CONFERENCE CHAIRMAN'S REPORT

The 2019 General Meeting and PIESA-IERE South Africa Forum

"Electricity & the 4th Industrial Revolution – an Africa Perspective"

Sun City Resort, South Africa
28-30 October 2019

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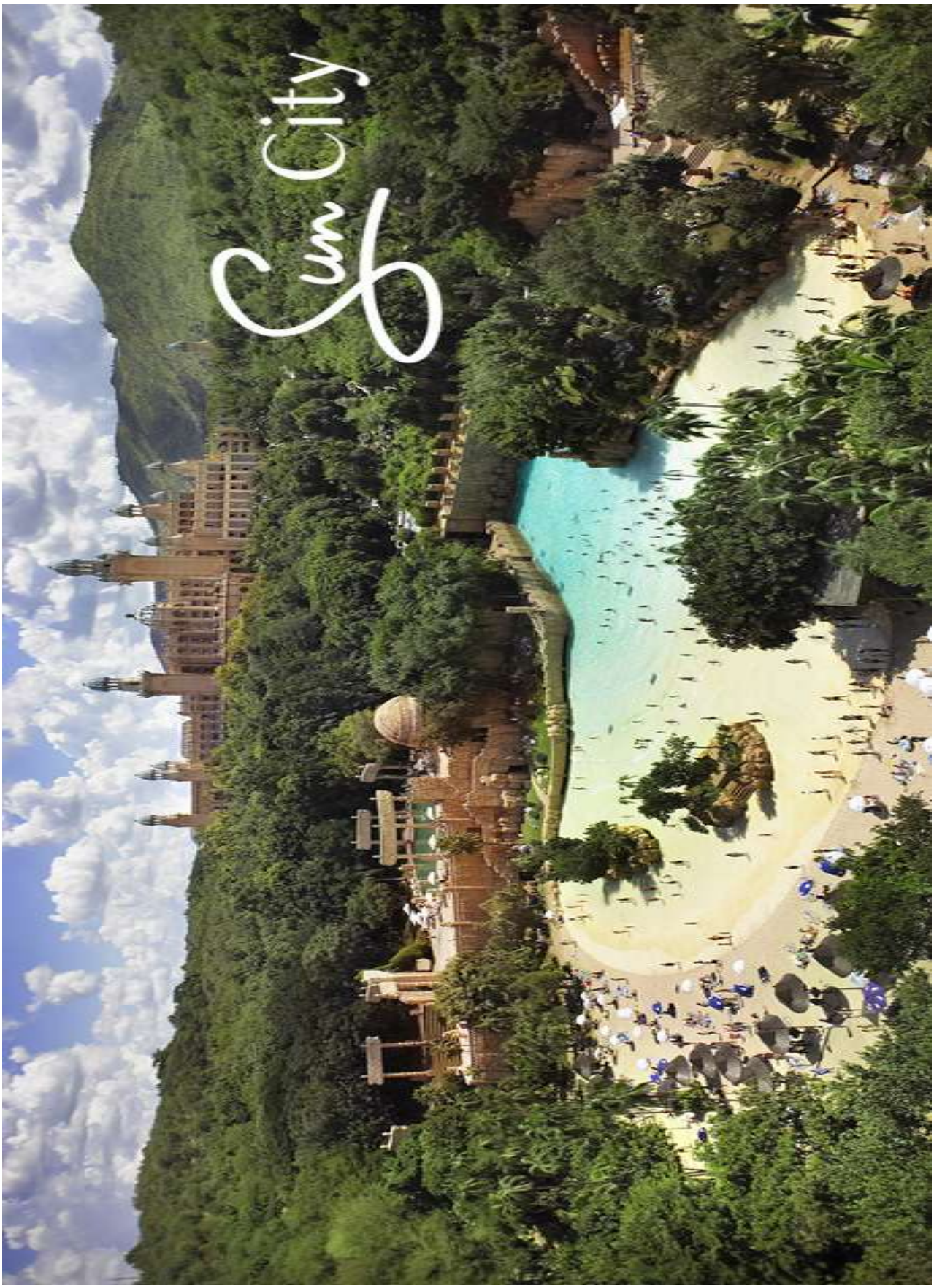
Forum/Conference Chairman


Sun City

PIESA and IERE Board Members that attended the international 2019 General Meeting and PIESA IERE South Africa Forum held at the Sun City Resort in South Africa from 28 - 30 Oct 2019

Some international delegates at the 2019 General Meeting and PIESA IERE South Africa Forum held at the Sun City Resort in South Africa from 28 - 30 Oct 2019

Some international delegates in serious discussion

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The 2019 General Meeting and PIESA-IERE South Africa Forum ("Conference")

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Forum Chairman: Vally Padayachee, Executive Officer, PIESA

INTRODUCTION

The purpose of this report is to reflect at a reasonably high level the proceedings of the aforementioned Forum from the perspective of the Forum or Conference Chairman

It was indeed an honour and a privilege to have been appointed jointly by both the PIESA and IERE leadership to be the Overall Forum Chairman of the aforementioned international 2019 PIESA-IERE General Meeting and South Africa Forum **("Conference").**

IERE is a worldwide, non-profit organization that was established in 1968 as the International Electric Research Exchange **("IERE")** serving executives, senior managers, engineers, and researchers who are responsible for electricity and energy related R&D and solutions. IERE represents the electricity & energy supply industry, equipment providers, energy associations, academic researchers and government.

IERE's vision is to be a unique global platform serving its members through the exchange of technical expertise and know-how of advanced and appropriate technologies and research and development in the electric power sector.

IERE's mission is to:

- Evaluate innovative and emerging technologies and promote their implementation to realize safe, sustainable, affordable and resilient electric power systems.
- Help establish corporate strategy related to R&D given the emerging trends influencing the evolving power industry landscape.

The Power Institute for East and Southern Africa (PIESA) is a voluntary regional power utility association established on 28 February 1998.

The PIESA aims to improve electrification in East and Southern Africa through sharing information, research, technology, skills and experiences for the benefit of customers and suppliers in the electricity distribution industry. The main focus is on technical rationalisation to achieve economies of scale with local manufacturers in an effort to enhance electrification in the region.

The PIESA's core activities are conducted through its four Advisory Committees:

- Electrification
- Non-Technical Loss Reduction
- Environmental and Safety Management
- Standardisation

THE FORUM/CONFERENCE

There was almost unanimous consensus from those that attended that this was an excellent conference that was well managed and with excellent presentations and papers delivered. The conference proper extended for two days and 29 presentations were delivered in the five sessions. There was a good spread of presenters coming from different parties of the world. There was also a good spread of session chairpersons also coming from different countries.

In total there were approximately 170 delegates that registered and in this respect the conference was attended by delegates from various parts of the world and included Japan, China, Hong Kong, Korea, Indonesia, South Africa, Malawi, Zimbabwe, Lesotho, Uganda, Tanzania, UK, Germany, Philippines, Malaysia, Thailand, France and Singapore.

A minor challenge and probably it was an unintended consequence (noting and given the large number of nationalities that attended the conference) was that a few presenters experienced some difficulty in trying to articulate their key messages and/or information from their presentations in English which was not their primary language of communication and exacerbated further given the presentations where very technical in nature. In furtherance

questions posed in English from the floor in some cases where not easily understood by some presenters

Besides or let alone the content of the various presentations and papers that were delivered the choice of the overall forum or conference theme for the conference i.e. ***"Electricity & the 4th Industrial Revolution – an Africa perspective"*** also contributed to significantly enriching and/or enhancing the body of knowledge (in some cases wisdom) that was presented and/or shared at the conference. As further elaboration of the aforementioned theme the 4th Industrial Revolution in a nutshell, is the advancement and emergence of new technologies that is ushering in a new era that sees a greater impact of digitization on our lives, in ways that are new and unanticipated. As a quote from an article on the World economic forum website, "The Fourth Industrial Revolution can be described as the advent of "cyber-physical systems" involving entirely new capabilities for people and machines. While these capabilities are reliant on the technologies and infrastructure of the Third Industrial Revolution, the Fourth Industrial Revolution represents entirely new ways in which technology becomes embedded within societies and even our human bodies." With emerging technologies moving at a rate of knots, the question then is, what do we want these technologies to do for us and what impact will it have on all of us?

As the novelist William Gibson famously said: "The future is already here – it's just not very evenly distributed." Indeed, it is time to see an even distribution of this potential. It is time for Africa!

MONDAY, 28 OCTOBER 2019

Registration and Welcome reception

TUESDAY, 29 OCTOBER 2019

KEYNOTE ADDRESS

There were two Keynote Addresses:

1. **"The use smart technologies to mitigate revenue collection challenges especially in African electricity distribution utilities" by Eng. Dr Alfred Kaponda (ESCOM, Malawi) and PIESA Board Member**

   Dr Kaponda concluded:

   If electricity distribution businesses are going to fully embrace the benefits of emerging technologies to maximize revenue amid various challenges that cannot be resolved in the short term, emphasis should now move from technologies to packaged solutions as is the current focus on Internet of Things (IOT) in this Fourth Industrial Revolution environment.

2. **"Sustainability of (renewable) electricity production" Prof Dr Jan Mertens (ENGIE)**

   Prof Dr Mertens concluded:

   - The electricity sector must contribute the most to the GHG reduction (40 % of all emissions reduction) and must be carbon free by 2050 and carbon negative soon after
   - Urgent need for more R&D and pilots and demo's on new emerging electricity generation (and storage) technologies so we can speed up and prove the roadmaps wrong! CO2 should be seen as a resource and not a waste.
   - Sustainability is not only CO2: water issues and mineral depletion are becoming increasingly with respect to renewable electricity production (and storage)
   - Avoid the pollution displacement trap so supply chain of renewable electricity infrastructure must be considered.

GENERAL SESSION

In the General Session there were three presentations:

1. "The report of IERE activities" by Mr. Gregory Tosen (IERE Chairperson)

2. "The report of PIESA Activities and TIS" by Mr. Vally Padayachee (Executive Officer, PIESA)
3. "Methanol Ageing Marker Project (Phase 2)" by Prof Dr Jan Mertens (ENGIE)

SESSION 1:

Theme: Evolving 4IR technologies and its effect on the customer

There is no doubt digital transformation has blurred the line between man and machine, but in the process, it has also created countless opportunities to engage and assist customers. As the Fourth Industrial Revolution continues to evolve, the key to business success will be evolving simultaneously in order to provide a revolutionary customer experience. IoT, for example, is in the early stages of maturity, and most customers have yet to unlock the full potential and functionality of connected devices.

Session Chairperson:

Dr Jie Huang (Deputy Manager, Senior Engineer, New Technology Department, NARI Group Corporation, China)

Presentations/Papers:

There were five (5) presentations delivered in this session.

1. **'A deep learning based obstacle detection and distance measurement for substation patrol robot' by *Dr Hongsheng Xu (Senior Engineer, NARI Research Institute, NARI Group Corporation, China)***
    - How does a human avoid obstacles when walking
    - First Step: Obstacle detected by eyes
    - How about a substation patrol robot?
    - Why we use vision system?
        - Magnetic track guidance: high accuracy and stability, but lacks flexibility and deployment expensive
        - Laser sensor: high accuracy and resolution, but suffers from limited sensing range

2. **'Application and Development of Artificial Intelligence in Power Equipment State Evaluation and Maintenance' by *Mr. Ji Qiao (Engineer, Artificial Intelligence Application Research Institute Department, CEPRI, China)***

- With the development of smart grid and the rapid expansion of power grid in China, it is very difficult to grasp and analyse the operating state of power equipment timely and accurately only by manual monitoring.
- In recent years, the information level of electric power has risen considerably. Data from condition monitoring system, power production management system, operation dispatching system, and environmental meteorology system are gradually integrated and shared, which have the typical characteristics of big data, i.e., volume, variety and velocity.
- Artificial intelligence is considered to be the most disruptive technology available today. Different from the previous academic research drive, the development of the artificial intelligence is driven by the needs of enterprises and reality. Driven by the power of data, significant computing power, new algorithms, there has been the mature conditions for artificial intelligence to be applied in various fields.
- As a conclusion intelligent robots will be everywhere! Let's embrace and grasp the trend of Deep Integration AI.

3. **'TID Rollover' by *Mr. Franco Pucci (STS Association, South Africa)***

- A unique token identifier (TID) is calculated and coded into the token every time a token is created at the POS
- The TID is currently calculated as the number of minutes that have elapsed since a base date of 1993
- The meter records the TID when the token is entered into the meter - this prevents token replay
- The TID has a limited range of 31.9 years
- In November 2024 the TID will reset (roll over) to zero

- Any new tokens after this date will not be accepted by the meter as the meter will consider these as being “OLD”
- The remedy is to clear the meter’s memory of previously accepted TIDs and to change the meter’s cryptographic key at the same time in order to prevent token replay
- Why was the TID not designed to last longer than 31.9 years?
    - The token string would be much longer than 20 digits
    - Impractical for consumer entry on keypad
- It is normal practice to upgrade the cryptographic strength at least every 30 years
- It is thus a good compromise to converge the timing of these two elements into one operation
- The current TID is calculated from base date 1993
- A new base date of 2014 has been introduced and is associated with a new vending key revision with increased cryptographic strength that will be good for use up to 2045
- After the TID rollover key change, the new TID will be calculated from the 2014 base date and will have a lifespan up to 2045
- Utilities are urged to start the process as soon as possible

4. **‘Readiness Index for Indonesian Power Plant toward Industry 4.0’ by *Mr. Harry Indrawan (Manager, Research and Assessment Technology Power Generation And Energy, PT. PLN (Persero) Reseach Institute, Indonesia)***
    - Industry 4.0 applications are needed to ensure that plant operations remain competitive and efficient
    - The existing study is a feasibility study on the application of Industry 4.0 technology but there is no comprehensive readiness study yet
    - An analysis of the readiness of the PLN power plant is needed to implement Power plant 4.0

- So that the Power plant 4.0 technology that will be applied can be optimized and effective
- Conclusion and recommendations
    - INDI 4.0 - Power plants (Indonesia Industry 4.0 Readiness Index - Power Plant) have been made and tested in two power plants, planned to be tested in other units on 2020.
    - PT PLN's plant readiness index (from 2 case studies) is at the moderate level of readiness. The average weakest is the "management and organization" pillar while the most ready is the "technology" pillar.
    - The digital transformation process requires commitment from senior management and HR readiness. Therefore awareness and training related to Power Plant 4.0 must be done properly and properly to all PLN employees.
    - Implementation of Power Plant 4.0 requires a transformation team that comes not only from IT people but also must involve field and R&D people.
    - Cyber security must be the first priority in implementing Power plant 4.0, so the selection of data security strategies must be thoroughly studied comprehensively.

5. **'Artificial Intelligence for the Detection of Electricity Theft and Irregular Power Usage in the African Electricity market' by *Mr. Keith Katyora (Electrical Engineer, Aurecon, South Africa)***
    - This paper demonstrated successful application of decision tree learning for detecting energy theft.
    - The conducted experiments unveiled the ability of the machine learning model to accurately predict energy consumption values from the same month of a year, subsequent weeks, and within the same weather season.

- Furthermore, the historical data were used in these experiments to generate the machine learning model and predict future energy consumption.
- Using the RMSE it was shown that the machine learning algorithm was able to accurately predict the future values and hence detect electricity theft.
- In smart grid data analytics system, it is necessary to know the real time electricity consumption data to forecast the exact future demand of electricity and plan accordingly.
- The identification of power theft will also extend its support for load forecasting that permits the utilities to exactly predict the power demand for future specific to individual customer.

SESSION 2

Theme: Asset Management – let's get smart about it

Distribution power companies are subject to increasing quality, safety and environmental constraints that, in a highly competitive arena, call for the maximization of asset reliability, efficiency and flexibility, while operation and maintenance costs are reduced. To this end distribution energy companies are adopting an intelligent asset management approach to asset management. Smart or intelligent asset management is a cutting-edge technology that is being increasingly adopted by various industries, and with future inclusion of Industrial Internet of Things ("IIOT"), it is deemed as a sheer necessity in a manufacturing facility where downtime / slowdown affects the bottom line results.

Session Chairperson:

Mr. Hans-Jürgen Behnke (POA External Operation & Maintenance, Business Development & Sales, RWE TI, Germany)

Presentations/Papers:

There were six presentations delivered in this session

1. **'Current market developments and their effects on asset flexibilities' by Mr. Hans-Jürgen Behnke (POA External Operation & Maintenance Business Development & Sales, RWE TI, Germany)**
    - Turning Flexibility into Profit, by applying and connecting State-of-the-Art Technology Solutions on large and small Scale
        - Deeply understanding, modelling and simulating the market
        - Optimising the Asset Capabilities (and our control thereof)
        - Tying Market Intelligence and optimised Asset Portfolio virtually together

2. **'A Real-world Dataset for Automatic Visual Diagnosis of Power Transmission lines' by Mr. Min-Hee Choi (Senior Researcher, Digital Solution Lab., KEPCO RI, Korea)**
    - One could argue that controlling a rotary UAV under a 500m span with a 250m line of sight is prone to errors and hazards. (On airborne inspections: aircraft and crews, Newsletter of Albatroz Engineering, '14)
    - Due to large scale of power transmission lines in their height and span, drones should fly on autopilot along a planned path.

3. **'Application of RFID System for Managing Repair Parts of Underground Power Cables and Accessories' by Mr. Yuya Manabe (Senior Researcher, Electric Power R&D Center, R&D Division, Chubu EPCO, Japan)**
    - In Japan once underground power cables break down, a long time is needed to repair them.
    - It takes six months or more to manufacture some repair parts.
    - It is necessary to store some repair parts for quick recovery.

- More than 28,000 parts to repair cables and accessories are stocked in Chubu Electric Power Company (CEPCO).
- Inventory checks, quality checks and part replacement are carried out regularly.
- These tasks take a lot of manpower.
- RFID(Radio-frequency identification) is an automatic recognition technology using wireless communication
- RFID technology has the following characteristics:
    - The RFID reading device can get information on multiple IC tags instantly with non-contact by using UHF-EM(Ultra high frequency-electromagnetic) waves.
    - The IC tag does not require a battery.
- It has been confirmed that applying RFID technology can improve the work efficiency for managing repair cables and accessories.
    - Reduction of inventory work time
    - Reduction in the number of repair parts
    - Reduction by database sharing

4. **'4IR technologies Application on KEPCO Power Distribution equipment maintenance' by Mr. Gi-Dae Oh (Senior Researcher, Smart Power Distribution Laboratory, KEPCO RI, Korea)**

- Wireless Smart sensors (Goal)
    - (Smart sensor) Detecting Abnormal signal detection before the component fault
    - As Is : Detecting failure by diagnosing certain degradation time frame
    - - To be : Smart Sensor, concentrate on pre-failure duration

- IoT sensing data + Legacy system data + Big data => Predicting Life expectancy / Investment
- AR (Augmented Reality) key technologies
    - AR key Technology = Tracking + Contents + Interaction
- Full 3D is future, we need to develop tech (simple/cheap mapping tech) for 2D -> 3D

5. **'High efficiency status evaluation for main equipment based on cyber physical systems in distribution network' by Dr Keyan Liu (Manager, Power Distribution Department, CEPRI, China)**
    - Distribution network CPS simulation lays the foundation for the development of various types of services such as digital protection control, operation scheduling and risk prevention and control of distribution network in the future.
    - Subsequent problems should be further solved in the complex distribution network physical system and information system fusion simulation synchronization error, low simulation efficiency, slow simulation speed, etc.
    - The research and application of CPS simulation can effectively improve the safe and reliable economic operation level of the distribution network, and has high economic and social benefits.

6. **'MR System Solutions for Asset Management' by Mr. Kobus de Villiers (Managing Director, Reinhausen, South Africa)**
    - (MR)* is a world-leading manufacturer of on-load and off-circuit tap changers for power transformers. The company also provides plant equipment such as diverter switches, motor drive units, voltage regulating systems, supervisory

- equipment, oil filter units and monitoring solutions for on-load tap changers (OLTC).
- (MR)* Services is to manage, analyse, maintain, repair and offer training and consultancy solutions.
- (MR)* deliver premium services such as asset retrofitting, installation, commissioning, moisture management and autonomous automation of substations.
- Benefits of a maintenance plan
    - Maximum Operational Reliability
        - Monitoring of all equipment in real-time, 24 hours a day, 7 days a week
        - Trend monitoring and equipment comparison
        - Active asset management support through a condition-based maintenance strategy
        - Increased equipment service life
        - Errors are detected before a fault occurs
        - Central visualization of all connected transformers
        - Guarantees a detailed analysis in the event of a fault
    - Cost advantages
        - Significantly lower investment costs of a modern connection of the embedded transformer operating systems to the control point by means of network protocol (fiber-optic cable) instead of a conventional connection via copper cables
        - Cost-effective elimination of defects only using GSM via predictive maintenance
        - Improve savings

- Increase in equipment service life

- Easy and fast integration
  - Existing communication structure and devices can be used
  - Optional connection and analysis of information provided by the control system
  - Integrated document management and archiving
- Reduction in complexity
  - 1 System from 1 source
  - Easy integration into existing infrastructure
  - Simple connection of sensors and data sources from all manufacturers
  - Easy to expand

TUESDAY, 30 OCTOBER 2019

SESSION 3

Theme: Distributed Renewable Energy Technologies: Are we ready?

At the distribution level, increasing numbers of renewables and Distribution Energy resources ("DERs") in general present a host of issues. One of the major challenges is that distribution system operators must transition from managing the safety and reliability of a system with a limited number of energy producers and unidirectional and predictable flow from substations to customers to a system with power flows from many sources at varying times of day and in different directions. These changes mean not only greater operational complexity, but also more complex maintenance and emergency operations. The result will be needed modifications in the design and operation of the distribution system and investments in new or upgraded circuits as well as additional tools, sensors and communication systems.

Session Chairperson:

Dr Tomohiko Ikeya (Associate Vice President, Materials Science Research Laboratory, CRIEPI, Japan)

Presentations/Papers

There were five (5) presentations delivered at this session

1. **'Secondary battery energy storage systems for enabling use of renewable energy to realize a zero-CO2-emission society' by Dr Tomohiko Ikeya (Associate Vice President, Materials Science Research Laboratory, CRIEPI, Japan)**
    - By 2030, Japan should decrease the thermal generation plants by 40%, and double the capacity of zero-emission power generation to decrease CO2 emissions.
    - By 2050, zero-emission power generation will provide 80% of supply.
    - Large increase in renewable energy power generation from photovoltaics and wind farms will make the power grids unstable because these power sources can't be controlled
    - Secondary battery energy storage systems are necessary for realizing a zero-CO2-emission society.
    - High safety is required for these systems.
    - CRIEPI is studying the battery degradation mechanism and proposing operation conditions to prolong cycling life.
    - CRIEPI is developing all-solid oxide batteries that will contribute to creating zero-CO2-emission cities.

2. **'The future of infrastructure: Challenges & opportunities for utility companies' by Dr Felix Cebulla (Senior Expert, Corporate Technology, Strategy &Technology, Innogy SE, Germany)**
    - Four main trends impact the development of infrastructures

- Digital transformation
- Sustainability
- Demographics and urbanisation
- Politics

- Key take aways for 2050 for further consideration
  - Physical infrastructures will undergo an evolutionary development while service provided on them will change extensively.
  - Telecommunication infrastructure will be as important for societies and economy as electricity and water infrastructures are today and will be the crucial basis to support changes in infrastructure usage.
  - To handle the complexity of strongly interconnected infrastructures, partnerships and more intensive collaborative work in new value creation networks will be the new normal for infrastructure operators.
  - Societal pressure will result in changes to policy and regulation. There will be and increasing focus on aligning the development of infrastructures with environmental protection and climate change.
  - The evolutionary developments in infrastructures will be driven by new, easily accessible and cheap sources of financing.

3. **'Development of a System Dynamic Model for Utilities Revenue Evaluation under Distributed Energy Resources' Dr Desmond Ighravwe (University of Johannesburg, South Africa)**

- Problem statement
  - Cut-down on non-renewable energy resource for power generation.
  - Increased availability of distributed energy resources.

- Increased in energy theft.
- Increased in energy poverty.
- Increased household disconnecting from national grid.

- Aim of the study
  - To study the impact of distributed energy resources on utility firms' revenue
- Case study
  - The proposed SD model performance is evaluated based on data sets in South Africa.
  - The electricity price is taken as 1kWh @ 89c.
  - Estimated rate of electricity demand per month for a household of four people is 1233kW.
  - To simulate a utility firm revenue, it was assumed that the firm uses five gas turbines of 350MW, with a 90% capacity factor.
  - 5000 households.
- Concluding remarks
  - This study used system dynamics approach to study the impact of distributed energy resources on utility firms' revenue.
  - Techno-economic and social parameters that affect utility revenue were considered.
  - The model was able to determine the point at which a utility firm should re-evaluate the amount of energy that is supplied to households.
  - The model showed that the impact of DER on utility revenue will decrease for specific periods, and then follows a steady increasing trend.

4. **'The Grid Interconnection Study of Renewable Energy in the Distribution system to ensure Safe Grid Integration: Case Study of PV Grid Connected in Indonesia' by Mr. Dimas Bangun Fiddiansyah (Division Project Management Office (PMO) & Manager of Project Management and Integration for Sumatera Projects, PT. PLN (Persero), Indonesia)**

    - Renewable energy development has become the main target of Government of Indonesia (GOI) to gain share portion in its energy mixed by 23 % in 2025.
    - The increasing capacity of intermittent generations both, in their size and complexity play an important role in to the transition to cleaner energy mix, but they could impact the stability of power system.
    - Integration of these intermittent generation in the power system is becoming critical issue without any assessment in its grid interconnection.
    - PLN faces challenges in operating the network system with large penetration level of these generations due to their intermittency and variability.
    - Publishing the technical guidance for renewable energy grid interconnection is compulsory.
    - Conclusions
        - PLN has set the commitment to achieve the GOI's target to increase REGP penetration level without disregarding the stability and reliability issue in the power system
        - Grid connection study is proposed based on the PLN's perspective to conduct operational, financial feasibility study and risk management to mitigate the instability impact to the grid.

- The grid facilities cost which is resulted from the connection facility study should be based on the business to business mechanism
- Instability condition should be considered in the grid integration of REGP since it would trigger the first step of UFLS scheme
- Distribution system impact studies would determine the connection requirements, safe grid integration, and penetration level of REGP in the system
- From the case study proposed, it would be recommended to decentralize the PV farm to maintain the reliability of its power system

5. **'Status and Future of Renewable Energy Technology Development and Application in KEPCO' by Mr. Seong Jegarl (Director & Chief Researcher, Renewable Energy Research Group, KEPCO RI, Korea)**
    - KEPCO is performing the renewable energy R&D to achieve national target of 3020 especially, Offshore Wind and Utility scale PV
    - For offshore wind R&D
        - As the national offshore wind development plan of 2.5GW, KEPRI performed Site assessment, wind farm design , and developed technologies for wind turbine foundation (suction bucket), subsea cable & offshore substation , and SCADA & CMS Green Eye TM),
        - KEPRI is developing all in one installation vessel (MMB) and co-location model of offshore wind and fishery, and will develop core techs for large offshore wind farm and floating wind
    - For Utility Scale PV R&D

- KEPRI is developing UAPV (Utility scale Agro Photovoltaic), Underwater PV at salt farm , and
- Perovskite PV cell, and demonstrated CPVT (Concentrated Photo Voltaic and Thermal) and RIPV (Road integrated PV)
- KEPRI has a plan to develop technologies of transparent & colour PV module , PV O&M optimization, Floating PV, and Ocean renewable energy fishery complex

SESSION 4

Theme: Advanced distribution automation in the 4IR era

The goal of Advanced Distribution Automation **("ADA")** is real-time adjustment to changing loads, generation, and failure conditions of the distribution system, usually without operator intervention. This necessitates control of field devices, which implies enough information technology (IT) development to enable automated decision making in the field and relaying of critical information to the utility control centre. The IT infrastructure includes real-time data acquisition and communication with utility databases and other automated systems. Accurate modelling of distribution operations supports optimal decision making at the control centre and in the field. In the era of the 4IR we are going to see a significant convergence of Operating Technologies ("OT") and Information Technologies ("IT") underpinned by smart communications to achieve the goal of ADA.

Session Chairperson:

Mr. Seong Jegarl (Director, Renewable Energy Research Group, KEPCO RI, Korea)

Presentations/Papers:

There were three (3) papers delivered in this session

1. **'Plant simulation, visualization and control platform based on OPC and Simatic WinCC' by Rotimi Agbebi (Specialist Engineer (Control and Automation), Siemens, South Africa)**
    - Technical issues that arise are :
        - Power quality
        - Harmonics
        - Frequency and voltage fluctuation
        - Power fluctuation
        - Small time power fluctuations
        - Long time or seasonal power fluctuations
    - Plant protection system must be;
        - Reliability
        - Selectivity
        - Speed
        - Economy
        - Simplicity

2. **'Improvement of Power system Analysis Tools (CPAT) for planning, operation and control/protection studies under a large penetration of photovoltaic generations' Mr. Hideo Koseki (Senior Research Scientist, System Engineering Research Laboratory, CRIEPI, Japan)**
    - Japanese Interconnected Power System
        - Network configuration
            - Interconnected System is composed of 9 control areas (electric utilities)
            - Maximum voltage : 500kV and 275kV
            - AC systems is divided into 3 area by 3 frequency converter stations and HVDC transmission lines.
        - Demand and Renewable Energy condition
            - Peak demand : 159GW (2019 planning)

- Installed PV capacity：56GW*
- Installed WT capacity：3.58GW*

*end of 2018

- Summary and future tasks.
  - CPAT has been used by Japanese electric utilities as de-facto standard tools.
  - A major feature of CPAT is, users can model the control system flexibly.
  - Now, the energy structure has changed dramatically due to renewable energy.
  - We have to provide renewable analysis model and advance analysis function.
  - And we have to improve usability of CPAT. For example Internationalization, GUI interface, Visualization on web-based.
  - At the same time, we have to provide the solutions about power quality in any future.

3. **'The Implementation of Smart Asset Management System to Monitor the Health Index of Power Distribution Assets: Case Study of PLN's EAM in Indonesia' by Mr. Dimas Bangun Fiddiansyah (Division Project Management Office (PMO) & Manager of Project Management and Integration for Sumatera Projects, PT. PLN (Persero), Indonesia) and Mr. Job Syam (Division Information Technology System & Manager of IT Development in Transmission, Distribution and Customer Service, PT. PLN (Persero), Indonesia)**

   - Power Distribution Asset has installed in (seven (7) PLN's main region, with the total number more than 50.000 MVA transformers & 500.000 kms distribution grids.

- Methodology of asset management-based maintenance equipment distribution is the integration between Preventive Maintenance (Time-based) and Predictive Maintenance (Condition-based).
- The basis of the asset management implementation is the requirement for optimal management for PLN's distribution asset which has high number unit and level of utilization
- Optimization of distribution asset management try to elaborate optimum point of 3 main conflicting driver consist of: cost, performance and risk.
- Lesson Learned from (Distribution Enterprise Asset Management (DREAM) application
    - In DREAMAP, it has implemented a distribution grid administration which would be the foundation to develop main functions in Centralized EAM platform
    - It has dashboard web based to monitor WO implementation (making WO Inspections & WO follow-up). Hence, it has a feature for calculating the results of the Inspection and the next Inspection schedule
    - Next step, current EAM platform should be integrated and customized with SAP platform since DREAMAP is operated separately from its Health Index and SAP platform.
    - Health Index application for transformers and feeders should be flexibly implemented considering business process, update data and IT infrastructures

SESSION 5

Theme: 4IR's impact on revenue collection and non-technical losses

The revenue model on which utility businesses are based on is under threat from the shifting industry norms. The 4th industrial revolution is underway and already utilities are witness to digitalisation, decarbonisation and decentralisation – all affecting their traditional revenue collection strategies and non-technical losses mitigation approaches.

Session Chairperson

Mr. Vally Padayachee (Executive Officer, PIESA, South Africa)

Presentations/Papers:

There were six (6) presentations delivered in this session

1. **'Energy storage on municipal grids - why this makes sense' presented by Mr. Vally Padayachee, (Executive Officer, PIESA, South Africa)**
    - Peaky loads cost a lot to service
    - As a grid operator, we do benefit from the diversity that the community connected to the grid demands
    - However, the peakier the load of our own customers is, the more costly it becomes for a distributor to both source the power and to deliver it.
    - In reality very few loads are flat
    - Whatever can be done to remove the kinks in the load curve, will reduce costs of both cost drivers
    - The supplier of last resort – this will be Eskom or the future ISMO's new role – will be the price setter, and the price for capacity will become more and more costly over time, particularly for peaky load
    - The ideal load – a flat line – is a constant demand and a predictable quantity of energy to be delivered

- Energy Storage can be applied to:
    - Optimizing energy procurement costs
    - Protecting the Economy
    - Preserving overloaded distribution infrastructure
    - Unlocking property development
    - Supporting densification
    - Optimizing Investment in renewable energy systems
    - Providing basic energy services
- However, it all depends on where it is placed on the distribution network and how it is operated:
    - Benefits of stacking for better, improved DSM
    - Putting storage at the door of the customer has advantages
- The highest value of all
    - Storage is an antidote to load shedding -
    - Direct cost of unserved energy is estimated at R17 per kWh (planned outages) + Indirect costs can be as high as R87 per kWh (figure from IRP 2019 Update)
    - Those companies that have UPS units (storage systems) to ride through power interruptions are already reaping the benefits of storage
    - The benefit is proportional to the frequency of load shedding – how much can we expect over the next few years?
    - Under continuous Stage 1 conditions, the system may pay for itself in <1 year?

2. **'Security Testing for Preventing Backdoor Threat in Smart meter Implementation in Indonesia' by Ms. Astri Kartika El Nur (IT Strategy Manager, ICT Division, PT. PLN (Persero), Indonesia**

- PLN provides most of the public electricity and electricity infrastructure in Indonesia, including power generation, transmission, distribution, construction of power plants, and retail sales of electricity
- The smart meter implementation worldwide has arisen. PLN is expanding its current smart metering system which based on AMR to AMI system to monitor its customer energy consumption in near real-time as well as to establish a more robust process analysis and evaluation of the meter data.
- The ability of smart meter to communicate with control centre or among its component might be exploited to cause unexpected remote/physical attack to manipulate energy consumption read, including blackout to the grid. Attack commonly exploit vulnerabilities which cause by isolation assumption, increased connectivity, and heterogeneity.
- Conclusion
    - Security threats in the form of backdoor are expected to be minimized through White-box testing on the source code before it is being compiled into binary file.
    - To ensure the firmware is not changed or modified throughout the smart meter lifecycle start from the plant floor to the field for 15 years operation, integrity testing is proposed.
    - There is no such thing as 100 percent protection. However, the proposed security test together with existing security means, may make them a great starting point for defending against attacks and reduced the

security risk of smart meter implementation in Indonesia.

3. **'Carbon Market Risk Analysis & Defence based on Hybrid Simulation - a Perspective from Cyber Physical Social Systems in Energy' by Dr Jie Huang (Deputy Department Manager, Senior Engineer, , NARI Power System Stability Control Company, NARI Group Corporation, China)**
    - A simulation tool for carbon market
        - by integrating the causal data (based on mathematical models), the statistical data (with non-causal relationship), and the behavioural data of (human participants)
        - capable to simulate the dynamic impacts of global financial crisis and European debt crisis on European carbon market in its second phase (2008 to 2012)
    - Adopting engineering techniques to analyse and manage carbon market risk
        - a multi-defence-line control framework for carbon market risk
        - preventive control, emergency control under different disturbance scenarios
    - "All models are wrong, some are useful"
        - capable to provide decision support for carbon market design and operation

4. **'Incorporating Embedded Generation onto Municipal Networks' by Ms. Poonam Lutchman (Solution Architect - Digital Power Solutions, Schneider Electric, South Africa)**
    - Opportunity for transformation: Microgrids seen as the mobile phone in the Electricity Industry
    - Residential customers represent 18% of consumers, during peak this can increase to 35%.
    - Munics supply electricity at winter peak at a loss.

- Recoup During Peak and Off Peak
- Studies show that 97% of PV is generated between 9am – 6pm. Standard time, when munics recoup losses. Represents up to 60% of profit loss.
- Opportunity - New Roles for Municipalities
    - TOU
        - Mitigate against losses during peak
        - Surcharge outside sunlight hours
        - TOU or Smart Meters
    - Include fixed charges
        - Eliminate Free Rider Effect
        - Rate determined by power consumed
    - Feed-in-tariffs
        - Purchase Power cheaper from developers who sell excess power to the grid
        - Change in legislation

5. **'Revenue Protection "Moving Meters out the home and making them visible to the Utility' by Harold John Hayes, Global Head, Utility Business Solutions, Smart Energy, Landys & Gyr**
    - Pilot project, migration of an in-home common base prepayment metering solution to a spilt pre-payment smart metering online solution
    - Current Problems when attempting to remove meter from the house:
        - Meters Built into house
        - Meter included in kitchen cabinets
        - Meter enclosures built into the walls
        - Cable connection and safety (cable joint required when removing)
        - After removing common base, what is left behind
        - Protection?

- Load limiting options

- Move the meter out of the house
- New technology discussions and planning required
- Basic Meter requirements (Smart ready)
    - Post Paid
    - Prepaid
    - Quality of supply (power failures, voltage and current dips, swells etc.)
    - Revenue protection (Tamper, reversal, Magnetic, etc)
    - Load profiles 30 minute values (Minimum kWh, remaining Credit)
    - 12 months billing history
- Data concentrators (DC)
    - Communication mediums (GSM. Ethernet)
    - Data Concentrator placements in the field (number of customers per transformer)
    - What part of the utility maintains transformers?
- Why smart metering ?
    - Pre-payment or Credit metering
    - Convert Credit customers to Pre-payment
    - Remote connect and Disconnect
    - Outage notifications
    - Power Quality
    - Voltage
    - Current
    - Events
    - Online monitoring
    - Two way communications
    - Load Limiting
    - Time of Use enabled
- Roll out plan

- Install new Meter enclosures
- All meters programmed in credit / post-paid mode
- Monitor and analyse data (energy, power quality,
- consumption patterns)
- Gather as much information as possible before going to site
- Start full (SMART) exchange program
- Replace in-home meters with adaptors
- Final readings
- Capture tamper conditions
- Enter remaining credit
- Gather customer details
- Other admin

6. **'Is the technological revolution opening up new avenues for rogue entities to exploit?' by Rens Bindeman (Technical Advisor, SARPA, South Africa)**
    - The entire Revenue Protection concept has developed in the past 20 years and has now reached a new level of expertise, which has resulted in the need for those involved in such actions to go to the next level of specialization and taking of joint responsibility
    - This is due to the fast tracking of the technology development process of metering worldwide.
    - Forming of organized crime syndicates seeing loopholes and targeting the Utility environment
    - One of the most dangerous things in life is " when people don't know what they don't know"
    - Rogue meters
        - The concept of "rogue meters" was identified last year this time and it is now seen as one of the biggest threats to hit Municipalities in Southern Africa for many years.

- This threat involves replacing a Municipal prepaid meter with what we call a “sub-meter” and then channelling the funds to a third party’s banking account.
- This threat creates new levels of understanding the different modus operandi of the perpetrators, the charges to be utilised to convict them, the most effective way to detect such actions, the way to “follow the money” and how to obtain information and evidence from companies operating in this space

- A Rogue meter can be defined as a meter foreign to the utility fleet and which will be:-
  - A meter not purchased by the utility
  - Not installed by the utility and or utility agent
  - Installed under the pretence of a check meter
  - Revenue does not go to the utility
  - Have a foreign Security group code
  - Have a foreign meter number sequence
  - Purchased from a local vendor street or internet
- Conclusion
  - The fast tracking of the technology development process worldwide has triggered service providers to produce all kind of packages and wonderful solutions full of “little dragons” for unexpected Utilities
    - Utilities need to wake up and realize this and take evasive actions to prevent them from completely derailing and finding themselves in a position which they cannot control and recover from