UPEC 2000
6~8 September 2000, Queen's University Belfast, UK

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The 35th Universities Power Engineering Conference (UPEC 2000), was held 6~8 September, 2000 at Queen's University Belfast, Northern Ireland, UK. It surpassed previous conferences by the quality of the presentations, the technical content of the papers, the number of delegates attending and the number of countries represented. As in the past, it had a broad theme, covering all aspects of electrical power engineering, and was attended by academics, research workers, and members of the power service and manufacturing organizations. During the sessions, 220 papers from almost 40 countries were debated. A plenary session, 32 technical sessions, and a closing session were held, with all technical papers being presented orally in four groups of parallel sessions. The high standard of the papers, presentations, and technical discussions was particularly gratifying.

Held annually, UPEC provides a forum for the exchange of ideas among practising engineers from the universities, consultants, and in the manufacturing and supply industries. The first full conference was held at the University of Glasgow, UK, in 1967, following an inaugural meeting in Newcastle. Last year the conference was held at Leicester University, UK. The thirty-sixth (2001) conference is to be hosted by University of Wales Swansea, UK, while venues for the 2002 and 2003 conferences are Staffordshire University, UK and Thessaloniki, Greece. The working language at all meetings is English.

This year the conference sponsors included IEEE PES, IEE, Northern Ireland Electricity, Belfast City Council, F G Wilson (Engineering), and Kelman Ltd.

Opening Session

Dr Brendan Fox, Chairman of the Organising Committee, welcomed participants to the conference, to Belfast, and to the UK. He said that over 300 abstracts were received from all five continents and 220 papers would be presented orally in four parallel groups of sessions. One page summaries of each paper were contained in the Abstract Records. The full conference papers were published on CD-ROM.

Dr Fox thanked the institutions and the companies supporting the conference. Contributions of members of the International Steering Committee and the Local Organizing Committee, the reviewers, and the session chairpersons were highly appreciated.

Professor Adrian Long, Dean of Engineering at Queen's University, said it was a great honor for him to welcome participants in the name of the Senate of the University and wished participants successful and rewarding work at the conference and some nice days in Belfast.

Tom Hammons, Chair, IEEE UKRI Section and Chair, IEEE Power Engineering Chapter said he was very pleased to welcome delegates and conveyed greetings from the PES Governing Board. PES had 24,000 members world-wide, with more than 300 in the UKRI Section. He had the pleasure of attending many previous UPECs that were very successful,

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This conference review article was prepared by T. J. Hammons, Chair of UKRI Section Power Engineering Chapter; Chair of UKRI Section; and Chair of International Practices for Energy Development and Power Generation; University of Glasgow, United Kingdom.

and looked forward to the present conference being of equal success. The goal of PES was to encourage and sponsor more international meetings. He considered UPEC to be an important meeting and looked forward to other co-sponsored UPEC meetings in the coming years. IEEE, with a third of a million professional electrical and electronic engineers as members, publishes roughly one quarter of the world's publications in electrical and electronic engineering and was proud to be a co-sponsor of this event.

Plenary Address

This followed the Opening Remarks and was on Development of the Northern Ireland Electricity Market. It was delivered by Brian R Lunn, System Operations Manager, Northern Ireland Electricity plc (NIE). It focused on the simplicity of the trading arrangements in Northern Ireland (NI), the minimal cost of introducing these arrangements, and importantly the criteria to be satisfied in the development of systems to meet an evolving market culture.

He said an essential element in the theme of the address was encapsulated in the following lines of Rudyard Kipling (1865-1936):

I keep six honest serving men
(They taught me all I knew)
Their names are What and Why and When
And How and Where and Who.

Mr Lunn considered that these lines have real relevance in the evolving electricity market.

He described the developments to date with emphasis on the commitment to a workable but cheap system generating minimum overheads.

Background

The EU Directive 96/92/EC came into force on 19 February 1999 in NI, and required that suppliers/eligible customers should be able to contract directly with Independent Power Producers for their electricity supply.

Prior to this date all output from the Province's four power stations was contracted to NIE's Power Procurement business. Some Second Tier Suppliers came to NI but initially there was only competition at supply level as none of the generating capacity that came out of contract was offered as independent plant. A proxy for competition at generation level was introduced in August 1999 when NIE's Power Procurement business auctioned 2 x 100MW tranches of generation capacity to second tier suppliers, giving them capacity they could sell on to eligible customers based on the price they had bid for the capacity.

This arrangement was known as Virtual IPP (VIPP) as the capacity was not linked to specific generating units.

From 1 April 2000 for one generating unit, and 1 May 2000 for two more generating units, contracts were bought out and the capacity offered to Second Tier Suppliers, so from 1 April 2000 fully independent generation was running and the market had really started.

Settlement System

The essence of the system, continued Lunn, is that bilateral trading volumes are nominated to the system operator on the previous day by both the IPPs and the suppliers.

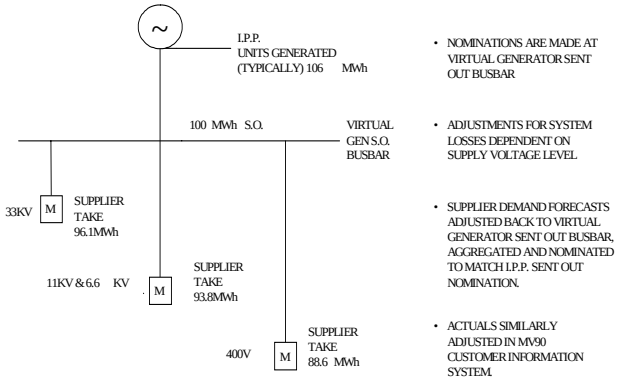

Figure 1. Energy Nominations within NI

The essential features of the nomination process are as follows (see Figure 1):

- Nominations are for energy for 48 1/2 hour settlement periods starting at 06.00 hrs each day.
- Nominations must balance, i.e., suppliers and IPP nominations must be complementary. This is achieved by both parties making their nominations at what is described as the virtual generation sent out busbar.
- Thus IPPs nominate units sent out from their station and suppliers nominate their customer demand factored to compensate for system losses appropriate to their supply voltage (3.9% at 33kV, 6.2% at 11kV and 6.6kV, and 11.4% at 400V).
- Nominations for transfers over the interconnector with Republic of Ireland (RoI) will be equal at the interconnector commercial boundary. In NI the adjustment to the virtual generation sent out busbar will be 2% with IPP and supplier nominations then being made as for internal nominations.

These nominations are fed into the settlement system as are the ex-post actual deliveries to the network by IPPs and actual off takes by suppliers.

Variations from nominations are calculated in settlement, a shortfall being charged at Bulk Supply Tariff (BST) and spill being paid for at a system avoidable price of 1.0p/kWh in summer and 1.5p/kWh in winter.

Nominations are made by 10:00 hrs on Day 1 for the 24-hour period commencing at 06:00 hrs on Day 0 (i.e., the next day). The nominations represent the bilateral contracts between IPPs and suppliers. Settlement of variations from nominations is carried out separately for IPPs and suppliers.

This simple system fulfils the basic requirements of the Directive 96/92/EC and is regarded as interim, with an obligation on NIE and other industry players to review the interim arrangements by October 2000.

The existing system was developed in time for the 19 February 1999 market opening (although VIPP trading did not commence until 1 August 1999) and cost £10k in software development.

In summary the interim solution achieves the following:

- ♦ facilitates trading
- ♦ delivered at minimal cost

- ♦ can be extended to accommodate new players and new trading rules

Interconnector Trading and Settlement

Since 19 February 1999, suppliers in NI have traded with IPPs in the Republic of Ireland (RoI). ESB have secured customers in NI and purchased capacity to meet at least part of their customer demand. On 19 February 2000 the RoI market was opened up and trading over the N-S interconnector in both directions became possible.

Energy trading and settlement over the interconnector mirrors the arrangements in place in NI, i.e., suppliers and IPPs nominate their bilateral contracts to their System Operator with appropriate adjustments for system losses.

To secure access to the interconnector a tranche of interconnector export capacity was auctioned. This tranche of capacity, for the first year, reflects the level of export capacity both NIE and ESB have judged to be deliverable without system driven constraints over the full year. The auction has resulted in interconnector capacity being secured by successful bidders from 1 April 2000 to 31 March 2001.

From 19 February 2000 to 1 April 2000 capacity was obtained on request up to the level to be auctioned with pro rata downward adjustment if requests for capacity exceed the tranche allocated for auction. This secured the minimum needs of the Directive 96/92/EC from the due date for RoI.

The Transmission Operators (TSOs) jointly check that the nominations balance and produce an interconnector transfer schedule for each settlement period. Settlement is on the following basis:

- nominated transfers will be deemed to have been delivered
- variations between supplier or IPP nominations and actual take or delivery are settled in the Supplier's or IPP's jurisdiction
- variations between nominated interconnector transfers and actual transfer are settled between the TSOs

Between now and October 2000 all aspects of trading, especially over the interconnector, will be revisited with the objective of releasing as much interconnector capacity into the market as possible from April 2001. This review will deal with variable available transfer capacity, firm and non-firm capacity, liabilities, possible compensation, system security, and the need for market instruments such as countertrading to solve interconnector capacity limitations.

The market process must be put in place quickly to secure all the potential benefits of the Scottish Interconnector due at the end of 2001. At this stage no additional running costs (settlement) are envisaged to accommodate the changes to interconnector trading.

System Support Services

NI has only 14 thermal generating units and 5 fast start gas turbines totalling 1,641MW of thermal capacity and 232MW of gas turbine capacity to meet a peak demand which is currently 1,560MW.

When considering operational security of supply some additional features were added to the concept of ancillary services in devising the System Support Services (SSS) agreement. The main elements of the SSS agreement are:

- commercial incentives driving annual overhaul programmes to meet anticipated system demand throughout the year
- MVAr generation up to unit capability as system requirements dictate
- commercial incentives on short-term outage planning
- contracted operating characteristics for all generating units in NI with rebates for failure broadly reflecting additional system costs
- an overall payment of circa 50p/MWh for all available centrally dispatched generating units (CDGUs) in NI which conform to the provisions of the SSS agreement

The arrangements are very similar to the provisions in the Power Purchasing Agreements (PPAs) put in place in 1992, which have been shown to be correctly structured to provide relevant incentives. This similarity allowed NIE to make relatively minor alterations to the Contract Management System (CMS) which calculates payments under the PPAs to accommodate payments (and rebates) under the SSS agreement.

Settlement of SSS payments is expected to total around £7 million/annum, which will provide sufficient incentive to all CDGUs to meet system requirements. Modifications to the existing CMS for SSS payments cost around £30k and the running costs will be minimal.

Summary

The achievements in developing the electricity market in NI can be summarised as follows:

- Requirements of EU Directive 96/92/EC have been met by 26% market opening in NI
- Interconnector trading arrangements in place coincident with the RoI market opening
- System for provision and payment of system support services in place
- All the above achieved at minimal cost
- VIPP auctions effected as a proxy for IPPs
- Real price reductions for eligible customers
- Every prospect of market liquidity improving with enhanced interconnection and IPPs appearing
- A developing market culture among market players

Although the existing market facilities are simple, they were cheap to develop and cost little to operate. By avoiding the huge expenditure which has occurred in Great Britain we can further develop market facilities as the need arises, without incurring any unnecessary expenditure and market overhead cost. This should ensure that the best market structure for NI emerges to facilitate the maximum reduction in electricity prices from their current high level.

The Future

Where do we go from here? There is no universal solution in the search for the ‘right’ trading system. The answers are different for each system, and we should return to Kipling’s six honest serving men for some appropriate questions and answers.

What

What is wrong with our existing system? Whereas the adage 'if it works don't fix it' is not the most positive approach for implementing change we do need reasons to change a working model.

What changes are being requested by market players? The view of market players needs to be incorporated into the change process. They will experience any real problems.

What changes are necessary? Is beneficial market development being hindered if we maintain the status quo?

Where

Where has a system been developed which would meet our requirements? There is no need to re-invent the wheel, but the developed system should be a reasonable 'fit' for NI requirements and should include the full range of issues outside simple energy trading such as plant size and flexibility, support services agreements, and level of market opening.

Why

Why are particular changes being requested? Care should be taken that the request for change is based on a requirement to improve the trading system and is not a mechanism by which an individual market player can strengthen his position to the disadvantage of others.

Who

Who do you ask if an existing system works well? There is a danger that advice can be available from people with experience of designing or implementing trading systems that will not fit ones requirements. It is important that whereas a system can be configured to meet ones requirement, an appropriate solution should not be "shoe-horned" as a bad fit for local issues. The customer and operator of an existing system will be in a position to offer good advice. Who will benefit? For a number of reasons it is important to evaluate in advance who will benefit, among them being the answer to the next question.

Who will pay for it? Whoever benefits should pay for, or at least contribute to, the cost of developing and running the system. This imposes a discipline on the complexity of the system being proposed and any requests for changes. Our experience in Northern Ireland was that the demands of the market players in terms of the complexity of the system were considerably reduced when it became apparent that they would be expected to pay for the development.

Who should design and evaluate the proposed changes? The industry's input should not be undervalued although outside experience/consultancy can add to the breadth of expertise going into the design process. People who will benefit from the changes should be consulted rather than be part of the decision making process. People with no commercial interest should be at the heart of the process.

How

How much will it cost to implement and run? Some form of cost benefit analysis must be carried out. It is not sufficient to argue for a sophisticated trading system without any attempt to justify it.

How much will it bring prices down? Since the objective in the final analysis is to bring electricity prices down, any proposal that does not hold out reasonable expectation of this happening should be scrapped.

When

When can this be implemented? The process of major change can lead to timetables that are optimistic. Strong project management will prevent unwilling parties dragging their feet while accepting that some programme slippage is inevitable.

When should there be a review? Any new system being installed should have a review timetable up front. Without this a market player can be faced with an unexpected review and possibly genuine cause for complaint. Additionally, reviews are required because the financial, commercial or operational outcomes are not as anticipated. The Northern Ireland experience from 1992 was that having no price review for generation was a mistake from which all should learn.

All the questions and possible combinations have not been dealt with here. Simplistically, a balance is required between development plus running costs and benefits derived. The evaluation of these benefits must be made beforehand. There is no point in having a complex and expensive (some may say sophisticated) system which costs more than it delivers.

Technical Paper Sessions

Topics debated in the four parallel groups of technical sessions on the first day included: short term load forecasting, electrical machines, power system transients, power system protection, power system control, motors and actuators, power transmission, power system operation, induction machines, fields, distribution system protection, embedded generation, electric vehicles, power flow calculations, and long-term forecasting.

On the second day, there were parallel groups of sessions on: renewable and energy efficient generation, power engineering education, power system dynamics, power system planning and reliability, interconnection, power electronics, high-voltage measurement, and distribution systems.

Topics debated in parallel groups of technical paper sessions on the third day included: wind power, flexible ac transmission, high voltage engineering, distribution system operation, power industry restructuring, power plant control, insulation, and power quality.

Other Conference Highlights

Highlights of the conference included:

- Civic Reception and Welcome Buffet in Belfast City Hall on the evening of the first day of the conference where delegates were addressed by the High Sheriff of Belfast, Councillor Tom Campbell, over drinks and a welcoming buffet.
- A program of cultural and technical visits on the afternoon of the second day of the conference, which included the Giant's Causeway, Bushmills Distillery, B9 Energy Efficient Office and Elliot's Hill Wind Farm, and F G Wilson (Generator Manufacturer).

- Conference Dinner at the Elms Residences, Queen's University Belfast, during the evening of the second day of the conference, at which the after dinner speaker was Professor H W Whittington, University of Edinburgh.

After Dinner Speech

In his address, Professor Whittington reminded delegates of the "good old days", before privatisation of the Electricity Supply Industry (ESI) in the UK when engineers dominated the industry. He recalled the excitement of managing the engineering and technical challenges of the supply network and contrasted these with the market-driven industry of the past 10 years. While some changes that have occurred have brought with them benefits, they have also brought difficulties, which are now becoming manifest. Most important has been the significant reduction in the number of engineers employed by the ESI and the dramatic reduction in research and development funding from the industry. This has coincided with a serious decrease in the number of power engineers being educated in our universities and entering the profession. Professor Whittington considered that we have coped up till now because of the legacy of good work done by both the universities and the ESI in the past, but he explained that predictions indicate serious shortfalls in the number of qualified people in the next few years. The problem is international, with most of the countries of the European Union reporting insufficient numbers of power engineers in training and forecasting the problem to get worse. Professor Whittington suggested that there was no "quick fix" and that the general drift from science and engineering must be addressed at school level. Such a long-term view is essential to the future well-being of power engineering. He ended by exhorting all delegates to become active in promoting their discipline to ensure a supply of highly educated and competent power engineers for the future.

Conference Proceedings

All technical papers were incorporated in the UPEC 2000 Proceedings CD-ROM which was distributed to delegates at the conference. The Abstract Records (235 pages), also distributed to delegates, contained one-page hard copy summaries of each paper.

UPEC 2000 Proceedings (CD-ROM and Abstracts) may be purchased for £40 (sterling), until supplies are exhausted, from Brendan Fox, UPEC 2000 Organizer, School of Electrical Engineering, The Queen's University of Belfast, Ashby Building, Stranmillis Rd, Belfast BT9 5AH, UK, +44 28 9027 4053, Fax: +44 28 9066 7023, E-mail: B.Fox@ee.qub.ac.uk

Award

A prize was awarded for the best oral presentation at the conference by a young engineer. The recipient was Ms Wai Jing Cheong, of the University of Bath, for her paper 'Accurate Fault Location in Capacitor Compensated Lines using a Hybrid Fuzzy Neural Network'.

Conference Wrap-up

Papers were well thought out and benefited from the 15 minutes that were allowed for the presentation and discussion of each paper. The general level of the presentations was extraordinarily high and the discussions were stimulating. The pleasure the participants experienced in meeting colleagues with similar interests from so many countries should be particularly noted.

Gratitude is expressed to Professor B W Hogg (Chairman of UPEC 2000), Dr Brendan Fox (UPEC Organiser), Dr. Alf Refsum (Organizing Committee), and colleagues at Queen's University Belfast for the detailed organization of the meeting.

UPEC 2001

In closing the conference, Dr Brendan Fox stated that the 36th UPEC will be organized by the Department of Electrical and Electronic Engineering, University of Wales Swansea, United Kingdom, and will be held September 12~14, 2001. It will be co-sponsored by IEEE PES, and IEE. It will be held on the main university campus. Its aim will be to provide engineers and academia with the opportunity to explore recent developments, current practices and future trends in power engineering, and young engineers and research students are especially invited to contribute. The conference will again have a broad theme covering all aspects of power engineering. The working language will be English. The majority of accepted papers will be presented in oral sessions.

For more information on UPEC 2001, contact Dr M S Khanniche, UPEC 2001 Organizer, Department of Electrical and Electronic Engineering, University of Wales Swansea, Singleton Park, Swansea SA2 8PP, UK, Tel: +44 1792 295 421; Fax: +44 1792 295 441; E-mail: upec@swansea.ac.uk; Website: http://eepe.swan.ac.uk/upec/. Abstracts are to be submitted by January 31, 2001, notification of acceptance of papers will be March 2001, and receipt of full papers will be May 2001.