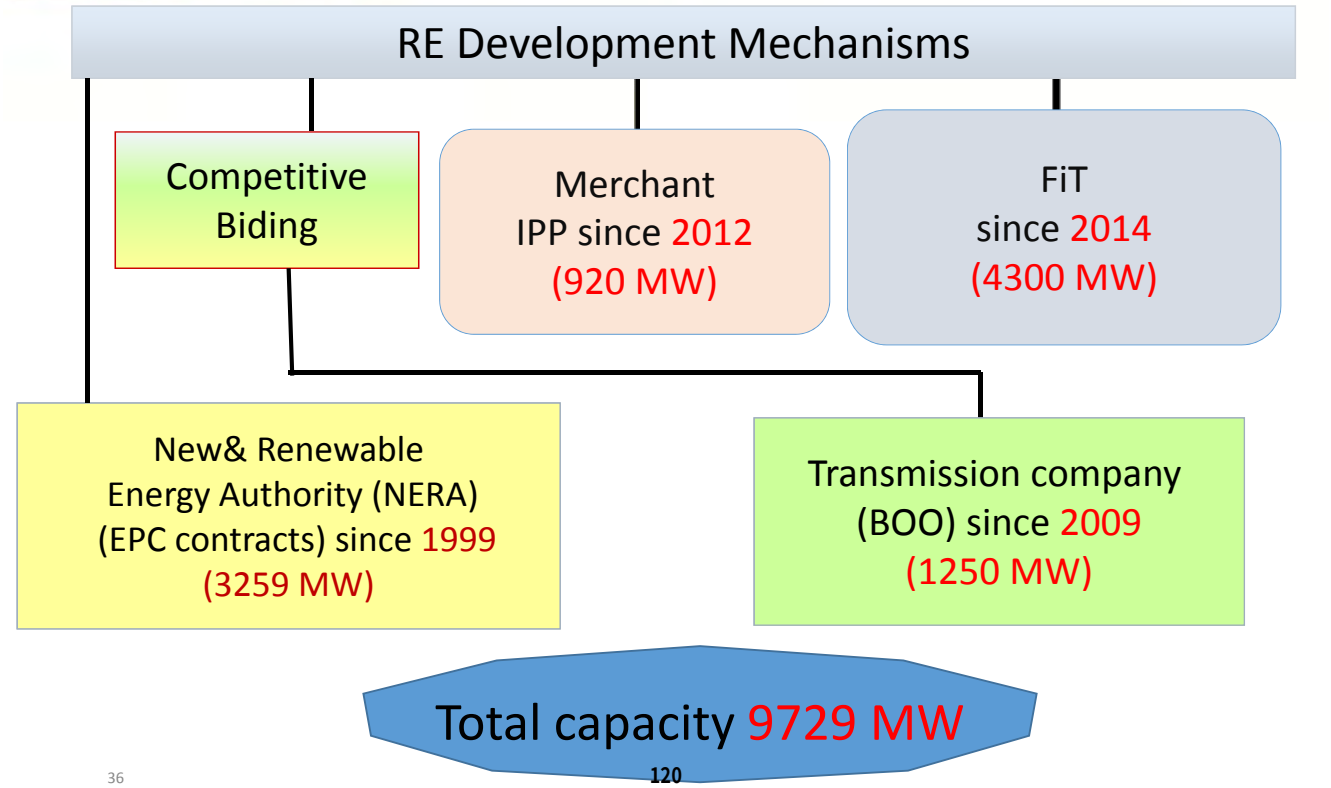
| Areas | | |
|---|---|---|
| Zone | | Areas ($km^2$) |
| Suez Gulf (wind) | | 1220 |
| East Nile | Wind | 841 |
| | Solar | 1290 |
| West Nile | Wind | 3636 |
| | Solar | 606 |
| Benban (Solar) | | 37 |
| Kom Ombo (Solar) | | 7 |
| TOTAL | | 7637 |

Total Capacities ≈ 56 GW (Wind + Solar)



# Renewable Energy Development Schemes

## Renewable Energy Development Schemes



# Feed-in Tariff

- In Sep. 2014, The Cabinet has approved the Feed-in Tariff system for PV & wind farm with capacity less than 50 M.W.
- the Regulatory Agency (Egypt ERA) has finalized the regulation rules.
- FIT aims at reaching 2300 MW (PV) (2000 M.W. by investors + 300 M.W. for residential rooftop) and 2000 MW (wind).
- A central unit for FIT(On stop Shop) has been established to provide the necessary support for the investors.
- In the first phase 3 contracts were singed with total capacity 150 MW .

# Feed-in Tariff

- In Sep. 2016, A new phase of the Feed-in Tariff system for PV & wind farm has been announced to be applied by 28/10/2016.
- In the end of April 2017 32 qualified investors submitted letters of commitment from international financial institution on terms of the second phase.
- The financial closure of the project will be in October 2017.

# BOO Projects

## 250 MW BOO Wind Project

Egypt announced for 250 MW wind energy project, In Build Own Operate, BOO, scheme which attracts more than 30 international consortiums.

**Clear Evaluation Criteria**

Tender documents have been offered in two groups; (Prequalification (PQ) - Technical and Financial offers). Based on the evaluation of the PQ, 10 international consortiums have been short listed.

# 250 MW BOO Wind Project

**Clear Role for National Entities**

BOO projects need synergy among the designated national entities; in other words;

EgyptERA, the regulator, for licence.

Egyptian Electricity Transmission Company, EETC, for grid connection

New and Renewable Energy Authority, NREA, for site selection, resource assessment, permits and technical assistance.

General Authority for Investment and Free Zones, GAFI, for establishing Special Purpose Vehicle, SPV.

# 250 MW BOO Wind Project

**Payment in foreign currency or Equivalent**

Developer will receive his payments in foreign currency in BOO project . This reduces the payment risk and encourages either investors or financing institutions.

**Management of the Whole Process**

To guarantee soft management for the whole process a Steering Committee has been established to manage and pave the way towards the implementation of the process. Steering Committee involves participants from all the relevant entities in addition to an international consultant.

# 250 MW BOO Wind Project

**Based on that, we got an excellent price, US$ 3.82 Cent per kWh, flat rate 20 years.**

**The PPA will be signed with the winning consortium of Toyota Anji and Orascom in the near future**

Currently we are using this price as a benchmark. Any investor can apply to the ministry to sign a MOU to obtain land for the establishment of a wind project under the same condition.

To date We have been singed MOUs with a total capacity of 2320 MW

Another 4 tenders under BOO scheme 250 MW wind project , two projects 400 MW PV and 100 MW CSP with 6 hours storage under evaluation

# Solar Energy FIT Second round

| Plant Installed Capacity | Finance | FiT / kwhr |
|---|---|---|
| Residential | ----- | 102.88 pt. |
| Non Residential Less than 500 KW | ----- | 108.58 pt. |
| 500 KW – 20 MW | 70% Foreign finance 30% Local finance | 7.88 $ cent |
| 20 MW – 50 MW | | 8.40 $ cent |

Contract Period : 25 years

# Wind Energy FIT

| Operational Hours | FiT $ cent / kwhr |
|---|---|
| 2500 | 7.96 |
| 2600 | 7.65 |
| 2700 | 7.37 |
| 2800 | 7.11 |
| 2900 | 6.86 |
| 3000 | 6.63 |
| 3100 | 6.42 |
| 3200 | 6.22 |
| 3300 | 6.03 |
| 3400 | 5.85 |
| 3500 | 5.69 |
| 3600 | 5.53 |
| 3700 | 5.38 |
| 3800 | 5.24 |
| 3900 | 5.10 |
| 4000 | 4.97 |

45

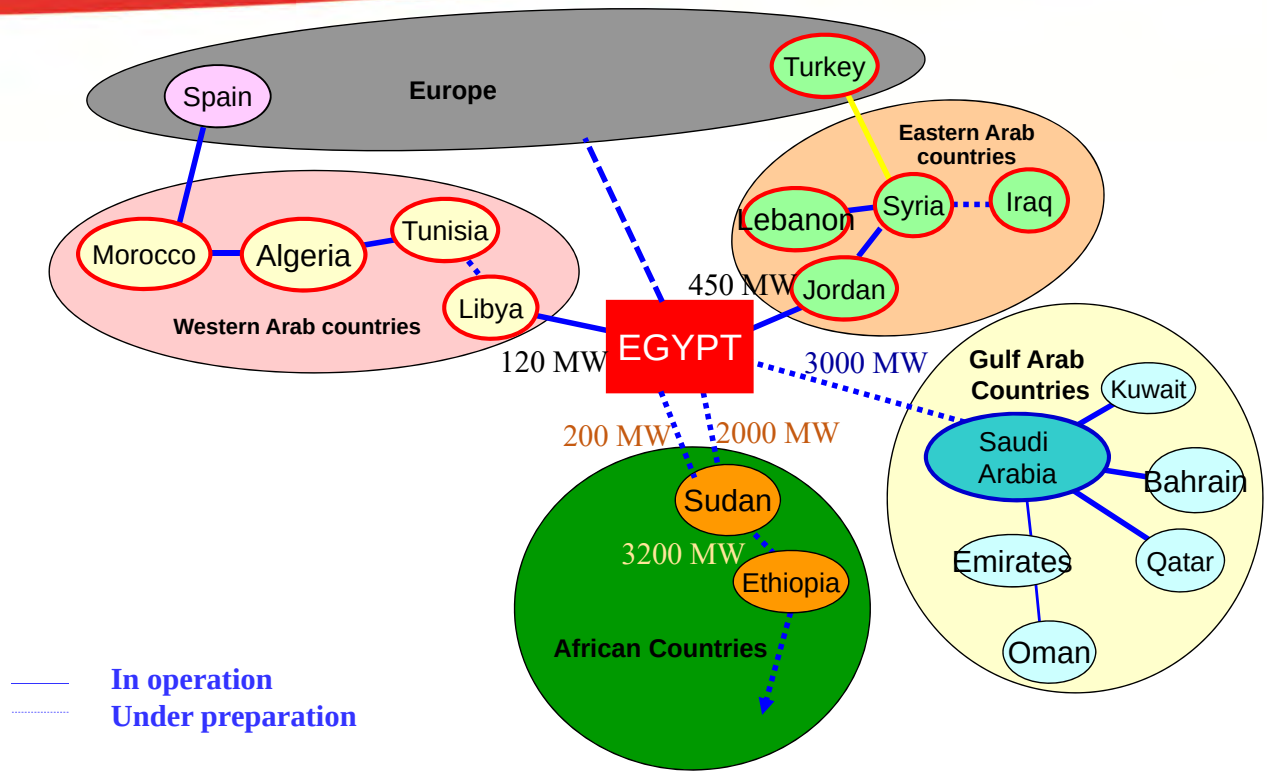
| Operational Hours | FiT $ cent / kwhr |
|---|---|
| 4100 | 4.85 |
| 4200 | 4.74 |
| 4300 | 4.63 |
| 4400 | 4.52 |
| 4500 | 4.42 |
| 4600 | 4.33 |
| 4700 | 4.23 |
| 4800 | 4.15 |
| 4900 | 4.06 |
| ≥ 5000 | 4.00 |

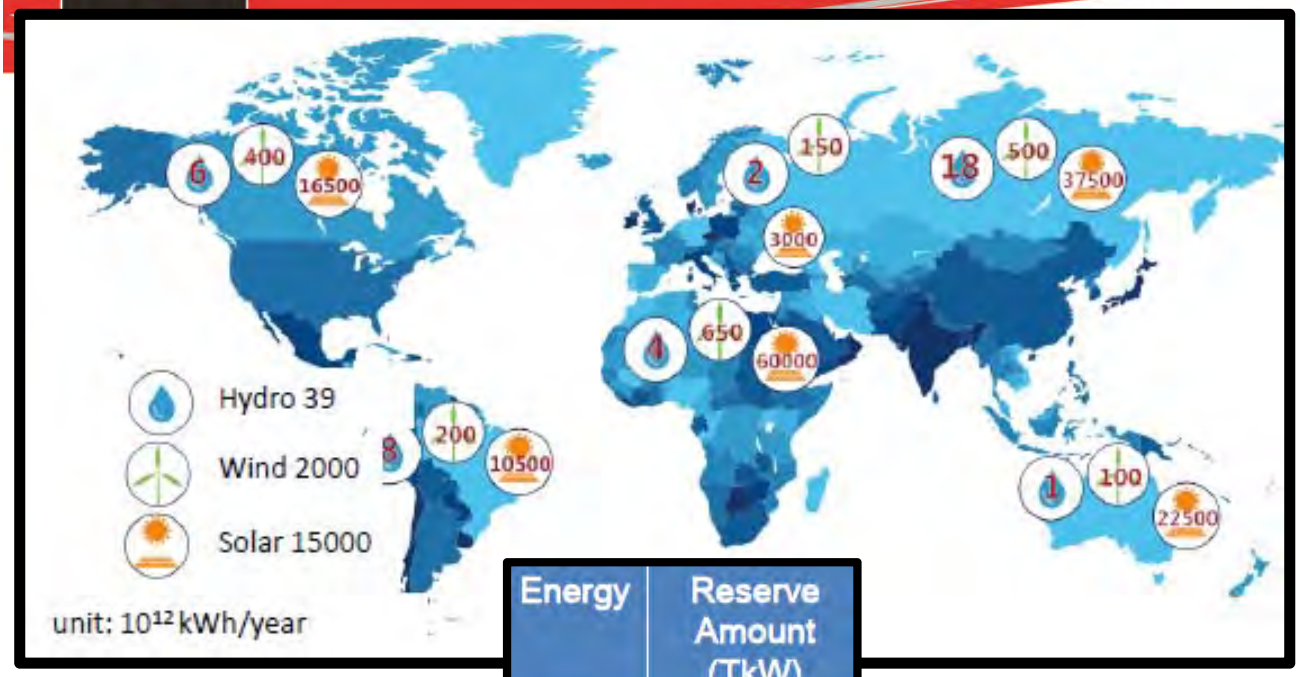
Contract Period : 20 years

60% Foreign finance
40% Local finance

# Egypt is a Hub for Electrical Interconnection

# Egypt is a Hub for Electrical Interconnection




| Energy | Reserve Amount (TkW) |
|---|---|
| Hydro | > 10 |
| Wind | > 1000 |
| Solar | > 100,000 |

# Egypt as an Energy Hub

- Egypt is currently connected from both eastern & western sides towards Europe.
- The Egyptian / Saudi interconnection FS has been concluded , An agreement was signed in May 2013, and in Dec. 2014 three project agreements have been signed, the project is expected to be finished by 2019.
- The feasibility study for interconnection between Egypt & Sudan has been finished and the project is in the preparation steps.
- The energy trading investment and interconnection study between the Eastern Nile Basin Countries has been concluded, currently the complementally studies for the project is under preparation.

# Egypt as an Energy Hub

- The study of upgrading the interconnection voltage between Egypt and the Arab Maghreb Countries was conducted, the project is expected to be in operation in 2018.
- On 6/2/2017, A MOU has been signed with Euro Africa Interconnector to conduct a feasibility study for the interconnection project between EGYPT, CYPRUS & GREECE.

# Local Manufacturing

MOERE established a localization program for Design , Installation and manufacture of Components of electrical equipment . The following are now achieved:

- 100% of the Transmission Networks up to 220 kV and all Distribution Network components.

- 42 % of power plants components.
- 30% of the wind energy equipment (70% at the end of 2020).
- The local share in the 1st solar thermal power plant project is 50%, with aiming to reach 80% by 2020.

# Local Manufacturing

- It's planned to reach 100% of PV components.
- The ministry of military production is planning to establish a factory a full chain to produce PV cells in Egypt  using white sand available in Egypt
- Egypt has signed an MoU between NREA and Siemens during the Egyptian economic conference (March 2015) to build 2000 M.W. wind farms with EPC+F Scheme, in addition to establish a wind turbine blades factory with annual capacity of 340 M.W. we have received two offers from Vestas and General Electric with the same approach

# Energy Efficiency

# ENERGY EFFICIENCY IMPROVEMENT

## On the Supply Side:

- Optimizing the share of the combined cycle power plants.
- Usage of super critical steam technology.
- Conversion of old thermal power plants to work in dual firing system.
- Improve power plants efficiency and rehabilitation and renewal of transmission and distribution networks to reduce fuel consumption and electrical losses .
- Modernization of the transmission network to be converted into smart grid.

# ENERGY EFFICIENCY IMPROVEMENT

## On the demand side:

### In the residential sector

❖Around 12 million CFL lamps were distributed with half price and 18 months guarantee.

❖ Another initiative for distribution 13 millions LED lamps has been announced (until now, about 11 millions LED lamp have been distributed).

### In street lighting sector:

❖Currently, a new project has been set to replace 3.9 million lamps with more efficient ones.(1.4 have been replaced)

## Other programs:

- Energy conservation measures (mainly efficient lighting and power factor correction) in many administrative buildings.
- Labeling and standards program for home appliances.
- Energy efficiency codes for residential, commercial and public buildings.

Energy label for refrigerator

ENERGY EFFICIENCY IMPROVEMENT

## Other programs:

- Electricity sector started awareness campaign in cooperation with the Central Bank in 2016 for three years to reduce the energy consumption in the residential sector.
- This campaign has a good effect with other measures to reduce the expected max. load by 1500 MW.
- A second phase of the National Energy Efficiency Action Plan for Electricity Sector 2017 - 2020 (NEEAP) is under preparation.

# Energy efficiency in the light of Energy Strategy 2035

- The National Energy Efficiency potential at 2035 is estimated to save 20 Mtoe or 18% of the 2035 total final energy consumption from the base year 2010 as follows:

| Economic Sector | Mtoe | % |
|---|---|---|
| Transport | 4.6 | -23% |
| Industry | 6.8 | -18% |
| Buildings (including tourism, street lighting..) | 8.6 | -16% |
| Total | 20.0 | -18% |

# National Energy Efficiency Action Plan 2012-2015

- Issued on Nov 2012 for Energy Efficiency at the end user in certain measures (residential, Street lighting, tourism).
- The measures were as following:

**First, sector (residential):**

- High efficient lighting
- High efficient residential appliances program.
- New standard and labeling are under preparation for electrical appliances (fans, dish washers, TV, water pumps, furnaces and Motors).

**Second, sector (Public facilities and governmental buildings):**

- Street lighting
- Governmental buildings.

**Third sector (tourism):**

- Circulate the usage of water solar heaters in hotel facilities.
- Until Now, Existing solar water heater systems reaches 30 hotels with a gross area of 3820 m2 of solar collectors that represents 76% of the target.

# National Energy Efficiency Action Plan NEEAP 2, ( 2017-2020)

Currently, the MoERE is finalizing the second NEEAP to be approved which aligned with the short term action plan of the national Energy strategy 2035 including:

- Completion of the institutional framework.
- Securing financial mechanisms.
- Data gathering and MRV system.
- Capacity building.
- Raise the awareness.
- Issuing the first Energy Efficiency Report.
- EE measures in ( Building, Tourism, Education and Transport) sector.
- EE Public Sector(Procurements, Public lighting, Public facilities, Electrical equipment's).

# The New Electricity Law

**Electricity law has been issued on 7/7/2015 to reflect a liberalized market reform as well as to strengthen the regulatory framework and also the bylaw has been issued on march 2016.**

**The main features of the new law:**

- Establishment of competitive electricity market which is based on bilateral contracts and adoption of the concept of eligible customers.
- Third Party Access (TPA).
- Establishment of Transmission System Operator (TSO) and provide assurances for its independence and full unbundling from other sector participants.
- Tariffs to be ratified by the regulatory agency
- Supporting renewable energies, cogeneration and power generated from secondary resources
- Supporting integrated resources planning including: energy efficiency and demand side management.

# Restructure of Electricity Tariff

## Restructure of Electricity Tariff

- The Cabinet has approved a five years plan for tariff reform to be completed in 2018/2019 by which subsidy will be fully lifted.
- The plan was announced in the first of July 2014 and published in the official gazette.
- The plan was applied for 2014 , 2015 and 2016.
- Although this reform program is not targeting renewable energy, renewable energy will benefit from it, as the right price signal is becoming available.

# Restructure of Electricity Tariff

According to the current economic situation and challenges related to currency floating

- The Cabinet has approved a four years plan for tariff reform to phase out the subsidy by 2020/2021
- The plan was announced in 4 July 2017.
- The plan has applied for 2017.

# Current Cooperation between Egypt and Japan

## Cooperation between Egypt and Japan

- **Electricity Sector Rehabilitation and Improvement :** To recover the installed capacity of existing thermal power plants and reduce the greenhouse gas emissions through upgrading the equipment of the existing thermal power plants and provision of spare parts.
- **Electricity Distribution System Improvement Project:** To reduce the energy loss and improve reliability of power supply to target areas of Alexandria, North Cairo and North Delta Distribution companies, through upgrading the electricity distribution system and network.

## Cooperation between Egypt and Japan

- **20 MW Photovoltaic Project in Hurghada:** Construction of 20 MW PV Project in Hurghada and installation of 30 MWh Battery in addition to establishment of Information Center.
- **Gulf of El Zayt Wind Power Plant:** Construction of 220MW and 32 MW Additional extension to the plant.
- **Gulf of El suez Wind Power Plant:** Construction of 250MW.

# Cooperation between Egypt and Japan

- **Energy Control System Upgrading Project in Upper Egypt:** To achieve the stable and efficient electricity transmission and distribution in South Region of Egypt, by upgrading existing UERCC (Upper Egypt Regional Control Center), constructing new MERCC (Middle Egypt Regional Control Center) and related equipment.

# "Egyptian power sector cooperation planning survey"

The survey is started in November 20th 2016 and aims to analyze the current situation of the electricity sector in Egypt and to identify the challenges and potential areas of future cooperation. The survey studying the following issues:

- Overall situation in power sector.
- Issues and Basic frames of possible solutions on the power sector policy.
- Issues and possible solutions on individual sectors (such as power supply- Upgrading of fault current – loss reduction of transmission and distribution systems – support energy efficiency improvement – finance – environment – Human resource development – reinforcement of the transmission system – introducing of TSO – assistance on the reform – short period technology transfer – stable operation of the entire system from long term perspective).

# Cooperation with JICA in the field of capacity building

The training programs covers several areas like energy policy, energy conservation, energy efficiency, power grids and more, as follows:

- In the framework of bilateral cooperation with JICA about 300 Egyptian trainees.
- In the framework of trilateral cooperation with JICA 2004-2017 several training programs were conducted in Egypt benefited about 281 Iraqi Trainees, 186 Palestinian and 129 from Nile Basin countries.
- Annual Training Programs for about **10 engineers**.

# Business opportunities

## Egypt offers significant future opportunities for investment in the field of electricity and renewable energy.

- Egypt has developed a power generation plan till the year 2022 the installed capacities will reach about **56** GW.
- The private sector is invited to invest in the electricity sector projects through different contractual schemes such as EPC+ Finance, BOO, IPP, Competitive Bidding and FIT.

## Proposed Areas of Cooperation with Japan

- Reinforcement and rehabilitation of the transmission and distribution networks
- Developing the Egyptian electricity grids to be smart grids.
- Transforming Egypt as a hub for electrical interconnection
- Implementation of new projects mainly for wind farms, PV plants
- Exchange experiences about Digitalization of Electricity sector
- Promotion of Electric researches, studies specially the impact of large scale RE on the grid and power system planning.
- Technology transfer - Local manufacture for the components of conventional, renewable energy plants and networks equipment( EV- PV- CSP- Storage- smart grid – DC- Efficient Lighting ….)
- Capacity Building in the fields of conventional, renewable energy networks O&M and energy efficiency.

***Thank you***
***for your attention***

# Summary of Power Sector Cooperation Planning Survey in Arab Republic of Egypt


**The Team leader : Tsutomu Watanabe**

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., Ltd. (TEPSCO)


## Objectives and Context of the Seminar

◆**Seminar Objectives;**

To share survey analysis and issues identified by the Survey

To receive opinions from the participants

◆**Context-1: Overall Summation of the Survey Result**

Issues identified in short and mid-long terms

Possible solutions to issues

Possible Japanese contribution

Candidate JICA projects from overall standpoints

◆**Context-2: Analysis and Projects by Area**

Some essential issues

Candidate projects

Japanese technologies related to candidate projects

◆**Lunch**

Further discussion and clarification are welcome!

# Table of Contents

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# Survey Objectives

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1. Collecting and analyzing information on the power sector

2. Clarifying the challenges to be tackled in short and mid/long-term

3. Identifying the solutions to the challenges and the priority assistance areas for Japanese ODA with the candidate projects

   - Short-term: Issues to be solved by 2020
   - Mid-/long-term: Issue to be solved by 2035

# 2. Survey Team Members (specialists in the sectors)

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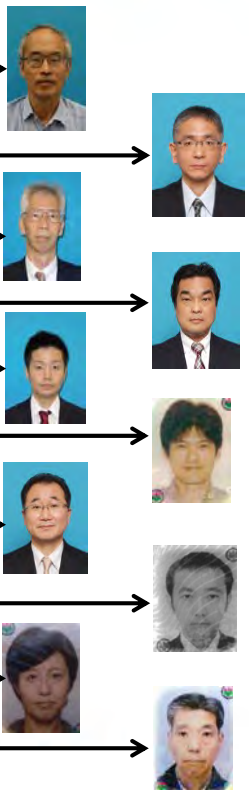
| Specialty | Name |
|---|---|
| Team Leader／Power policy1／Transmission Line | Tsutomu Watanabe |
| Deputy-Leader／Power Development Plan | Sari Ishizuka |
| Thermal Power Plant | Tetsuro Sasayama |
| System Planning | Hidekazu Takase |
| Substation／Power policy2 | Yasuhiro Ishikura |
| Distribution Line | Kenjiro Mori |
| Energy Utilization Efficiency／New and renewable energy | Hirokazu Tsujita |
| Energy Conservation | Ryosuke Oguri |
| Environmental & Social Consideration | Akiko Urago |
| Economic & Financial Analysis | Shigeru Suzuki |







# 3-1 Terms Of Reference (TOR)

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**TOR (1) Collecting and analyzing information on Egyptian power sector**

TOR 1-1: Policy and governance in Egyptian power sector

TOR 1-2: Demand and supply of power

TOR 1-3: Power production sector

TOR 1-4: Transmission network Sector

TOR 1-5: Distribution network sector

TOR 1-6: New and renewable energy including Feed in tariff

TOR 1-7: Environmental aspects in power sectors

TOR 1-8: Energy efficiency

TOR 1-9: Human resource development system in power sector

TOR 1-10: Identification of the potential of Japanese technologies to be useful to the Egyptian Electricity Power Sector

# 3-1 Terms Of Reference (TOR)

Engineering for the NEXT

## TOR (2) Categorizing the identified challenges and proposing the solutions according to their time frames

## TOR (3) Proposing the concrete projects to tackle the challenges

Propose the areas to be prioritized for JICA's assistance and propose concrete assistance projects and/or make recommendations in the areas, by 2 categories / time frames:

A) short-term (~ 2020)

B) mid/long-term (~2035)

The project proposals would be either ODA loan or technical cooperation and would be included in the final report.

**Present stage**





# 3-1 Terms Of Reference (TOR)

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## TOR (4) Dissemination of the survey results

- A seminar to present the result of the survey to related government officials will be held in Cairo under the auspices of JICA and Ministry of Electricity and Renewable Energy. The result of the survey will be also shared in the Japan-Egypt Power Sector Coordination Committee.

- The Seminar will be held in Mid-July 2017 ➡ Today

# 3-2 Schedule

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| | 2016 | | 2017 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul |
| Egypt | 2nd Mission | | 3rd Mission | | | 4th Mission | | | 5th Mission |

**(First Mission held in 2015 and intermitted for some reasons)**

**Second Mission* : November 27 – December 20 2016**

Data collection and interviewing for the mission objectives: TOR 1-1, 1-2,1-3, 1-4, 1-7 and part of 1-9 ,1-10

- To prepare Progress Report

## Third Mission : January 15 – 27 2017

- Continuous data collection and interviewing for the mission objectives : TOR 1-5, 1-8, part of 1-9,1-10
- To identify locations of energy efficiency diagnose and making the diagnoses: TOR 1-8





# 3-2 Schedule

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## Fourth Mission: April 16 – April 28 2017

- Follow-up data collections
- To confirm Short-Term, Mid-Long Term projects
- To make presentation on Interim Report

## Fifth Mission : July 2017

- To discuss on the prospected contents of Final Draft Report
- To hold a Seminar

## Report requirements:

1. **Progress Report : January 2017 (submitted to JICA in Japanese)**
2. **Interim Report : Early of April 2017**
3. **Draft Final Report : August 2017 (tentative)**
4. **Final Report : During Fiscal 2017 to be determined**

## 4-1 Overall Situation in Power Sector

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1) Electric demand has been rapidly grown along with the economic growth in Egypt in recent years.
2) Thermal power generation facilities have been strengthened by such as 5GW (FAST-TRACK and others) and is going on by 14.4GW new generation with Siemens and more than 2.5GW new generation financed by WB and other donors.
3) The national strategy of ISES 2035 (scenario 4b) was officially approved as the national energy plan, which includes 54GW new power generation in 2022, CREMP and other related plans.




## 4-1 Overall Situation in Power Sector

Engineering for the NEXT

4) ISES2035 shows the energy diversification strategy with Coal-fired generation, Nuclear generation and Renewable energy. Total capacity of Coal and Nuclear would surpass 10GW in the mid or after 2020s. Large amount of renewable generation would be also developed until 2035.
5) Drastic reinforcement of Transmission system, is now under study to cope with ISES2035 strategy, which would also include the reinforcements of the international connections.

**For realizing the large enforcement plans of the power sector, the required fund has been and will be expected To be secured.**

So far, it looks very good------,

Latest Demand growth
- Demand growth is 3.5%.
  ( Lower than average growth rate in ISES2035. )

Factors pushing up the increase in tariff
- Reduction in Electricity tariff subsidies by around 2020.
- Applying the floating policy for Egyptian Pound
- Decrease in energy source subsidies

Stagflation factors in Egyptian economy ?






**Current Expected Scenario:**
High potential for the high economic growth
→steady and high growth of electricity demand

**However**

**Possible Scenario : (Japanese experiences)**
Ever-rapid growing economy
→ Fluctuated growing economy
→Steady growing economy

Egyptian power sector may need to cope with fluctuated economic growth

# 4-2 Electricity Policy: Power Supply

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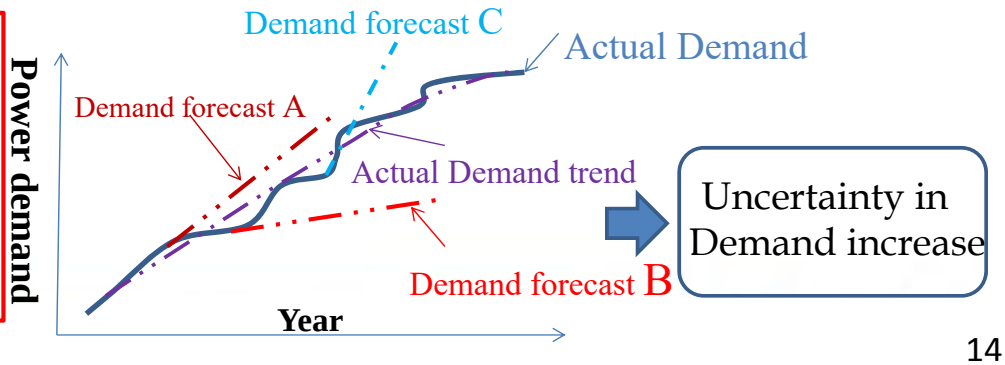
[Issues] Prepare for the increase in uncertainty (short, mid, and long term)

To realize the stable supply with good economy, minimized risks,
while fulfilling the social requirements such as environment

[ Possible solutions ]

- Improvement in demand forecast
- More flexibility in generation planning
- Demand control with use of more sophisticated tariff system
- Cost-reduction initiatives

**- Notice -**
**Japan has experienced almost same trend as shown in the figure**








# 4-2 Electricity Policy: Coping with drastic transmission

Engineering for the NEXT

[Issues] Identify the prospected subjects and put into proper countermeasures (short, mid and long-term)

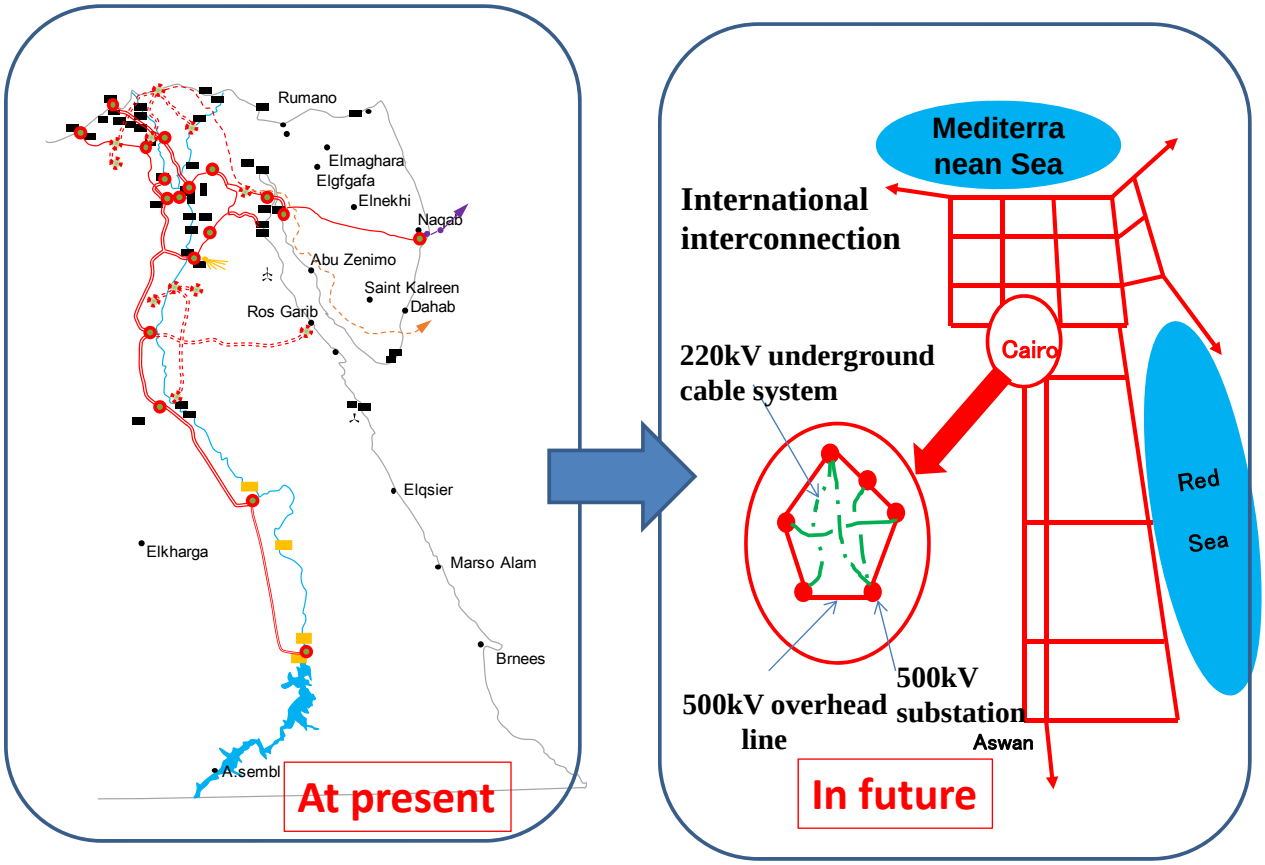
The power system is to be enlarged drastically, which would bring about planning and operational issues to realize stable and economical operation in the entire system

[Possible solutions ]

- Establishment of bulk power system control such as voltage and reactive power
- Preventive measures against large scale black out at rare accidents
- Long term vision for important area such as Cairo metropolitan area

Assistance Projects proposed

# Drastic Development of Egyptian Bulk Power System





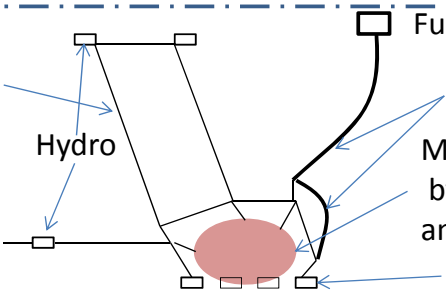



## The history in Japan: Transition of bulk power transmission system

275kV transmission lines

TEPCO* System around 1970

*Tokyo Electric Power Company



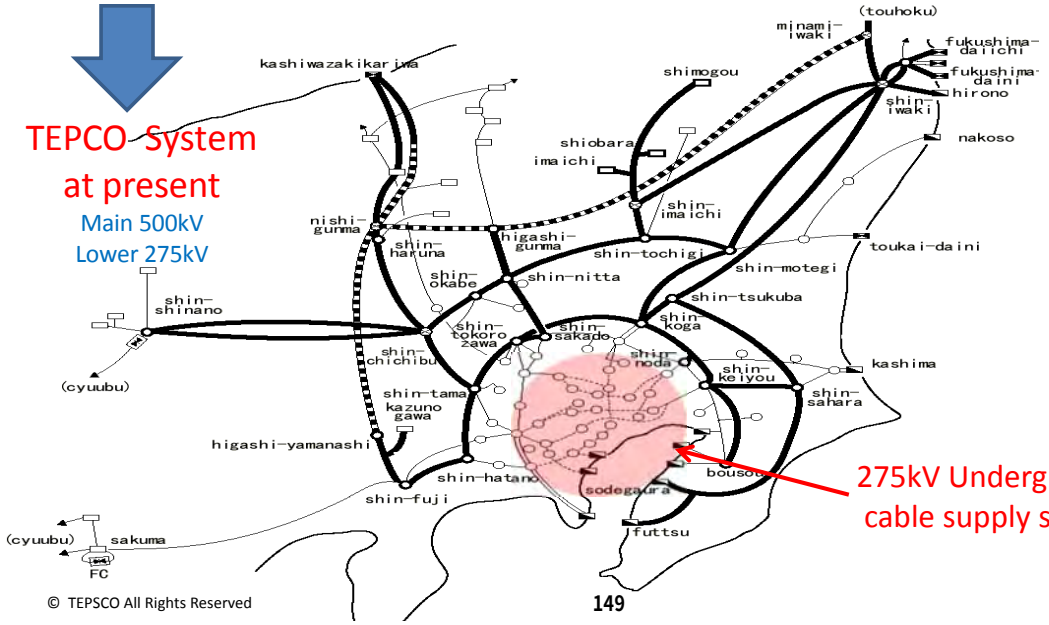

500KV transmission lines

Metropolitan area was mainly supplied by 154kV, 66kV system with overhead and underground cables combined

TEPCO System at present

Main 500kV

Lower 275kV



# 4-2 Electricity Policy: Coping with large introduction of Renewable

[Issues] Identify the prospected subjects and put into proper countermeasures (mid and long-term)

The large capacity introduction is prospected around and after 2020, along with new type base load generation development such as coal and nuclear and large capacity international interconnections, which would be new challenge in power sectors for stable and economical operation.

[Possible solutions ]

- Establishment of bulk power system operation covering the all concerned parties
- Counter measures to upgrade the system capability
- Countermeasures to mitigate the adverse effects in local systems

Assistance projects proposed

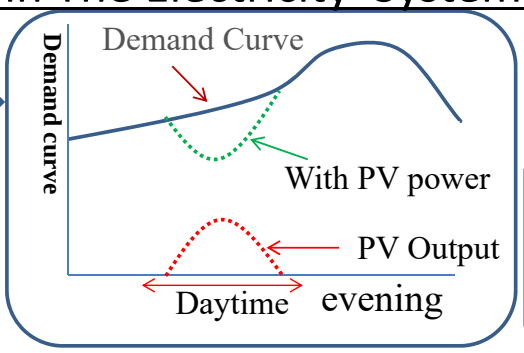




# Drastic Changes in The Electricity System Operation in future

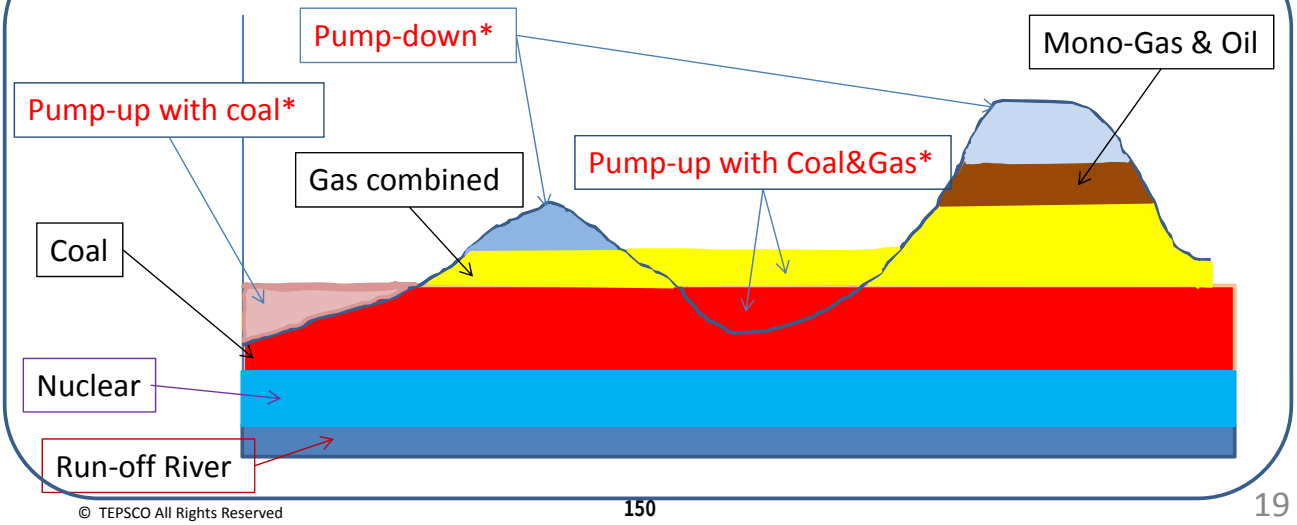
**Demand curve at present**

**Demand curve and supply in future**



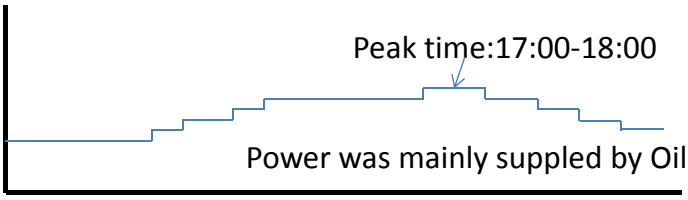

***Power Exchange by International interconnections should play a similar role as pumped storage plant function**

**Two saddle Load curve (First saddle: Morning, Second saddle evening)**



## The history in Japan: Transition of the Load curve and power supply

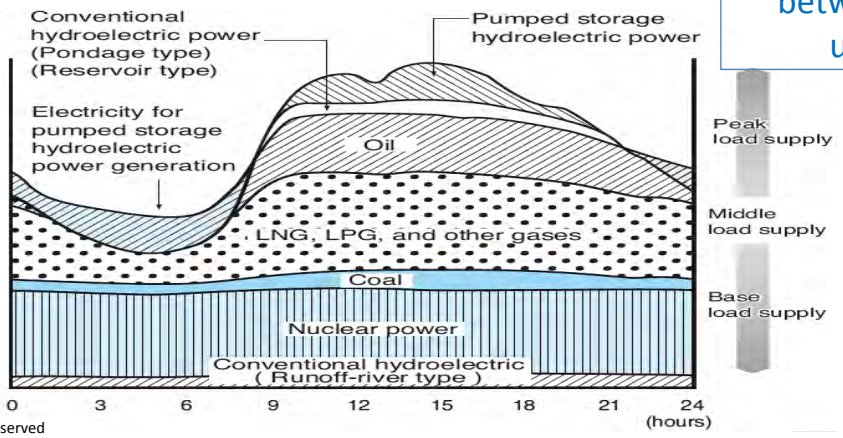
Around 1960's in TEPCO




Almost no Interconnection power exchange

Interconnection power exchange is also utilized between other utilities

At present in TEPCO








## 4-2 Electricity Policy: Reform of Electric Power Sector in Egyptian way

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[Issues] The Reform matched with Egyptian power sector should be introduced (Short-term)

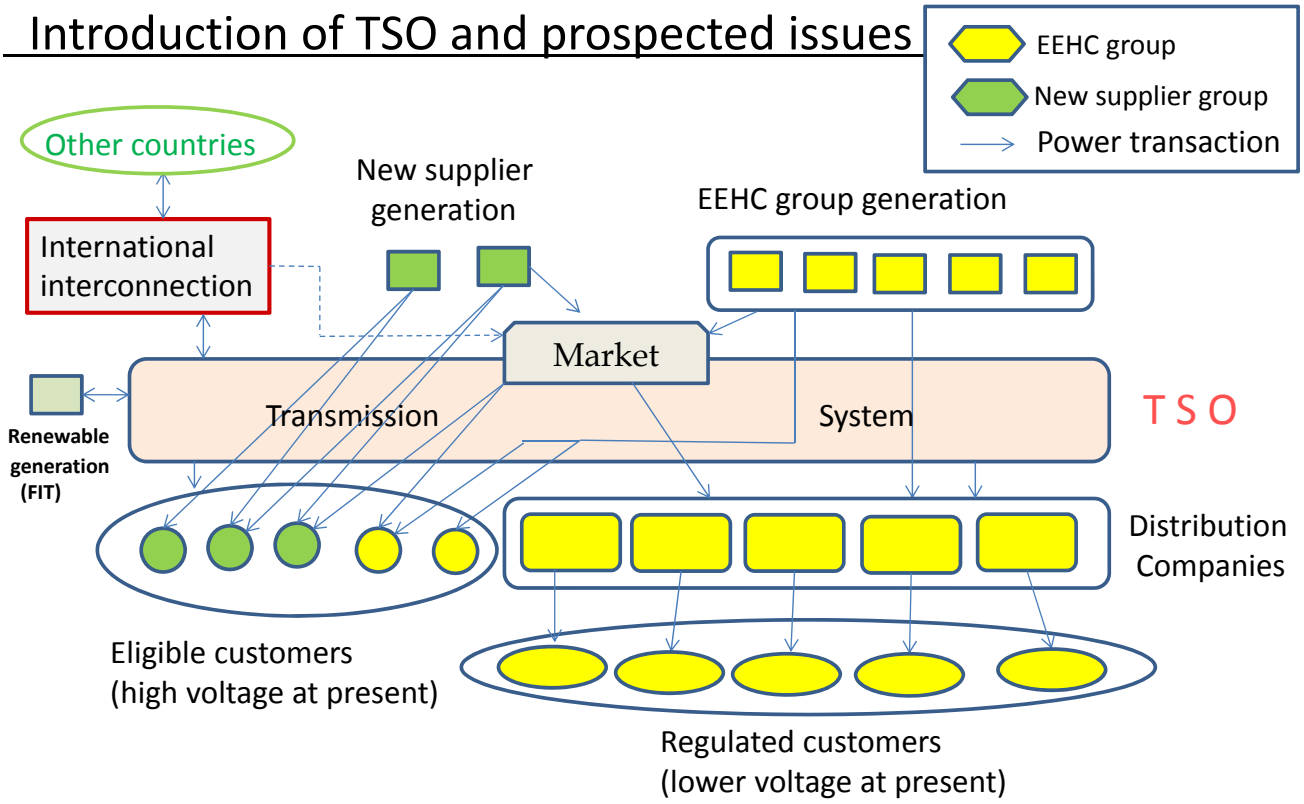
International standard of "unbundling" of the sector should be introduced while many challenges in the sector should be tackled.

[ Possible Solutions ]

First stage of the Reform "Establishment of TSO" is the key element for the success of the Reform in far into future in Egypt. Adequate consideration on Egyptian type TSO should be required. Japan has taken very steady step to realize this target and abundant experiences

Project No.7 : Technical assistance on formation of the implementation policy and realization of practical roadmap regarding TSO establishment

# Introduction of TSO and prospected issues




- TSO should realize equal footing among eligible customers and distribution companies
- TSO should secure the Market functions, which would be gradually expanded
- If lower voltage customers become eligible, the same concept should be applied





## History of Japan : Transition of Power Sector reform

**Steady steps have been taken →Abundant studies and experiences**

**1995 : Introduction of Independent Power Producer (IPP)**

**1999 : Introduction of Competitive Power suppliers**
**(Eligible Customers; 22kV or Above (Large-users )**

**2003 : Enlargement of the Eligible customers**
**~2004 (Eligible Customers : 6kV or Above (Middle-users )**
**(2003: Establishment of "Power exchange"(Market))**

**2016 : Total liberalization → all the customers are eligible**

**2017 : Unbundling of TEPCO**
**(One united company → Stock holding company)**

**2020 : All the utilities will be unbundled**

## 4-2 Issues and Solutions by Sector

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| Sector | Issues | Possible Solutions |
|---|---|---|
| Power supply | Increase in Uncertainty | Increase in flexibility in planning, facilities |
| Transmission System | Reduction of Transmission cost for coping with uncertainty | Flexible utilization of the existing facilities |
| Distribution System | Decrease of Non Technical loss | More advanced smart meter use |
| Energy Efficiency | How to encourage Customer incentive | More Sophisticated Tariff |
| Financial area | TSO is critical point | Proper regulations to TSO |
| Environment | Coal generation is the key | Human capacity building |





## 4-3: Stand point for the assistances

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Challenges in Egyptian power sector

Policy area
- Institutional
- technological
- Human resource

Each Sector
- Institutional
- Technological
- Human resource

Japanese Experiences for the solutions
- Related technologies
- Know how in utilities
- Available Human resources

- Usefulness
- Capacity building
- Win-Win

Needs and coordination

Creation of Candidate projects

Commitment of other donors
- History
- Future prospects
- Projects

# 4-4 Candidate Projects (Glimpse)-1

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| Policy | Sector | Projects | TA or Loan |
|---|---|---|---|
| Stable Supply (in uncertainty) | Generation | No.10 Long preservation of thermal | Training |
| | Transmission | No.1, No.2 500kV system control | TA →Loan |
| | | No.3, No.4, No5 Cairo supply vision | TA →Loan |
| Sector Reform | Related Institutions | No.7 Adviser to TSO Establishment | TA |
| Measures against Mass Renewable Introduction | Related Institutions | No.12 Frequency preservation measures | TA |
| | Distribution | No.6 Voltage Control measures | TA |





# 4-4 Candidate Projects (Glimpse)-2

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| Policy | Sector | Projects | TA or Loan |
|---|---|---|---|
| Loss reduction | Distribution | No.8 More advanced Smart-meter use | TA |
| Energy efficiency in customer side | Related Institutions | No.9 Higher Efficiency of large-customer | TA |
| Environment | Distribution | No.11 O&M of Coal-generation | TA |

Projects may be added or deleted in future according to discussion

In the Next Sessions, the Projects will be explained again

# Table List of Candidate Projects

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| Program | Concept of the Projects | Short, Mid, Long term | Sector | No. | Title | TA or Loan | Counterparts | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Assistance on Network in short and mid/long term with high relaibility | Improvement in planning and operational technologies to maintain the reliability of the bulk network and application of the suitable control systems and facilities | Mid and Long | Transmission | 1 | Technical Assistance on improvement of voltage / reactive power planning technique and introduction of power stabilization system in 500kV bulk power system | TA | EETC | | | | | | | | |
| | | Mid and Long | Transmission | 2 | Introduction of Voltage/Reactive Control System and Power Stabilization System in 500kV bulk power system | Loan | EETC | | | | | | | | |
| | Establishment of the supply vision for Cairo and surrounding Metropolitan area from long term perspectives along with the reinforcement of the 220kV underground cable system and the foothold 500kV substations | Mid and Long | Transmission | 3 | Technical assistance on development of 220kV Cairo and its metropolitan area supply strategy from long time perspective | TA | EETC | | | | | | | | |
| | | Mid and Long | Transmission | 4 | Introduction of 220kV Cairo and its conurbation metropolitan area supply system facilities | Loan | EETC | | | | | | | | |
| | | Mid and Long | Transmission | 5 | Introduction of 500kV Substation construction which would serve for the 220kV underground cable system starting point | Loan | EETC | | | | | | | | |
| | Introduction of the countermeasures to mitigate the adverse effects of mass Renewable Energy | Mid and Long | Distribution (Renewable) | 6 | Introduction of voltage countermeasure equipment in distribution system to cope with massive renewable energy generation | TA | EEHC or DEC | | | | | | | | |
| Assistance on the Reform | The key factors of the Power Sector Reform (TSO) support from optimization point of views | Short and Mid | Policy | 7 | Technical Assistance on formation of the implementation policy and realization of practical roadmap regarding TSO establishment | TA | EEHC (EETC, E-ERA) | | | | | | | | |
| Support on Energy Efficiency improvement | Development of potential application area for Smart meter diffusion | Mid and Long | Distribution | 8 | Technical Assistance on utilization of smart meter to realize the support for searching theft places, supporting for electric bill menu setting | TA | EEHC or DEC | | | | | | | | |
| | Introduction of the modeled energy efficiency system in large customers | Mid and Long | Ene.Efficiency | 9 | Demonstration on energy efficiency support by load leveling equipment installments and operational technologies | Loan | EEHC | | | | | | | | |
| Short-period technology transfer | Support on Diversification of thermal supply resources | Short and Mid | Generation | 10 | Human resource development on halted thermal power plant for long time preservation method | Training | EEHC | | | | | | | | |
| | | Mid and Long | Generation | 11 | Human resource development on O&M of coal fired thermal power plant, especially in the area of environment and coal handling | Training | EEHC | | | | | | | | |
| Stable operation of the entire system from long term perspective | Support on the Introduction of Hydro pumped storage system along with development of the entire system proper operation from long term perspectives | Mid and Long | Generation (Renewable) | 12 | The Preparatory survey on the Construction Project of Nile Valley Pumped Storage Power Plant | Loan | HPPEA (EEHC, EETC) | | | | | | | | |
| | | Mid and Long | Generation | 13 | Technical assistance on optimization of power source planning for meeting the peak demand as well as securing the stable operation | TA | EEHC, EETC, HPPEA | | | | | | | | |
| | | Mid and Long | Generation | 14 | Construction Project of Ataqa Pumped Storage Power Plant (Concerning the two adjustable speed pumped storage system) | Loan | HPPEA, EETC | | | | | | | | |

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# 1. Thermal Power Generation


**Tetsuro Sasayama**

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., Ltd. (TEPSCO)


## Thermal power generation at Present

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### ◆ Installed generating capacities

| Generation Type | Capacity | Ratio |
|---|---|---|
| Gas Turbine | 4,847 MW | 15.3% |
| Steam Turbine | 15,083MW | 47.5% |
| Combined Cycle | 11,777MW | 37.1% |

(Source : EEHC Annual Report 2014/15)

- Nearly half of the total thermal power capacities are steam turbines.
- Most of the newly installed generating capacities are either combined cycle or gas turbine.
- No coal fired power plant so far.

### ◆ Electric energy generation

| Generation Type | Generated Power | Ratio |
|---|---|---|
| Gas Turbine | 15,446GWh | 9.7% |
| Steam Turbine | 78,262GWh | 49.1% |
| Combined Cycle | 65,641GWh | 41.2% |

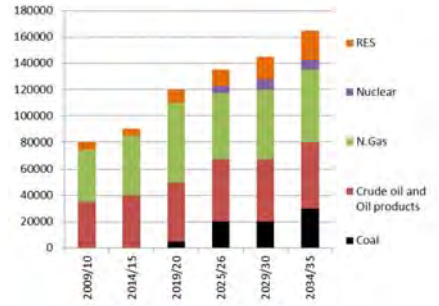
(Source : EEHC Annual Report 2014/15)

- Gas Turbines are not highly utilized in comparison to their capacity.
- Combined cycles seem to be highly utilized. (i.e. high capacity factor)
- Average thermal efficiency is around 40%.

# Thermal power generation in Future : Primary energy supply

Engineering for the NEXT

## ◆ Primary energy supply by fuel

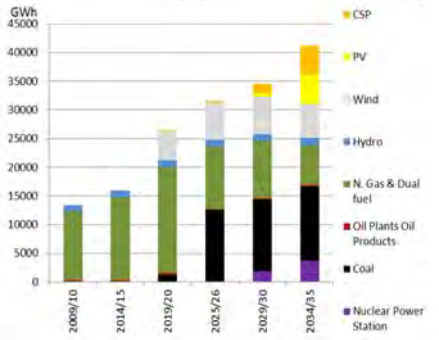



(Source : ISES2035 Scenario4b)

- In the year of 2034/35, the rates of natural gas and crude oil are expected to be down to 30%.
- Coal, renewable energy, and nuclear power are expected to account for about 20%, 15%, and 5% of the energy supply respectively.

Diversion of energy source in the future

## ◆ Electricity production by plant type




(Source : ISES2035 Scenario4b)

- In the year of 2034/35, total electricity production is expected to grow over twice as much as current electricity production.
- Large amount of the future electricity will be from renewable energy and coal. Nuclear will play a certain role.





# Thermal power generation in Future : generating capacities

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## ◆ Thermal power capacities under construction

| | 2016 /17 | 2017 /18 | 2018 /19 | 2019 /20 | TOTAL [MW] |
|---|---|---|---|---|---|
| COAL | 0 | 0 | 0 | 0 | 0 |
| ST | 0 | 1,300 | 650 | 1,300 | 3,250 |
| Conversion GT ➡ CC | 0 | 750 | 1,090 | 0 | 1,840 |
| CC | 9,600 | 4,800 | 0 | 0 | 14,400 |
| TOTAL [MW] | 9,600 | 6,850 | 1,740 | 1,300 | 19,490 |

(Source : Survey Team )

- Large scale Combined Cycle plants, provided by Siemens, have already been in operation partially.
- Conversions from gas turbines to combined cycle plants by adding steam turbine systems are also in progress.

## ◆ Thermal power capacities to be installed after 2022/23

- Some large scale coal fired power plants will be installed after the year of 2022/23.
- Intention of introducing Coal
  - ✓ To diversify energy source
  - ✓ As a result, to allow natural gas resources to be used for higher value

## Coal Fired Thermal Power Plants in Egypt and the Candidate Program

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◆ **Coal fired thermal power plant developing plans in Egypt**

- Hamrawein
  - ✓ Output : Approximately 6,000MW
  - ✓ Expected commissioning date of the first unit : 2023
  - ✓ Owner : EEHC
- Oyoun Moussa
  - ✓ Output : Approximately 4,000MW
  - ✓ Expected commissioning date of the first unit : 2022 to 2024
  - ✓ Owner : BOO scheme

Candidate Project No.11

Human resource development on O&M of coal fired thermal power plant, especially in the area of environment and coal handling

Since there has been no coal fired thermal power plants in Egypt, Japanese experience on O&M of coal fired power plants, especially in the area of environment and coal handing, might be helpful. Contents would be finalized in due future.





## Egypt will have plenty of electric capacities, however・・・

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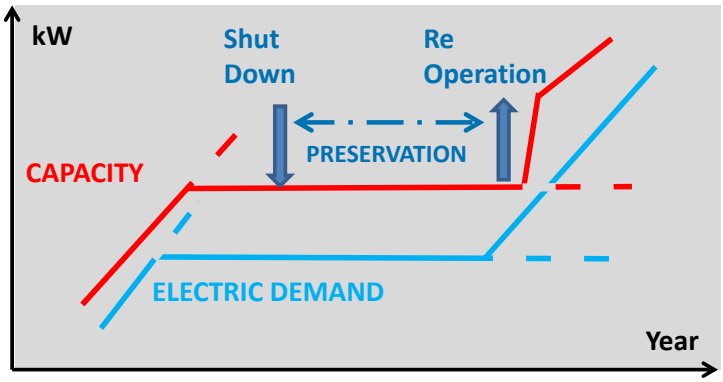
- Up to 10、000 MW of coal fired thermal power plant, as well as 14,440MW of Siemens combined cycle plants, etc. will be installed in the near future, however, electric demand will fluctuate.
- The demand growth might be lower and/or higher than the forecast.




- When demand grows rapidly, in stead of installing new capacity, re-operation of shut down units might be beneficial from time and cost saving point of view.
- It also allows power generation operated more flexibly.
- However, if the plants are not preserved properly, more time and cost might be needed when re-operated.

Plant Long Time Preservation Method

# The Candidate Project

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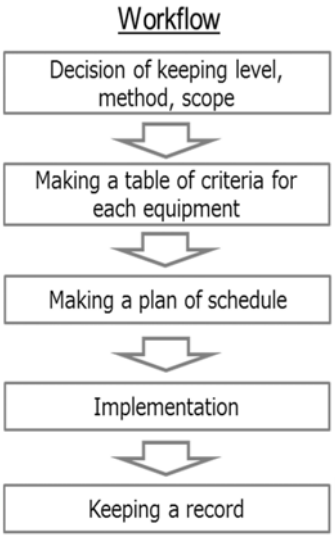
Candidate Project No.10

Human resource development on halted thermal power plant for long time preservation method

TEPCO, one of the Japanese electric utilities and our parent company, has many experiences of long time preservation and re-operation.

- Decision of preservation level
  :based on the estimated preservation period
  - ✓ Level A: Less than 4 months
  - ✓ Level B: Less than 12 months
  - ✓ Level C: More than 1 year
  - ✓ Level D: More than a few years (possibly scrapping)
- Application of preservation criteria for each facilities
  - ✓ Rust / corrosion prevention
  - ✓ Insulation degradation prevention
  - ✓ Dust / Frost prevention
  - ✓ Disaster / Environmental pollution prevention
- Implementation, periodic check, and keeping records




Source: TEPCO





# Experience of TEPCO

Engineering for the NEXT

◆ **Latest example of re-operation (Hirono #1)**

- Plant description
  - ✓ Output : 600MW
  - ✓ Type : Steam Power Generation
  - ✓ Fuel : Oil
  - ✓ Commissioning Date : April, 1980
- Re-operation record
  - ✓ Shut down Date: April, 2016
  - ✓ Re-operation date: March, 2017
  - ✓ Time needed for re-operating
    : Approximately 3 months

**Inspection before re-operation**

Source: TEPCO

◆ **Preserved plants at present**

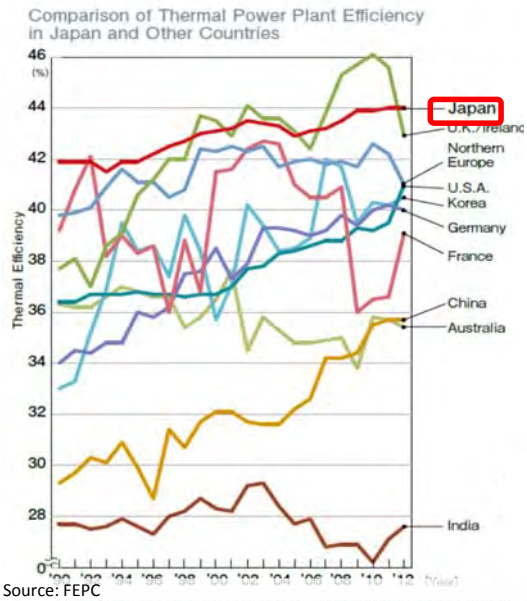
- Number of plants :16 (Fuel : LNG, OIL)
- Type of plants : Steam Power Generation Plants including one Gas Turbine
- Duration of preservation : more than 1 to 3 years

We assume this experience would help gaining flexibility in generation operation. In addition, it will allow to harness the personnel in this filed.

# In case of installing new generating capacity…

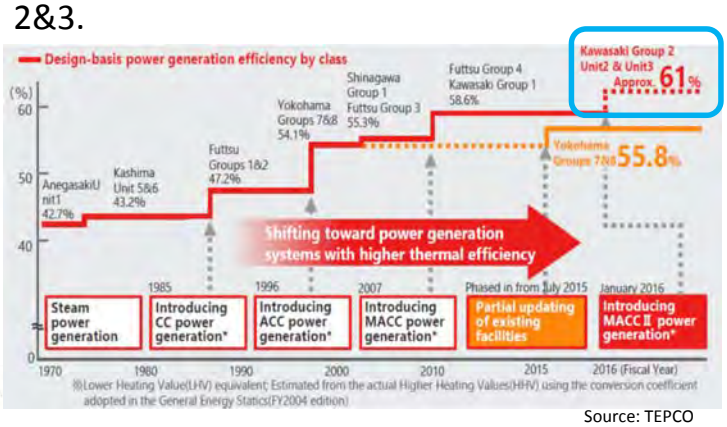
- One of the issues to be reviewed is Thermal efficiency.
- Average thermal efficiency of Egypt is around 40% (2014/15).

**Japan has achieved world's top level thermal power plant efficiency.**




Source: FEPC
The Federation of Electric Power Companies of Japan

Especially, TEPCO has been a pioneer in actively embracing cutting-edge high-efficiency facilities.
The newest and most efficient thermal power plants of TEPCO are Kawasaki Group2 Units 2&3.




Source: TEPCO



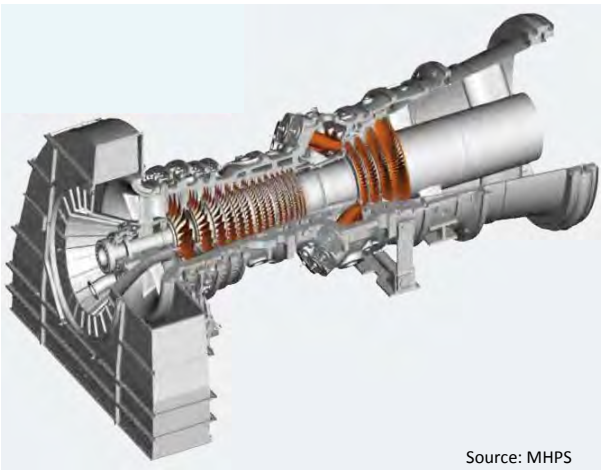




# MACC II : the highest level thermal efficiency

Source: TEPCO

Kawasaki Group2 – Units 2 & 3 adopt the 1600℃-class Combined Cycle II (MACC II) system, which offers the world's highest level of thermal efficiency (approximately 61%).



Source: MHPS

The core component of MACC II is the state-of-the art Gas Turbine (M701J), the product of MHPS, Japan.
MHPS has already provided M701F series GTs into several power stations in Egypt.

Adopting these facilities (at private sector projects) will contribute to improve thermal efficiency in Egypt.

# 2. Renewable Energy

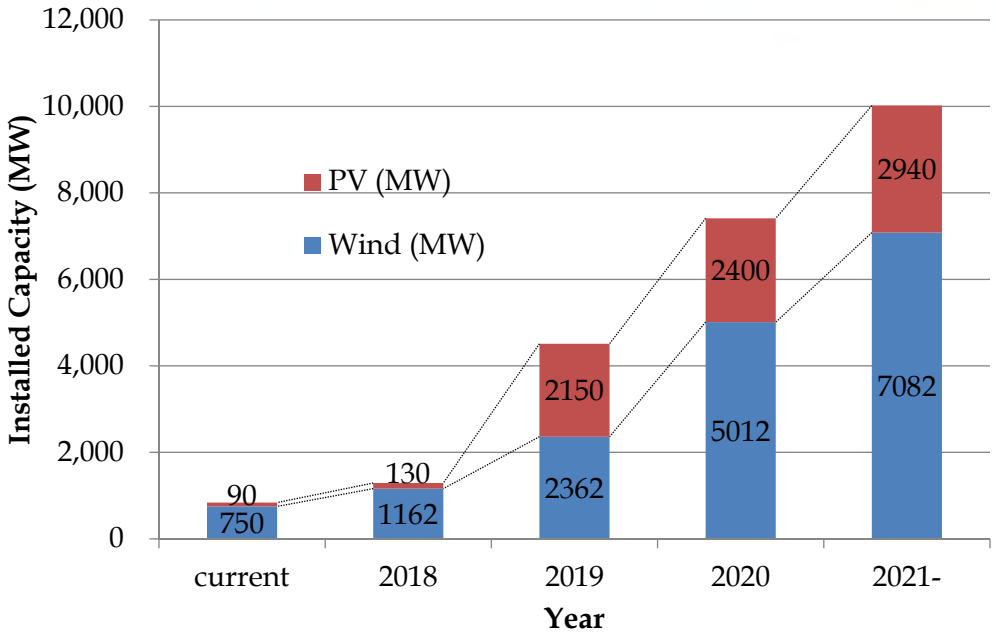
**Hirokazu TSUJITA**

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., Ltd. (TEPSCO)

## Development Plan for Renewable Energy





# Expected PV plant development plan list (until 2021)

Engineering for the NEXT

| Project | | Capacity (MWp) | Site | Expected operation start |
|---|---|---|---|---|
| Existing | Current Capacities | 90 | Stand Alone and Roof Top Grid Connection. Excluding street light | |
| NREA Project | Hurghada (JICA) | 20 | Hurghada | 2018 |
| | Kom Ombo (AFD) | 20 | Kom Ombo | 2018 |
| | Hurghada (Korea) | 20 | Hurghada | 2019 |
| | Zafarana (KfW) | 50 | Zafarana | Not confirmed yet |
| | Kom Ombo (Arab Fund for Economic & Social) | 50 | Kom Ombo | 2020 |
| BOO Project | BOO Kom Ombo | 200 | Kom Ombo | 2020 |
| | EETC BOO West Nile Valley | 200 | West Nile Valley | 2021 |
| FIT Project | Kom Ombo by Feed-in-Tariff | 2,000 | Kom Ombo | 2019 |
| | Roof top small PV by FIT | 290 | | 2021 |
| Total | | 2940 | | |





# Location of the PV project (Existing and Planned)

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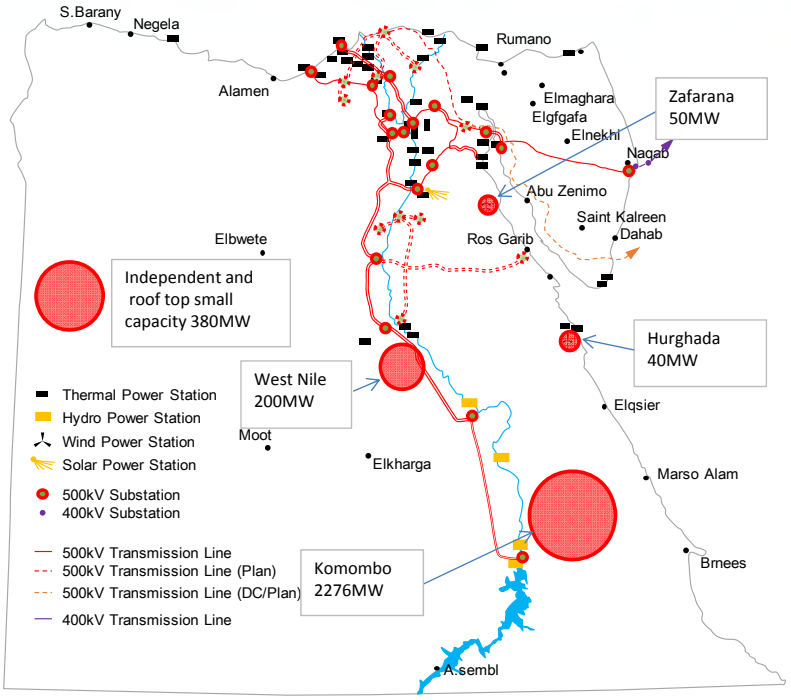


# Expected wind project development plan list (until 2021)

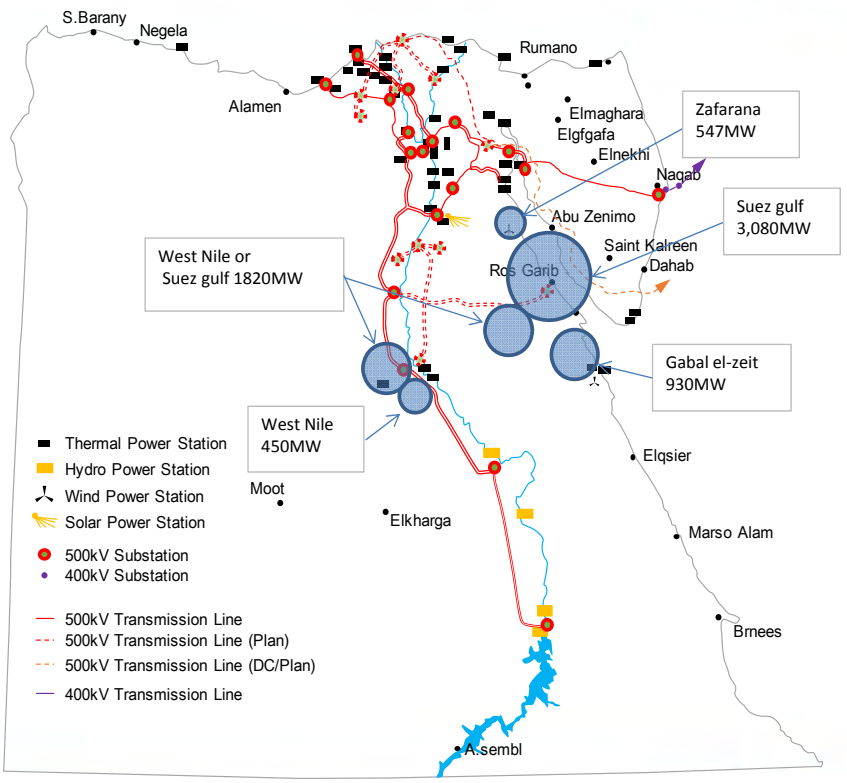
Engineering for the NEXT

| Project | | Capacity (MW) | Site | Expected operation start |
|---|---|---|---|---|
| Existing | Current Capacities | 750 | Zafarana, Hurghada and Gabal El-Zayet | |
| NREA Project | Ext. of Wind (Gabal El-zayte-1) | 40 | Gabal El-zayte (KfW5) | 2018 |
| | Wind (Gabal El-zayte-2) | 220 | Gabal El-zayte (JICA 2) | 2018 |
| | Ext. of Wind (Gabal El-zayte-2) | 32 | Gabal El-zayte | 2018 |
| | Wind (Gabal El-zayte-3) | 120 | Gabal El-zayte (Spain) | 2018 |
| | Wind (Suez Gulf-1) | 200-250 | Suez Gulf (KfW 6) | 2019 |
| | Wind Masdar and NREA | 200 | Suez Gulf | 2019 |
| | Wind West Nile (JICA) | 200 | West Nile | 2020 |
| | Wind AFD Ras Ghareib (Suez Gulf-3) | 200 | Suez Gulf (AFD) | 2020 |
| | Siemens - Wind | 180 | Suez Gulf | 2019 |
| | Siemens - Wind | 1820 | Suez Gulf and West Nile | Not confirmed yet |
| BOO Project | Toyota WIND BOO Suez Gulf | 250 | Gabal El-zeit | 2019 |
| | Wind BOO (West Nile) | 250 | West Nile | 2020 |
| | Wind BOO (South Gulf) | 250 | Between Zafarana and Gabal El-zayet | Not confirmed yet |
| | Italgen (BOO) | 320 | Gabal El-Zayet | 2019 |
| FIT Project | Wind Feed-in-Tariff Projects | 2,000 | Suez Gulf | 2020 |
| Total | | 7,082 | | |



# Location of the Wind project (Existing and Planned)

Engineering for the NEXT



## Current situation of the institution and regulation

Engineering for the NEXT

**Major Program and regulations for Renewable Energy have been already issued**

### Feed In Tariff (FIT) Program

- ◆**2014 Phase 1 issue**
  - ✓ For Wind and PV
  - ✓ Participants are few
- ◆**2016 Phase 2 issue**
  - ✓ FIT price was decreased
  - ✓ Considering the risk hedge for investor

### Grid Code

- ◆**2015 Grid Code for Wind Energy issued**
  - ✓ Voltage and Frequency range, Power Quality, Active and Reactive power control
  - ✓ Fault ride through, Protection and Real time Monitoring
- ◆**2017 Grid Code for Solar (Incl. PV and Solar thermal ) issued**





## Suggestion

Engineering for the NEXT

**According to the Development Plan of Renewable Energy generation will occupy more than 30% of the total Power supply ( at the bottom load)**
**Following study and appropriate measures would be required**

1. **Proper reinforcement of the transmission line network**
2. **Measures for voltage stabilizing ( Locally )**
3. **Measures for sudden power drop or unexpected excess power output ( Effect for Thermal or Hydro Power Generations and their operation )**

# Suggestion for Issue 1 (Reinforcement of network)

Engineering for the NEXT

**Issue 1** is referred to "Transmission system"

- ✓ **Appropriate development plan especially up to year 2025 is under study in EETC.**
- ✓ **Long term plan such as year 2030 need to be issued in future.**





# Suggestion for Issue-2 (Measures for Voltage fluctuation)

Engineering for the NEXT

**Issue 2** is referred to "Distribution System"

- ✓ **For the moment, renewable energy would be introduced mainly transmission system.**
- ✓ **However in future such as after 2020, there might be concentrated introduction of PV in distribution system.**

Candidate Project No.6

Introduction of voltage countermeasure equipment in distribution system to cope with massive renewable energy generation

# Suggestion for issue-3 (Measures for sudden power change)

Engineering for the NEXT

**Issue3** is referred to the first section "Overall results"

- ✓ **It needs to stress the appropriate measures to maintain the frequency while preserving stable and economical generation operation.**

Candidate Project No.12

The Preparatory survey on the Construction Project of Nile Valley Pumped Storage Power Plant





# Applicable Japanese Technologies regarding the issue-3

Engineering for the NEXT

**Regarding Issue3 It need to maintaining the system frequency.**

Adjustable speed pumped storage system

- ✓ can absorb or produce the power swiftly to cope with the renewable energy output change.
- ✓ can change its absorbing power even at the absorbing power(pump-up) mode.
  - ➢ There are widely applied in Japanese network.
  - ➢ Japanese manufacturers and utilities have high level technologies on facility and operation.
  - ➢ In Japan, to exploit the ability of the hydro pumped storage generation to realize stable and economical operation of the thermal generations.

# Applicable Japanese Technologies - Pumping storage

Engineering for the NEXT

## One of Solution for frequency fluctuation

*Adjustable Speed Pumped Storage System (Kazunogawa Hydro Power Plant)*

| | |
|---|---|
| Installed capacity | 400[MW] x 3 units = 1,200[MW] (#3: under construction, final total1,600[MW]) |
| Max. turbine discharge | 210[m3/s] (#4: 70[m3/s]) |
| Max. pump discharge | 170[m3/s] (#4: 60[m3/s]) |
| Max. effective head | 728[m] |


Surge chamber

Penstock
L = 1,615m～1,618m

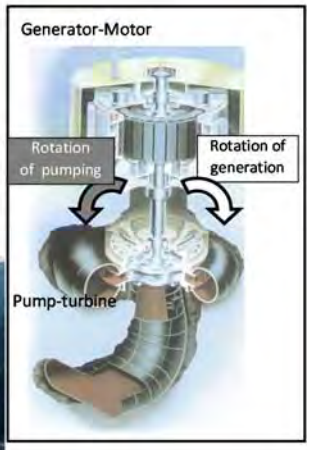
Headrace tunnel
3,278m

Elevation: 87.0m
Crest length: 494m
Volume of dam: 4,060,000m³

Tailrace
Surge tank

Elevation: 105.2m
Crest length: 263.5m
Volume of dam: 622,000m³

Tailrace
3,369m





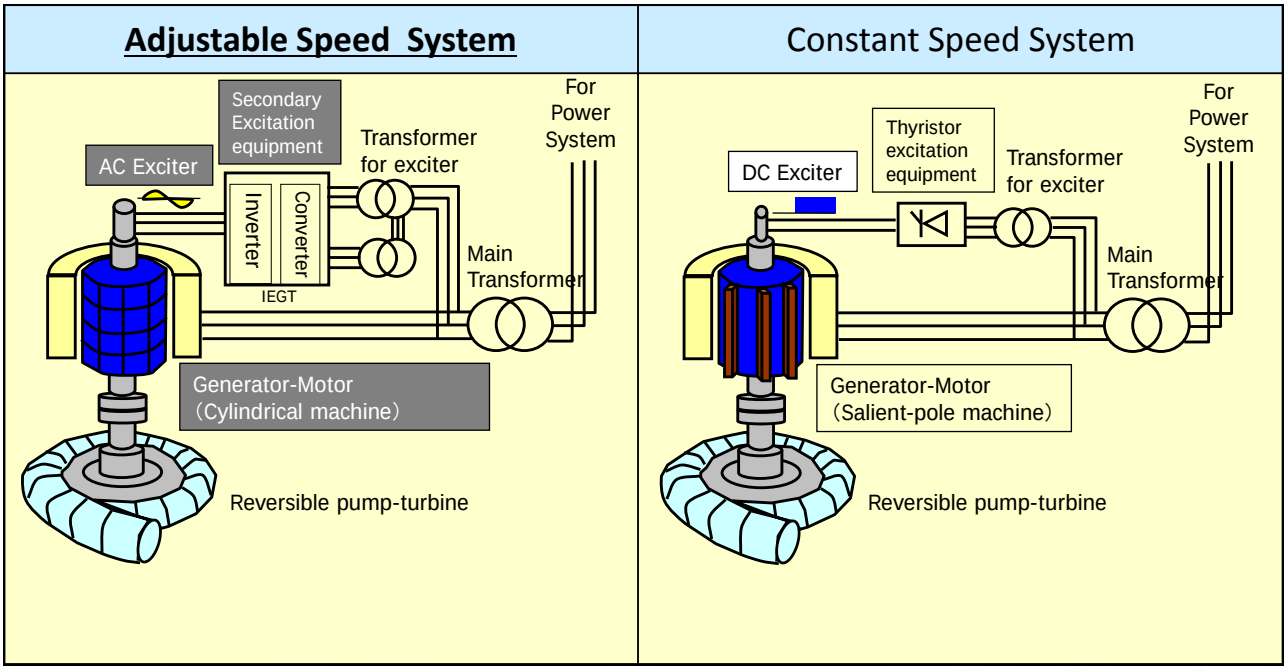



# Applicable Japanese Technologies - Pumping storage

Engineering for the NEXT

## One of Solution for frequency fluctuation

*Adjustable Speed Pumped Storage System*

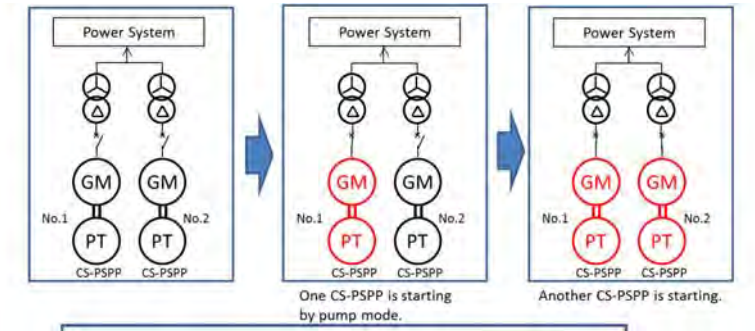


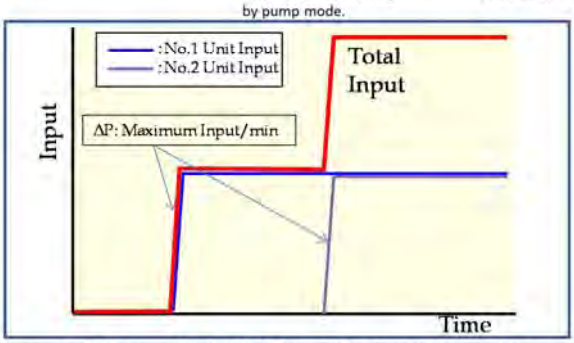
# Applicable Japanese Technologies - Pumping storage

Engineering for the NEXT

## One of Solution for frequency fluctuation

***Adjustable Speed Pumped Storage System***




GM : Generator-Motor　　AS-PSPP : Adjustable Speed Pumped Storage Power Plant
PT : Pump-Turbine　　CS-PSPP : Constant Speed Pumped Storage Power Plant



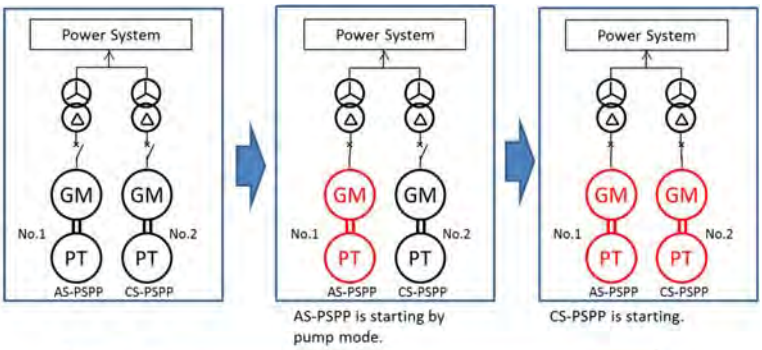


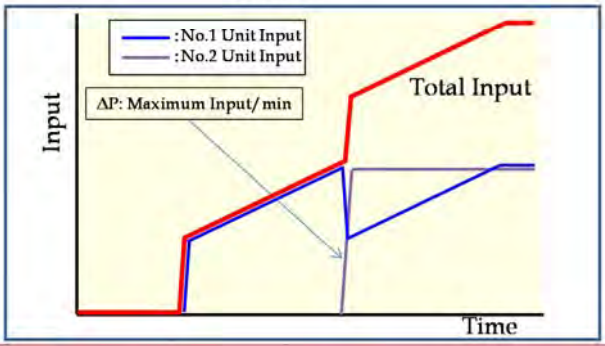
# Applicable Japanese Technologies - Pumping storage

Engineering for the NEXT

## One of Solution for frequency fluctuation

***Adjustable Speed Pumped Storage System***




By adopting AS-PSPP, rapid input change is improved.

# Applicable Japanese Technologies - Pumping storage

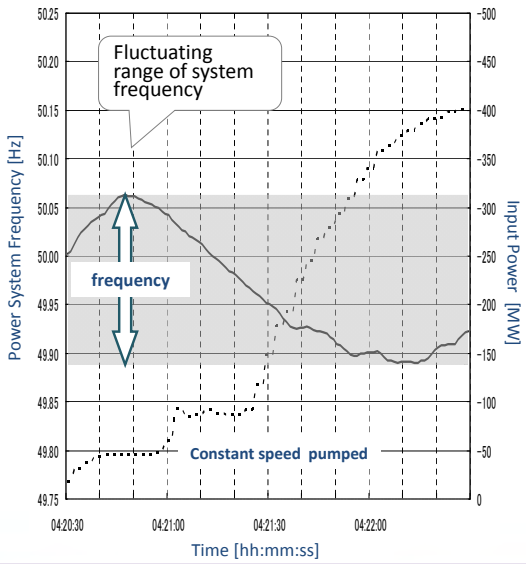
Engineering for the NEXT

## One of Solution for frequency fluctuation

***Adjustable Speed Pumped Storage System***

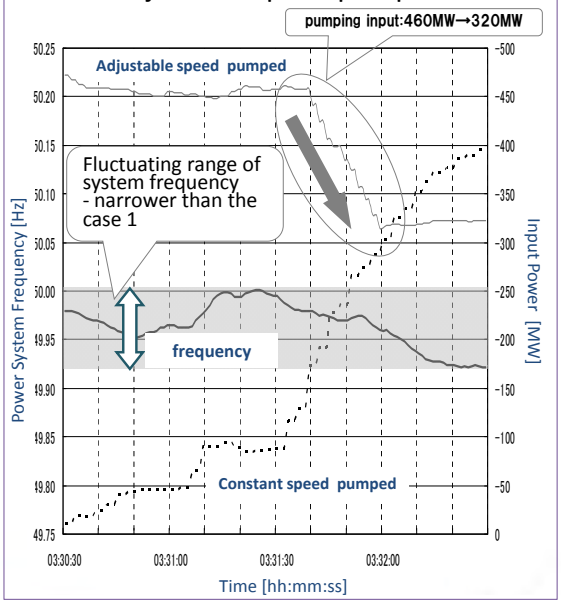
Case 1.

Without Adjustable speed pumped




Case 2.

With Adjustable speed pumped








# Applicable Japanese Technologies – Battery System

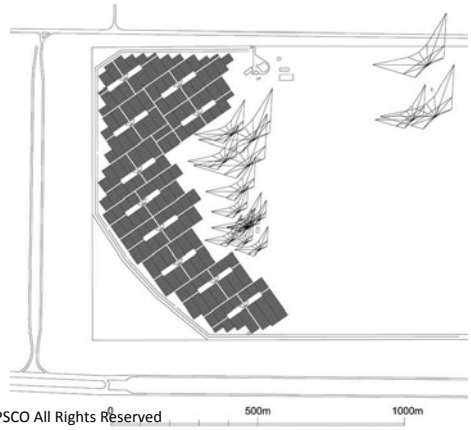
Engineering for the NEXT

## One of Solution for voltage fluctuation

Large Scale Battery system can be used for stabilizing of voltage fluctuation and energy shifting of renewable energy.

Large scale Battery system will be applied by JICA 20MW Hurghada PV project.

- 4MW-2MWh for stabilizing fluctuation
- 6MW-28MWh for energy shifting





Sodium sulfur battery (34MWh system)

# 3. Transmission system

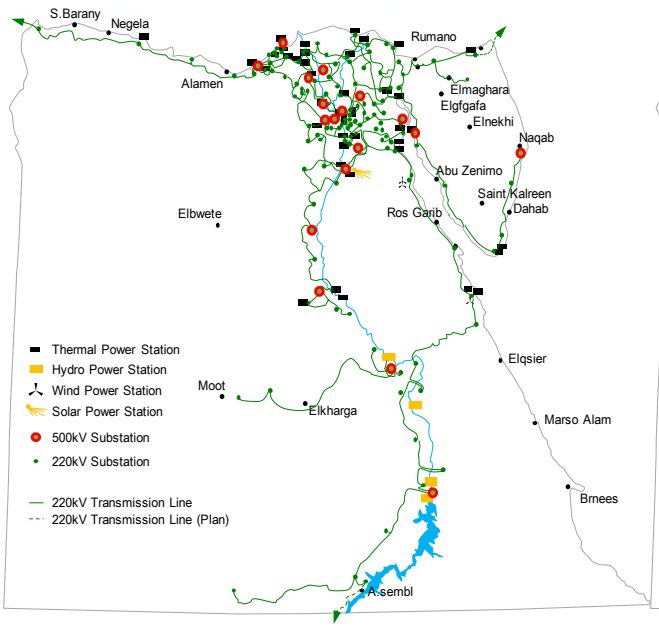
**Hidekazu Takase**

Japan International Cooperation Agency (JICA)

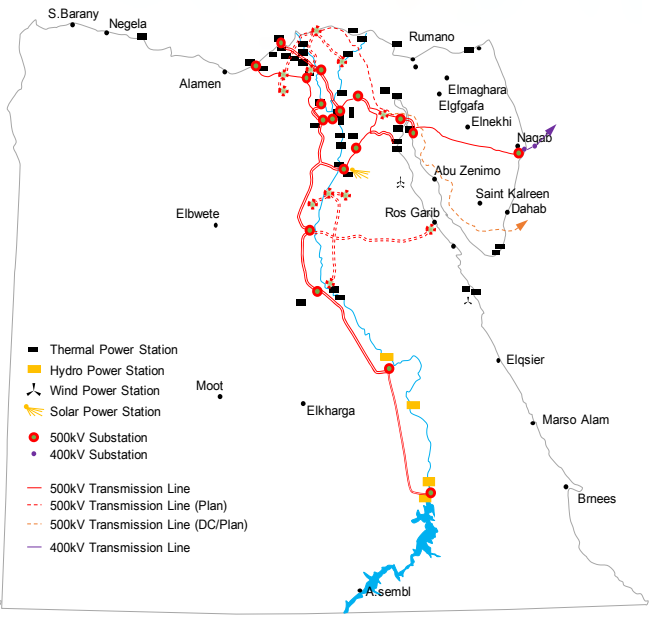
Tokyo Electric Power Services Co., Ltd. (TEPSCO)

## Power System Network at Present






220kV Power System Network in 2015



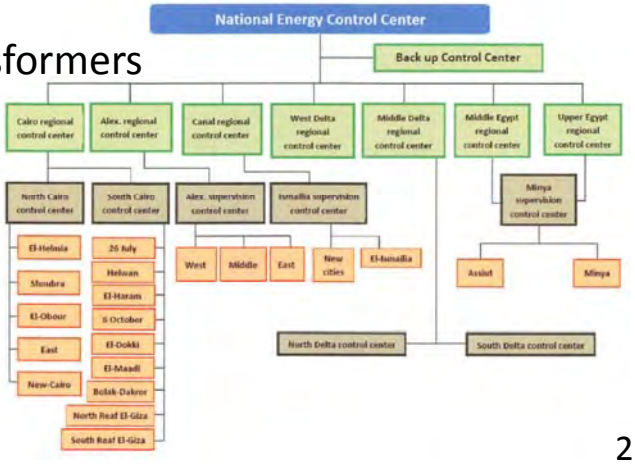

500kV Power System Network in 2015

# Transmission system operation at Present

Engineering for the NEXT

**The Power system network in Egypt is operated by the National Energy Control Center, Regional Control Centers and Distribution Control Centers according to voltage levels.**

- ✓ Supervision of Power Plant
- ✓ Power flow control
- ✓ Voltage supervision and control
  - Generator voltage
  - Bus-bar voltage of substation
  - On Load Tap changer for Transformers
  - Reactive power compensator
- ✓ Management of Fault current
- ✓ Network configuration control (Apply the N-1 criteria)
- ✓ Data Acquisition








# Over all Observation of the Transmission system

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**Network**

- ✓ Power system network has been constructed under N-1 criteria
- ✓ Transmission network is consisting with Radial configuration
- ✓ 220kV fault current is increasing at Cairo zone due to reinforcement of power plant on surrounding area

**Operation**

- ✓ Operation is maintained with specified voltage and specified frequency
- ✓ Load shedding has not been done in recent years
- ✓ Load and generation balance has been maintained well.

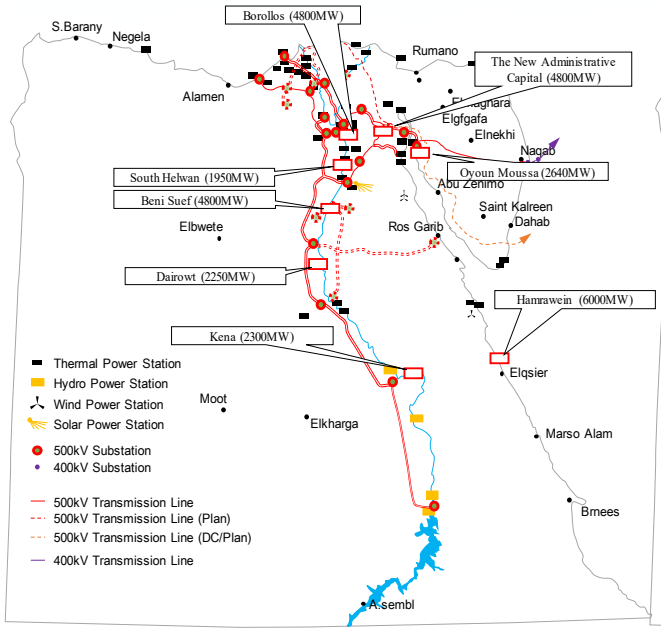
**Training**

- ✓ EEHC has a lot of programs for development of human resource
- ✓ The programs include the sector of power generation, substation, transmission and distribution
- ✓ The training centers are located in various places in Egypt

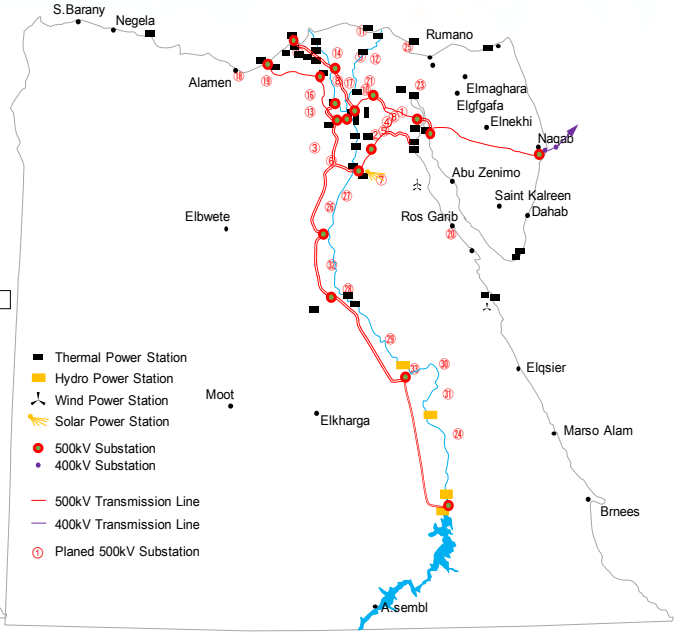
**Currently, the Transmission network has been operated well. And the trainings has been executed well**

# Development Plan by EEHC and EETC

Engineering for the NEXT




Power Plant Development Plan



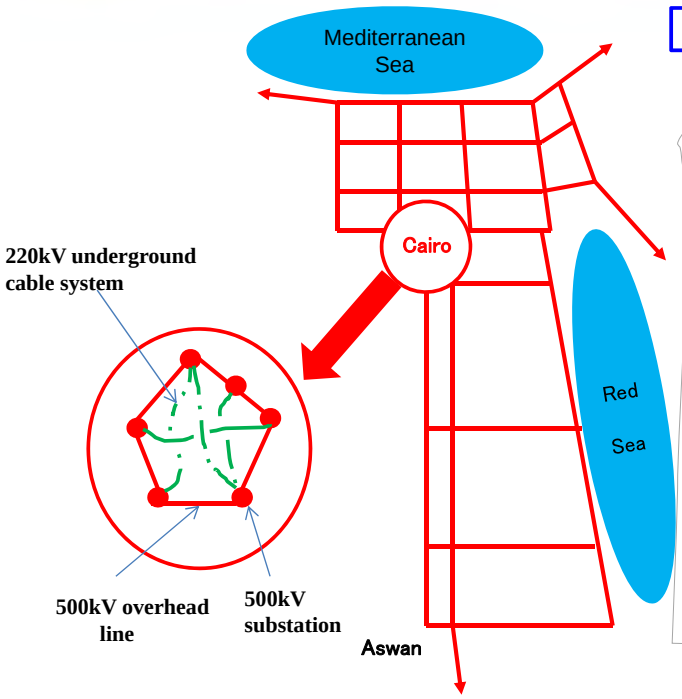

Plan of the 500kV Substation Development Locations





# Image of Power System Network in Future

Engineering for the NEXT



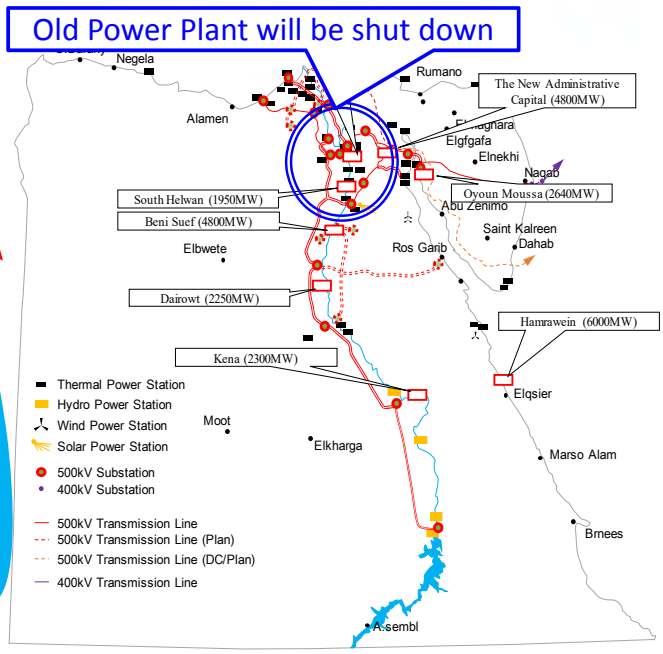




Image of Power System Network in Future

*Result of interview with EETC / Made by survey team

Changing of Power supply situation

# Image of Power Flow in Future

Engineering for the NEXT

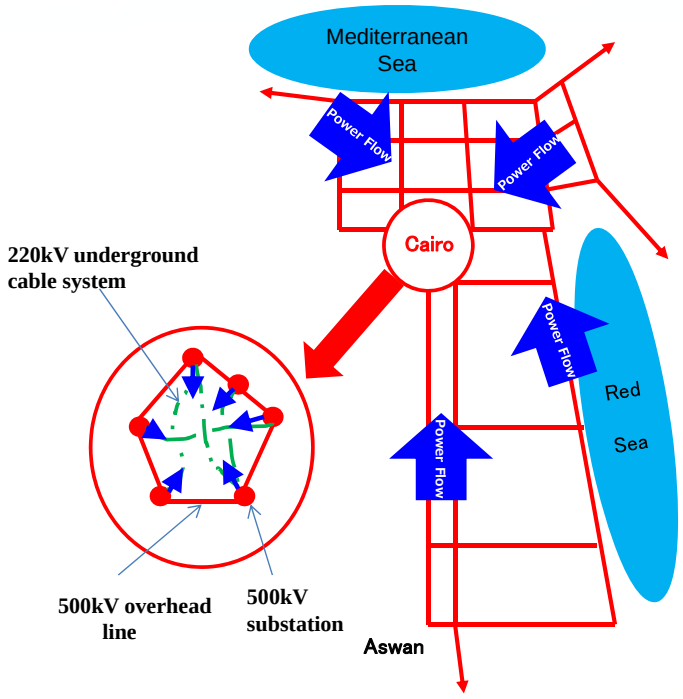



Image of Power Flow in Future

**Following problems may occur in future, due to gathering the power flow in Cairo.**

- ✓ Over load of transmission lines
- ✓ Over load of transformers in hub substation
- ✓ Increasing of Fault current

**In addition, frequency and voltage fluctuations will be increasing, when the connected capacity of renewable energy become lager.**

**Considering the above situation, measures for network extension will be needed.**





# Improvement of the Network system in Future

Engineering for the NEXT

**By renovation from radial configuration to loop configuration, reliability of the power system will be improved.**

**but …**

**Voltage control**

Adjustment of reactive power must be considered throughout the entire system

**Response to failures**

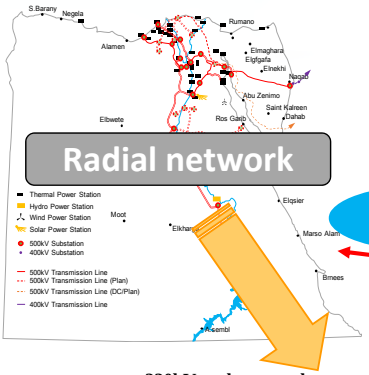
Total management of network protection is important for loop configuration network.

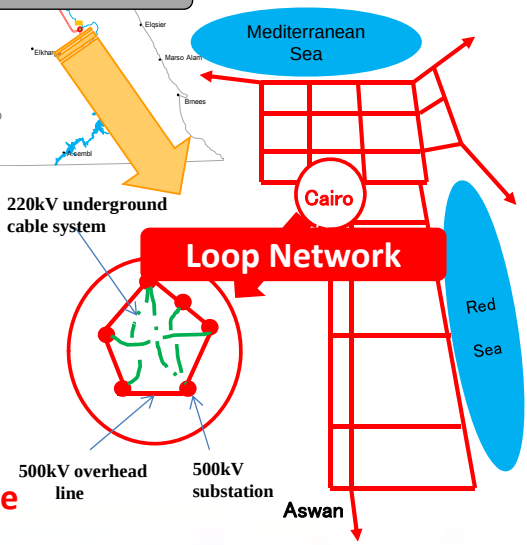
**Fault current**

Fault current will be increased more with applying the loop configuration.

**Technical Cooperation can be apply with Japanese advanced experience, if the assistance will be requested officially from Egyptian side.**

Current 500kV Transmission Network




Future 500kV Transmission Network

# The Candidate Project for Improvement of Network

Engineering for the NEXT

Candidate Project No.1

*Starting Year 2019*

Technical Assistance on improvement of voltage / reactive power planning technique and introduction of power stabilization system in 500kV bulk power system

**This technical assistance would advise voltage and reactive power control methods in 500kV bulk power system, based on the experience in Japan.**

Candidate Project No.2

*Starting Year 2020*

Introduction of Voltage / Reactive Control System and Power Stabilization System in 500kV bulk power system

**This ODA loan project would plan to install power system stabilization and reactive power control devices, based on the result of candidate project No.1.**





# Constraint of the new transmission facilities in Cairo considering the improvement of the network

Engineering for the NEXT

## High Reliability

The higher reliability of the substation facilities shall be required for new 500kV substations around the Cairo metropolitan.
The effect of the operation suspension of the 500kV substation will be huge.

## Compact

Land acquisition for substation and transmission line will be difficult in Cairo.
It needs to consider the effective utilization of the site. Adaptation of the Compact size equipment (such as GIS) is the one solution for the issue.

## Safety

The Substation requires higher safety. Especially in case underground substation must be careful with assure of the room ventilation and measures for fire incident.

# The Candidate Project for Improvement of Network

Engineering for the NEXT

Candidate Project No.3

*Starting Year 2018*

Technical assistance on development of 220kV Cairo and its metropolitan area supply system facilities

**This technical assistance would conduct to formulate basic policy and roadmap of the power supply network development suitable for Cairo metropolitan area in long term perspective, based on experience in Japan.**

Candidate Project No.4

*Starting Year 2021*

Introduction of 220kV Cairo and its conurbation metropolitan area supply system facilities

**This ODA loan project would include some important part of installation on underground or indoor substation(s) for the city central area with underground network cable system.**

Candidate Project No.5

*Starting Year 2021*

Introduction of 500kV Substation construction which would serve for the 220kV underground cable system starting point

**This ODA loan project would include installation of higher reliability new 500kV GIS substation(s) which will supplying for Cairo metropolitan area.**



# Issue on Upgrading of fault current levels

Engineering for the NEXT

**Issue**

- ✓ The large enhancement of the electric power network will be a cause of rising of fault current.
- ✓ In Egypt, fault current level would be upgraded to
  - 50kA in 500kV network
  - 63kA in 220kV network
- ✓ Upgrading fault current requires replacement of circuit breakers and the other substation facilities. In addition replacement of some transmission line facilities ( such as spacer, insulator ) will be needed.

**Possible Solution**

- ✓ Appropriate survey of the effect to the transmission facilities by the fault current upgrading.

# Conclusion

Engineering for the NEXT

**For the transmission network, major points of view are listed as follows;**

- ✓ **Voltage Control**
  - Adjustment of reactive power throughout the entire system
- ✓ **Proper Protection System**
  - Certain protection system applying for loop configuration network
- ✓ **Fault Current increasing**
  - Upgrading Fault current level for 500kV and 220kV network
- ✓ **Voltage and Frequency fluctuation**
  - Energy storage battery system for local voltage fluctuation
  - Adjustable speed pumping system for frequency fluctuation
- ✓ **Introduce of new 500kV loop configuration network**
  - Improvement of reliability of the network
- ✓ **Introduce of new 220kV underground network**
  - Measures for over load of transmission network

Technical Assistance of study for the above issues will be helpful





# Applicable Japanese Technologies

Engineering for the NEXT

| Facility | Japanese Technology | Key Word |
|---|---|---|
| Bulk power system | Power System Control | High Reliability |
| Outdoor Substation | Gas Insulated Switchgear | High Reliability<br>Compact |
| Under Ground Substation | Gas Insulated Transformer | High Reliability<br>Compact<br>Safety |
| Under Ground Cable | Under Ground Grid Under Ground Cable | High Reliability<br>Compact<br>Safety |
| Over Head Transmission Line | Conductor | High Reliability<br>Compact |

# Applicable Japanese Technologies

Engineering for the NEXT

## Power system control

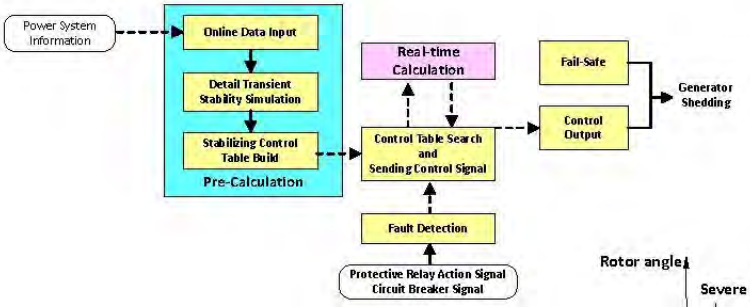
High Reliability | Compact | Safety

MITSUBISHI ELECTRIC Changes for the Better

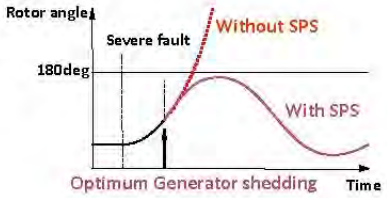
### Special Protection System (SPS)

for a greener tomorrow

**Prevents wide-area blackout in case of severe faults. Transmission Capacity can be raised up to the thermal limit of transmission lines.**




Block diagram of Advanced SPS (on-line adaptive type)








# Applicable Japanese Technologies

Engineering for the NEXT

## Power system control

High Reliability | Compact | Safety

MITSUBISHI ELECTRIC Changes for the Better

### Special Protection System (SPS)

for a greener tomorrow

◆**Advantages**

◆**Enhancement of Power System Stability and Reliability**

➢Stability, frequency or voltage problems can be solved by it's enough robustness and adaptiveness

◆**Investment Cost Reduction**

➢Transmission Capacity can be raised up without constructing other transmission lines

◆**System Operator Support**

➢Optimum amount of generation restraint to keep stability can be offered on-line

# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Switchgear

High Reliability | Compact | Safety

### Gas Insulated Switchgear (GIS)

HITACHI
Inspire the Next

- Solution for Low High Voltage & High Quality Power System Network
- Many experiences of outdoor installation

| Customer (Country) | Rated Voltage | Year |
|---|---|---|
| B.P.A. (U.S.A.) | 550 | 1977 |
| Kyushu Electric Power Co., Inc. (Japan) | 550 | 1979 |
| Tokyo Electric Power Co., Inc. (Japan) | 550 | 1994 |
| Hokuriku Electric Power Co., Inc. (Japan) | 550 | 1997 |
| Shandong Electric Power (China) | 550 | 2005 |
| EGAT (Thailand) | 550 | 2015~ |
| --- | --- | --- |
| MEC (Saudi Arabia) | 420 | 1980 |
| SCECO-E (Saudi Arabia) | 420 | 1987 |
| WED (Abu Dhabi) | 420 | 1992 |
| --- | --- | --- |







# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Switchgear

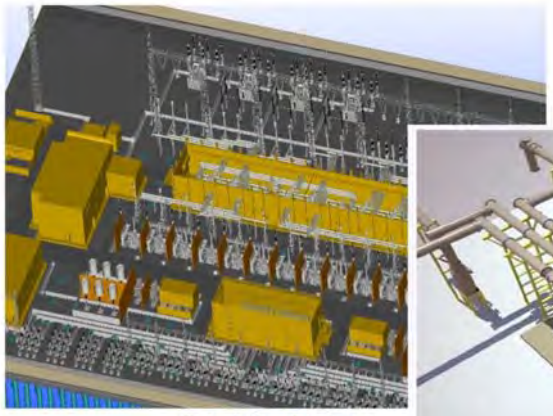
High Reliability | Compact | Safety

### Substation & GIS Design

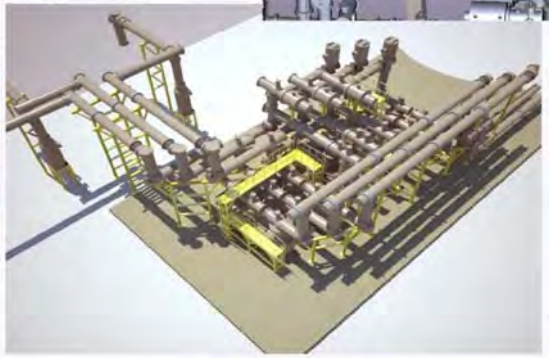
HITACHI
Inspire the Next

- Solution for optimized substation and GIS layout design with 3D Technology

GIS Installation work support



Substation Design



GIS Layout Design

# Applicable Japanese Technologies

Engineering for the NEXT

**Gas Insulated Switchgear**

High Reliability | Compact | Safety

## Mitsubishi GIS Advantages

for a greener tomorrow

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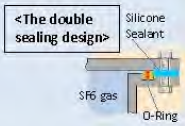
| | Items | Features |
|---|---|---|
| 1 | Outdoor installation | ・Proven supply experiences of outdoor installation since 1968  |
| 2 | Spring operating mechanism | ・Low failure rate<br>・Torsion bar spring  |
| 3 | Low failure rate | ・High reliability<br>・Proven experience |
| 4 | Gas leakage rate | ・Less than 0.1%/year    |
| 5 | Insulator | ・In-house production<br>・Less than 0.1pC partial discharge |
| 6 | PDM sensor & system | ・In-house production |
| 7 | Synchronous switching GCB | ・Solutions of surge elimination<br>・Longer life |





# Applicable Japanese Technologies

Engineering for the NEXT

**Gas Insulated Switchgear**

High Reliability | Compact | Safety

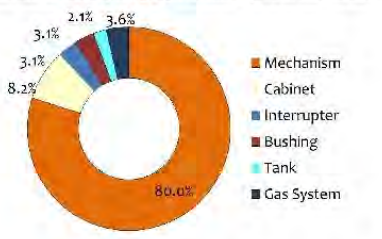
## Spring operating mechanism(1)

for a greener tomorrow

**Higher reliability - Spring vs. Hydraulic**

- Trend of operating mechanism development is spring-spring mechanism for higher voltage, considering maintenance-free and high-efficiency.
  - ・80% of failures occur in operating mechanism.
  - ・More simple controls of spring operating mechanism account for less failures, comparing with hydraulic mechanism.

◆Failures in spring/hydraulic operated GCBs




Ref: Reliability and Failure Analysis of Gas Circuit Breaker (Koyama et al. ) CIGRE technical colloquium A3-212, 2011

◆Failure rate: Spring vs. Hydraulic (Failure/unit x 100 years)


No parts in spring mechanism = No chance of failure

# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Switchgear

High Reliability | Compact | Safety

MITSUBISHI ELECTRIC Changes for the Better

### Spring operating mechanism(2)

for a greener tomorrow

**Spring operating mechanism**

**Maintenance Free**

- Less electrical/mechanical parts = less chances of failure.
- Lubrication coating and sealed bearings to reduce periodic lubrication.

**High Efficiency**

- Stable operating characteristics
  - Negligible degradation of spring characteristics, especially for torsion spring
  - Minimum variation in operating characteristics over various ambient temperature
- Efficient energy consumption by torsion bar spring.

◆ **145kV/245kV**


◆ **420/550kV Torsion bar spring**








# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Switchgear

High Reliability | Compact | Safety

MITSUBISHI ELECTRIC Changes for the Better

### Gas leakage rate

for a greener tomorrow

**Low SF6 gas leakage rate**

➢ Mitsubishi Electric has more strict criterion for both factory tests and site tests
- to consider environment protection.
- to secure high quality and reliability for long-term usage.

| | Factory Test | Site Test |
|---|---|---|
| Mitsubishi Electric | ≤ 0.1 % / year | ≤ 0.1 % / year |
| IEC Standard | < 0.5 % / year | < 0.5 % / year |

◆Double sealing

Double sealing with different materials (o-ring for primary gas sealing and silicone sealant for water/oxygen-proof) to ensure;
- < 0.1%/year leakage rate
- no water ingress
- no rusting
- no o-ring rubber oxidation

◆Additional protection for outdoor installation

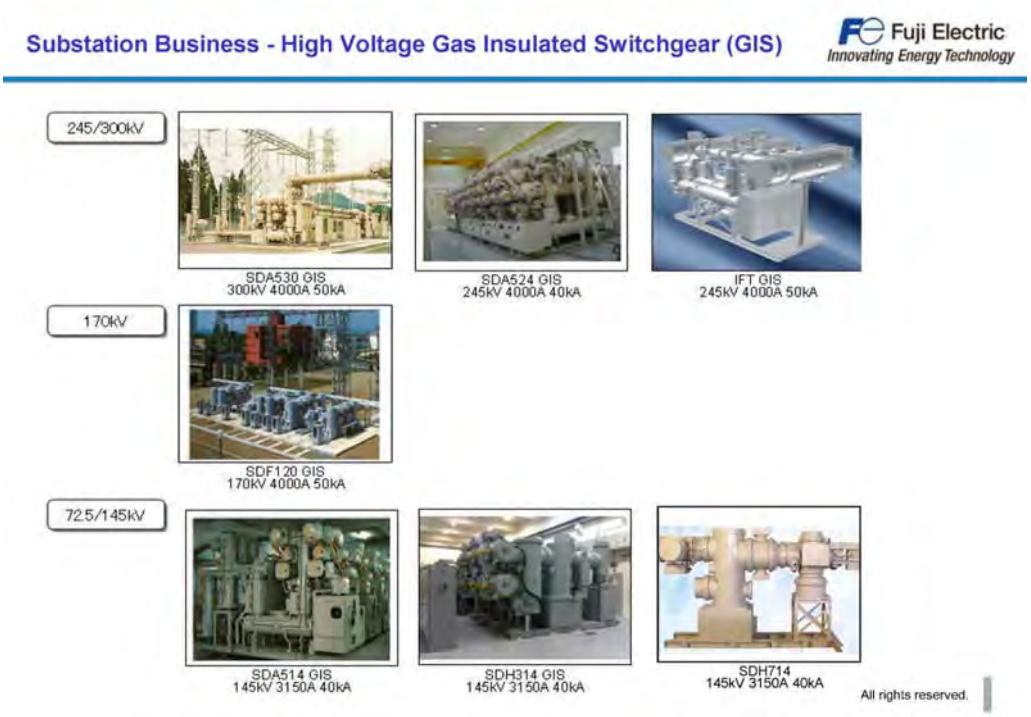
For outdoor installation, the followings are applied in addition to the double sealing;
- Seal washers
- Special bolts with groove & silicone sealant injected washers for insulating spacers

# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Switchgear

High Reliability | Compact | Safety








# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Transformer

High Reliability | Compact | Safety

MITSUBISHI ELECTRIC
Changes for the Better

### Mitsubishi Gas Insulated Transformer

for a greener tomorrow

**MITSUBISHI GIT (Gas Insulated Transformer ) History**

1. In 1963, Start for development of Gas Insulated Transformer
2. First supply, 3MVA 66kV for Bank of MITSUBISHI in 1979
3. The first supplier to Overseas 1.5MVA 11kV for Hong Kong Electric in1981
4. First supply of power Gas Insulated Transformer to Overseas
   60MVA 275kV for Hong Kong Electric in 1992

**MITSUBISHI GIT (Gas Insulated Transformer ) Product Range**

1. CAPACITY : Max.100MVA on 132kV class, Max.50MVA on 275kV class
2. VOLTAGE : Max.275kV (LI 1050kV)

**Supply record of GIT (>1000kVA) (as of 2016)**

More than 1,000 units of Gas Insulated Transformer had supplied in the World from AKO factory.


Suitable for Under Ground S/S and Building S/S in URBAN area and VIP area

**Feature of GIT**

1. Non-Flammable, Non-Explosive
2. No fire-fighting system requirement
3. Easy maintenance
   (1) Less Maintenance Item than OIT
   - SF6 GAS (Basically, no maintenance)
   - CHECK GAS TEMP. • CHECK GAS BLOWER
   - CHECK GAS PRESSURE (Check gas leakage)
4. Reduction of installation period
   (1) Installation schedule : approx. 25% reduction against OIT.
   (2) Transportation volume : approx. 25% reduction against OIT.
5. Flexible arrangement
   Much low density(SF6 gas ≒ 1/60 of mineral oil)
   Flexible radiators arrangement

# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Transformer

High Reliability | Compact | Safety

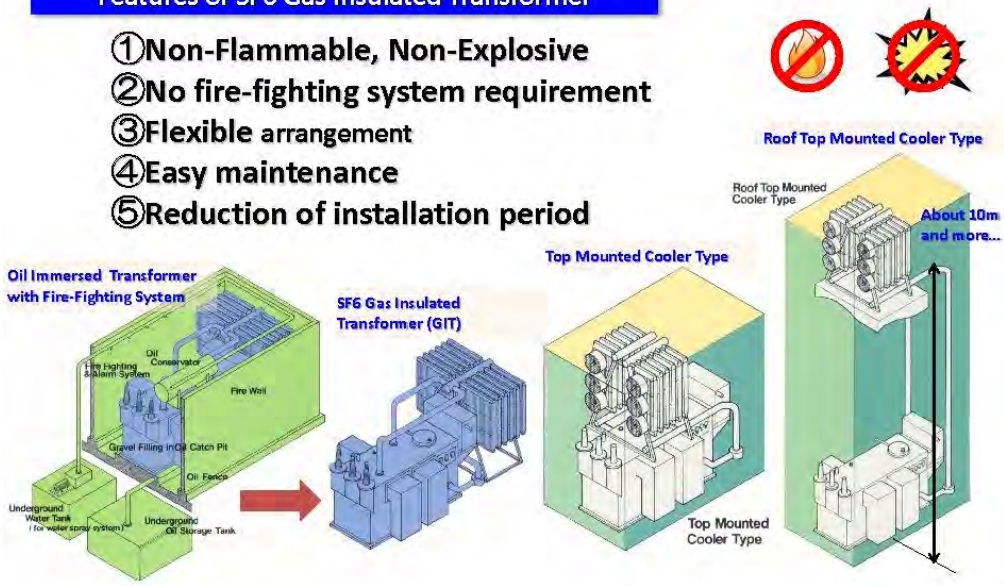
MITSUBISHI ELECTRIC
Changes for the Better

### Feature of SF6 GAS Transformer

for a greener tomorrow

**Features of SF6 Gas Insulated Transformer**

①Non-Flammable, Non-Explosive
②No fire-fighting system requirement
③Flexible arrangement
④Easy maintenance
⑤Reduction of installation period










# Applicable Japanese Technologies

Engineering for the NEXT

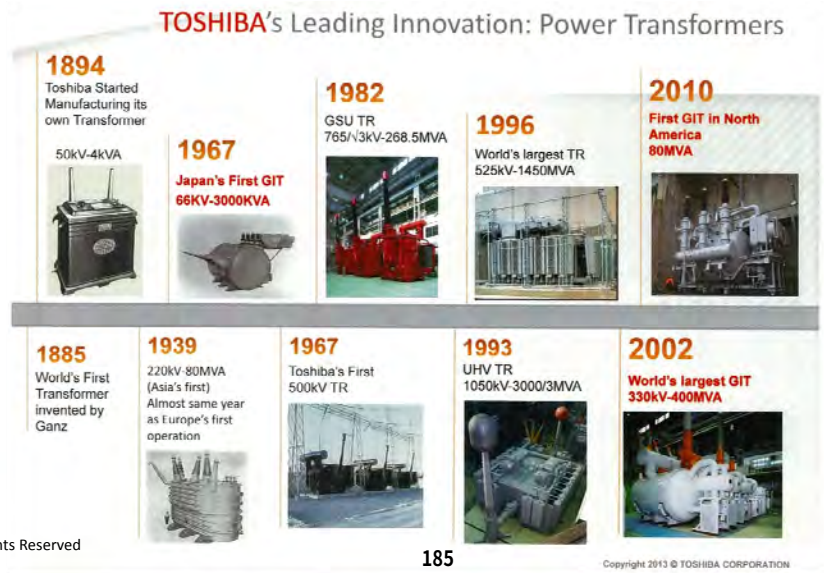
## Gas Insulated Transformer

High Reliability | Compact | Safety

TOSHIBA
Leading Innovation

Upon increase of power consumption in urban area, a large number of substations have been constructed in the area with several constraints against space and safety such as explosion and fire. Toshiba Gas Insulated Transformer (GIT) was developed as a solution for ultimate safety against fires and explosions with advantages for very compact layout in substation application.

The GIT has several excellent features over the conventional oil transformer.



# Applicable Japanese Technologies

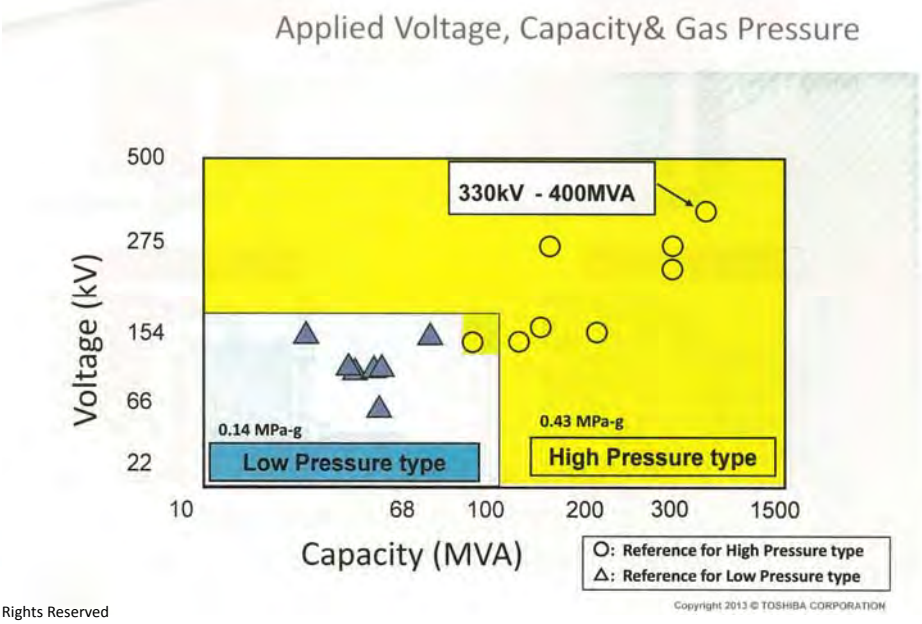
Engineering for the NEXT

## Gas Insulated Transformer

High Reliability | Compact | Safety

TOSHIBA Leading Innovation

Toshiba supplies a wide range of GITs with low pressure gas and high pressure gas technology.








# Applicable Japanese Technologies

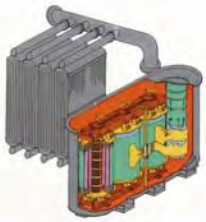
Engineering for the NEXT

## Gas Insulated Transformer

High Reliability | Compact | Safety

TOSHIBA Leading Innovation

The construction of a GIT is basically the same as an OIT, with the exception of insulating material and cooling medium. Therefore broad experience of OIT technology can be applied to GIT design, manufacturing and maintenance.



Comparison of the GIT and OIT

| Item | | GIT | OIT |
|---|---|---|---|
| Medium | | SF6 | Insulating oil |
| Conductor insulation (Thermal class) | | Polyethylene terephthalate(PET) film (120℃ or 130℃) | Cellulose paper (105℃) |
| Solid insulation material | | Pressboard | |
| Core material | | Grain-oriented silicon steel tape bind clamping type | |
| Winding conductor material | | Copper or Aluminum | |
| Conservator | | Unnecessary | Necessary |
| Pressure relief device | | Unnecessary | Necessary |
| On-load tap changer | Arcing switch of the diverter | Vacuum valve | Arcing contact in insulating oil |
| | Tap selector | Roller contact | Sliding contact |

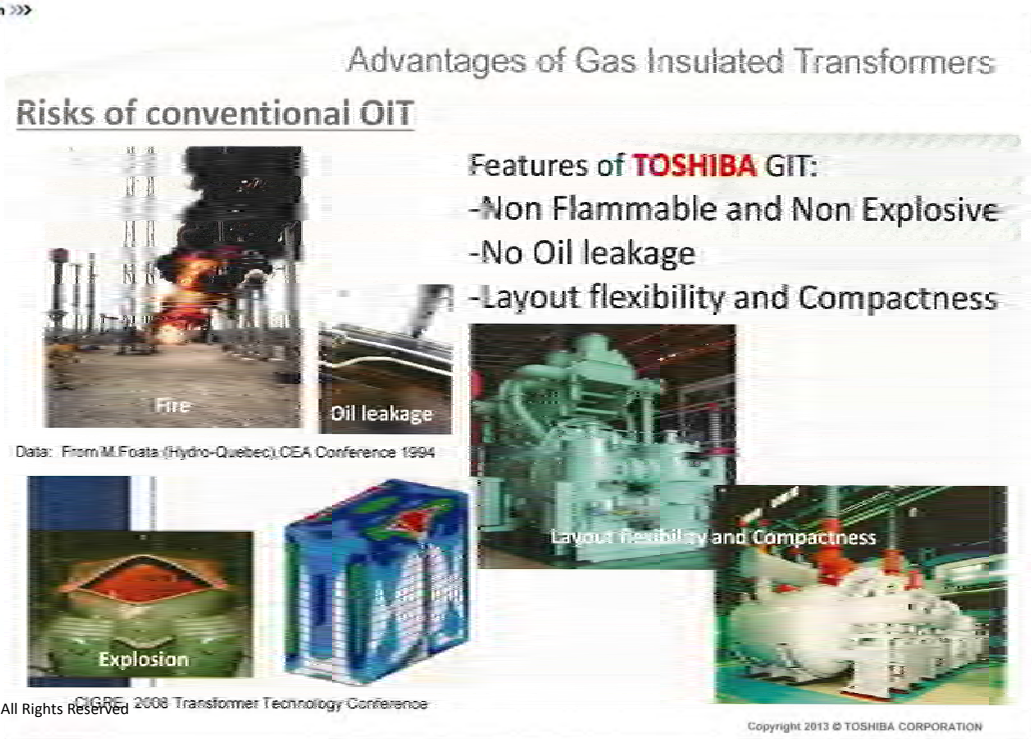
# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Transformer

High Reliability | Compact | Safety

TOSHIBA
Leading Innovation








# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Transformer

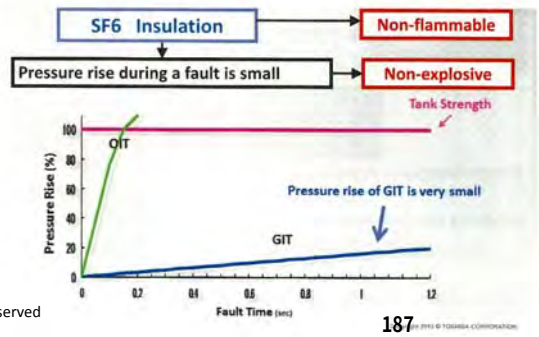
High Reliability | Compact | Safety

TOSHIBA
Leading Innovation

Transformer comparison regarding the explosion/fire risks

| | Gas insulated | Oil-immersed | Ester oil-immersed |
|---|---|---|---|
| Medium | SF6 | Mineral Oil | Ester oil |
| Tank explosion | No risk | Possible | Possible |
| Fire risk | No risk | Risk | Risk |
| Remarks | - Non explosion<br>- Non flammable | Flammable<br>(Flash point = Approx. 140 °C) | Flammable<br>With condition<br>(Flash point = Approx. 300 °C) |

Non Flammable and Non Explosive




Gas insulated type:
Tank explosion is no risk due to non-explosion and no fire of the SF6 characteristic.

Ester oil immersed type:
Tank explosion is possible and fire risk is unavoidable.
At tank internal failure, as internal arc and surrounding gas temperature will be 1700°C to 3500°C, higher flash point of 300°C on Ester oil has still tank explosion risk same as mineral oil transformer. The fire of Ester by the explosion will continuously burn and lead to serious substation fire disaster.
CIGRE brochure in 2013 declarers that such oil transformer can still burn and GIT is only the transformer with virtually a zero fire risk.

Significant tank pressures do not occur during internal failures due to the Gas characteristics. The risk of a tank explosion or fire incident can be completely eliminated.

# Applicable Japanese Technologies

Engineering for the NEXT

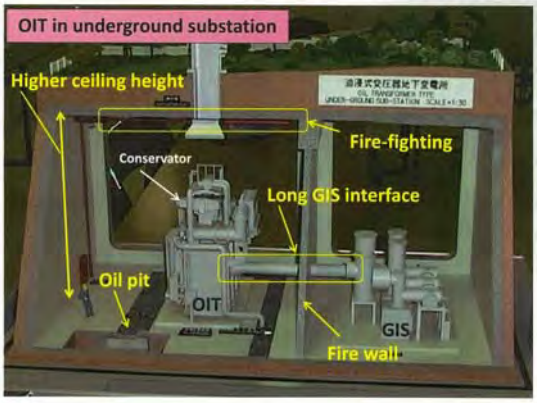
## Gas Insulated Transformer

High Reliability | Compact | Safety

TOSHIBA Leading Innovation

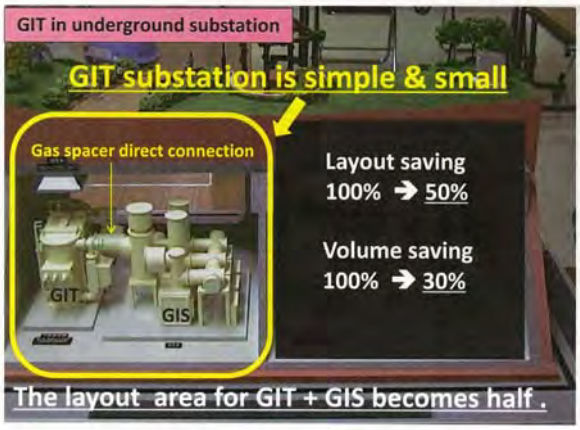
As oil is not used in both GIT and GIS equipment, neither a fire wall nor separate rooms are required. Fire fighting, oil pit, higher ceiling height, long GIS interface are also not required.
By installing both GIT and GIS in the same room, a compact substation can be realized.

Layout flexibility and Compactness feature of Gas Insulated Equipment






Layout flexibility and Compactness feature of Gas Insulated Equipment










# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Transformer

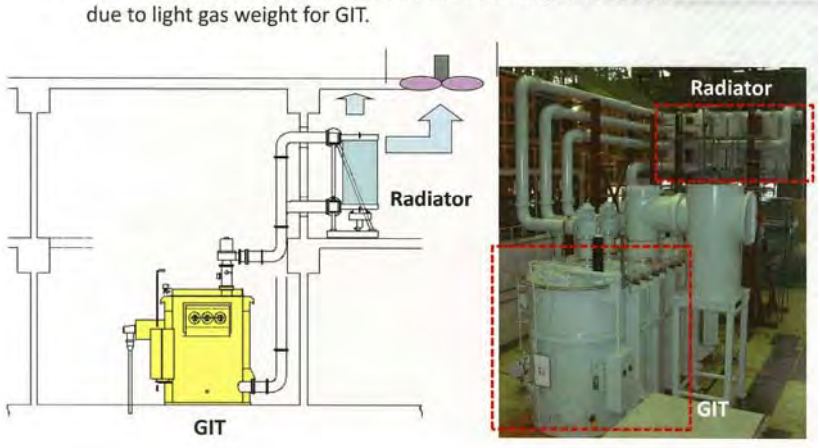
High Reliability | Compact | Safety

TOSHIBA Leading Innovation

Flexibility for Substation Layout

GDAN/GDAF-20/63MVA - 110kV GIT

- The height level of radiator location can be arranged as flexible due to light gas weight for GIT.






Since the head pressure of SF6 gas is negligibly low and conservator tank is not required, cooling equipment can be located above the GIT level as indicated in the Fig. 10. The GIT offers excellent flexibility when locating components such as radiators or coolers.
Water cooling system for Underground substation can be omitted by the construction.

# Applicable Japanese Technologies

Engineering for the NEXT

## Gas Insulated Transformer

High Reliability | Compact | Safety

TOSHIBA
Leading Innovation

This is the first application for GIT in North America. As the transformers were located over the river, oil leak contamination was very serious for the river. To remove a risk of oil leakage, GIT has been applied as only one solution.






# Applicable Japanese Technologies

Engineering for the NEXT

## Under Ground Grid

High Reliability | Compact | Safety

*Effective utilization of underground substations' top spaces and building aesthetics*


Park


Temple


Corporate building


Data center

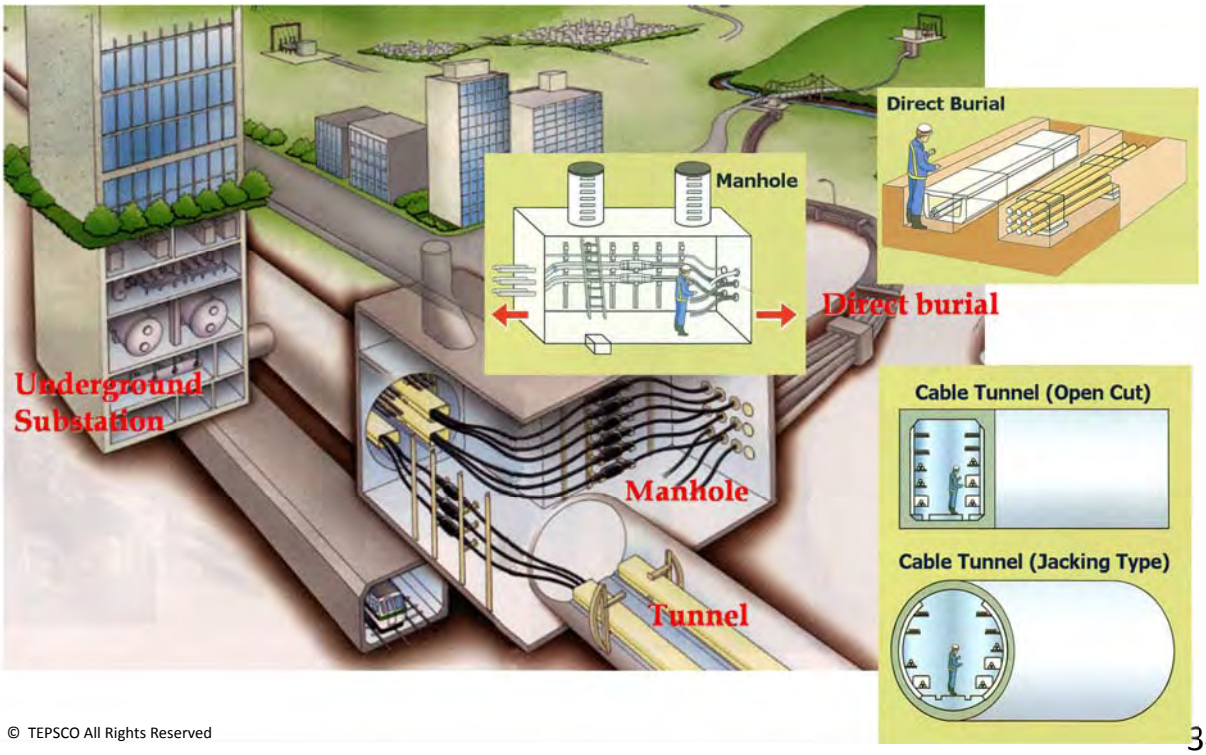
Buildings and other structures are build above those underground substations for effective utilization of substations' top spaces

# Applicable Japanese Technologies

Engineering for the NEXT

## Under Ground Grid

High Reliability | Compact | Safety





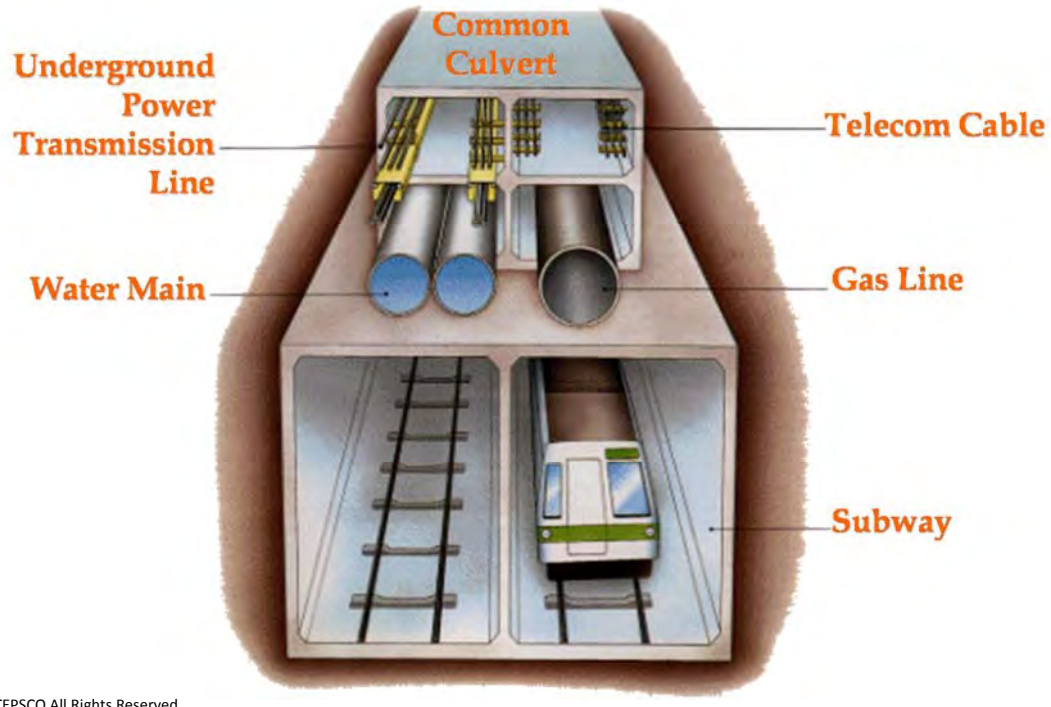



# Applicable Japanese Technologies

Engineering for the NEXT

## Under Ground Grid

High Reliability | Compact | Safety



# Applicable Japanese Technologies

Engineering for the NEXT

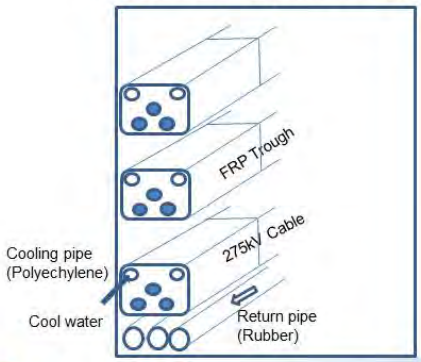
## Under Ground Grid

High Reliability | Compact | Safety

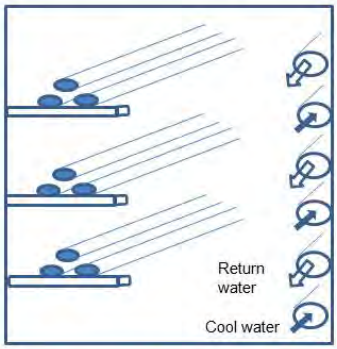
### *Indirect Cable Cooling system*

- *When Numerous cables are installed in tunnel, Indirect cable cooling system is effective for holding back a rising of temperature for tunnel and cable*
- *Cool water from cooling facility (one end) is extruded in Polyechylene pipe and take away the heat of cable and air in tunnel*

*Indirect Cable cooling system in Trough*




*Indirect cable cooling system in Tunnel*






Fujikura







# Applicable Japanese Technologies

Engineering for the NEXT

## Under Ground Cable

High Reliability | Compact | Safety

### *CONSTRUCTION OF 275kV XLPE CABLE IN JAPAN*

Confidential

| | | | |
|---|---|---|---|
| |  |  |  |
| Metallic Screen | Aluminum Sheath | Copper wire | Copper wire |
| Moisture Barrier | Aluminum Sheath | Stainless-steel Sheath | Laminated Aluminum Tape |
| Advantage | Large Capacity of Earth Fault Current | Low Eddy Current Loss | Small Diameter |
| | | Mechanical properties | Low Eddy Current Loss |
| Insulation Thickness | 23mm | | |

SUMITOMO ELECTRIC



SUMITOMO ELECTRIC GROUP

# Applicable Japanese Technologies

Engineering for the NEXT

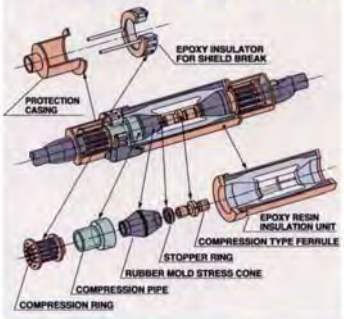
## Under Ground Cable

High Reliability | Compact | Safety

### Joint for XLPE Cable

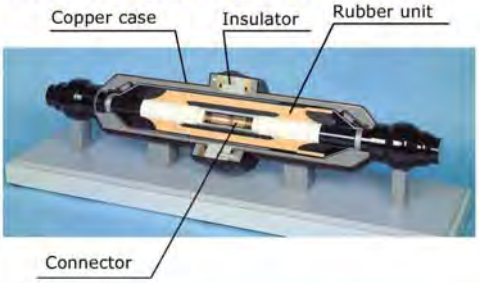
Confidential

**PRE-FABRICATED COMPOSITE TYPE JOINT**




| Voltage class | First operating year |
|---|---|
| 220kV | 1993 |
| 345kV | 2002 |
| 400kV | 2006 |

**CONSTRUCTION OF PRE-MOLDED ONE PIECE TYPE JOINT**




| Voltage class | First operating year |
|---|---|
| 132kV | 1995 |
| 220kV | 1999 |
| 400kV | 2008 |

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# Applicable Japanese Technologies

Engineering for the NEXT

## Under Ground Cable

High Reliability | Compact | Safety

### Y-Branch Joint JOINT

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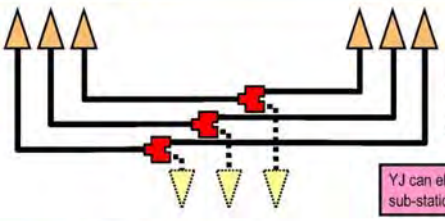
Special Schematic with YJ use



Cable: 3 phases
YJ : 3 sets
BE-A : 3 sets

YJ can eliminate the expensive sub-station equipment.

| Voltage class | First operating year |
|---|---|
| 66-132kV | 1980 |
| 154kV | 1998 |
| 275kV | 2002 |

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# Applicable Japanese Technologies

Engineering for the NEXT

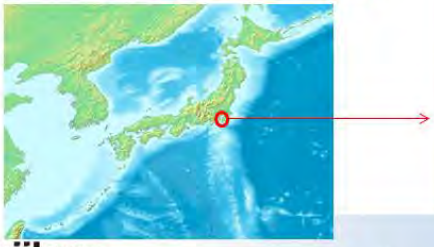
## Under Ground Cable

High Reliability | Compact | Safety

### Example of 500kV Project in Tunnel

**CUSTOMER:** TOKYO ELECTRIC POWER COMPANY
**TRANSMISSION:** 1200MW/cct IN FUTURE
**TYPE OF CABLE:** 500kV XLPE CABLE
**ROUTE LENGTH:** 40km (25mile) x 2ccts
**TYPE OF THE SPLICE:** Extruded Mold Joint
**START OF OPERATION:** Nov. 2000

**CABLE OUTER DIAMETER:**
170mm (6.69 inch)
**WEIGHT OF CABLE:**
43.5kg/m (29.2 lb/ft)



Fujikura







# Applicable Japanese Technologies

Engineering for the NEXT

## Under Ground Cable

High Reliability | Compact | Safety

### Cable drum for project

FLANGE DIAMETER:
4250mm (167inch)
DRUM DIAMETER:
2750mm (108inch)
OUTER WIDTH:
8300mm (327inch)
TOTAL WEIGHT:
9500kg (210,000lb)

DRUM FOR VERY LONG CABLE APPROX. 1800m (5900feet)

- FLANGE DIAMETER : 3700mm
- DRUM DIAMETER : 2550mm
- OUTER WIDTH : 11750mm
- WEIGHT OF CABLE : 80000kg

Cable laying(Hauling machine)

BASE OF LAYING



Fujikura

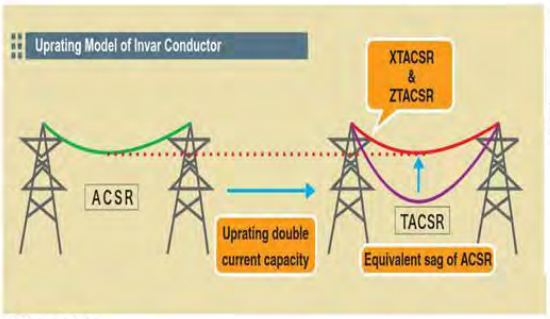
# Applicable Japanese Technologies

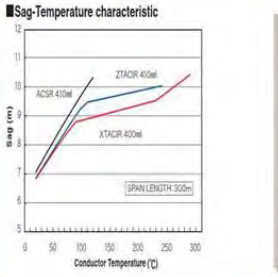
Engineering for the NEXT

## Conductor for over head transmission line

High Reliability | Compact | Safety

### Low Sag and Uparating Conductor "Invar Conductor"



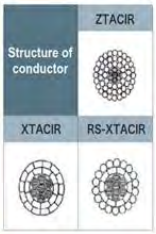

■Characteristic

| Conductor | | | ACSR330 | XTACIR320 | | ZTACIR330* | | RS-XTACIR330 | |
|---|---|---|---|---|---|---|---|---|---|
| Structure | Aluminum | No./mm | 26/4.0 | 14/SB(4.05)+10/SB(4.05) | | 26/4.0 | | 16/4.0+10/SB(4.05) | |
| | Core | No./mm | 7/3.1 | 7/3.8 | | 7/3.1 | | 7/3.6 | |
| Cross section | Aluminum | mm² | 326.8 | 79.38 | | 326.8 | | 329.9 | |
| | Core | mm² | 52.84 | 309.1 | | 52.84 | | 71.26 | |
| | Total | mm² | 379.6 | 388.5 | | 379.6 | | 401.2 | |
| Overall diameter | | mm | 25.3 | 23.8 | | 25.3 | | 25.3 | |
| Tensile strength | | kN | 107.2 | 114.3 | | 98.1 | | 110.1 | |
| Mass | | kg/km | 1320 | 1418 | | 1282 | | 1423 | |
| Resistance | | Ω/km | 0.0888 | 0.0924 | | 0.0871 | | 0.0879 | |
| Modules of elasticity | | GPa | 82.0 | 80.2 | Below tp* | 74.4 | Below tp* | 77.8 | Below tp* |
| | | | | 152.0 | above tp* | 152.0 | above tp* | 152.0 | above tp* |
| Coefficient of linear expansion | | 10⁻⁶/°C | 19.0 | 15.5 | Below tp* | 17.5 | Below tp* | 16.3 | Below tp* |
| | | | | 3.7 | above tp* | 3.7 | above tp* | 3.7 | above tp* |
| | | | | 10.8 | above 230°C | - | | 10.8 | above 230°C |
| Capacity | Continuous | A | 730(90°C) | 1505(230°C) | | 1487(210°C) | | 1589(230°C) | |

*tp = transition point

**Character of Invar conductor**

- Invar alloy for steel parts which has very small Coefficient of thermal expansion.
- Extra thermo-resistant aluminum alloy (XTAL) or super thermo-resistant aluminum alloy (ZTAL) for Aluminum parts.
- Double current capacity of ACSR
- Same sag as ACSR
- Rebuilt of tower is not required




**XTAL+ INVAR core is most effectve for upratiig**





# Applicable Japanese Technologies

Engineering for the NEXT

## Conductor for over head transmission line

High Reliability | Compact | Safety

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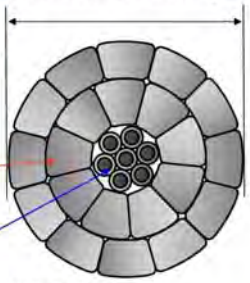
### Design Concept of Low Loss Conductors



1. Maximized AL (Trapezoid Shaped AL)
2. Minimized St core (High strength material)

✓ Lower electrical resistance while keeping mechanical properties

Same diameter as existing ACSR



Trapezoid shaped AL

**LL-ACSR/AS**

Low Loss

Extra high strength aluminum-clad steel (14EAS)

***Advantages***

- 15 ~ 25% times lower losses operation compared to the equivalent size ACSR
- Same diameter design suppress the tower stresses in heavy loading condition
- 2 times higher current capacity by TAL makes T/L more reliable (N-1 system)

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# Applicable Japanese Technologies

Engineering for the NEXT

## Conductor for over head transmission line

High Reliability | Compact | Safety

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### Economical Study for 230kV OHTL

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○Calculation Condition
Twin-bundle Drake x 2cct, Route Length:100km, Voltage:230kV, Peek Current:324A/conductor
Load Factor:0.5, Generation Cost:0.05USD/kWh

*Only after 7 year, LL-(T)ACSR/AS will have economical advantage*

Conductor Price:
ACSR Drake
5 USD/m
LL-ACSR/AS 460SQ
6.5 USD/m
LL-TACSR/AS 530 SQ
7 USD/m

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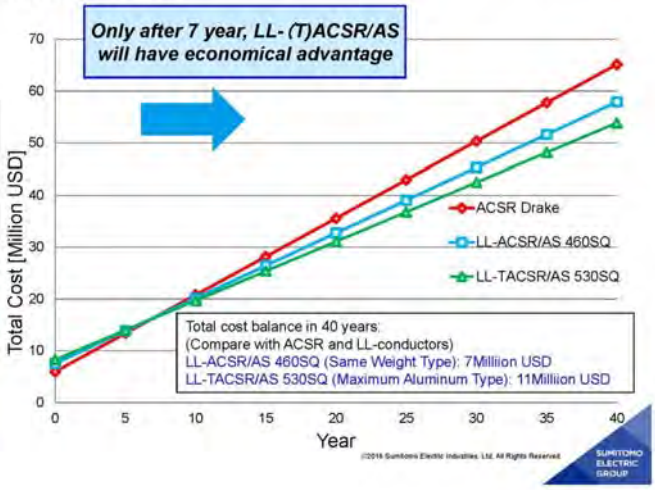






# Applicable Japanese Technologies

Engineering for the NEXT

## Conductor for over head transmission line

High Reliability | Compact | Safety

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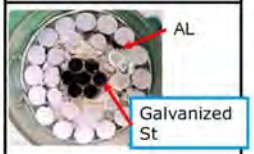
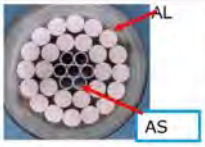
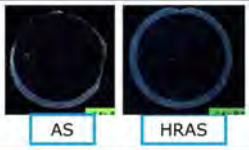
### High corrosion Resistant Aluminum-clad Steel (HRAS)

| ACSR | ACSR/AS (Better corrosion resistance) | ACSR/HRAS (Superior corrosion resistance) |
|---|---|---|
| Corrosion starts from the inside of ACSR once Zn coating Is gone. | AL remains on Steel longer. Corrosion may observed in heavy condition. | 1.6 times longer life than standard AS by AL alloy cladding. |
|   |   |   |
| Life time: Standard Price* : 1 | Life time: 5 times than ACSR Price*: 1 | Life time: About 8 times than ACSR Price*: 1.2 |

*Conventional ACSR = 1

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# Applicable Japanese Technologies

Engineering for the NEXT

## Conductor for over head transmission line

High Reliability | Compact | Safety

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### *Overhead Conductor*
### *-High Temperature Low Sag Conductors-*

OUTLINE

High Temperature Low Sag Conductors (ie. HTLS conductors) are expanding its application field in existing T/L replacement and new T/L construction. **Sumitomo Electric** is the **pioneer** of HTLS conductors and have **supplied over 45 years** since 1971.

FEATURES

**(a) Gap type conductor** (Unique construction)
- -Gap between Aluminum layer and steel core.
- -**Double** the current-carrying capacity for the same size conductor
- -**No modification or reinforcement** required for existing towers
- -**Low cost** and **short** construction period.

**(b) Invar core conductor** (Unique material)
- -Invar alloy, which has extremely small thermal expansion coefficient, is applied to steel core
- -**Double** the current-carrying capacity for the same size conductor
- -**No modification or reinforcement** required for existing towers
- -**Same installation** and **maintenance** procedure as conventional ACSR

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# 4. Distribution System


Kenjiro Mori

Japan International Cooperation Agency (JICA)

Tokyo Electric Power Services Co., Ltd. (TEPSCO)


## Overall situation in Distribution-1

### Main survey in the distribution field

（Questionnaire was conducted among 9 distribution companies many thanks to EEHC and DCs ）

**1.Supply Reliability**

Improvement of the distribution has been done well.
However major cause of the accident has still aged and deterioration.
It is necessary to keep capital investment for maintenance continuously.

**2.Proper Investment**

Short term, Medium and long term investment are well planned.

**3.Smart Meter and Distribution Management System (DMS)**

Some areas have been applied Auto Meter Reading system. However they have not sufficient functions as Smart Meter.
DMS SCADA have been installed to some area. Replacement/ Installation of more advanced functional DMS will be expected.

# Overall situation in Distribution-2

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## 4.Distribution loss

Increasing trend in recent years.
--- It Need to consider about new measures. ----

## 5.Maintenance of Proper voltage

--- Renewable Energy ( Roof top PV) connected to distribution line is increasing. ----

## 6.Human resource development

Technical Training for advanced technology will be expected.

**In this session, the team conduct Explanation of above No.4 and 5 .**





# Issue-1 Reduction of distribution loss

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## 1. Survey results on distribution loss

**Transition of distribution loss (Total of 9 Distribution Company)**

| Year | 12/13 | 13/14 | 14/15 | 15/16 |
|---|---|---|---|---|
| Distribution network loss (%) | 8.89 | 9.03 | 10.70 | 11.02 |

**Increasing year by year**

***Major cause of distribution loss***

No.1: Electric thief (non-technical loss)
No.2: Cable (technical loss)
No.3: Other causes (non-technical loss) - Misreading of the meter
Other causes(technical loss) - Transformer

# Issue-1 Reduction of distribution loss

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## [ Breakdown ( Reference ) ]

The average of power factor(pf)

during 1/1/2016 till 31/7/2016

| Name of EDC | Energy Purchase from EEHC[GWh] | Energy Sales[GWh] | Distribution Loss[%] |
|---|---|---|---|
| North Cairo | 22110 | 18644 | 11.68 |
| South Cairo | 28099 | 24220 | 13.80 |
| Alexandria | 10503 | 9403 | 10.476 |
| North Delta | 24019 | 22098 | 7.99 |
| South Delta | 14251 | 12259 | 13.98 |
| Canal | 12668 | 11436 | 9.73 |
| El-Behera | 11130 | 9728 | 12.60 |
| Middle Egypt | 16325 | 14985 | 8.20 |
| Upper Egypt | 12480 | 11210 | 10.18 |
| Total | 150584 | 133985 | 11.024 |





# Issue-1 Reduction of distribution loss

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## 2. Status of Major Loss Reduction Measures

### Power factor management

- ✓ Existing Power factor Management of the distribution has performed well.
  - Even at light load, the power factor value exceeds 90%.
- ✓ Egypt has a power factor discount system similar to that of Japan.

### Transformer

- ✓ Reducing load loss is much effective for loss reduction, because load factor is high according to EEHC.
  - Amorphous transformer ( Effective for iron loss reduction) is not recommended according to EEHC.

# Issue-1 Reduction of distribution loss

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## Improvement of unbalance current

- ✓ Effect of loss reduction is limited. (Less than the other measures)

## Thickness of the distribution line

- ✓ Conductor size has been decided by the capacity.
- ✓ The purpose of loss reduction has not been considered.





# Issue-1 Reduction of distribution loss

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## 3. The Other efforts to reduce losses (Questionnaire results)

### Technical loss (Example)

- ✓ Checking of cable termination bolts. Installation of ventilation fans. Replacement of damaged ones.
- ✓ Re-compression of cables termination.
- ✓ Replacement of damaged bus-bars and LV·MV fuses.
- ✓ Quick repair of damaged LV cables. Management of cable Load less than 80%.
- ✓ Balancing the loading of the LV network at the main LV distribution boards and LV panels.
- ✓ Opening of MV loop at the point of yielding minimum losses.
- ✓ Implementation of smart meters and remote meter reading projects. and so on

# Issue-1 Reduction of distribution loss

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## Non-Technical loss (Example)

- ✓ Continue intensive daily patrols by network technicians and police to find electricity thefts and take legal measures.
- ✓ Review meter reading before issuance of bills to find out and investigate abnormal readings.
- ✓ Survey of installed meters and inspection of connections to ensure their soundness using modern devices.(provided by JICA project)
- ✓ Installation of coded meters for unlicensed buildings.
- ✓ Replacement of meters which exceeded their life time to eliminate inaccurate readings.

· On the whole, efforts to reduce losses have been done exactly.
· **Some additional measures would be required for non-technical loss.**




# Issue-1 Reduction of distribution loss

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## 4. Direction of solution

**Measures against theft using smart meters**

--- Reduction of Non-Technical loss ----

**Support of Electricity rate menu using smart meters**

--- Reduction of power loss by load leveling ----

**Development of concept on the utilization of Smart Meter system, reflecting the peculiarities in Egypt, is required**

# Issue-1 Reduction of distribution loss

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## 5. Current Situation

**Electricity Distribution System Improvement Project**

- ✓ On-Going $220M Loan Cooperation
- ✓ 1 Million Nos. of Smart Meters for North Cairo, North Delta and Alexandria DCs
- ✓ Under procurement stage





# Issue-1 Reduction of distribution loss

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## 6. Recommendation

- ✓ Consideration with the support of Consultant of the Project (TEPSCO) for the best usage of smart meter and take necessary actions in parallel with procurement
- ✓ This area might be a potential area of future cooperation with using the Smart Meters

***We propose the candidate project***

Candidate Project No.8

***Starting Year 2021***

Technical Assistance on utilization of smart meter to realize the support for searching theft places, while supporting for electric bill menu setting

**This technical assistance would advise on how to utilize data acquired by smart meter. As expected results, reduction of technical loss and non-technical loss are expected, further efficient operation of distribution lines will be done.**

# Issue-2. Maintenance of Proper Voltage with mass RE

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In future, large amounts of renewable energy will be introduced in Egyptian network.

It is expected that maintaining the proper voltage will become difficult.

It is possible to support installation of voltage countermeasure equipment ( Battery, SVC, SVR etc. ) to the distribution system

***We propose the candidate project***

Candidate Project No.6

***Starting Year 2019***

Technical Assistance on Introduction of voltage countermeasure equipment in distribution system to cope with massive Renewable

**This technical assistance would advise effective voltage improvement method. As expected results, It is possible to show where to install the voltage countermeasure equipment ( SVC, SVR and others) on the distribution system.**



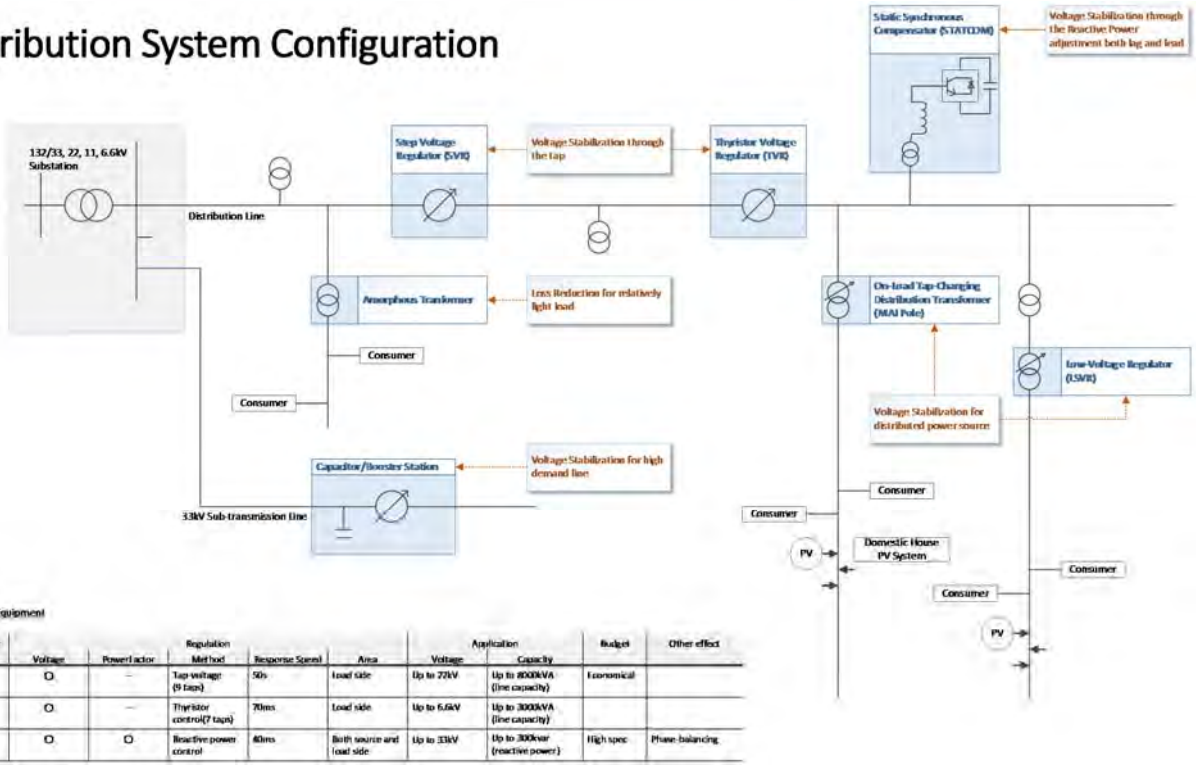


# Applicable Japanese Technologies on voltage issue

Engineering for the NEXT

## One of solution for Voltage drop

### Distribution System Configuration




Choice of Equipment

| Equipment | Voltage | Power Factor | Regulation Method | Regulation Response Speed | Regulation Area | Application Voltage | Application Capacity | Budget | Other effect |
|---|---|---|---|---|---|---|---|---|---|
| SVR | O | – | Tap voltage (9 taps) | 30s | Load side | Up to 22kV | Up to 4000kVA (line capacity) | Economical | |
| TVR | O | – | Thyristor control(7 taps) | 70ms | Load side | Up to 6.6kV | Up to 3000kVA (line capacity) | | |
| STATCOM | O | O | Reactive power control | 40ms | Both source and load side | Up to 33kV | Up to 300kvar (reactive power) | High spec | Phase-balancing |

# Applicable Japanese Technologies on voltage issue

Engineering for the NEXT

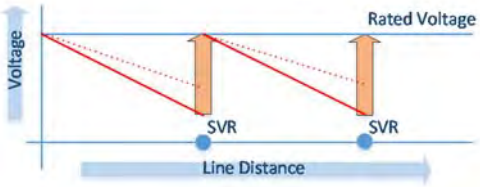
## One of solution for Voltage drop

Aichi

## Step Voltage Regulator (SVR)

- SVR will be used to stabilize the distribution voltage fluctuated.
- Newly developed VI type Tap-Changer(TC) realized the maintenance free operation.
- Control system will be responsible for the reverse power flow caused from the distributed power sources.




**Specification**

| | |
|---|---|
| Number of phase | Single(1P), Three(3P) |
| Voltage (kV) | 6.6kV, 11kV, 22kV |
| Current (A) | 440A(6.6kV), 320A(11kV), 200A(22kV) |
| Numbers of tap | 9 taps |
| Voltage adjustment | -10 to +10% (as of standard) |

AICHI ELECTRIC CO., LTD.



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# Applicable Japanese Technologies on voltage issue

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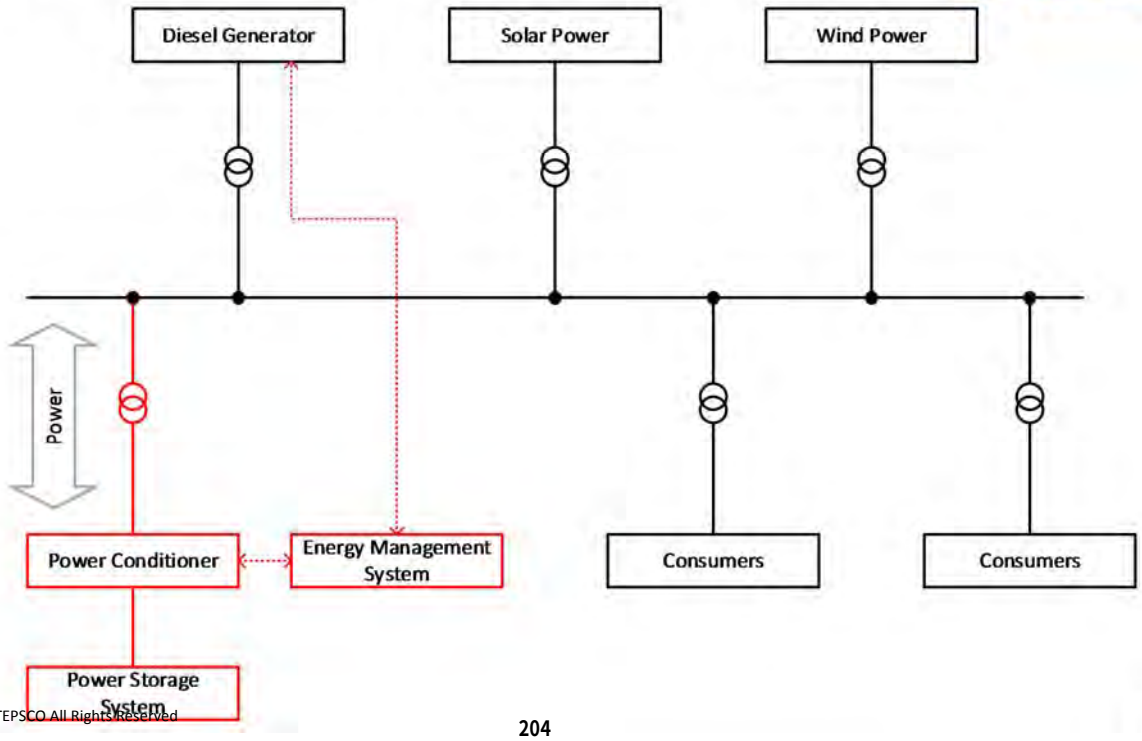
## One of solution for power flow control

### Power Storage System Configuration

Aichi





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# Applicable Japanese Technologies

Engineering for the NEXT

## One of solution for power flow control

FORTELION Olivine type LEP Lithium Ion battery

Aichi

### 1) Safety

- Insulated between battery module and upper system
- Safety Approvals obtained
  UL1973 / CE / IEC62619 / IEC60730 /
  SBA S1101 / Japan Fine & Disaster Manag't Agency 16C801
- Nailing/Compression Tests (SAE J2464 NOV 2009)
- Anti-Explosion Mechanism on each Battery Cell

### 2) Long Life expected life : 20 years

- Capacity after 10,000 cycles vs. initial capacity will be
  70% or more (DOD100%, 1C/1C, 23℃)
  60% or more (DOD100%, 1C/1C, 45℃)

### 3) Practical Functions

- Capacity Monitoring
- Life Prediction
- Capacity Balance Adjustment among System/Module/Cell
- Swapping per String with no down-time of the system

### 4) Quick Charge

- 95% or more of capacity can be charged in 1 hour

### 5) Actual Capacity

- Actual Capacity(kWh) equals to
  Nominal Capacity(kWh) x {DOD(SOC)} of module
  x System Conversion Efficiency (PCS)

### 6) Energy Saving

- Natural Discharge almost none
  No supplementary charge required
  - Capacity deterioration after 1 year : 5% or less at SOC100%, 23℃
  - Capacity deterioration after 1 year : 10% or less at SOC100%, 45℃
- No Cooling Fan required for modules






# Applicable Japanese Technologies on voltage issue

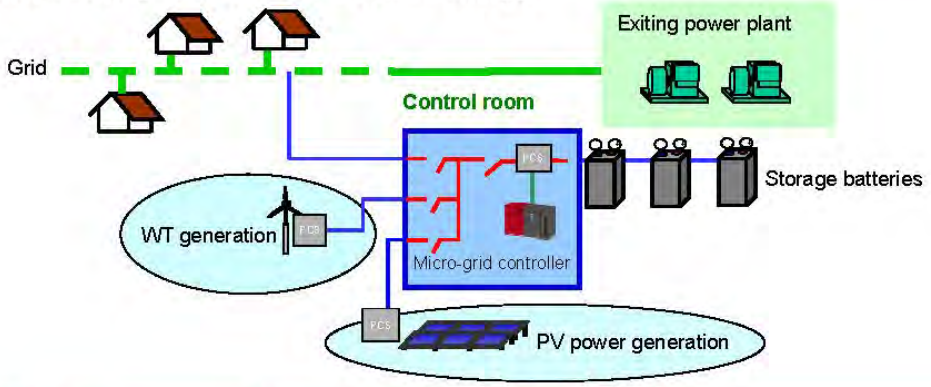
Engineering for the NEXT

## One of solution for power flow control

Energy Storage System (ESS)

Fuji Electric
Innovating Energy Technology

General configuration for Renewable Energy




| | Challenges | Causes | Solutions |
|---|---|---|---|
| 1 | Stable power supply | Output power fluctuations | Compensation by energy storage system |
| 2 | Power quality | Frequency fluctuations | Coordinated control by energy storage system |
| 3 | Surplus energy | Output power exceeding a demand | Peak shift operation by energy storage system |

*(Note) WT : Wind turbine generation / PV : Solar power generation*

# 5. Energy Efficiency

**Ryosuke Oguri**

Japan International Cooperation Agency (JICA)

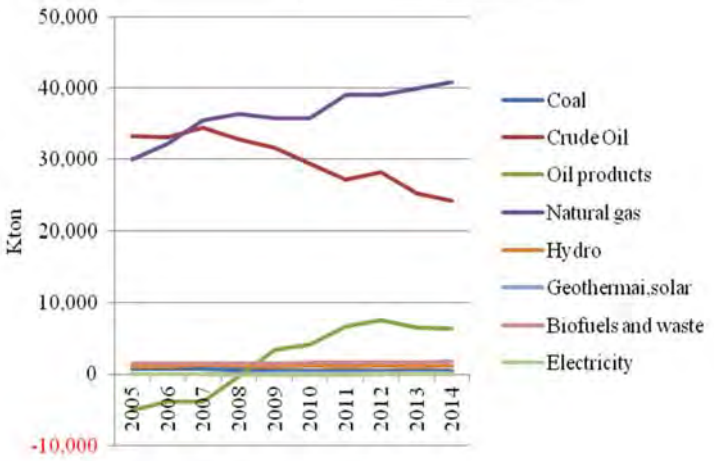
Tokyo Electric Power Services Co., Ltd. (TEPSCO)

## 1-1. Objectives on Energy Efficiency & Conservation



**Present Situation**

- Annual electrical energy consumption in 2014 in Egypt was 150,054GWh.
- This number is ranked 25th in the world country.




- Energy consumption growth of the Egypt → 4.6%
- This ratio so high → Expected to continue in near future.
- Energy efficiency improvement in Egypt is important.

# 1-2. Objectives on Energy Efficiency & Conservation

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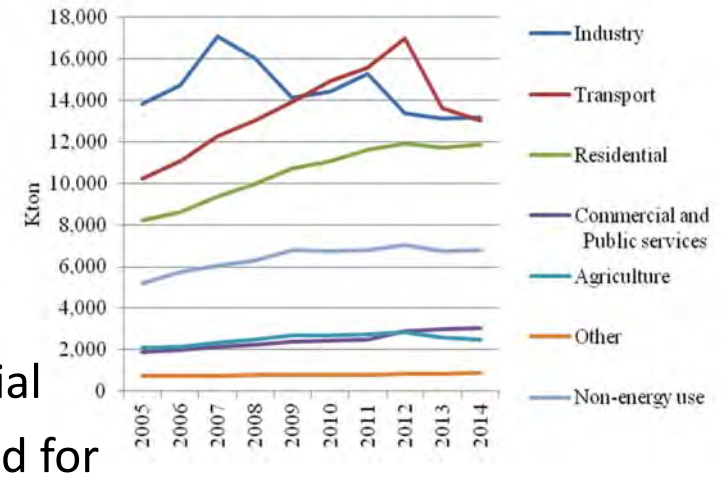
## Present Situation

1. 44% of the electrical
   → Residential use

2. Growth ratio
   → High for residential
   → Amount increased for industrial use








# 1-3. Objectives on Energy Efficiency & Conservation

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## 1. Energy efficient activities take much time

✓ Important to prepare countermeasures in advance

## 2. Study Policies

✓ Energy efficiency strategies/ programmers based on energy audits at some customers

✓ Objective of preparing realistic plans comparing to existing activities and policies

# 2-1-1. Example in Industrial Sector

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Audit in 2 February, 2017 at a Tile factory in El Sadat

## 1. General Information

- This factory produces 50,000 sqm of ceramic tiles per day.
- The company started 60 years ago with just 30,000 sqm.
- It operates, 24 hours a day

## 2. Primary Energy Resource

- Neutral Gas (80%) for the furnace
- Electric power (20%)

Electrical Panel (Testing at the first location)

Voltage measurement

Equipment setting





# 2-1-2. Studies from Data

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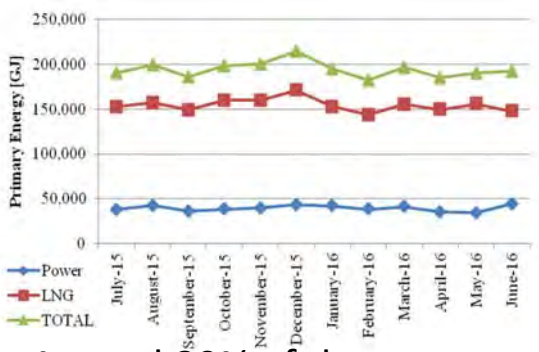


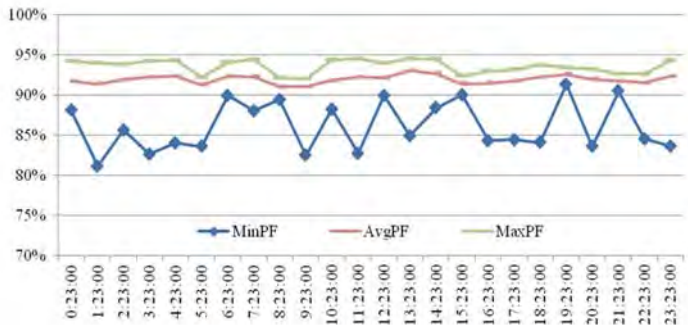


Around 80% of the energy
→Consumed by the furnaces

No fluctuations
→ No A/C* load in this factory

Energy consumption
→ Dependent on the factory operation.

Power Factor (PF)
→ Around 91% (average)

PF rate is
going down
→ Some manufacturing equipment operating under bad condition.

*A/C: Air Conditioner

# 2-1-3. Sample of Solution Ideas

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**Solution**

To improve the efficiency → Waste Heat Management

Cogeneration system (Combined Heat and Power)
Waste heat from generator for heating in the furnace
(Reduce gas amount in the furnace)


CHP (Combined Heat and Power), Co-Generation System





*For Official Use Only*

# 2-2-1. Example in Commercial Sector

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Audit in 18,23 April, 2017 at a shopping mall in Cairo

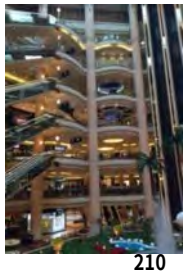
## 1. General Conditions

- Started operations in 2007
- Composed of mall, hotel (2 towers) and high-rise residences (10 towers).
- Total floor area → 750,000 $m^2$ (plan) with 7 stories.

## 2. Electrical Equipment

- The 11kV MV Switchgears owned by EETC
- There are three (3) substations and six (6) feeders for each with a 11kV/400V transformer.


Outlines



LVSG

BMS

# 2-2-2. Chillers and Monitoring

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1. Conditions
   - ◆ Chillers in the mall → 1450RT* x 8 units.
   - ◆ Documents and daily reports → Good
   - ◆ Recorded data → Not utilized for energy conservation
2. Loads in the Commercial Building
   - ◆ Lighting & power outlet load → Not fluctuated
   - ◆ Air conditioning load → Big factor in forming a peak power demand.

*RT:Refrigeration Ton





# 2-2-3. Studies from Data

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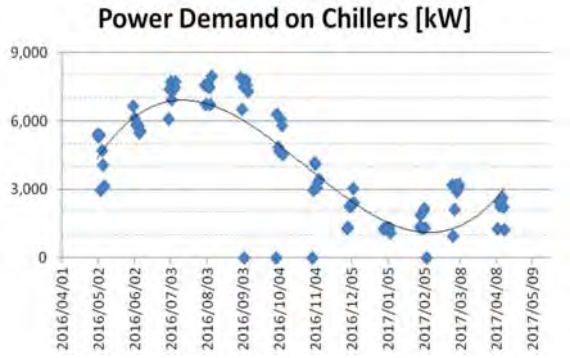


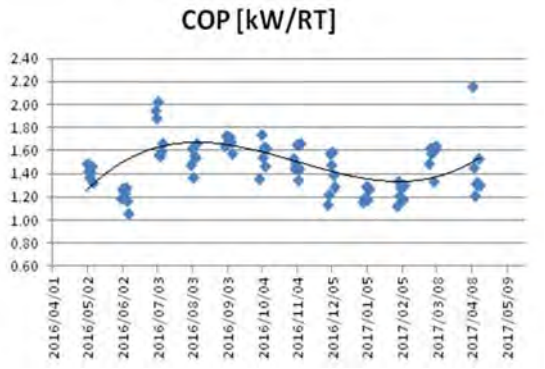


1. The COP during the summer is approximately 1.6[kW/RT], the current performance is around 40% only to the original spec.
2. Maximum Energy Saving Potential in Chiller Plant
   - ◆ Present : 8,000kW of peak power and 15GWh/y of energy
   - ◆ Saving Potential : 4,000 kW of peak power and 8GWh/y of energy.
3. PBP* = around 7 years ( Supposed case: Retrofit cost = EGP5,000/RT)

*COP: Coefficient Of Performance
*PBP: Pay Back Period

# 2-2-4. Studies from Data

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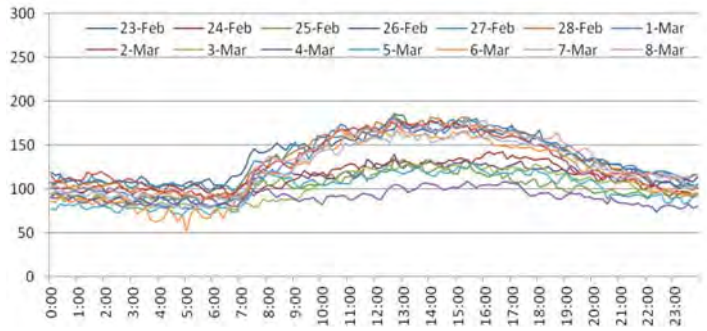


1. Less power load in the residential towers during the noon time of holidays.
2. This gap is such as the lighting, power outlet, and A/C in the office.
3. The night time power load of the residential towers is high.
   - Waster energy in the refrigerator use or standby-power in the residential areas
   - Timer controls for fan in parking or excess lighting putting out lights for reducing useless energy in common areas





# 2-3. Summarize from Audits

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**Result**

1. Operators in average level
2. Data →
   - Hand written or BMS* without storage
   - Not utilized for their voluntary energy saving activities
3. Energy saving potential →
   - Only equipment replacement
   - Installed with capacity building
4. Integrally managing heat energy and power
5. Few incentives for energy efficiency and saving





*Building Management System

# 3-1. Present Activities for Energy Efficiency

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## 1. LED promotion

- 80% proceedings as 1st step from 2011 to 2018
- Institutional and street lightings for 2nd step


## 2. Standard and Labeling activities

- Implemented from 2003 by NREA.
- Completed those on refrigerators, washing machines, air-conditioners, water heaters and compact HF lighting systems
- Under preparation for TV sets, dish washers, fans, motors and space heaters.

## 3. Master Plan

A) INTEGRATED SUSTAINABLE ENERGY STRATEGY TO 2035 that was approved by the SCE (Supreme Council of Energy) in October 2016

B) The energy saving targets by 2035 ( vs. 2010 figures )

- Industrial sector (18%)
- Commercial sector (16%)
- Tourism sector (13%)
- Street lighting sector (41%)
- Transportation sector (23%)



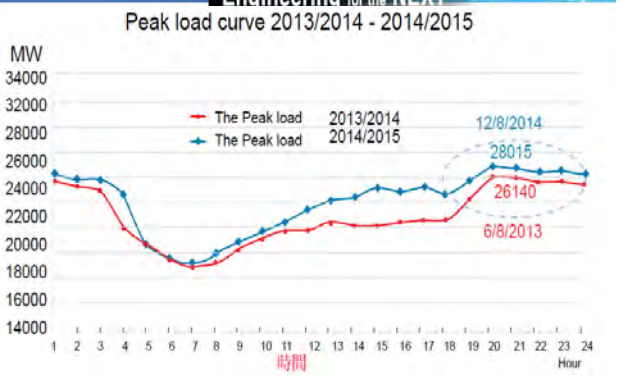


# 3-2. Present Activities for Energy Efficiency

Engineering for the NEXT

## 4. Energy Manager System

- RCREEE planning to set up an institution for energy management certification and training facility for instructors in 2017
- World Bank to support




## 5. Time of Use (ToU) for peak power management

- EEHC asked to switch their operation from peak time to off-peak time
- Time slot of on-peak is for five hours from 6 p.m.
- EEHC planning peak shift activities from noon peak to off-peak in early morning for residential customers by ToU
- utilized by smart meters set at each customer

# 4. Suggestions : Candidate project

Engineering for the NEXT

## Suggestions

1. Currently JICA country-specific energy conservation training is underway and issues/challenges to be tackled will be extracted from this training.
2. Based on these issued/challenges, the future technical assistance and direction on the sector to be financed with loan will be determined.

Candidate Project No.9

***Starting Year 2021***

**Demonstration on energy efficiency support by load leveling equipment installments and operational technologies**

**In this project, for example, Co-Generation might be the targeted equipment, analyzing the characteristics of the large customers to realize win-win relation between utilities and customers.**
**In some cases, the results of the project might be enlarged to the more broad concepts of such as Smart-Grid.**

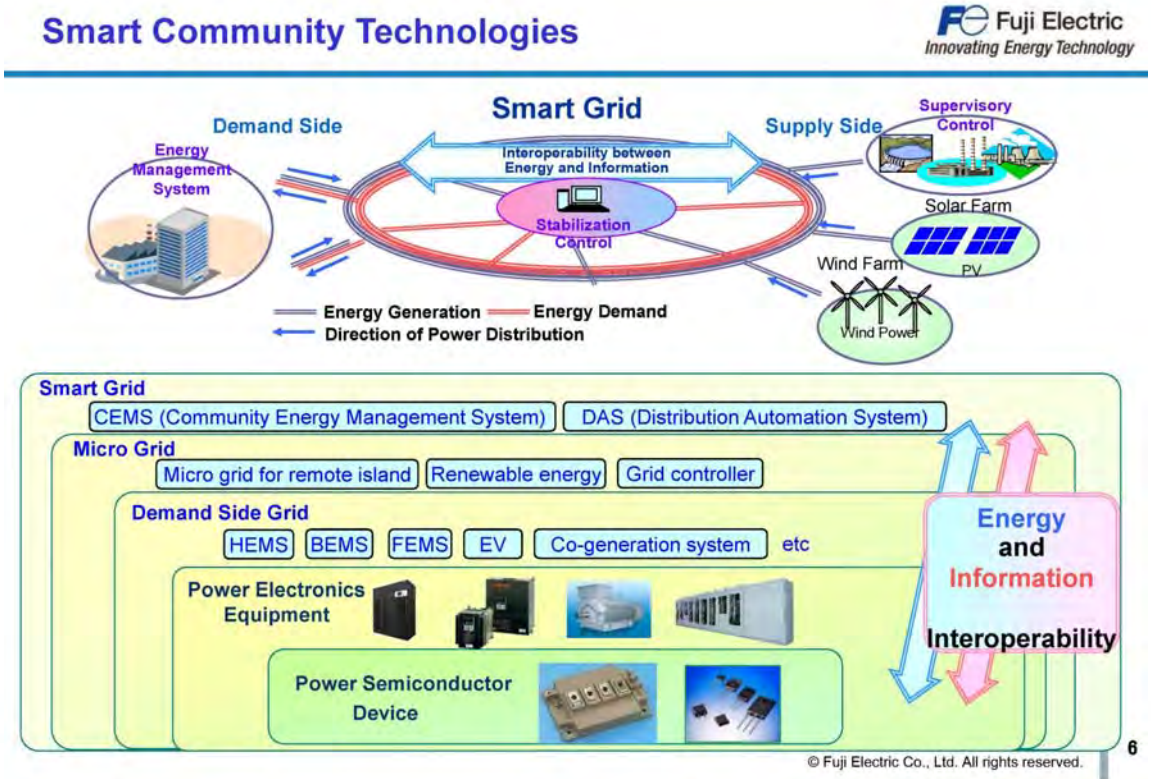




# Example of Applicable Japanese Technologies

Engineering for the NEXT

## Energy Efficiency



# 5. Conclusion

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The energy efficiency and saving in Egypt is a field of development potential in the future.

## Challenges

1. Comprehensive legal framework and plan for energy efficiency is insufficient.
2. Leading organization and cross sectional coordination is insufficient.
3. Few incentives for energy efficiency and saving, as well as cheap power rate that obstructs voluntary energy saving activities.

## Conclusion

1. Set up a system that integrates management and front-line for energy management.
2. Establishment on a cross-ministerial organization to take the lead in energy efficiency and saving, as well as set up a system for integrally managing heat energy and power.





# 5. Conclusion

Engineering for the NEXT

**Country Focused Training on Energy Conservation**

- ✓ From 18 to 30 July in Japan
- ✓ Participants from related entities ( MOERE, EEHC, ERA, MOP, MOH) to make a plat form

**Future action**

As outcome of the training program, ideas for potential future cooperation will be explored