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A BRIEF INTRODUCTION TO OPERATIONAL CONSTRAINTS ON THE GENERATION INFRASTRUCTURE EXPANSION PLANNING IN AN OPEN MARKET ENVIRONMENT

There is no doubt that the outcome of expansion planning studies, including the location of Power Stations and the types of generating units employed, largely influences the operational practices and standards as well as reliability and security of supplies through the Transmission Network.

The Market Environment for generating, transmitting and supplying electrical energy has a strong bearing on the planning of the generation infrastructure. The past methods of preparing long–term plans for generation expansion by vertically integrated utilities were safe in obtaining long-term overall optimisation, by simultaneously taking into consideration all factors during a 25-year horizon. In a regulated market environment however, the long-term examination of overall interests has been replaced by investments largely based on market decisions. It is a matter of a long debate as to which environment results in optimum projects in the long-term. There are many examples of fundamental improvements in this respect in the competitive environment. There is also evidence of the opposite happening, owing to failures in combining expansion plans with transmission network reinforcements. The correct decisions with a long-term bias are now dependent on regulatory frameworks, which should send the proper signals to the market, reflecting the optimum long-term needs of the country's electrical energy requirements. Such signals should take into consideration a variety of factors, many of which are related to the operation of the generation and transmission systems. Neglecting operational constraints when preparing long-term generation expansion plans can only result in jeopardising security standards and inevitably leading to frequent interruptions of supply and even black-outs. Such factors become more predominant in isolated insular systems.

There are many contradicting requirements, on one hand related to minimising power generation capital investments and on the other to maximising operational effectiveness. For example, operating large units for gaining economies of scale or maximising the use of a natural gas terminal plant may result in a generation mix for many hours during which only a small number of large-size inflexible units are committed. Tripping of one heavily loaded large size unit would result in a major system disturbance of such magnitude leading to extensive disruptions of supply.

The proper regulatory market signals and incentives must take into consideration the need for adopting different types and technologies of generating plant for a suitable plant mix at each and every hour. Conventional steam unit plant, C.C.G.T.'s, industrial type gas-turbines, aero-derivative type gas-turbines, hydro-electric power or pump storage plant, each has its own distinctive role for better system operation. The Transmission System Operator has no significant role to play in the process of selecting technologies other than advising on sending some price signals or demonstrating operating restrictions.

In insular systems, the size and location of power stations has a strong bearing on the transmission network interconnecting capacities. The availability of many power stations near load centres reduces power transfer capacity requirements through the transmission network. Reducing transfer capacities improves most security of supply factors, such as limiting load flows, better voltage and power regulation, improved transient stability performance. When only one or two power stations are available, then there is a need of reinforcing the transmission network, building new lines, uprating transmission voltage. With the ever-increasing obstacles in obtaining planning permits for new transmission lines, getting on time the necessary interconnections becomes a near impossible task.

At the same time getting planning permits for new Power Stations at suitable sites is difficult, if not more difficult. In Cyprus, unit sizes are getting larger and available locations are becoming a scarce commodity, possibly now being reduced to one in the government controlled region. There are no easily available market signals that can improve the situation, for avoiding risks for prolonged delays to commission new plant. However, some welcome technological advances in improving small generating units embedded in the distribution network can reduce the transmission network transfer requirements.

Under such conditions, accurate generation forecasting is very important, employing reliable and proven techniques which give due consideration to the changing climatic conditions in Europe. A relevant factor is the correct use of operational reserve requirements, in order to maximise the unit response to disturbances, whilst at the same time minimising overall costs of reserve, a well as delaying the need for additional generation.

Insular systems face some added challenges when considering the strong wish to employ large scale generation using renewable energy sources. A great operating challenge lies in the way of the Transmission System Operator. Large scale wind generation or photovoltaic generation might end being supported at times by only a small number of large conventional units. The most economical ways of providing cover against a sudden drop of wind or a cloud over a photovoltaic park must be found. Such problems common to many insular systems are anticipated to appear in the near future and solutions are now sought.

The conclusion from this brief note presenting the TSO’s perspective is that no Generation Expansion Planning Study can ignore the real operational issues associated with scenarios considered.

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