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A Review of Power System Modelling Platforms and Capabilities

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About this report

The Institution of Engineering and Technology was commissioned by the Council of Science and Technology (CST) to research the emerging challenges for modelling electricity systems and how Britain's capabilities would need to be adapted to assess electricity system resilience as GB makes the transition to a low carbon electricity system.

This project commissioned, and received, fifteen individual papers from GB-based specialists of international standing in power system modelling. The authors of the papers worked with a wide stakeholder base of network companies, academics and others, who provided review and challenge. Professor Graham Ault CEng FIET was contracted to provide technical co-ordination and drafting. The emerging conclusions were further validated by means of an industry and academic workshop sponsored by Government Office for Science. The entire project was conducted under the direction of an independent steering committee composed of senior IET Fellows, two of whom were also CST nominees.

The report is composed of three parts:

- Part 1: Main report
- Part 2: Summary of Commissioned Papers
- Part 3: IET Special Interest Publication – Academic & Industry Papers

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EXECUTIVE SUMMARY

Power system modelling is a critical aspect of the successful operation and management of electricity networks. Long term planning models and software serve to provide a platform where testing can be performed and scenarios can be verified in an offline environment such that the operation of the networks can be planned and optimised appropriately. Operational and real-time modelling and software is the primary method of interaction for control engineers in their supervisory and management role.

A description of the power system modelling software platforms which are available and widely used is provided. This highlights the wide range of tools and capabilities that are used to plan networks, providing functionality spanning steady-state, dynamic[1], harmonic, electromagnetic transient (EMT), real-time simulation and hybrid analysis. The evaluation which follows notes that the large number of available software platforms and simulation environments has resulted in fragmentation of the modelling capabilities used for analysis and planning within network operators, with many different packages used to meet the variety of needs. The same is true of shorter term modelling capabilities such as forecasting, where bespoke systems have been developed internally within companies as well as several commercial packages being available. Operationally, there are again a great many network management platforms available however there is better alignment of these throughout Great Britain[2] (GB) with all but one of the 6 DNO companies using a GE product.

A number of conclusions and recommendations have been made to address future challenges, gaps and shortfalls. Consistency of modelling software and associated disparity within companies is an area of concern as better alignment is encouraged. Challenges with data consistency could be better managed with more uniformity in this area.

The key challenge of modelling of new technologies, such as HVDC (high voltage direct current) components must also be addressed, and viable options for this must be pursued to facilitate widespread and harmonised dissemination across many software packages. A harmonisation of development processes across network operators is also advised here, again such that the modelling tools and techniques, and any benefit they bring, can be successfully shared.

1. BACKGROUND

Power system modelling is a broad field with many different aspects. It can be loosely categorised however into modelling for planning purposes (long-term), and modelling for operational network management (short-term, real-time). The type of models, platforms, data and assumptions used varies considerably between operational and long-term modelling, and also between software packages.

1.1 Long Term Modelling for Planning Purposes

The power system must adhere to certain criteria and standards, some of which are licence requirements; for example the transmission network must be designed according to minimum requirements set out in the SQSS (security and quality of supply standard) [1] (and other supporting documents) and distribution networks to Engineering Recommendation P2/6 [2], and additional distribution code requirements such as P28, P29 and G5/4. This includes the existing backbone infrastructure as well as new extensions and reinforcements, and new generation or demand connections.

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[1] The term 'dynamic' refers to both transient and dynamic disturbances and/or studies throughout this paper.

[2] Northern Ireland (NIE) is not included in the scope of this study.

Power system modelling is carried out to ensure this is achieved. For this type of long-term planning, power system analysis would be carried out. Electricity network analytical models, whole energy system models and economic models may also be utilised for long-term planning and scenario testing.

Power system analysis software e.g. DINIS, IPSA, PSS/E and DIgSILENT provides the platform upon which detailed power system studies can be conducted, encompassing steady-state, dynamic, harmonic and EMT studies. Load flow, reactive power capability, contingency analysis, fault level, P28, harmonic analysis, transient stability and fault ride through are among the most common studies carried out for network planning and generation connections. On distribution networks the study of reverse power flows has become a major concern in respect of voltage management and protection stability and coordination. Outputs from many of these studies can be used as evidence of Grid/Distribution Code compliance, provided the input data and/or assumptions are sufficiently accurate.

Electricity and whole energy system models, such as MARKAL-based modelling or ESME can be used to study the long term evolution of energy systems which is becoming more important as the energy mix diversifies. Economic modelling is carried out in a number of ways, one being the use of forecasting where economic growth is used as an input. Economic modelling is also used to derive the most economic network intervention solutions which will often incorporate cost calculations and benefit analysis of reinforcement and smart solutions.

1.2 Modelling on Operational Timescales

Moving into the operational timescales, generation and demand forecasting is modelling which is critical for effective system balancing, more so at transmission but balancing is rapidly becoming important for distribution networks. Forecasting can be done on any timescale basis e.g. hour-, day-, week-ahead, depending on the model and available data. Forecast modelling can be undertaken on a number of commercially available software platforms, however within the GB network companies, it is generally carried out on models created and developed internally.

Networks are operated and managed in real-time in systems known as Network Management Systems (NMS) which are employed at both transmission and distribution voltages. Energy Management Systems (EMS) and Distribution Management Systems (DMS) are highly integrated systems which transmission owner (TO) and distribution network operator (DNO) control rooms respectively use to operate and manage networks via real-time models of the power system, relying on the ICT (information and communication technology) infrastructure to achieve this.

The ICT network provides the inputs to the management systems through real-time data collected by the SCADA (supervisory control and data acquisition) network, encompassing voltage, power factor, current, frequency and equipment switch states i.e. open or closed, information at points around the network where SCADA is available. This provides an accurate view of the network at any one time and allows for informed decision making.

2. METHOD

The data and evidence for this paper has been collected through desk based research, stakeholder engagement and TNEIs experience through recent projects.

Research has been performed to inform on the current state of commercially available power system modelling tools. Stakeholder engagement has been another useful source of information on existing power system modelling capabilities, giving a network company perspective.

TNEI Services Ltd is also in a unique position to be linked with IPSA Power, the software platform which is used widely by a number of network operators in GB for power system analysis modelling. Engagement with the software developers has provided a very helpful insight into how commercial software responds to industry requirements.

Knowledge and lessons learned from power system modelling projects within the TNEI consultancy business has also been a useful resource.

3. CURRENT POWER SYSTEM MODELLING CAPABILITY

The following sections detail the current power system modelling capabilities, encompassing power system analysis, economic, market and forecasting, and operational modelling.

3.1 Power System Analysis Modelling

Power system analysis is the most common type of modelling used for planning purposes by electricity companies. Table 1 highlights the types of power system analysis modelling undertaken and provides examples of widely used (in GB) software packages that are currently available and used to perform these. Each of the modelling types is also described in further detail below.

Power system analysis modelling tools are used for studies such as load flow, fault level, dynamic stability and harmonics. Steady state analysis, such as load flow and fault level studies, is performed to assess the thermal loading, voltage profile and steady-state reactive capability of a network under pre-determined conditions. Dynamic analysis involves carrying out studies in the time domain to understand how networks and their components react to disturbances. This includes studies such as fault ride through, which seeks to understand generator recovery capabilities in the event of a fault. Harmonic analysis is undertaken, generally for a new connection to determine its contribution to the total harmonic distortion in the area, and if it exacerbates any resonant frequencies. Commercial software packages such as DIgSILENT [3], ETAP [4], IPSA [5] and PSS/E [6] are widely used in GB, and indeed globally, to perform these types of studies. OpenDSS is an open source power system analysis platform developed by EPRI that is designed specifically for the study of electric distribution systems [7]. One of its main features is its extensibility such that it can be modified and extended to meet future requirements.

EMT analysis involves the detailed representation of power system equipment to ensure that models are accurate and valid for study in the frequency domain. EMT studies include lightning and switching studies for insulation coordination.

Type of Modelling	Purpose	Study Types	Examples of Software Packages
Steady state power system analysis	Assessment of voltage and thermal conditions, fault levels	Load flow, voltage step, fault level contribution of DG	DIgSILENT, DINIS, ERACS, ETAP, IPSA, Power World, PSS/E, SKM Power Tools, OpenDSS
Dynamic power system analysis	Assessment of the transient and dynamic behaviour of equipment e.g. generators, DFIGs, and/or the network	Transient stability, critical clearing time, dynamic voltage step/control, fault ride through	DIgSILENT, DINIS, ERACS, ETAP, IPSA, Power World, PSS/E, SKM Power Tools
Harmonic analysis	Assessment of harmonics, distortion levels and identification of resonances	Impedance scan, harmonic load flow (including impact of VSC)	DIgSILENT, ERACS, ETAP, IPSA, PSS Sincal, SKM Power Tools
Electro-Magnetic Transient (EMT) Analysis	Assessment of eletro-magnetic transients and phenomena	Insulation coordination (lightning, switching), HVDC/ FACTS equipment design, sub-synchronous resonance (SSR)	ATP-EMTP, EMTP-RV, PSCAD/ EMTDC
Real Time Simulation (RTS)	Closed loop and scenario testing in real time	Real time simulations, protection testing, control system testing	RTDS, Opal-RT
Hybrid Simulation	Assessment of multiple models/ programs in the same dynamic simulation environment	Dynamic analysis of the interaction between two systems	ETRAN (PSS/E and PSCAD)
Multi-Domain Analysis	Assessment of multiple systems and their interactions	Study of interactions between electrical, power electronic, mechanical and fluid dynamic systems	MATLAB (including Simulink and SPS/Simulink), DYMOLA

Table 1: Summary of Power System Analysis Modelling Capability

Any of the EMTP (electromagnetic transients program) family of tools can be used for these studies, e.g. ATP-EMTP [8] or PSCAD/EMTDC [9]. EMTDC is the electromagnetic transient solution engine for the PSCAD family of products, and is often referred to simply as PSCAD. In addition to HVAC (high voltage alternating current) EMT analysis, PSCAD is also widely used for modelling HVDC (high voltage direct current) and FACTS (flexible AC transmission system) devices, including HVDC control system design and modelling of sub-synchronous resonance (SSR). It is commercial software, developed by Manitoba HVDC Research Centre [10]. The ATP (alternative transients program) version of EMTP is free dependent on agreement of the licensing terms [11].

Real time simulations for power systems are increasing in importance as models and systems are becoming more complex. Research on the Real Time Digital Simulator (RTDS) began in the mid-1980s at the Manitoba HVDC Research Centre and the first commercial simulator was available from 1993 [12]. Opal-RT also offers a range of real time simulation products for power system development [13]. Real time simulation activities can provide training, understanding of control and protection and investigation of operational problems, and are particularly useful for complex power systems such as HVDC, VSC-HVDC (voltage source converter), power electronics and the interaction of these power electronics systems with HVAC systems. The large HVDC manufacturers such as ABB, Siemens and Alstom have their own real time simulation environments; they use these facilities for development but also for defining operational procedures and training operators. SHE-T (Scottish Hydro Electric Transmission), together with SPT (Scottish Power Transmission) and NGET (National Grid Electricity Transmission), has been awarded NIC (network innovation competition) funding for a Multi-Terminal Test Environment (MTTE) from Ofgem. This test facility will incorporate a Real Time Simulation environment with replica HVDC control panels and will be used for transmission planning involving HVDC schemes. Investigative studies will be performed on control interactions for multi-terminal systems amongst other activities [14]. The platform will also be used to train Transmission Planning and Operational engineers.

A number of GB academic research facilities, including the University of Strathclyde and the University of Manchester also have real time simulation facilities that are used particularly for HVDC research. These and other universities are aiming to expand their facilities in this area to keep abreast of technological advances.

Software tools are also being developed which integrate different power system analysis functionalities. For example, the software package ETRAN has the ability to perform the hybrid simulation of EMT simulation and transient stability analysis using parallel processing [15]. This type of functionality enables the simulation of large and complex systems, for example multi-terminal HVDC systems integrated with offshore wind farms. Simulations can be separated at transmission line boundaries and run on multiple CPUs (central processing unit). The Atlantic Wind Connection is using this capability in ETRAN to model possible configurations of their Atlantic Wind Project, a VSC-HVDC backbone configuration to connect multiple offshore wind farms along the US East coast. The simulation environment incorporates real control systems from VSC and wind turbine manufacturers. Prior to this capability being available, it was difficult to model multi-terminal configurations given that the modelling of converters in PSCAD was limited to a few, and the capability to simulate a large number of converters in detail during transient events was restricted.

Matlab and SIMULINK, both products of MathWorks [16], are software packages that can be used to model interactions between different domains, such as electrical and mechanical systems. These packages are commonly used in academic environments for research.

3.2 Economic, Market and Forecast Modelling

There are a number of modelling tools available to assess the economic and market aspects of power systems. Types of economic and market modelling, and the available platforms and tools, are summarised in Table 2 and are described in further detail below.

The MARKAL generic model was developed by the Energy Technology Systems Analysis Programme (ETSAP) of the International Energy Agency. The model predicts the evolution of a specific energy system over a long period of say 40 or 50 years. Within MARKAL, specific types of energy are represented by a set of performance and cost characteristics and the model selects the combination of generation and demand technologies that minimises the total energy system cost [17]. One of the key initiatives of the Energy Technologies Institute (ETI) was to build an energy system model to inform priorities for technology development programmes, which became ESME [18].

Type of Modelling	Purpose	Study Types	Examples of Software Packages
Whole Energy System Models (design tools that integrate power, heat, transport and infrastructure with energy resources and demand scenarios)	Study the long term evolution of energy systems	Scenario testing of future power systems taking account of various energy vectors	MARKAL-based modelling (International Energy Agency), Energy System Modelling Environment (ESME) developed by ETI, NGET's Future Energy Scenarios
Power Network Economic Models	Assessment of the economics of planned developments	Cost vs. Benefit analysis	Smart Grid Forum WS3 "Transform" model, Scenario Investment Model (SIM) from the FALCON Low Carbon Network Fund (LCNF) Project
Market, pricing, demand and customer models & Dynamic resource and supply models	Inform on regulatory issues, optimise generation dispatch	Price forecasting, generation dispatch, transmission investment planning	Commercial Models: PLEXOS (used by National Grid), AURORAxmp, Ventyx PROMOD IV. Non-commercial: BID3 (incorporates BID2.4 and Zephyr – Pöyry), ECLIPSE (IPA)
Generation and demand forecasting	Forecasting for system balancing (may also feed into trading tools)	Forecast modelling to optimise network operation whilst minimising costs	Network operators use internal modelling tools. Commercial wind and solar forecasting models include AWS Truepower, Garrad Hassan – GH Forecaster, 3Tier – PowerSight Wind Forecasting System, Element Energy's Forecasting Tool, Grid Scientific's Load Profile Modelling

Table 2: Summary of Market, Economic and Forecast Modelling for Power Systems

The Committee for Climate Change (CCC) is making use of MARKAL-based modelling to define its pathways up to 2050. The Department for Energy and Climate Change (DECC) is using MARKAL and ESME to inform the UK carbon plan, its carbon capture and storage (CCS roadmap and heat and bio energy strategies.

The Smart Grid Forum's Work Stream 3 "Transform" model is a parametric model that analyses the costs and benefits of smart developments on the GB distribution systems. It is based on generic network parameters rather than nodal analysis which is useful as an overall indicator of long-term investment options but not necessarily as a means of assessing the impact of the smart developments on any specific part of the network. The model was used by the DNOs and Ofgem to develop the RIIO-ED1 business plans to enable the total cost for Low Carbon Technology (LCT)-related reinforcement to be determined [19]. Another economic-focused model has been borne out of the LCNF FALCON project, the SIM. The SIM takes smart solutions produced by the FALCON modelling and calculates the lowest cost options over a 30 year period [20].

Market modelling tools generally provide market analysis functionality including price forecasting and generation forecasting, operational modelling including short-term unity commitment (dispatch) and fuel budgeting, and transmission studies encompassing transmission investment economic analysis and outage planning. The most widely used commercial tool in GB is PLEXOS which is used by NGET and other parties such as Baringa, an energy consultancy. Other commercial market modelling tools include AURORAxmp and Ventyx PROMOD IV, which are primarily used in North America and Canada.

Market modelling tools that have been developed internally by consultancies include BID3, which was developed by Pöyry, and incorporates their previous models, BID2.4 and Zephyr. BID3 accounts for the cost implications of intermittent generation in terms of system balancing. ECLIPSE is a power market modelling tool developed by IPA.

In terms of forecasting, there are a number of global providers. AWS Truepower provides wind and solar forecasting to grid operators, energy traders and generation plant owners amongst others.

Garrad Hassan provides short term wind power forecasting to a range of global clients. 3TIER is owned by Vaisala, a global environmental and industrial management company, and provides wind and solar forecasting. Element Energy's tool provides granular forecasting of conventional and LCT-driven load growth. It is used by DNOs and also by Smart Grid Forum Work Stream 3 in conjunction with the Grid Scientific load profile modelling.

NGET use both generation and demand forecasting tools developed internally. Most, if not all, of the GB distribution companies use in-house demand forecasting tools and there is recognition that generation forecasting at these voltage levels may become prudent in the coming years as more generation connects to distribution networks.

NGET currently has a forecasting error of approximately 5%, measured as mean absolute forecast error against capacity [10] [21]. With potentially 50GW of wind on the system by 2030, this could lead to a 2.5GW discrepancy between predicted generation and actual generation. Wind forecasting errors are already leading to curtailment costs, and can be a particular issue where wind forecasting errors affect system balancing and this will impact upon future system balancing and reserve service requirements.

3.3 Operational Modelling

Operational modelling is carried out by each of the GB network operators which provides the functionality to ensure control engineers can monitor and manage their networks in real time. This is achieved using NMS platforms which are fully integrated with the communications and SCADA networks. Engagement with a number of the GB network companies revealed that all but one of the DNOs use the GE products ENMAC or PowerOn Fusion DMS (where PowerOn Fusion is an upgraded and rebranded version of ENMAC) [22], while NGET use the GE PowerOn Reliance EMS product [23].

The GE PowerOn Fusion DMS encompasses monitoring and control of distribution networks, fault management and outage planning, and performance optimisation through a range of integrated modules. It also offers a platform where smart grid technologies can be implemented and deployed, and tools to make managing vast LV networks more efficient.

The PowerOn Reliance EMS is an open-standard, distributed architecture tool which focuses on grid situational awareness and reliability as is required for the transmission network. Emphasis is also placed on security, with a comprehensive layered approach to provide a ‘defence-in-depth’ strategy.

Other NMS platforms used in GB are the Thales NMS [24] at distribution, and the Alstom (previously Areva T&D) e-terra product at transmission [25]. The Thales product is a SCADA system designed to manage infrastructure and provide real-time control, and also to provide the core capability in the control room. There is also an emphasis on security to protect data over the communications links. The Alstom e-terra product also a widely used NMS platform.

4. EVALUATION OF MODELLING CAPABILITY AND GAPS

This section provides an evaluation of the main identifiable gaps in power system modelling software, those which are felt to be the most critical to address at this stage.

4.1 Consistency of Use of Software Platforms

The wide range of modelling products, platforms, technologies and tools available currently means that there is the capability to model most things. This was echoed in the engagement with the GB network companies, where there is general satisfaction that modelling requirements can be achieved in some way whenever necessary, however it can mean that their modelling portfolio spans several different software packages and tools. This is not ideal when a shift towards uniformity, more so within companies than across them, is the desired path as power systems increase in complexity and efforts are being made to streamline data and databases. Having said that, there is a benefit to having a suite of specialist models and tools, rather than one modelling package that performs most things adequately but nothing exceptionally. A balance must be struck here within the network companies and care should be taken to avoid becoming locked-in to a specific package which would limit development opportunities. This is where the adoption of a tool such as the CIM could prove invaluable.

Software developers make continual efforts to stay abreast of the requirements placed on them. As the platforms increase their scope of functionality, natural alignment should occur as users shift towards those capable of meeting more of their requirements.

4.2 Shift in Modelling Timescales

In recent times, and looking ahead to 2030, there has been a definite shift in the timescales for power system modelling as networks move from the “fit and forget” operating philosophy to more active network management. Where previously, modelling for planning purposes would be carried out well in advance of any developments being made, now bespoke modelling tools, which look to connect generation and LCTs, have moved into the operational timescales and some even into real-time, fulfilling a more reactive role.

4.3 Unbalanced Load Flow

Useful modelling of LV (low voltage) networks requires the capability to perform unbalanced load flow analysis to assess the phase imbalance which is characteristic of these networks. There is a gap in the capability of some software modelling packages here as this functionality is not always available. However, the main limitation of LV modelling is the availability of data. If the necessary time-series data were available then it would be relatively easy to model phase imbalance and its impacts.

4.4 Modelling Future Technologies

New technologies and equipment e.g. power electronic converters and smart grid technologies will need to be modelled, and with this comes a variety of challenges, both technical and commercial. There is the question of building the models themselves and who this would fall to, whether it is the equipment manufacturer, the software developer or some third party. The issue of cost, ownership and responsibility is one of the commercial challenges accompanying the modelling of future technologies, and establishing who would pay for developing and maintaining the models.

4.4.1 Power Electronics, HVDC and FACTS and Integration with HVAC Networks

Modelling of HVDC components and other power electronic devices is increasing in significance as the deployment of these technologies grows it is important therefore, not only that the modelling of these technologies is improved, both in terms of obtaining the data and having the necessary standards in place, in such a way that their behaviour is modelled accurately in existing power system analysis software (for use in steady-state, dynamic and harmonic models), but also that the modelling of HVDC and HVAC systems operating together becomes more commonplace.

Study of the interoperation of HVDC and HVAC technologies, especially multi-terminal HVDC systems with the AC network, is of considerable interest as multi-terminal VSC-HVDC links have several advantages. Presently, the preferred power system analysis software for studying HVDC is the EMTP family of tools.

4.5 Modelling of Multiple Networks within the Power System

The power system comprises a number of networks; electrical, communications, protection/control. These networks are all modelled and studied separately, for instance load flow and fault levels studies are conducted in a software package specifically designed for the study of the electrical network, and depending on the results of these analyses, protection coordination studies are carried out in a different software package where the focus is the performance of the protection network devices. As these networks become more complex and interdependent, and operating margins decrease, it has been suggested that it may become more prudent to model them together, for instance modelling protection device performance and coordination alongside fault level studies. There are a number of benefits that could be gained from this type of modelling, namely data consistency across a number of studies thus increasing confidence in the results, and improved efficiency.

Another route going forward is the adoption of adaptive protection. As power flows and fault levels become more dynamic, and the concept of 'steady-state' is challenged, an adaptive strategy will potentially become increasingly necessary.

5. CONCLUSIONS AND RECOMMENDATIONS

This section presents some conclusions and recommendations relating to the gaps and issues described in Section 4 previously.

5.1 Consistency of Use of Software Platforms

To address the issue of software and data consistency for modelling within companies described in Section 4.1, there is a general preference to see the capabilities of the software platforms they currently use to be extended to meet their needs; it is unlikely that transferring to an entirely new software platform would be considered as an option, even if it did offer fully integrated system modelling capability.

Recognising this, the software developers are taking steps to extend their modelling capabilities. Some examples of this include the software developers at IPSA currently working to provide an LV modelling platform and unbalanced load flow capability. ETAP Version 12.6, released in May 2014, also now offers an unbalanced load flow module and improved fault analysis options to test reliability. DIgSILENT Power Factory Version 15 offers a number of improvements on its predecessor, including voltage profile optimisation for bi-directional power flows (where voltage profile was cited as a concern by DNOs) and a techno-economic evaluation capability for grid expansion strategies.

The developments of IPSA and ETAP described here are also addressing the gap in unbalanced load flow capability noted in Section 4.2.

In addition to this, consideration should be afforded to the adoption of a CIM strategy by the various software platforms such that models are more readily interoperable without the need for laborious (and error prone) data conversion processes. This method would improve data consistency even where software platforms differ.

5.2 Modelling Future Technologies

As discussed in Section 4.3, the issue of modelling future technologies needs to be addressed. There are a number of ways in which this could be achieved, two of which are described below.

5.2.1 Common Block Diagrams

There is a definite difficulty in building common models across all software platforms due to the diversity of formats that are used, so common functional block diagrams produced by manufacturers and disseminated to software developers has been cited as one way to manage this. This would allow models to be built in each software package with the appropriate amount of detail for their purposes at the discretion of the developers, and a validation procedure would likely be necessary to ensure the correct modelling.

5.2.2 Software Package Plug-Ins

Plug-ins to software packages are another effective means of simplifying the task of deploying a technology across a number of different platforms. In this instance it would be the responsibility of the equipment manufacturer to provide the plug-in and the interface. In the paper by ABB [26], this option has been explored with an HVDC Light model, whereby a 'common component' model has been produced which can then be implemented for analysis in a variety of different simulation tools.

The paper presents the successful implementation of the HVDC Light model in PSS/E and DIgSILENT Power Factory through a user model interface (UMI).

5.3 Modelling of Multiple Networks within the Power System

ETRAN, described in Table 1 in Section 3.1, has the capability to perform hybrid simulations, in this case with PSS/E and PSCAD. This philosophy may well be adaptable to integrate the modelling of the electrical and protection networks, as suggested in Section 4.4, such that they can be simulated alongside one another.

5.4 Harmonisation of Processes

It is recognised that alignment of modelling tools across the network operators is not likely to be possible, and it is not necessarily encouraged either so as not to stifle innovation or result in a lock-in to specific tools. Harmonisation of processes would be a positive step rather than any attempt at the standardisation of software platforms used. Other industries, for example the telecommunications industry, have benefitted greatly from a certain level of divergence between companies in times of technological advancement, such as is being experienced by the power industry presently with the materialisation of renewable generation and smart grid philosophies.

The Ofgem LCNF and NIC funding initiatives have gone some way to promoting this idea, with all outputs (data, software, models, solutions) from projects required to be shared among the other network operators for collective knowledge sharing and growth.

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