



THE EGYPTIAN FIRST NUCLEAR POWER PLANT: NEEDS AND REQUIREMENTS

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Electricity Demand and Supply

Current Situation 2007- 2008:

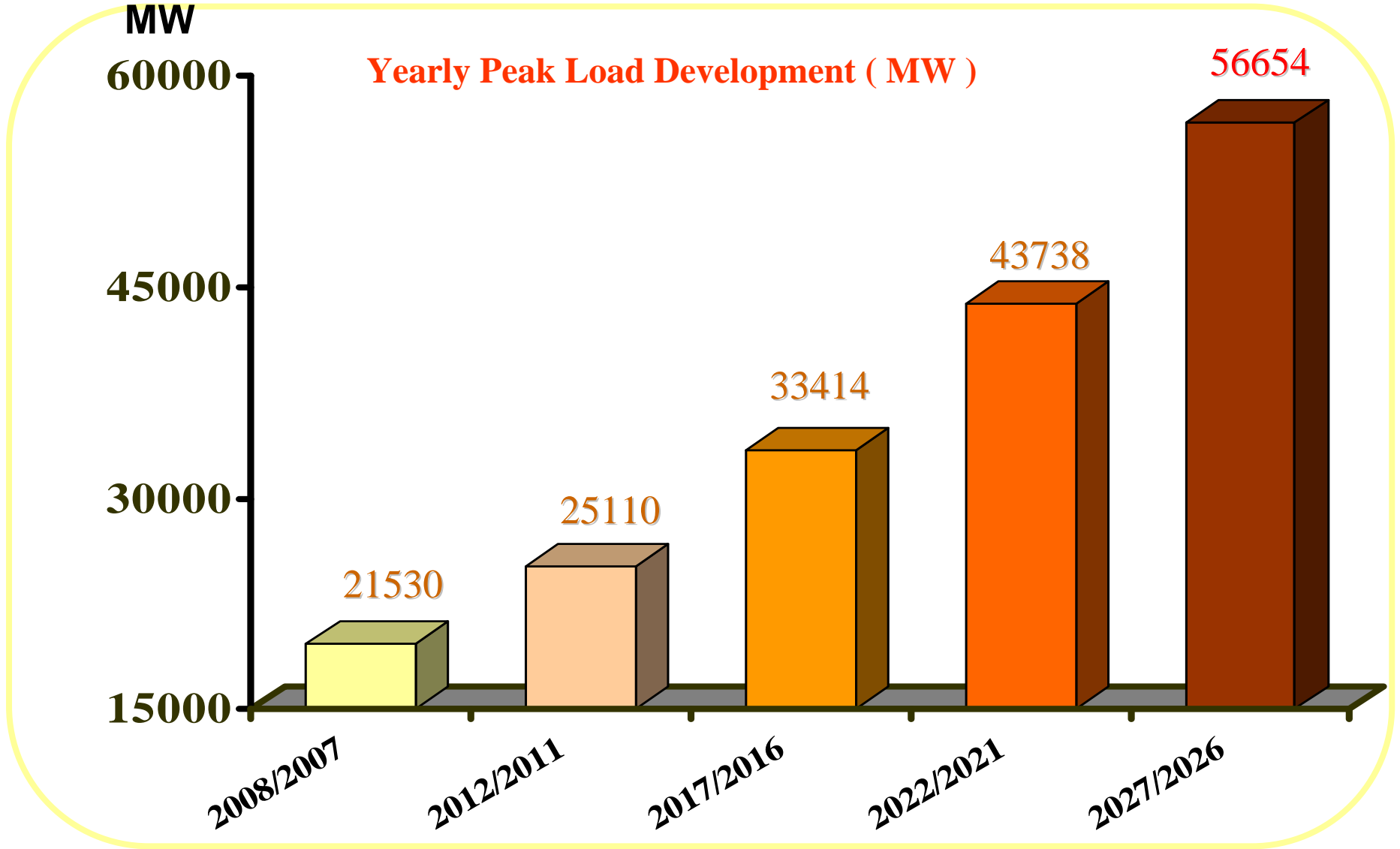
- ❑ Current total installed capacity 23,530 MW, and Peak Load 21, 250 MW
- ❑ Electricity generation by type:
 - Thermal **89.8%**
 - steam **52.5%**
 - combined cycle **36.8 %**
 - gas **0.5 %**
 - Hydro **9.3 %**
 - Wind **0.9 %**
- ❑ Oil and Natural gas provided 85% of electricity generated in 2007.
- ❑ Wind Energy installed with capacity of 240 MW is under construction.
- ❑ The first integrated solar-thermal power plant (~140 MW with solar contribution by 30 MW) is under construction and will be in operation by the year 2010.
- ❑ Grid transmission lines: 413, 000 km, including Transmission High Voltages: 500, 220 and 66 kV.

Electricity Demand and Supply

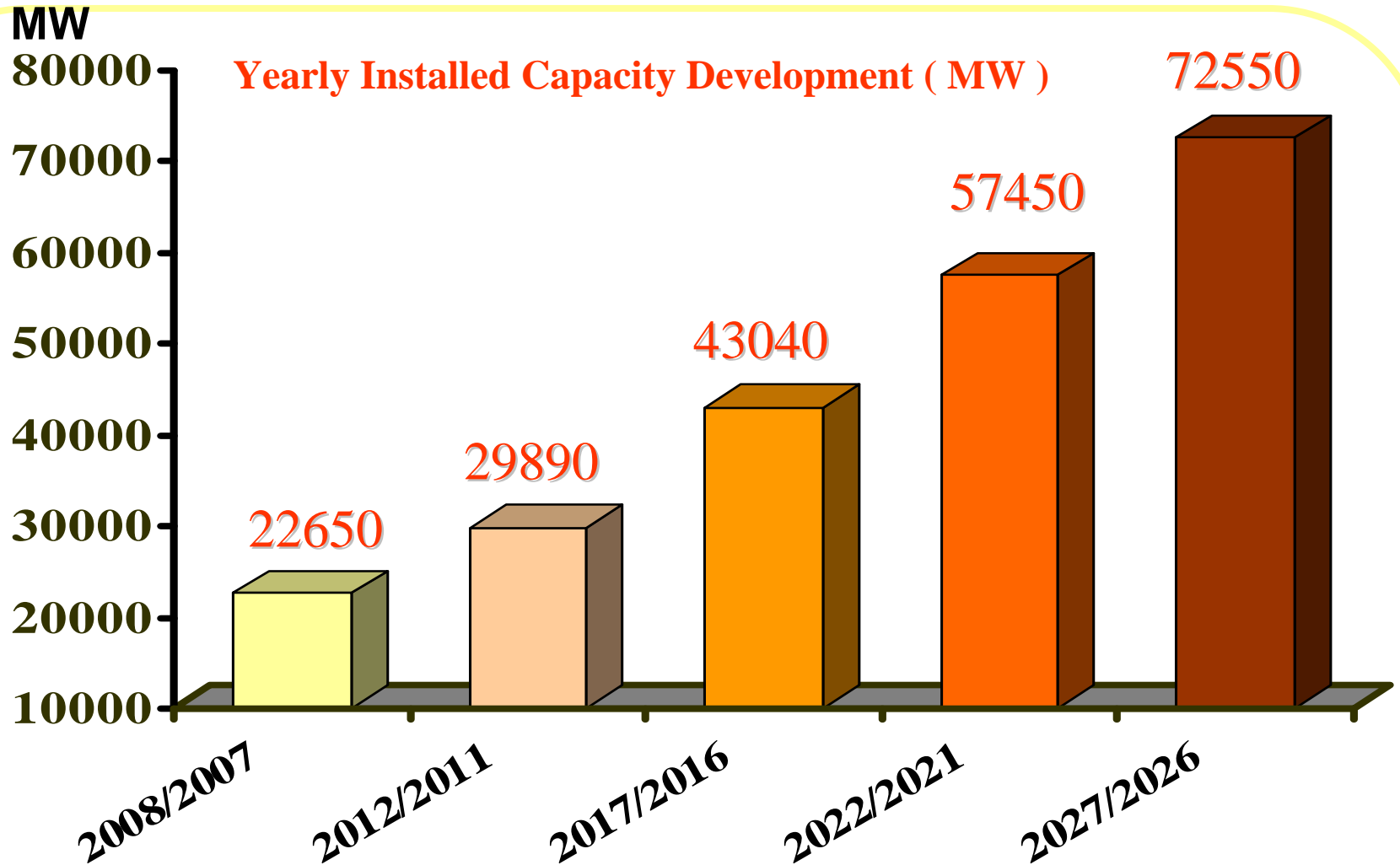
Demand for New Power Generation Capacity:

- ❑ Electricity demand increased at an average annual growth rate of 7% in the past decade and goes up to 10.3% in 2007.
- ❑ Egypt electricity demand will continue to increase in near future with a higher rate.
- ❑ The recent studies showed that:
 - Peak Load is expected to reach to about 57 GW by the year 2027.
 - Total installed capacity is expected to reach 73 GW by the year 2027.

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Electricity Demand and Supply

Power Generation Expansion Plan:

The increasing demand will be met in the best possible ways:

- ❑ It is planned to add 55 GW by the year 2027.
- ❑ By the year 2012 the system will be increased by about 10 GW, and 12 GW will be added from 2012- 2017.
- ❑ Increase the share of renewable energy, including hydro in electricity generation to 20% by 2020 .
- ❑ Regional grid interconnection with east and west Arab countries, and to Europe through Turkey and Spain. Also, it is planned to extend interconnection to the south (Sudan and other African countries).
- ❑ Conservation of electric energy and energy efficiency usage in industry, transportation and residential sectors.
- ❑ **Revival of the Egyptian Nuclear Power Program.**

Past Experience Related To Assessment of Nuclear Power Technology

1- Initiation of the Nuclear Power Program

- ❑ In 1955 the utilization of nuclear power in various fields was foreseen in Egypt.**
- ❑ During 1958-1961 research and development labs. were built covering major fields of nuclear science and engineering.**
- ❑ The future electricity needs and the role of nuclear power was analyzed and discussed.**
- ❑ in 1963 a “Power Reactor Project” group was set up for preparation and implementation of introduction nuclear power for electricity generation.**
- ❑ Cooperation agreements were signed with several nuclear countries (Russia, U.S.A, FRG, Norway, And Yugoslavia)**
- ❑ Several studies were performed in various aspects, including the following main areas:**
 - Site survey and selection of suitable sites.**
 - Types of power reactor systems and their commercial availability.**
 - Fuel cycles used in different power reactor systems**
 - Economic and technical status of nuclear power plants.**

Past Experience Related To Assessment of Nuclear Power Technology

❑ The studies concluded that:

- Nuclear power reactors technology and experience for electricity generation was confined to few industrially advanced countries.
- Technology of different nuclear reactors were being developed.
- Most of plants built and operate were in the size rang of 100- 300 MWe.
- Regardless to economic aspects, there was a need to explore nuclear power for meeting future long- term needs.
- There is a possibility to use nuclear power for sea water desalination, and to use the desalted water for agriculture purposes.

❑ The decision for early installation of a NPP has been based on:

- To gain adequate experience in NPP, design, construction and operation in sufficient times before expanding nuclear power program.
- To introduce nuclear technology and train the scientists, engineers, techniciansto be familiar with this new technology as well as to enable them to gain the required experience.
- To provide realistic data and information that would be extremely valuable in the assessment and judgment of future projects.

Past Experience Related To Assessment of Nuclear Power Technology

- ❑ **An International Adjudication for the dual purpose plant was issued in August 1964**
 - **Requested a nuclear plant with nominal capacity of 150 MWe and a desalting unit of 20, 000 m³/day.**
 - **Opened for only proven reactor systems (PWR, PHWR, BWR and GCR).**
 - **Four tenders were received, two for BWR, one for PWR and one PHWR.**
 - **All tenders offered a desalination plant.**
- ❑ **Detailed technical and economic evaluation as well as discussions and consideration led to the selection of a PWR reactor.**
- ❑ **The letter of intent was issued to the selected company in 1966.**
- ❑ **The project was not implemented due to:**
 - **Difficulties in securing adequate financing, and**
 - **The international situation arising from the 1967 war.**

Past Experience Related To Assessment of Nuclear Power Technology

2- Second Phase of the Nuclear Power Project

- ❑ In early 1970's the power situation in Egypt was reviewed and the prospects of introducing Nuclear Power was examined in the light of the forecast future requirement of the industrial and agriculture development.**
- ❑ The economic studies for the available sizes under various economic assumption and parameters were also analyzed.**
- ❑ The main conclusions were that nuclear power plants in the size range 400-600 MWe could be integrated in the Unified Power System (UPS) in the early 1980's.**
- ❑ Technical and economic feasibility studies proved the need and competitiveness of a nuclear plant of 600 MWe.**
- ❑ In addition, market survey study carried out by the IAEA in 1973, confirmed these conclusions.**
- ❑ After careful studies and comparatives technical and economic analysis of various proven reactor systems, LWR system was chosen, leaving competition between PWR and BWR only.**

Past Experience Related To Assessment of Nuclear Power Technology

- ❑ In 1974, BIS was prepared and invitation was sent to four USA LWR Vendors.**
- ❑ A fuel enrichment Service Agreement was concluded in 1974 with a USA firm.**
- ❑ Two Firms submitted Bids in 1975.**
- ❑ An Egyptian- USA Cooperation Agreement was signed in 1976.**
- ❑ Nuclear Power Plants Authority was established in 1976 to be a responsible for carrying out all activities related to introducing nuclear power in Egypt.**
- ❑ Westinghouse was selected for the negotiation of contract for the design and construction of 600 MWe plant and a letter of intent was issued in 1976.**
- ❑ After long negotiations, the project not realized. Mainly due to:**
 - Lack of financing.**
 - Revision of the Cooperation Agreement by USA in 1978, which introduced some unacceptable conditions to the Egyptian Authorities.**
 - The TMI accident in 1979 and the negative effects it left on public opinion towards nuclear power.**

Past Experience Related To Assessment of Nuclear Power Technology

3- Third attempt to introduce nuclear power

- ❑ In early 1980's, a new site was selected after evaluation of three candidate sites.
- ❑ Also, great effort were made to regain the support and drive for the nuclear power program. Mainly due to:
 - Vast increase in oil prices, and
 - The necessity of a reduction use of oil as fuel for generation of electricity.
- ❑ Detailed evaluation showed an essential role for nuclear power in meeting the needs for future electricity generation.
- ❑ It was planned to add 6-8 GW by the year 2000.
- ❑ The electric grid can adopt, at commercial date of the first NPP, a unit of 1000 MW.
- ❑ To overcome the previous problems:
 - Egypt signed and ratified NPT in 1981.
 - Portion of the revenue from oil production was allocated to finance the renewable energy including nuclear power.
 - A national Center for nuclear safety and radiation control (RB) was set.
 - Several Bilateral Agreements in field of peaceful uses of nuclear energy were signed.

Past Experience Related To Assessment of Nuclear Power Technology

- ❑ **A PWR** type was selected for the first plant.
- ❑ **BIS** was prepared, and International Adjudication for construction NPP on a complete Turnkey contract was issued in November 1983.

Main Technical Requirements:

- **A NPP consists of one- two units, rated power per unit of about 1000 MWe.**
- **Base load operation. However, the plant could be operated in load following.**
- **Reference plant: proven design, cooling by sea water and FSAR should be provided.**
- **Financial proposal to cover 80% at least.**
- **Spent fuel pool capacity : 10 years of operation at least.**
- **Waste storage facility : 10 years of operation at least.**
- **Annual Load factor 85% and Annual Availability factor 90%.**
- **Licensing and safety of the NPP should comply with National nuclear regulation, Contractor's home country, and IAEA safety standards.**

Past Experience Related To Assessment of Nuclear Power Technology

- The reactor shall not trip due to any of the following cases:**
 - **Loss of external load.**
 - **Turbine trip at any load.**
 - **Trip of one reactor main coolant pump.**
- Shall permit normal operation at rated power with 1% clad failure**
- Life time requirements:**
 - **30 operating years, except for not easily replaceable parts.**
 - **40 operating years for RPV and Steam generators.**
- Nuclear fuel supply:**
 - **First core, 10 spare fuel assemblies, and**
 - **An agreed No. of reload batches (separate contact).**
- Guarantee period for designed equipment and systems:**
 - **12,000 effecting operating hours, or 24 months after provisional takeover.**
 - **10 years for the building and structures**
 - **Until re-closing of RPV following the first refueling after the termination of the guarantee period.**

Past Experience Related To Assessment of Nuclear Power Technology

Design criteria:

- The plant shall be designed and constructed using standard component and systems already proven in other commercial NPP.
- Component and systems of new design will be accepted only if:
 - The operation of prototype has proved to be satisfactory, and
 - A No. of units has already been ordered for the same use in similar installations.
- Sufficient redundancy and physical separation should be provided.
- Standardization for elements and material to reduce the quantity of spare parts which are necessary to stock.
- Training of personnel for any position shall be 20% more than the required No. to fill that position.
- The design shall not prevent the extension of fuel cycle to 18 month.
- Ensure (-ve) power coeff. and (-ve) moderator temp. coeff. under all operating conditions.
- The technical and economic evaluation for four bids took place through 1984- 1986.
- The project was suspended due the negative effect of Chernobyl accident.

Revival of The Nuclear Power Program

- ❑ An important development in the Egyptian nuclear program occurred in September 2006.**
- ❑ President Mubarak initiate a national debate about government's intention to reconsidering the nuclear option as a part of a comprehensive Energy policy.**
- ❑ In October 2007, and based on the outcome of the national debate, the president declared the strategic decision to a program to construct a number of nuclear power plants for electricity generation, and, also**
- ❑ To start the implementation of the necessary steps to construct the first nuclear power plants for electricity generation.**
- ❑ The program will be developed in cooperation with our international partners and IAEA within the framework of transparency and respect of commitments of the non proliferation regime.**

Motivated Factors to Revival of The Nuclear Power Program

- ❑ Steadily increasing demand for electricity.**
- ❑ Insufficient known national fossil energy resources, and almost full utilization of hydropower.**
- ❑ Price volatility of oil and gas.**
- ❑ Maximizing the usage of national energy resources, achieve long-term economical benefits and sustainable development for future generation.**
- ❑ Nuclear energy is technically and economically viable source of energy.**

Revival of The Nuclear Power Program

Since October 2007, a number of activities have been carried out:

- ❑ Several top-level committees have been restructured for overseeing, monitoring progress, coordinating different activities necessary for nuclear power program.**
- ❑ Drafting of “Nuclear and radiation Law”. The Law covers Nuclear safety, Security, Safeguards, Civil liability issues, and Establishing and independent regulatory body to regulate and monitor the nuclear and radiation facilities, activities and practices.**
- ❑ Reviewing the on going studies related to energy strategies and planning.**
- ❑ Hiring a consultant engineering to providing the required consulting services. The scope of services includes, but not limited to the following:**
 - Site selection and evaluation.**
 - Pre contract activities:**
 - Technology assessment including:**
 - * Long term nuclear fuel supply strategy,**
 - *Spent fuel and radioactive waste management strategy,**
 - * Physical protection and nuclear security, and**
 - * Emergency plan strategy.**
 - * Development of infrastructure.**
 - *Training and technology transfer.**

National Infrastructure of the Nuclear Power Program

- ❑ A National Unified Electrical Grid can accommodate a large NPP.**
- ❑ Specialized Nuclear Organizations and a National Center for Nuclear Safety and Radiation Control.**
- ❑ Availability of a suitable nuclear site capable to accommodate up to 4000 MW.**
- ❑ Joining relevant international treaties, agreements and conventions.**
- ❑ Concluding several bilateral agreements for cooperation in the peaceful uses of nuclear energy with nuclear countries.**
- ❑ Availability of trained personnel in the operation and maintenance of research reactors and conventional power plants.**
- ❑ Large pool of graduates and post graduates in of nuclear engineering fields.**
- ❑ A potential for local participation on conventional part and on some NPPs components.**
- ❑ Public support to the NPP Program.**
- ❑ Egyptian banks can finance at least local part of the construction costs.**

Specific Requirement/ preferences for the First NPP

Infrastructure:

- ❑ The first NPP should be constructed on Turnkey contract.
- ❑ The local capabilities should be utilized to the maximum extent possible.
- ❑ The Egyptian personnel should involve in the project management of the first NPP.
- ❑ The supplies should assure the fuel supply (first core and 3 reloads at least). In addition, long term assurance should be provided with competitive market price.
- ❑ Latest up- to date internationally acknowledged analysis methods should be applied for nuclear safely assessment.
- ❑ The supplies should provide the technology transfers to the Egyptian resources required for safe, reliable, and economic operation of the NPP.
- ❑ The supplies should provide a compressive Human Resource development program that enhancing national capabilities to undertake the activates associated with constriction, license, O & M of the plant during its life.
- The supplier should have an experience to construct NPPs in overseas in recent 5 years with good record to keep the schedule and budget, and should have sound financial status.

Technical Specification:

- Proven NPP technology is essential for the first NPP.
- The NPP component and systems should be proved in commercial NPP.
- A reference plant in operation for at least 5 years with a satisfactory record.
- The reactor will be a Water Cooled Type.
- The unit size will be 600- 1000 MWe.
- The NPP will be utilized as a base load power plant.
- The NPP performance should match the best practice in the world in the recent past.
- Sea water desalination should be incorporated in the Nth NPP.

Nuclear Safety

- The NPP design should be licensed in the suppliers home country and comply with IAEA safety standards.
- The design of safety systems should be capable to maintain the plant in the safe conditions under all possible operating and accident conditions.
- Non-safety grade elements and components should be brought as much as possible to maximize local participations without effecting the overall safety level.
- Licensing support should be provided by the suppliers and the supplier country.

Economic requirements:

- The electricity generation cost (/kW- h) after the first unit should be competitive with that generated cost of natural gas base load station.**
- The supplier and his government should provide financial support cover for the foreign portion of NPP.**
- The construction period should be minimized by the best available means.**
- Pre-fabrication which could result in reducing the construction period and cost should be applied**

Radioactive waste requirements

- The supplier should provide all facilities that required to manage and storage of low and medium radioactive waste.**

Nonproliferation

- The supplier should follow international best practice for proliferation resistance design of the NPP systems.**

Physical protection

- The supplier should follow international best practice for physical protection design of the NPP systems.**

Thank you

