power generation (due to a plant outage or shortage of transmission capacity) is reduced.

For the increased generation capability to be beneficial, priority has to be given to making critical local plants Y2K compliant.

In addition to preparing the generation end by putting all the reserves on the grid, equally important precautions are also necessary at the load end. Several grids (eg, many of the European systems) have sophisticated load management systems in place. Critical system states can be countered through targeted shedding of loads. Emergency load shedding plans should be developed for all networks. These have to include predefined priorities for the supply of more or less important customers.

Other solutions include installing new controls and devices which allow a more precise and faster detection of the system status, eg phasor measurement units and voltage instability predictors. Better status detection can contribute significantly towards preventing wide area disturbances. Remedial Action Systems (RAS) provide another means of limiting the impact of major disturbances. These are documented, predefined procedures for handling critical situations. Examples could be series capacitor insertion, switching shunt capacitor banks, opening lines, tripping generated load and dropping load. A properly designed and implemented Y2K-specific RAS could be a cost-effective solution to disturbances having severe consequences but with a low probability of occurrence.

Another important step in the prevention strategy is operator training. Due to the many possible outage scenarios, it is essential for the system operators to be prepared to deal with the unexpected.

Finally, a restoration strategy should be developed for the case in which, even though all the measures described are implemented, a widespread or even partial blackout cannot be avoided. The physical configuration of an interconnected transmission network is such that problems occurring in one utility's system could quickly spread to neighbouring systems. An effective restoration plan is therefore essential for returning the electrical grid to normal operation quickly and safely. Some of the main restoration issues are:

- High system voltage problems,such as open-ended line voltages
- Matching of generation and load
- Limitation of generator capability for absorbing reactive power
- Source and adequacy of restoration of cranking power (auxiliary power needed for the start-up of a plant)

Y2K: Power Utilities

Proposed prevention strategies

- Remedial Action Systems (RAS)
  - Verify Y2K compliance of existing RAS and modify accordingly
  - Develop new RAS to counter scenarios not previously expected
- Develop reliable operating solutions
  - Redispatch generation (uneconomic operation)
  - Increase spinning reserves
  - Install new devices and controls
  - Predefine load-shedding schemes
- Operator training

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Y2K: Power Utilities

Proposed restoration strategies

- Analyze restoration procedures
  - Generator blackstart requirements
  - Sequence of line energization
  - Load pickup
- Determine additional capabilities
  - Ratings and locations of existing and/or new generation
  - Ratings and locations of voltage control equipment
  - Higher rating for specific circuit-breakers
- Operator training

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A successful restoration strategy needs to include the following:

- Simulations to establish operating procedures for re-energizing the grid after a partial or complete blackout
- Review of the existing blackstart capabilities and need for additional capability
- Operator training
- Review of station service battery power systems

the system operators and suppliers give them an 'insider bonus' which is essential for finding solutions to the Year 2000 problem. A close partnership and cooperation between the two parties is essential if the Y2K challenge is to be tackled successfully. ABB offers customers a range of Y2K-related services. For maximum results, these should be implemented in combination with the main activities recommended for the utilities.

References

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Conclusions

The described measures will have to be combined in order to ensure a very robust and reliable electricity supply system. Not only the general public has to be clear about this; as a major consumer of electricity, and one which depends on a reliable, uninterrupted supply, ABB also has a vested interest in knowing that all possible steps have been taken by the power utilities.

ABB offers cooperation in all the areas and activities mentioned above. The company is prepared to make its Y2K experience available to its customers among the utilities, and to provide support in the area of system behaviour and simulation.

The special expertise and know-how of

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Electrical equipment for major pumping station project in Egypt

The *Ministry of Public Works and Water Resources*, Egypt, has awarded contracts for the construction of one of the world's largest pumping stations, to be built at the Aswan dam, close to the village of Toshka. Water from the station will be used to irrigate a side valley south-west of the Nile. With its installed power rating of 250 MW, the station will be able to pump 25 million cubic meters of water through a 200-km long system of canals.

Kvaerner Construction, UK, Hitachi of Japan and Arabian International Construction of Egypt will act as main contractor. A consortium comprising ABB Industrie GmbH of Germany, ABB Industrie AG of Switzerland and Hitachi have been awarded contracts valued at approximately US$ 26 million for the electrical equipment for the station.

ABB deliveries include converters, 12-MW synchronous motors, transformers, switchgear and uninterruptible power supplies. The pumping station is scheduled for completion in 2002.

Turnkey construction of a 1100-MW steam power plant in Saudi Arabia

ABB Kraftwerke AG of Germany has received an order from the *Saudi Consolidated Electricity Company in the Western Region* for the turnkey construction of a three-unit, 1100-MW steam power plant. The plant will be built at Shoaiba, 120 km south of Jiddah on the Red Sea. The contract, worth approximately US$ 800 million, includes an option for the construction of two additional units.

Among the ABB deliveries are the three 370-MW steam turbosets and the complete electrical equipment, including the power plant control system. ABB is also responsible for engineering and the project management.

The first unit of the oil-fired steam power plant will go on stream in mid-2001, the second and third units following 8 and 14 months later, respectively.

200-MW HVDC link between Estonia and Finland

An order has been received by ABB Power Systems AB of Sweden to build a 200-MW high-voltage DC submarine link that will connect the electrical power grids of Estonia and Finland. The order sum is about US$ 100 million. ABB's partners in the project are the Estonian state-owned utility, *Eesti Energia AS, Graningeverkens AB of Sweden and Pohjolan Voima Oy and Helsinki Energy*, both of Finland.

With its power network linked to the Nordic grid, Estonia will be able to export electricity and generate revenues that will allow the country to modernize its power plants.

Construction of the link is scheduled to begin in mid-1999 and will take approximately 15 months.

Electrical equipment for an Egyptian cement plant

Kobe Steel Ltd of Japan has awarded a contract to ABB Industrie AG, Switzerland, for the supply of the complete electrical equipment for the new Beni Suef cement plant being built by the *Arab Cement Company* in Cairo. The value of the order is approximately US$ 17 million.

The main items of the electrical equipment are high-voltage and low-voltage switchgear, transformers, drives and automation systems. ABB will also be responsible for the associated engineering work. Cement production in the plant will be controlled and monitored by the Advant® Cement System, which is already operating successfully in numerous cement plants. Commissioning of the plant is scheduled for the end of 2000.

New DC power supply system for Nucor Steel

ABB Industrial Systems Inc, USA, and ABB Industrie AG, Switzerland, have developed for *Nucor Steel Corporation* the world's first rectifier system with combined DC power supply and static var system for electric arc furnaces. Rated 140 MW continuous, the new *Nucor Steel* installation will also be the largest ever single electrode DC power supply for arc furnaces.

The main items of the delivery are four newly developed, fiber-optics controlled thyristor rectifiers, two 90-MVA furnace transformers and the 34.5-kV furnace switchgear. The static var system is rated at 220 MVAr and is equipped with 'ArcComp' – an innovative arc stabilizing system which allows DC furnaces to be used down to short-circuit power to furnace power ratios as low as 10:1. Under the terms of the contract, ABB will also deliver a static 80-MVAr static compensator for a rolling mill. Start-up of the new system is scheduled for the end of 1999.

Order won for a gas-insulated 110-kV substation in Heidelberg

Stadtwerke Heidelberg AG, Germany, has awarded a contract to ABB Calor Emag Schaltanlagen AG for the delivery, installation and commissioning of 110-kV switchgear for the transformer substation 'Nord'. The order is mainly for six gas-insulated switchbays of type ELK-0, including the integrated control units. Start-up is due in September 1999.

The order confirms the utility's satisfaction with ABB technology; it is the sixth of its kind to be received from Stadtwerke Heidelberg.