E.S. Cornwall Memorial Scholarship

Third Quarterly Report

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Working for RTE International in Lyon, France

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Disclaimer

This report provides a summary of the experiences and work undertaken by the author during the period of January – April 2026 as part of an overseas ES Cornwall Memorial Scholarship placement. Statements and material contained within this report are the opinion of the author and do not reflect the opinion or positions of any other person or organisation. Reproduction or referencing of this report should also reflect this.

Glossary

Term/Abbreviation	Definition
CPC	Centralised Protection and Control
VPC	Virtualised Protection and Control
IED	Intelligent Electronic Device (e.g. Micro-processor protection relay)
VIED	Virtual Intelligent Electronic Device
MU	Merging Unit. An IED used to interface between the physical power system and the digital protection and control system.
SMV	Sampled Measured Values. SMV is a time-synchronised, real time communication protocol defined by IEC 61850 or IEC 61869 and used to share measured data.
GOOSE	Generic Object Orientated Substation Events. GOOSE is an ultra-high speed and reliable communication protocol defined by IEC 61850 used to share signals.
Hypervisor	A software that runs virtual machines. Can be used to allow one host computer to support multiple virtual machines and virtually manage the computer's resources.
RTDS	Real-Time Digital Simulator
VM	Virtual Machine
OLTC AVR	On Load Tap Changer Automatic Voltage Regulation.
CBF	Circuit Breaker Fail Protection
HIL	Hardware in the Loop
DSO	Distribution System Operator
TSO	Transmission System Operator
SDS	Software Defined Substations

Contents

E.S. Cornwall Memorial Scholarship 1
Third Quarterly Report 1
Acknowledgements 2
Disclaimer 2
Glossary 3
Executive Summary 5
1. Background 6
2. Placement 2 – RTE International (RTEi) 7
2.1 About RTE International 7
2.2 My Role at RTEi 8
3. Adoption of Digital Substation Solutions 9
3.1 Definition and General Discussion of Digital Substation Solutions 9
3.2 The Roadmap towards adopting digital substations 10
3.2 Adopting Digital PAC in Brownfield Substations 12
3.3 Operational Staff Considerations 14
4. Projects 16
4.1 RTE VIP'R Project 16
4.2 Pre-qualification of an emerging VPAC product 16
4.3 Development of the RTEi Digital Substation Division 17
5. Next Steps 18

Executive Summary

The Australian Power Industry is experiencing an increase in the portfolio of substation projects to be delivered, which is driving an increase in spending and strain on resources in utility companies. One of the key factors to this is the rapid adoption of renewable distributed energy generators connecting to the network to meet renewable energy targets. To ensure the industry can effectively deliver the large portfolio of work required to transform the grid, the efficient delivery of future-proof substation upgrades is more important than ever.

One of the keys to efficiently delivering future-proof substations modifications is a protection and control system that is both scalable and flexible. The traditional protection and control systems typically utilised throughout the industry has a level of rigidity that is typically costly and time-consuming to expand or modify to meet the network's changing requirements.

I believe that the Australian Power Industry would benefit from learning about new and innovative protection and control technologies that can make these systems more flexible and scalable. I consider digital substation protection and control to be one of the most promising technological developments in this space with the potential to create significant value to the entire Power Industry.

This report provides an overview of the third quarter of my ES Cornwall Memorial Scholarship Experience. I began my second placement in January 2026 with RTE International's Digital Division based in Lyon, France. In this report, I will focus on sharing my learnings regarding my role at RTE International, my thoughts on important considerations for adopting digital PAC including the adoption roadmap, brownfield site installations, and operational staff considerations. I will also discuss the key projects and tasks I have been working on, and what my key learnings and take aways have been.

1. Background

The Australian Power Industry is experiencing a significant increase in the portfolio of substation projects to be delivered, which is driving an increase in spending and strain on resources in utilities. This is attributed to a combination of factors including the rapid adoption of renewable distributed energy generators connecting to the network, the need to maintain aging assets to provide a high level of network reliability, and the necessity to augment the network to keep up with increasing demand and changes in functionality requirements. To ensure the industry can effectively deliver this significant quantity of work, the efficient delivery of future-proof substation upgrades is more important than ever to ensure Australia's renewable energy targets can be delivered.

One of the keys to having future-proof substations that can be efficiently augmented to meet the ever-changing requirements of the power system is a flexible and scalable protection and control system. Most Australian utilities still use the traditional protection and control system philosophy which has a level of rigidity. This rigidity makes modifying existing substations to meet the changing requirements of the power system a complex task that demands a significant amount of funds, time and resources.

The traditional protection and control system philosophy is based around function-specific hardware and analogue and binary data being transmitted via dedicated copper wiring. Historically, this type of system was a requirement due to the limitations of the technology available at the time such as electro-mechanical protection relays. However, due to modern technological developments such as intelligent electronic devices (IED's), digital technology, and communication standardisation, systems are no longer bound to using this philosophy.

My experience as an engineer at Energy Queensland enabled me to identify the significant value that could be gained by the Australian Power Industry by learning about new alternative protection and control philosophies that are more flexible than traditional systems. During my first 6-month placement as part of the ES Cornwall Memorial Scholarship with ABB, I was able to learn about digital protection and control, and ABB's associated products. As a result of this experience, I believe that digital protection and control technology is a viable replacement to traditional PAC technology and holds significant value regarding flexibility and scalability.

2. Placement 2 – RTE International (RTEi)

2.1 About RTE International

RTE international is an engineering consultancy company specialising in delivering a range of services to the global power industry. RTEi operates as a subsidiary of the French Transmission System Operator (TSO), RTE, which is the largest TSO in Europe. The company was established in 2006, and while it is headquartered in France, RTEi also has a global presence, with numerous subsidiaries across Europe and the world including Australia. RTEi supports TSOs, DSOs, and other utilities and energy stakeholders worldwide in the development, operation, and optimisation of power networks. Its expertise includes key topics including grid planning and studies, HVDC and power system engineering, network modernisation, technical advisory services, and digital services, with an overall focus on enabling the integration of renewable energy and supporting the energy transition.

A key differentiator for RTE international is its Digital Solutions division, which supports the power industry's shift towards smarter, data-driven grid management. This team combines power system engineering expertise with IT, software development and digital system expertise to develop solutions and tools that help utilities optimise their day-to-day operations and solve the problems they face. Some of their solutions cover areas such as network monitoring, forecasting, operational coordination platforms, and advanced simulation tools. An exciting emerging team in the digital solutions division the digital substations team, which focusses on enabling the development and adoption of digital substation solutions like virtualised protection and control.

Figure 1 – RTE International

2.2 My Role at RTEi

This placement represents the second and final stage of the ES Cornwall Memorial Scholarship programme, undertaken as a Power Systems Engineer within RTE international (RTEi). Based at the RTE Campus Transfo in Lyon, the role is situated within the Digital Substations team, where I support customers to develop and adopt digital substation solutions like virtual protection and control.

This role includes working closely with stakeholders from the different sides of the digital substation transition, including power system utilities, protection and control product IED vendors, and power system testing and simulation vendors. This opportunity enables me to continue learning about and experiencing the convergence of the IT and OT disciplines, as this is essential to adoption of digital substation technology.

Working at the RTE Campus Transfo is also an excellent opportunity, as it provides me access to many technical experts from RTEi and RTE, as well as access to state-of-the-art laboratories and training facilities. Having access to these facilitates me to have excellent learning opportunities, not only relating to the adoption of digital substation solutions, but in other important and interesting areas of power system engineering.

A key aspect of this placement is the opportunity to develop a more aligned with the perspective of an integrator of digital substation technology. I feel as though this complements my previous experience in substation design in Australia, as well as my first scholarship placement with the protection and control product vendor ABB. This includes gaining deeper insight into the engineering, integration and commissioning of digital protection and control systems in a more practical sense. I am also expecting this role to enable exposure to the non-technical dimensions of digital PAC adoption, such as stakeholder engagement, change management, and the operational challenges associated with implementing new technologies in complex transmission systems.

Figure 2 – RTE Campus Transfo, Lyon, France.

3. Adoption of Digital Substation Solutions

3.1 Definition and General Discussion of Digital Substation Solutions

In this report, the term digital substation, or digital substation solutions, is used to describe protection and control systems that rely on digital concepts instead of traditional hardwired architectures. In particular, this refers to solutions that use the communication protocols defined in the IEC 61850, including Sampled Values, GOOSE messaging or MMS, as well as solutions that use virtualised technology. These elements enable a shift away from conventional copper-based signalling towards a more flexible and scalable substation design.

From my perspective, within this definition, there are different levels of digital substation solutions, varying by the level of commitment to digital technology. The first level shares the most similarity to current traditional PAC architecture, with the main digital technology implementation being the use of GOOSE messaging for peer-to-peer IED communication. The next level is centralised PAC solutions, where the hardware consists of merging units at the bay level, communicating with a centralised PAC product using sampled values and GOOSE. And the final level is virtualised PAC solutions, where PAC functionality is decoupled from vendor hardware and running in a virtualised environment.

My view is that virtualised PAC represents the most desirable end state for future adopters, due to the potential benefits in scalability, flexibility, lifecycle management, and hardware independence. However, it is also important to acknowledge that as substation architectures become more digital and software-defined, they increasingly diverge from the conventional systems the power industry is accustomed to. This shift can make adoption more challenging, particularly from an operational familiarity and integration perspective, even if the long-term technical advantages are significant. In the following sections, I will discuss what I consider to be the most important or challenging factors that utilities will consider on their journey towards adopting digital substation solutions.

Towards the end of this quarter, I was introduced to and began to understand another concept enabled by digital PAC, Software Defined Substations (SDS). From my perspective, this concept represents a more fundamental and overarching shift in how PAC systems can be designed, operated and modified from a whole system/utility perspective. This concept is quite an innovative and outside-the-box concept that could potentially challenge historical operational workflows used by utilities. I also think that SDS and could challenge the “levels of digital PAC solutions” discussed above, as well as the roadmap outlined in the following sub-section 3.2. Therefore, keep in mind that this report will discuss what I perceive as a more conventional approach to adopting digital PAC solutions, while the following report will discuss Software Defined Substations, and how it could introduce an alternative, more alternate approach.

3.2 The Roadmap towards adopting digital substations

Despite the clear potential of digital substation technology, adoption across the utilities sector has remained notably slow. Few utilities have made a tangible commitment to embarking on the journey towards adopting digital substation solutions, and for those that have, they are still in the early stages. While several utilities have begun to explore or implement elements of the technology, most are in the early stages of the adoption journey, with only a few having progressed into more intermediate stages. No utility has reached the point of full, large-scale integration, meaning that unfortunately the entire industry is still some time away from realising the potential benefits that digital substation solutions are expected to provide.

However, from the perspective this scholarship opportunity has provided me, I believe there is significant momentum gaining in this space, with a notable increase in investment and developments being made from companies across the international industry. I have noticed what seems to be an increase in the amount of utilities across Europe and North America who are actively investing and investigating digital PAC technologies. It also seems as though the vendor and technology industry is responding with increased investment in product development. Personally, I think there is an increase in pace by the industry towards the adoption of digital PAC solutions.

Among utilities that are actively investigating and pursuing digital substation adoption, a broadly consistent roadmap has emerged. The process typically begins with an extensive period of technology testing, during which utilities seek to develop a thorough understanding of the capabilities and limitations of currently available solutions. This is typically executed by developing a hardware-in-the-loop (HIL) environment in a lab, where a real network situation is simulated and the performance of the digital PAC solution is evaluated. This enables utilities to verify that the new technology can protect against real, challenging network scenarios from their network at least as effectively as current, traditional PAC technology. This phase also enables utilities to begin developing important other components such as internal standards, engineering and operational guidelines and processes, and beginning training and familiarisation programs.

Once sufficient confidence and technical ability in specialised staff has been established, utilities are typically then progressing to pilot deployments, adopting a cautious and highly staged approach. This typically begins with the installation of digital PAC technology in parallel to existing PAC systems and operating in an offline mode at a single substation. The new digital PAC solution is effectively isolated from being able to impact or control the network, ensuring any mal operation of the new technology does not cause an adverse operation of the network. The new digital PAC solution is also not relied upon at all to provide any protection or control functionality, with a full traditional PAC solution installed on site to ensure all essential protection and control of the network is guaranteed through the proven traditional technology.

This kind of solution is typically installed at a single substation, chosen specifically based on many key criteria, including being near to the specialist staff trained in the technology, being a cost-effective application of the technology for a trial, and technically being a effective position in the substation to test the effectiveness of the solution This trial installation is left operating in the background for some time, enabling the utility and staff to gain valuable data regarding its performance in a live substation situation. Importantly, this includes ensuring that the new protection device is operating as expected, and either as well or better than the existing traditional solution. Meanwhile, the deployment of training, standardisation, and documentation is increased and broadened to a larger audience within the company to prepare for large-scale deployment.

After sufficient data has been gathered to prove adequate performance of the new technology and training of operational staff, the next stage of the roadmap is to turn the digital substation solution into a live operational mode. This stage is highlighted by the trial solution being modified to be able to practically control the substation assets and power network, as well as being actively relied upon to perform key protection and control functionality on the power system. This is possibly one of the biggest steps in the roadmap, as it signifies a significant shift where the utility now relies upon the new technology to operate effectively.

The final stage of the deployment roadmap would be to progressively increase the installation of digital PAC solutions until it is the utilities standard solution. Most companies still seem to prioritise gradual deployment when planning this stage, which is understandable from my perspective. A staged and gradual implementation here enables for the operational staff to continue familiarising with the technology and developing relevant skills, as well as enabling for further refining of other important technical components such as the standards, processes, documentation, and knowledgebase.

Two utilities stand out as among the most advanced in the world on this journey, and together they illustrate this roadmap in practice; UK Power Networks (UKPN), and Réseau de Transport d'Électricité (RTE). UKPN is one of the DSO's in the United Kingdom, notably responsible for the London area, while RTE is the sole TSO for all of France, and is regarded as the largest TSO in Europe. While both utilities are responsible for different types of power system networks, and are at different stages of digital substation adoption, they both reflect this broad roadmap philosophy. This is very promising, as it shows that this common roadmap philosophy is likely emerging as an industry consensus, and sets standards for other utilities to follow.

From my perspective, UKPN is the leading adopter of digital PAC solutions in the international industry, while RTE is also a leader in this space. As documented through the "Unified Protection" and "Constellation" projects, along with presentations delivered by Digital Protection lead Colin Scoble, UKPN have already installed a pilot digital substation solution into a real substation in an offline mode. The latest information from UKPN is that this pilot installation will be turned into a live deployment (relied upon to control, operate and protect the network) during Q1 of 2026. To my knowledge, this will be a first for the international industry, and I believe it will be one of the most influential developments for digital substations. Meanwhile, while RTE mostly shares the same roadmap as UKPN and as mentioned in this section, they have a very slightly different approach. The key difference taken by RTE is to break the digital PAC solution into it's two components, protection and control, and develop them on separate timelines. Importantly, RTE has begun deploying virtualised control functionality through their R#SPACE project, while they are still conducting thorough testing of the protection functionality in their VIP'R project.

From my perspective, these two utilities are the leaders in the global industry in this regard, and the developments they are making will be valuable and important for all other utilities around the world who are considering the adoption of digital substation technology. Fortunately, both utilities are very open and proactive in sharing their knowledge, expertise and findings with other utilities and stakeholders, which is very valuable for the global industry.

3.2 Adopting Digital PAC in Brownfield Substations

During the initial stages of adopting the new digital PAC technology, it is generally perceived that greenfield sites are the ideal selections for pilot installations. This is because these sites would provide a cleaner site, as it would be free of legacy installation standards and technology that would provide constraints and challenges for implementing the new digital PAC system. For example, integrating a new digital PAC system with existing electromechanical protection IED's would be much more challenging than with IEC61850 native microprocessor protection IED's. However, while greenfield sites would be easiest for initial pilot projects, a challenge that must eventually be confronted it installing the new technology in a brownfield site where the existing installation and technology creates more challenges and constraints. From my perspective, brownfield deployment of digital PAC is one of the most important practical challenges that could be experienced as utilities adopt the new technology on a large scale.

During my time on the scholarship, I have been considering strategies for the deployment of digital PAC solutions in brownfield sites. The encouraging reality is that I believe the architecture of digital PAC solutions lends itself reasonably well to a deployment in brownfield sites, provided it is deployed using a thoughtfully crafted strategy. In this section, I will discuss what I believe are the key considerations and factors to be considered when creating a brownfield site deployment strategy. I would like to acknowledge that these thoughts assume that the entire substation will be converted to digital PAC in the same project. I have made this assumption as I believe this deployment of digital PAC solutions would be most effective regarding realising the benefits of this technology.

A key advantage that digital PAC solutions possesses is that a significant portion of the new digital PAC infrastructure, especially the virtual IED platform and process bus networking technology, can be installed extremely early in a project, and without impacting an operating substation. It can simply be installed in the substation control room, with no interfacing required at all to any live substation components (Primary plant or IED's). This allows utilities to establish the digital backbone of the new system, carry out initial configuration and testing, and build familiarity with the technology, all while the existing protection and control scheme continues to operate normally. This pre-installation phase broadly aligns with the passive background mode of operation adopted in early pilot programmes and similarly serves to reduce risk and build confidence before any operational transition takes place. This is also very valuable for utilities, as it enables a greater amount of installation and commissioning work to be done without the added complexity and costs associated with network outages and switching. Also, I believe with digital PAC solutions, there is potential for the testing and commissioning work during this stage to also be done remotely, reducing costs and risks by eliminating the need for technicians to travel and stay on site.

Another important consideration to be made for brownfield sites is the installation of the IED performing the role of a merging unit. This may prove to be the most challenging component of these kinds of projects, depending on the legacy installation. Ideally, the new merging unit IED's would be installed in series with the existing PAC system. The merging units would typically need to be installed on the same critical circuits, like VT, CT and tripping etc., and would require effective isolation designs in place to enable smooth cutovers. While this is more challenging than greenfield installations, for most utilities, this is would not be a new challenge, as most utilities are likely familiar with these kinds of installations with traditional and legacy technologies. The main consideration here is that the new merging units should be connected to the operational circuits, but

with temporary isolations in place. This would enable for even more testing and commissioning to be performed on the new digital PAC system without needing full network outages. If there are additional legacy limitations on site, a strategy that could be considered includes either temporarily or permanently replacing the existing protection devices with new IEC61850-native microprocessor-based IED's. While this would often not be the most cost-effective option, this could be useful for resolving technical constraints associated with particularly challenging brownfield sites.

Effective isolation design is also very critical for installing digital PAC in brownfield sites, especially during the crucial cut-over phase. As already discussed, effective isolation of the important analogue circuits like CT, VT, trip circuits etc. will be very important. This includes not only being able to electrically disconnect devices from circuits, but also enabling for the effective shorting and linking the circuits throughout the commissioning and cut-over processes. However, another important component for this cutover phase is the selective isolation for individual functionality. This has long been a request of utilities considering digital PAC technology due to it's importance and value in commissioning and cutover processes. In virtual PAC technology, there is multiple different ways in which this can be executed, but ensuring that the overall system design and process enables for the effective and selective isolation of individual functionality is important to installing digital PAC solutions in brownfield applications.

In summary, while I recognise that it would be harder to adopt digital PAC solutions in brownfield sites than greenfield, it is still very possible and I do not see it as a blocking point for adopting the technology. Utilities should formulate detailed and thoughtful cut-over plans for the different types of brownfield sites they have to ensure that the transition from traditional PAC to digital PAC is as smooth and risk-mitigated as practicable.

3.3 Operational Staff Considerations

In addition to the practical and technical challenges associated with adopting a new technology like digital PAC, it is equally as important to consider the human factors. From my perspective, a significant challenge in the adoption of digital PAC will be gaining the acceptance, confidence and competence in operational staff to manage the new technology. This is especially the case for digital PAC, as the new technology will look, feel and work differently to traditional and legacy systems, and substation protection and control is such a critical and technical component of the power system. Therefore, ensuring that all operational staff, who will need to use it every day, are comfortable, confident and component with the new technology is vital.

A potential concern that may be had by the operational staff is in the fundamental difference in how digital substation solutions look and feel compared to conventional PAC systems. Traditional substation protection and control is built on a physical, tangible architecture, with physical relays performing defined functions, copper wiring carrying analogue signals, and a direct, tangible relationship between cause and effect that experienced field workers have spent careers learning to understand and trust. Digital substation solutions challenge all of this, as the protection algorithms and sending of signals/data moves from a visible/physical concept to a virtualised/digital concept. Asking seasoned operational staff to place their confidence in a communication protocol transmitting sampled values over a fibre network instead of copper wiring carrying a measurable analogue signal represents a significant psychological as well as technical shift. Further, at the same time staff will also need to place their trust in a software running on a computer instead of a vendor labelled and tested box adds to this psychological shift.

Beyond trust, the skill competencies of operational staff presents a substantial challenge in its own right. Digital substation technology draws heavily on disciplines and skills like communications engineering, communication network architecture, cybersecurity, and IT, all of which have historically sat outside the core competency of most power industry professionals. The ability to configure and troubleshoot an IEC 61850 process bus, interpret a GOOSE message, or diagnose a communication network fault are skills that will increasingly become essential in day-to-day substation work, yet they are not part of the toolkit that the majority of today's protection and control workforce possess. This skills gap is particularly concerning for when things go wrong. Currently, fault-finding in a conventional PAC system relies on a well-established body of experience and intuition built up over decades, whereas diagnosing faults in a virtualised, communications-based environment requires a fundamentally different approach that the industry is not yet ready for.

Addressing these challenges requires deliberate and proactive investment in workforce preparation, and I believe that utilities seriously considering digital substation adoption should begin this process as early as possible and well in advance of any deployment program. The gap between technological readiness and workforce readiness has the potential to become a significant constraint if not addressed proactively. Based on my experience on the scholarship program, I think a useful tool for assisting operational staff with their confidence and competence with digital PAC technology would be to implement hardware-in-the-Loop (HIL) training and testing platforms. These platforms could be used to replicate the architecture, products, technology and situations they might experience in a live digital substation. Being able to train and test this technology in a hands-on environment but in a laboratory training environment would be incredibly valuable before having to work on the new technology in a real environment. For me during my experience on this scholarship, this kind of environment was incredibly valuable for developing my confidence and skills related to digital PAC technology.

Further, it would also be incredibly valuable for utilities to develop comprehensive and clear standards and other technical documentation that can be used by operational staff as they use the new technology. Providing clear documentation that outlines the processes, workflows, typical problems, best practices, and other important information would be very valuable for the effective deployment of digital PAC solutions on a large scale. Having access to the HIL platforms previously mentioned would be very valuable for the development of this documentation, as it would allow for engineering and technical staff to work together on the technology, performing real practical tests to ensure that the documentation and standards are as effective and useful as possible.

While it is certainly possible to improve the confidence and competence to the level required to adopt digital PAC on a large scale, this would be a long process. Development of high quality and comprehensive standards and technical documentation, along with developing a large range of new technical skills to a large workforce is not an easy task. Further, while digital PAC technology has significant potential to create value for the industry, deploying it while the workforce is not ready and capable of ensuring it is working reliably and effectively will have severe repercussions.

While so far, I have just focussed on the additional risks associated with the human element of adopting digital PAC technology, I think there are significant benefits to the human element that could be realised. This benefit for the operational staff is driven by a potential reduction in required time to be spent on-site. This is especially valuable for the Australian industry, as most Australian utilities require large amounts of operational staff to travel long distances to remote substations as part of their daily work. Currently, this creates a significant physical safety risk, as driving long distances creates a significant risk for field staff. Further, being in remote sites means significant time away from family and social lives, which can cause a strain on mental health. Therefore, reducing the number of tasks and time that are required to be on-site for would be incredibly valuable to both operational staff and utility companies. I believe that digital PAC solutions can reduce the amount of tasks and time required to be on site in multiple ways.

I believe that Digital PAC solutions should reduce the amount of time it takes to physically wire (or require) PAC systems during operational tasks or projects. This is because digital PAC solutions simplify and consolidate the physical devices and wiring required on site. Further, many different testing and commissioning tasks during operation or projects could also be done remotely. This would be done by providing engineers/technicians to have remote access to the substation's local digital PAC network, and the ability to deploy virtual testing products. This would also be applicable for performing problem solving of network or system level faults that might occur. And also, digital PAC could also be able to enable for the remote digital isolation of PAC information (SV or GOOSE), as well as functionality (protection or control). Being able to do this remotely would reduce the amount of on-site time required to perform isolation of secondary (PAC) systems when performing operational or project-related tasks.

4. Projects

During this quarter on the ES Cornwall Memorial Scholarship, I have been involved directly in numerous projects. This section will focus on the main projects I have been involved in, as well as the main learnings and takeaways I have made from these projects.

4.1 RTE VIP'R Project

One of the projects I was involved in during this quarter is the RTE VIP'R project. In the first two quarters, I was also involved in this project while working for ABB. RTE International is also involved in delivering this project, so my familiarity with the project, skills, and stakeholders led me to continue being involved in this project. My involvement during this quarter was mostly regarding providing technical support for the advanced components of the IEC61850 configuration, and the development of the HIL testing platform.

The work completed during this quarter on the VIP'R project represented the final stage of the testing and configuration of the SSC600SW against RTE's specifications. During the previous stages, a single transmission line feeder bay had been configured and tested. In this quarter the IEC61850 configuration of GOOSE messages and IEC6189-9 Sampled values were modified to meet the exact specifications defined by RTE. Also, the substation configuration was expanded to suit the final 6-bay configuration, and further IT and OT testing was conducted to investigate the limits of the technology.

Through my involvement in this project, I was able to continue developing my knowledge and gaining experience in advanced IEC61850 and IEC61869-9 configuration and testing. More specifically, a key skill developed during this project includes developing my understanding of the "Substation Configuration Language" (SCL) that is used to define IEC61850-based substations, and how these files are built and can be modified to work cohesively amongst the different substation devices. I also developed skills regarding the monitoring, diagnosing, problem-solving and validating of IEC61850 communication to ensure devices are communicating effectively and as per specifications.

It was also very valuable to understand how a utility like RTE views the configuration and testing of digital substation applications. This will be very valuable experience to be able to assist more utilities embarking on the application of digital substations to meet their specific requirements. This experience will be especially helpful in assisting in the development of internal specifications and standardisations for IEC61850 communication, which I view to be an essential part of adopting digital substation solutions.

4.2 Pre-qualification of an emerging VPAC product

Another project I have been involved in is the pre-qualification of a VPAC product that is being developed by an emerging VPAC vendor. While practical adoption of digital PAC has been relatively slow, there is still a lot of interest from utilities around the world. A current challenge with digital PAC adoption is that the development of VPAC products is not happening quickly. While ABB have released a product (SSC600SW), and the other major vendors are developing products, this process is taking time. My view is that this has created an opportunity for new companies to attempt to break into the PAC market. This is especially the case as most utilities in places like Australia and Europe typically require duplicated, multi-vendor PAC systems.

However, while the mainstream vendors have strong reputations and are trusted by the industry, these new vendors do not have this. To address this issue, RTEi provides a service for both PAC vendors and utilities, using its digital PAC expertise to independently pre-qualify products. This assists new vendors to develop their product by receiving valuable industry feedback directly during the development of the product and improve the market's confidence in the product. This is also valuable to utilities, as they can gain an understanding of the technical capabilities and limitations of the potential products on the market.

My role in this project has been to utilise my digital PAC knowledge and skills to develop and execute test plans regarding the OT (Protection and Control) performance of the product. Technically, I have thoroughly enjoyed the opportunity to build on the Digital PAC skills developed during my time with ABB by developing detailed and thorough test plans. I have also enjoyed the opportunity to perform detailed research and analysis tasks to provide detailed assessments of issues identified and potential root causes. These kinds of projects are a focus for RTEi, and I think they are incredibly valuable for the entire industry and adoption of digital PAC solutions as it facilitates vendor product development, as well as the understanding, confidence and preparedness for utilities to adopt digital PAC solutions.

4.3 Development of the RTEi Digital Substation Division

During this first quarter at RTEi, I have also had the opportunity to begin working on more general tasks associated with the development of the Digital Substation team and product offering. This has been an excellent opportunity for me, as it has enabled me to consider the non-technical aspects of digital substation solution adoption, which was something I was hoping for out of this opportunity.

The main task I have been involved in is the development of the digital substation training platform for testing digital PAC solutions. This included analysing the ideal architecture of the testing platform including design, products and configuration. Most of this work was practically planning, designing and executing upgrades to the system configuration to expand the testing and qualification capabilities of the platform.

I have also been involved in developing and delivering technical training content, as well as developing technical documentation to assist the team understand the fundamentals of digital PAC technology and how it can be tested and qualified. I have enjoyed the opportunity to develop my technical knowledge of digital PAC as I developed the training content and documentation. This task has also been particularly valuable for me as it has enabled me to gain a better understanding of the technical gaps that existing between typical power system knowledge and what is required to enable the effective adoption of digital PAC solutions.

Towards the end of this quarter, I have also been given the opportunity to begin understanding the services and products that can be offered to the industry to enable to facilitate the adoption of digital PAC solutions. This is exciting, as I combine my experience from the perspective of utilities, manufacturers and consulting service providers to understand what are the products or services that would be most valuable for the industry as it aims to adopt this new technology. This is assisting me understand the maturity of the technology, and what some of the key developments, products or services that currently don't exist, but would make digital PAC solutions more viable for adoption. While this was only something I started to focus on at the end of this quarter, I expect for this to continue in the next quarter.

5. Next Steps

My next report will be my final quarter on ES Cornwall Memorial Scholarship. During this period, I will continue to have a hands-on experience with digital PAC technology, as I will continue to work on the testing of new digital PAC products and the developing a structured testing platform and test suite for qualifying digital PAC products and implementations. This work is exciting for me, as the development of platforms that can be used to qualify PAC products and validate implementations will be essential to give utilities and integrators the confidence and information to adopt digital PAC technology.

SI am also looking forward to learning about the aspects of digital PAC adoption that are not directly technical. Working for a European engineering consultancy firm, I anticipate that in my final quarter I will also be provided the opportunity and challenge to understand the business and organisational aspects of adopting digital PAC. This would include assessing the current products, tools, services, training, and information that are currently available, and understanding what is else is required for ensuring easy and smooth adoption of the technology. To do this, a good understanding of what utilities will require to commit to digital PAC solutions will be required and developed.

Beyond my own work, I also anticipate that the upcoming period will be very significant for the wider industry regarding digital PAC solutions. Two of the most exciting VPAC projects in Europe, RTE's VIPR project and UKPN's Constellation project, are scheduled to reach important milestones in the near future. RTE, Schneider and ABB have recently achieved a major milestone on the VIPR project, having delivered a configured and tested VPAC application running on a SEAPATH hypervisor in a lab environment. They now move on to a new exciting stage of the project, where they aim to demonstrate the effectiveness of a multi-vendor VPAC solution. If RTE, the largest TSO in Europe and a well-respected utility, demonstrates good performance of multivendor VPAC solutions against their standards, this will be very positive for the improving the global industry's confidence in digital PAC solutions. Further, UKPN was scheduled to have transitioned a VPAC solution installed in a real substation into a live operational mode in April 2026. I anticipate that they will soon be able to release information and feedback about this process and the performance of a VPAC solution in live deployment. To my knowledge, this will be the first VPAC solution actively being used and relied on in a live operational capacity, so feedback and results of the performance of this will be incredibly important for the industry. I look forward to following these developments closely and incorporating the findings from these projects in my final report.