



Dr. Paul Espie BENG, PHD, CENG, MIET, MIEEE

Consultant Engineer



Location

Newcastle, United Kingdom

Experience

18 years

Qualifications/Accreditations

- CEng
- BEng (Hons) - Electronic & Electrical Engineering, 1998
- PhD - Electronic & Electrical Engineering, 2003

Key technical skills

- Electrical Networks
- Technical Rules
- Grid Codes

Memberships

- Institution of Engineering Technology
- Institute of Electrical and Electronic Engineers.

Relevant experience summary

Paul has significant experience in the assessment of capital investment options and the planning of electricity transmission and distribution networks as well as assessing the connection requirements and technical compliance of distributed and transmission connected generation projects.

He is familiar with Technical Rules, Grid Codes and standards in multiple jurisdictions including UK, Ireland, Oman and Australia. Previous experience in providing technical advice to regulation authorities, networks companies and generators, including those involving compliance and disputes with Technical Rules and Grid Codes.

Paul is also responsible for business development, project management and technical project work related to transmission and distribution system planning and investment studies as well as supervision of power system analysis studies and associated project teamwork.

Project experience - Australia

ESS Market Review

Role: Technical Advisor

Client: Western Power

Location: Perth, Western Australia

The ETIU is seeking to undertake a reform of the current market for ancillary or essential system services (ESS) in Western Australia. As part of the development of this market, and to inform wider sector discussions, Western Power engaged GHD to undertake a review of the proposed ESS market to identify and highlight potential impacts on the Western Power business. As part of the work GHD reviewed similar current markets in other jurisdictions, including the NEM and GB. GHD also performed 10 case study reviews considering the need for particular ESS services, the range of potential solution options and the appropriate responsible procurement party, to understand the range and type of ESS that would best fit within Western Power's wider business model.

Western Power Technical Rules Review

Role: Technical Advisor

Client: Western Power

Location: Perth, Western Australia

Part of the GHD team leading the review of the Western Power Technical Rules to update the rules to account for new and emerging developments, including micro-grids, potential DSO role and associated obligations as well as bringing the current Technical Rules back into line with good industry practice. Liaised with internal and external stakeholders to facilitate workshop sessions to identify and agree on required revisions to the Technical Rules and potential solution options. A revised set of Technical Rules will be drafted to incorporate the agreed changes and amendments which will be subject to stakeholder consultation.

GPS Review

Role: Technical Consultant

Client: Western Power

Location: Perth, Western Australia

Review of generator performance standards (GPS) within the Western Power Technical Rules in order to develop a set of revised generator performance standards that will bring the current Technical Rules back into line with good industry practice, including alignment where possible with the National Electricity Market (NEM) requirements. The work included defining a minimum acceptable technical performance standard as well as an ideal standard that would allow automatic generation connection access if all requirements were met. The draft set of GPS requirements were then issued in a consultation paper by Western Power and the Australian Energy Market Operator (AEMO).

WEM Review

Role: Technical Advisor

Client: ETIU

Location: Perth, Western Australia

Review of Wholesale Electricity Market (WEM) frequency control ancillary services framework. The work was centred around identifying and detailing the case for WEM essential system services reform, including considering current service definitions, energy market interactions, system contingency responses as well as the potential requirements for new services to address emerging issues expected to occur over the coming years associated with significant renewable developments.

SWIS Blackstart Review

Role: Technical Lead

Client: Australian Energy Market Operator

Location: Western Australia, Australia

Assessment of transmission system restart pathways under blackstart outage conditions for the South West Interconnected System (SWIS). A range of studies were performed in DIgSILENT to identify specific generation, transmission / distribution network components and system loads that could be successfully re-energised and enable stable system performance to be achieved whilst meeting technical performance criteria.

SWIS Frequency Response Evaluation

Role: Technical Studies Lead

Client: Australian Energy Market Operator

Location: Western Australia, Australia

Evaluation of system frequency impacts associated with increasing capacities of renewable generation on the South West Interconnected System (SWIS). A number of transient stability studies were performed in DIgSILENT for different system demand levels and with varying capacities of future renewable generation. The rate of change of frequency (RoCoF) that could occur following large generation or network

contingency events was monitored to determine how increased renewable generation, displacing conventional thermal plant, could lead to higher RoCoF values and potentially impinge on the adequacy and success of existing under-frequency load shedding protection schemes.

Capital Investment Review

Role: Technical Reviewer

Client: TransGrid

Location: New South Wales, Australia

Review of capital investment documentation to be submitted by TransGrid to the electricity regulator (AER) in support of the 2018-2023 price control. A selection of transmission capital investment projects were reviewed including those incorporating new demand connections, dynamic voltage control equipment, network security / licence compliance drivers and asset replacement issues. Recommendations were provided to augment the current documentation to enhance the proposed project business cases, with specific emphasis on documenting underlying investment drivers, conducting a detailed option assessment and comparison, and presenting an overall robust project investment case.

Capital Investment Strategy Development

Role: Lead Technical Consultant

Client: Western Power

Location: Western Australia, Australia

Development of a capital investment strategy for the Bunbury load area to address network capacity limitations, ageing asset replacement and network performance limitations out to 2030. The work required identifying and documenting known and emerging network issues and developing a range of investment options strategies, including potential migration for key transmission assets to 132 kV. Through the identification of key investment decision point's recommendations were made as to the appropriate staging to be adopted for the preferred investment option.

Capital Investment Strategy Development

Role: Lead Technical Consultant

Client: Western Power

Location: Western Australia, Australia

Development of a 25-year transmission system development plan for the Central Business District in Perth, Western Australia. Several alternative investment plans were developed, including potential voltage migration of key assets to 132 kV, which were assessed against a range of technical, financial, practical and environmental metrics to identify the preferred 25-year strategy. Further assessment of programme risks and deliverability issues was conducted to identify the timing for the key projects within the strategy to minimise the risks to end consumers.

Project Experience UK & Ireland

Review of Price Control Allowances

Role: Lead Regulation Advisor (TSO & TAO)

Client: Commission for Regulation of Utilities (CRU)

Location: Ireland

Review of historic and forecast transmission system capital expenditure requirements for EirGrid and ESBN for the PR5 price control period (2021-2025) for CRU in Ireland. This work included analysis of historic capital expenditure during the PR4 price control to determine if outturn expenditure to date was efficient and appropriate, plus review of proposed transmission developments and determination of expenditure allowances up to 2025. Transmission system capital investments proposed by EirGrid for PR5 and reviewed as part of the work included investments associated with improving system security of supply as well as facilitating the impact of additional renewable generation to increase the System Non-Synchronous Penetration (SNSP) level to 90% by 2030.

Cost Benefit Analysis of Transmission System Investment

Role: Lead Technical Consultant

Client: Scottish and Southern Energy Networks (SSEN)

Location: Scotland, UK

Assessment of transmission system boundary constraints and the economic cost of constrained renewable generation on Shetland. A generation scenario and dispatch model was developed to model prospective power flows from renewable generation on Shetland and assess the potential economic impacts of alternative transmission system investment options to the mainland, including the impact of potential transmission system constraints. The outputs of the projects supported business cases submissions to Ofgem.

Cost Benefit Analysis of Transmission System Investment

Role: Lead Technical Consultant

Client: Scottish Power Energy Networks (SPEN)

Location: Scotland, UK

Development of a power flow constraint evaluation model for the Dumfries and Galloway region in south west Scotland to assess prospective power flows and energy constraints associated with future renewable generation developments. The outputs of the work will be utilised by SPEN to evaluate the potential merits of a range of network capacity investment options and to support regulatory submissions to Ofgem.

Review of Price Control Allowances

Role: Lead Regulation Advisor (TSO)

Client: Commission for Energy Regulation (CER)

Location: Ireland

Review of historic and forecast transmission system capital expenditure requirements for EirGrid and ESBN for the PR4 price control period (2016-2020) for CER in Ireland. This work included analysis of historic capital expenditure during the PR3 price control to determine if outturn expenditure to date was efficient and appropriate, plus review of proposed transmission developments and initial expenditure allowances up to 2020.

Cost Benefit Analysis of Transmission System Investment

Role: Lead Technical Consultant

Client: Scottish and Southern Energy Networks (SSEN)

Location: Scotland, UK

Assessment of transmission system boundary constraints and proposed reinforcements across the Caithness – Moray area of northern Scotland for Scottish Hydro Electric Transmission Plc (SHE-T). An assessment was made of the boundary power flow constraints associated with prospective future levels of renewable generation across northern Scotland over a ten year period. The economic cost of the constrained generation was considered in conjunction with the cost of proposed transmission reinforcements to determine the lifetime net financial benefits associated with the proposed projects and support the SHE-T business case.

Power System Studies Review

Role: Technical Reviewer

Client: Government of St Helena

Location: St Helena

Principal technical reviewer for DlgSILENT power system studies of the St Helena island. The work comprised development of a power system model for the island electrical distribution system and existing diesel generation as well as the modelling of existing and proposed wind generation.

Project Experience – Middle East

Development of Technical Losses Calculation Tool

Role: Lead Technical Consultant

Client: Mazoon Electricity Distribution Company (MZEC)

Location: Oman

Development of a detailed electrical losses calculation tool covering the MZEC 33 kV, 11 kV and LV distribution network. The developed tool incorporates MZEC 33 kV distribution network modelling outputs obtained from ETAP and calculates peak annual distribution losses for all 11 kV distribution feeders individually based on SCADA and GIS system data. This allows the varying characteristics of the 11 kV feeder population based on feeder length, conductor type and load distribution characteristics to be directly considered, significantly improving the accuracy of the resultant losses calculation outputs. The updated model will be used by MZEC to support annual reporting to the Authority for Electricity Regulation (AER) in Oman.

Future Electricity Network Architectures Study

Role: Lead Power System Consultant

Client: Abu Dhabi Transmission and Despatch Company (TRANSCO)

Location: Abu Dhabi, UAE

Assessment of future electricity network architectures for the TRANSCO system up to 2050. This work includes the development of power system study models for key generation and demand scenarios to 2050 and performing a variety of steady state and dynamic studies to quantify potential future system impacts, including on equipment loadings, system performance and ancillary service requirements. For key studied scenarios the total system costs are calculated, including generation production / expansion as well as transmission network investment costs. This will allow identification of a range of strategic system conclusions including identifying key transmission investment projects, impacts of changing demand profiles on TRANSCO system performance as well as potential additional ancillary service costs associated with incremental renewable generation capacity.

Power System Studies Review

Role: Technical Reviewer

Client: Emirates National Oil Company (ENOC)

Location: Dubai, UAE

Independent technical reviewer engaged by ENOC to review the detailed power system analysis studies being performed by the site contractor Technip as part of the expansion of the Jebel Ali refinery in Dubai. The scope of the studies being performed by Technip includes load flow, short-circuit, motor starting,

transient stability, load shedding and harmonic studies which are being performed in CYME.

Capital Investment Review

Role: Technical Auditor

Client: Abu Dhabi Electricity & Water Sector Companies

Location: Abu Dhabi, UAE

Lead assessor performing a review of the needs case for the 2019 proposed capital investment projects for AADC and ADDC distribution companies, the transmission company (TRANSCO) and Abu Dhabi Sewerage Services Company (ADSSC) as part of the RC1 price control. Each company submitted a list of proposed projects and associated capital investment documentation which was submitted to a detailed assessment against an agreed set of criteria. Projects that were appropriate justified and supported were recommended for inclusion in the capital allowance for RC1.

Capital Investment Documentation

Role: Technical Consultant

Client: Oman Electricity Transmission Company (OETC)

Location: Oman

Development of capital investment documentation for proposed transmission system investments up to 2025. The work required developing, documenting and evaluating alternative investment schemes to address a variety of network drivers and licence compliance issues, including new generation connections, demand growth and security standard compliance and replacement of aging assets. The probability of risk issues arising, including those impacting on energy not supplied, regulatory / licence non-compliance, environmental impacts and staff safety were considered, pre- and post-investment.

Review of MZEC Price Control Submission Documentation

Role: Lead Technical Consultant

Client: Mazoon Electricity Distribution Company (MZEC)

Location: Oman

Review of MZEC proforma and supporting capital investment documentation submitted to the electricity regulator (AER) in support of the 2018-2022 price control. This included reviewing the detailed capex and opex projections for the MZEC business for the next five years considering aspects such as required staffing levels, network expansions as well as strategic business initiatives. Advice was provided to the MZEC board relating to the aspects of the MZEC submission most likely to be challenged by AER as well as potential mitigation strategies and enhancements to improve the quality of the submission.

Masterplan – Electricity Distribution Networks

Role: Lead Power System Consultant

Client: Saudi Aramco

Location: Saudi Arabia

Development of ten-year master plans for the electricity distribution networks serving the Ras Tanura and Abqaiq communities in Saudi Arabia. Each master plan was developed taking into account future demand growth, asset obsolescence and replacement requirements, as well as network loading and performance and safety aspects. A ten-year asset development and investment programme was created for each community network which would be used by Aramco to plan for future project capital investments. Power system studies were performed using ETAP to assess feeder and transformer loading issues, prospective short circuit levels, alternative network operational configurations and future network load power factor requirements.

Masterplan – 33kV Distribution Network

Role: Lead Technical Consultant

Client: Majan Electricity Distribution Company (MJEK)

Location: Oman

Development of a seven-year master plan for the Oman Majan Electricity Company 33 kV distribution network to address expected future non-compliances with licence conditions and statutory obligations. Analysis was conducted for three potential demand growth scenarios and a range of network reinforcements projects identified, with associated capital expenditure requirements. Based on the project timings under the considered demand scenarios a range of key and high-risk projects were identified to focus.

Renewable Generation Integration Study

Role: Technical Consultant & Advisor

Client: InfraCo Africa

Location: Malawi

Assessment of transmission system constraints and technical limitations associated with connecting new thermal and renewable generation plant in Malawi. This work included development of an appropriate DIgSILENT power system model of the Malawi transmission system, meetings with ESCOM (electricity transmission operator) to discuss future transmission reinforcement projects and conducting a variety of steady state and dynamic studies to quantify potential future limitations and constraints associated with proposed generating plant. Recommendations were provided in relation to the technical viability of specific generating plant, including the connection design and maximum generating unit set size in order to comply with technical requirements in the Malawi Grid Code.

Publications

Author and co-author of a number of conference and journal papers:

- "Multi-Criteria Decision Making Methods for Distribution Utility Embedded Generation Strategy Development", 34th Universities Power Engineering Conference, September 1999.
- "Multiple Criteria Decision Making In Distribution Utility Investment Planning", International Conference on Electrical Utility Deregulation and Restructuring and Power Technologies 2000, April, 2000.
- "A Multiple Criteria Model for Evaluating Distribution Generation Development Options", Second International Symposium on Distributed Generation: Power System and Market Aspects, October 2002.
- "An evaluation strategy for distribution network planning and design", 3rd Mediterranean Conference and Exhibition on Power Generation, Transmission Energy and Distribution (MED Power), November 2002.
- "Multiple Criteria Decision Making Applied to Electricity Distribution System Planning", IEE Proceedings C, Generation Transmission and Distribution, September 2003.
- "Improving Electrical Power Quality Using Distributed Generation: Part 1 - Assessing DG Impact and Capability", Proceedings of the 7th International Conference on Electrical Power Quality and Utilisation, September 2003.
- "Improving Electrical Power Quality Using Distributed Generation: Part 2 - Case Studies", Proceedings of the 7th International Conference on Electrical Power Quality and Utilisation, September 2003.
- "Offshore Wind and the SQSS", ACDC 2010 - The Ninth International Conference on AC and DC Power Transmission, October 2010.
- "Cost Benefit Analysis for Reinforcement of the Transmission System to Accommodate Growing Numbers of Renewable Generation in the United Kingdom, Twelfth Wind Integration Workshop, October 2013