Newsletter
Members Only
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IERE
Electric Power Technology Platform

PIESA-IERE South Africa Forum titled “Electricity & the 4th Industrial Revolution - an Africa perspective” was held on October 28-31, 2019 at Sun City Convention Centre, South Africa. From 12 countries/regions, 65 people were participated in and two keynote addresses, 27 oral presentations were performed.

2020 IERE-CSIRO Brisbane Hydrogen Workshop titled “Hydrogen: Enabling the Clean Energy Transition” will be held in Stamford Plaza Brisbane, Australia, on June 9 - 12, 2020, organized by IERE and CSIRO.

1. Report of The 2019 General Meeting and PIESA-IERE South Africa Forum

1-1. Outline

The 2019 General Meeting and PIESA-IERE South Africa Forum were held on October 28–31, 2019 at Sun City, South Africa. From 12 countries/regions, 65 people participated in. By country, the majority of participants were from South Africa (23), followed by 13 persons from Japan, six from Korea, five from China, four from Indonesia and Lesotho, three from Uganda, two from Germany and Zimbabwe. A total of 27 electric power companies, member-affiliated universities, etc. also participated in.
The Forum was hosted by South African executive member, PIESA, and the main theme was "Electricity & the 4th Industrial Revolution – an Africa perspective". Five sessions were held, and 27 oral presentations were performed over two days.

Keynote Address
- 'The use smart technologies to mitigate revenue collection challenges especially in African electricity distribution utilities'
  Eng. Dr. Alfred Kaponda (ESCOM, Malawi & PIESA Board member)
- 'Sustainability of (renewable) electricity production'
  Prof. Dr. Jan Mertens (Chief Scientific Officer, ENGIE Research, ENGIE, Belgium)

Technical Session
- Session 1: Evolving 4IR technologies and its effect on the customer
- Session 2: Asset Management – let's get smart about it
- Session 3: Distributed Renewable Energy Technologies: Are we ready?
- Session 4: Advanced distribution automation in the 4IR era
- Session 5: 4IR's impact on revenue collection and non-technical losses

Safari Tour Pilanesberg National Park

Fig. 1 Opening Address: Mr. Gregory Tosen (IERE Chair)

Fig. 2 Keynote Address: Dr. Alfred Kaponda (ESCOM, Malawi)

Fig.3 Keynote Address: Dr. Jan Mertens (ENGIE, Belgium)

Fig. 4 The venue and participants

Fig. 5 Discussion

Fig. 6 Welcome Reception

Fig. 7 Grope photo of participants

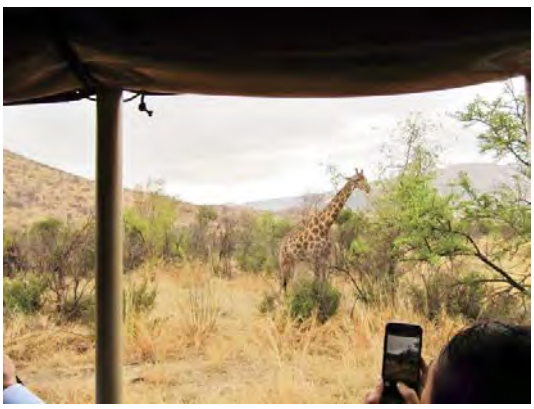


Fig. 8 Pilanesberg National Park

1-2. Opening Session

Opening Address Gregory Tosen (IERE Chair)

Welcome Address Eng Bukosi Siso (Chairman, PIESA)

1-3. Keynote Addresses

K-1 "The use smart technologies to mitigate revenue collection challenges especially in African electricity distribution utilities'

Eng. Dr. Alfred Kaponda (ESCOM, Malawi & PIESA Board member)

(The following is summarized by the Central Office from the content of the lecture)

(1) The situation of African electricity distribution utilities

Most of African electricity distribution utilities are still in such a difficult situation that it is sandwiched between these two big rocks. They have a mission to large extent to maximize social welfare in the provision of electricity and it becomes a challenge for this mission and electricity companies to survive, it is like they are caught between two rocks.

This illustration, that was the way utilities in Africa because instead of maximizing revenue, you are caught between two rocks. The customer possibly doesn't want to pay. If he pays, he doesn't want to pay in good time, and most of the time he wants to steal the electricity. But at the same time, the government will expect you to sort of survive and provide the service.

And what is now prevalent in African context is the issue of rural electrification where profitability and viability of the projects in the rural setup is not all that good but that is where the emphasis is because it's a political tool. Electricity has become a political tool, so as a state enterprise to do distribution you have to use other means because while political intervention – negative political interventions are there and again why we have got all this background.

(2) The Fourth Industrial Revolution

I think there are ways that distribution companies can maximize their revenue. And I think the issue of Fourth Industrial Revolution which we are discussing now is going to be a tool in order to maximize revenue within the current environment. If we compare the first, second and third Industrial Revolution,

I must say the first and second, there were very slow in terms of diffusion, but in terms of innovation diffusion for the third and fourth Industrial Revolution, it's moving at a faster rate such that you never know what is going to happen the next day, the next month because diffusion of innovation in the current Industrial Revolution is expected to move very fast. And if distribution companies in Africa continue to slip, they are not going to benefit and make maximum use of the Fourth Industrial Revolution.

So, what are the challenges that these companies are facing in the distribution setup in Africa? There are so many things that are happening.

(3) Various issues with stealing electricity

One of the issues that is also happening also right now in distribution companies is the fact that possibly we use new technologies whereby we are not actually providing the packaged solutions for our situations. So we may have the technology in African context but we don't use them as packaged solution in order to maximize revenue. That's one of the issues. Possibly out of excitement, but I think we need to move.

The second item that most of the revenue in the African context comes from light power users. In my country, it accounts for 75% but we find that technologies were very slow to provide the metering solutions for light power users and we have a lot of losses in that area where we have put the bulk of our revenue.

The other issue that is bogging down distribution companies in African context is non-supporting legal framework. Even related to tariffs which are cost effective but also related to the fact that when you have got issues of criminal in nature and you find that the legal framework is not surviving.

I will give an example of stealing electricity where you get the meter bypass, there is evidence, the police will come and they take pictures. But when you go to court, the court will say, yes, what you are saying is right and electricity was being stolen in these premises but you don't have evidence to prove who bypassed this meter. Then the case is thrown out. But we have the distribution and we don't have the supportive legal framework. At the same time, we also have big business management models that we need to improve crisis management and power shortages.

We have situations like this photo, a three-phase meter being bypassed like that. The meter is okay but the meter is not intelligent enough to note that they are being bypassed. So we need the Fourth Industrial Revolution to tackle such issues because I think most of the African context is like this picture. So what we are requesting through this discussion, it's very important that we discuss in further intelligence of the technology that we have.

I think from the industrial revolution up to now we have got a lot of technology but we just need to enhance in terms of intelligence in order to do energy balance, in order to do detection of such kind of things. That equipment will be able to detect what is happening. And if that is a three-phase customer, that is the one that brings us a lot of relief.

(4) Conclusion

So in conclusion, I would like to emphasize the points that there are the various challenges that cannot be resolved in the short term, political intervention and a lot of issues. If electricity distribution businesses are going to fully embrace the benefits of the emerging technologies to maximize revenue.

But I think if we embrace the technologies as solutions that address the challenges in the African context, we will be able to take advantage of the new environment of Internet of Things and the Fourth Industrial Revolution in order to maximize revenue in the distribution companies.

Thank you very much.

K-2 "Sustainability of (renewable) electricity production"

Prof. Dr. Jan Mertens (Chief Scientific Officer, ENGIE Research, ENGIE, Belgium)

(The following is summarized by the Central Office from the content of the lecture)

(1) ENGIE?

- ENGIE strategy

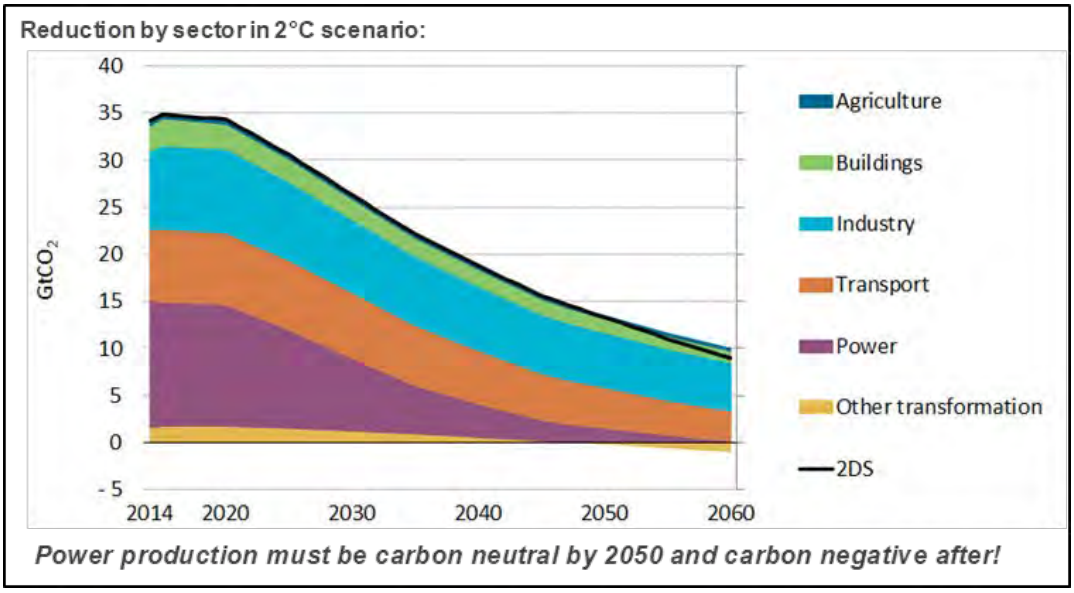
ENGIE, we actually just announced our new strategy. Our CEO announced our new strategy which is a remarkable it does. We have the ambition to lead the zero energy carbon transition as a service. It's no longer about selling kWhs of electricity, but really energy as a service.

- ENGIE in Africa

In Africa, we're not big in Africa, but I'd like to say our business unit Africa is not big yet but we're very ambitious. We're only 3,000 employees in Africa with 3 GW, but 50 projects done under development. More than 10 GW there in direct pipeline. And we're suppling to the people with clean off grid electricity.

(2) Why? IEA roadmap on the 2 Degree Scenario (2DS) and implications on electricity production

This is what the IEA predicts what should happen if we want to meet the 2-degree scenario target. So, the 2-degree scenario target is effective. We will allow global warming not exceed 2 degrees. Today we're emitting about 36 G tons of CO2. By 2050, it should be less than half. What is really striking? So, you see, what is a proper? Isn't it for the electricity on the power prediction? Today, electricity sector is emitting about 12 G tons of CO2. Well, by 2050, We're no more allowed to emit any CO2 if ever we think we will achieve this 2-degree scenario.



I think all races must fits all the reports last year through the IPCC and IEA and UN reports. They're all very negative, let's say that it's almost like doomy. It's very pessimistic. They're, everybody's predicting that we'll never achieve this 2-degree scenario leave along for 1.5. The good thing is that they have not taken into account in their road maps any new emerging breakthrough technologies. And that's what I think we should focus on. We should do a lot more research and pilot enable evaluating new emerging technologies that could just change the way we produce, transport and consume energy and electricity. These predictions are wrong, just because we have a breakthrough technology coming into the picture.

What happened with sun and wind is something that we never could have predicted. And not only us, nobody predicted what's happening today with, for example, the solar installed capacity. We have been wrong in the past.

(3) How? Emerging Technologies pilots and demonstrations CO2 as a resource

How should we do it? I said we should work on the breakthrough technologies to make sure we can prove that wrong in the future.

Some of the emerging technologies are today not into roadmaps of IEEE WCCS, which I think we together should work on to improve these roadmaps.

What we're doing today is for taking methane or natural gas at a ground. We're combusting it or emitting CO2 in the atmosphere.

Probably, it's a good idea to take CO2 out of the atmosphere, take water out of the atmosphere. If you're looking a lot at solar and wind to produce hydrogen, for example, and that you have your CO2 react with your hydrogen and turn it into hydrocarbons. This CCU concept, capture and utilization, is something that.

I think we should challenge to get rid of the idea that CO2 is a waste. We should see CO2 as a resource to obtain chemicals and materials.

We will need hydrocarbons for energy dense application such as aviation. I don't think we'll see planes flying long distance, planes flying on electricity and not even hydrogen. So, it's clear for me in the future, you will need to continue having hydrocarbon energy-dense fuels.

(4) Sustainability > CO2!

- **(Land), Water and Energy Nexus**

The water is becoming important. There is an American west proverb, saying "Whiskey is for Drinking, Water is for Fighting Over." It may be the next strategical resources of 21st century.

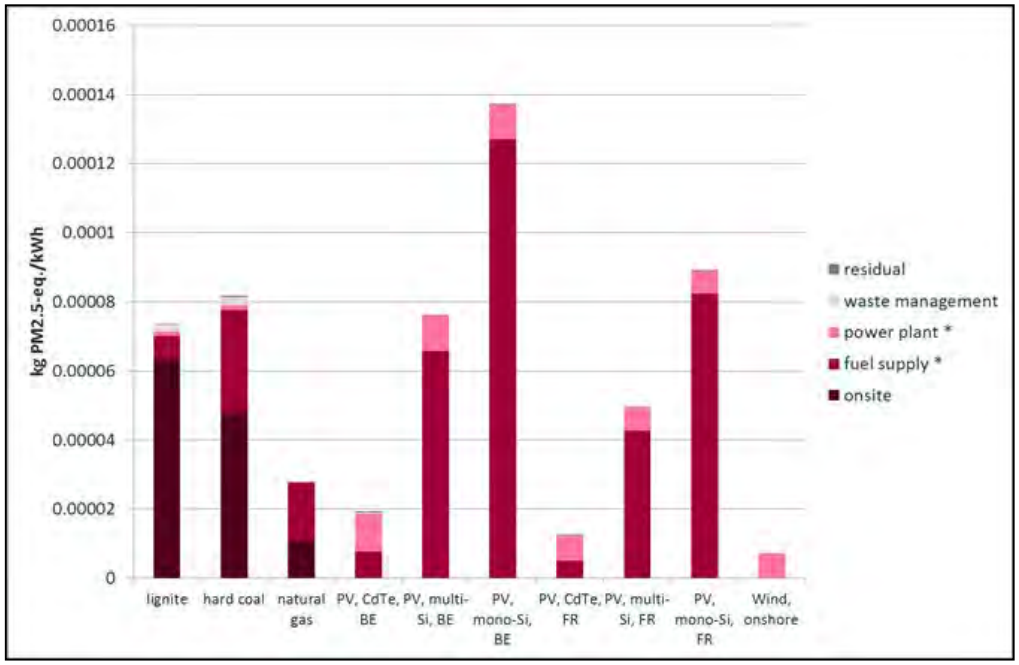
- **From emissions to resources**

Back in the 1700s, if we have a little bit of carbon, calcium for a cement, a little bit iron, we can do when everyone wants. Today, with our renewable electricity, these are the minerals of the metals that we're actually needing for our hydrogen economy, for our PV panels, even for our wind. So, we need a lot of metals. Mining these and recycling these are going to be crucial.

- **Impact of supply chain of renewables**

This is a life cycle assessment that we did last year, where we compared the environmental impact in electricity generation with different technologies. So, you can see the lignite, hard coal, natural gas and then PV, different technologies. Coal fired plant emits around 1 kg of CO2 per kWh of electricity. Natural gas is less than half. Using the PV panels, it is around factor 10, 20 better than coal and gas, but not zero. Where does this CO2 emission come from? Of course, it's from this manufacturing, the production of PV panels.

But we have to be careful. This is particulate matter emission, so define drastic emissions because of the production of electricity. In some of the renewable cases, especially for PV, we may be doing worse with respect to overall estimations to respect to a modern coal fired power plant. In Europe, it has proper flue gas treatment so electrostatic precipitator de NOx, de SOx. We have all those. It's certain cases we're doing than worse. This is something we need to work on. The reason is that in this particular case, if this PV panel is produced in an area where most of the electricity that is used to produce PV panel is coal fired without the best up-to-date flue gas treatment. This is why people are looking at the "Solar Breeding" concept. So, it means that you buy your PV panels which is certified that it's actually made also from renewable electricity.



5. Conclusions

- The electricity sector must contribute the most of the effluent expect 40% percent volume emissions. We must be carbon free by 2050.
- We can prove the road maps wrong if we do more R&D on the way to the emerging technologies.
- Seeing CO2 not as a waste, as a resource will be part of the solution.
- Sustainability is not only CO2. There's water. There's mineral depletion and waters that I haven't mentioned today.
- We should also avoid the pollution displacement traps. So, supply chain of our renewable electricity will be considered to avoid pollutions not only for one country to another, displacing the pollution to be built, but also from one impact category global warming.

1-4 Session 1: Evolving 4IR technologies and its effect on the customer

Chairperson: Dr. Jie Huang (Deputy Department Manager, NARI Group Corporation, China)
(The following is a summary of the session by the session chair)

S1-1, "An Instance Segmentation and Depth Perception based Obstacle Detection and Distance Measurement Method on Substation Patrol Robot", Dr. Hongsheng Xu, (Senior Engineer, NARI Group Corporation, China)
Dr. Hongsheng Xu proposes an obstacle detection and distance measurement method for substation patrol robot based on instance segmentation and depth perception. The pixel-level instance segmentation between road and obstacles are fulfilled by using Mask R-CNN network. In the first step, the pre-processed RGB image is used to train the deep neural network Mask R-CNN to perform pixel-level instance segmentation between obstacles and roads. In the second step, the obtained mask is combined with the depth data processed by using the Grubbs method to eliminate the abnormal data. Finally, the distance from the patrol robot to the obstacle can be measured through pixel-level matching.

S1-2, Cancelled.

S1-3, "Application and Development of Artificial Intelligence in Power Equipment State Evaluation and Maintenance", Dr. Qiao Ji (Engineer, China Electric Power Research Institute, China)
Dr. Qiao Ji investigates the development and application of artificial intelligence technology in equipment state evaluation and maintenance, including data mining, computer vision (CV), natural language processing (NLP), electric intelligent robots and so on. He briefly summarizes the basic principles of these technologies and their typical applications. The challenges of the application of artificial intelligence in the future and the relevant technologies that need to be researched are also discussed.

S1-4, "TID Rollover", Mr. Franco Pucci (STS Association, South Africa) and Ms. Keseree Rajoo (Business Development Manager, Utilities world, South Africa)
Mr. Franco Pucci discusses the limitations of the current TID. In November 2024 the TID will be reset to zero, and 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. Mr. Franco Pucci then talks about key actions to take and key changes that have to be made. After Mr. Franco Pucci, Ms. Keseree Rajoo introduces some case studies on the TID rollover project.

S1-5, "Readiness Index for Indonesian Power Plant toward Industry 4.0", Mr. Harry Indrawan (Manager, Research and Assessment Technology Power Generation And Energy, PT. PLN (Persero) Research Institute, Indonesia)
Mr. Harry Indrawan talks about the five pillars of Indonesia Industry 4.0 Readiness Index (INDI 4.0) for power plant, which are management and organization, people and culture, connectivity, digitalization, and technology. The five pillars are further divided into 15 fields. From these 15 fields the readiness reference is taken to measure Indonesian power plant transformation towards Industry 4.0. From the early assessment done in the early 2019, the result obtained shows that the average index score in Indonesia is in level 2. It means the power plant readiness to transform towards Industry 4.0 is in

"intermediate" stage. The study also shows that INDI 4.0 – Power Plant can effectively be used as the standard reference to measure the readiness of the power plant in Indonesia to transform towards Industry 4.0.

S1-6, "Artificial Intelligence for the Detection of Electricity Theft and Irregular Power Usage in the African Electricity market", Mr. Keith Katyora (Electrical Engineer, Aurecon, South Africa) and Mr. Tendai Matiza (Electrical Engineer, Aurecon, South Africa)

Mr. Keith Katyora and Mr. Tendai Matiza talk about the application of Industrial 4.0 in electric power industry and then focus on the electric power theft detection problem. A machine learning model is applied to model electric power consumption behavior. Abnormal data will be detected by the model and therefore theft behavior can be detected. Results of case studies unveil the potential of machine learning model to accurately predict and detect electric power consumption behaviors.

1-5 Session 2: Asset Management – let's get smart about it

Chairperson: Mr. Hans-Jürgen Behnke (POA External Operation & Maintenance Business Development & Sales, RWE Technology International GmbH, Germany)

(The following is a summary of the session by the session chair)

S2-1, "Current market developments and their effects on asset flexibilities", Mr. Hans-Jürgen Behnke (POA External Operation & Maintenance Business Development & Sales, RWE Technology International GmbH)

A general overview of the electricity market developments in Germany was given, with focus on the effects on the conventional power stations of RWE and their intrinsic effects on plant flexibility and fleet optimisation. In the following the measures taken and developments made by RWE were described, to improve plant flexibility and fleet profitability, using integrated algorithmic and SCADA-based IT systems for market simulation, load-and capacity-simulation, process optimisation and generation steering. Finally the newly developed Virtual Power Plant system (VPP) was presented, which ties many industrial consumers and producers together and markets them as one virtual generation asset on the electricity exchange.

S2-2, " A Real-world dataset for automatic visual diagnosis of power transmission lines", Mr. Min-Hee Choi (Digital Solution Laboratory, Senior Researcher, KEPCO Research Institute)

The application of power line inspection by autonomously acting drones was presented, which is in use since 2017. In a demonstration video an inspection drone, equipped with optical and thermographic cameras could be seen. It was demonstrated, that it can autonomously fly a safe predetermined inspection path, inspecting the condition of a power line and detecting upcoming failures. The recordings of the drone can also be re-checked by maintenance engineers, who then determine the optimal maintenance approach. The system continuously optimizes itself through deep learning algorithms and generates significant savings, compared to conventional approaches. The applicability of the system in areas of severe physical damage of the power lines was discussed after natural disasters.

S2-3, "Application of RFID System for Managing Repair Parts of Underground Power Cables and Accessories", Mr. Yuya Manabe (Electric Power R&D Center, R&D Division / Senior Researcher, Chubu Electric Power Co., Inc.)

The challenges of underground cable maintenance were displayed, with special focus on spare parts management. The application of an RFID-based system to immediately identify and define necessary spare parts, manage the spares in the ware house and efficiently distribute them to the point of works was described. Reduction of redundant spares on stock, fast distribution of spares and thereby avoidance of long downtimes were highlighted as key advantages. An example of inventory works showed a reduction

S2-4, ”4IR technologies Application on KEPCO Power Distribution equipment maintenance”, Mr. Gi-Dae Oh (KEPCO RI / Senior Researcher)

In this presentation the application of augmented reality in distribution grid maintenance was shown. The system uses optical and laser scanning technology for the 3D mapping and modelling. Several applications of AR were presented, e. g. for visualizing concrete pole health index data and underground distribution equipment. Also the use of solar powered wireless smart sensors was introduced, for preventive maintenance (pre-failure detection). The system already demonstrated its usability in real life application.

S2-5, “High Efficiency Status Evaluation for Main Equipment based on Cyber Physical Systems in Distribution Network”, Dr.Keyan Liu(Manager Power Distribution Department, China Electric Power Research Institute)

The high complexity in modern distribution networks was described. These networks can be negatively affected by physical and virtual failures and/or attacks. The presented approach is a (real time) simulation of complex cyber physical systems. The simulation can be employed in real time to detect and repair imminent problems and also to run offline simulations of the system, simulate possible failures and/or cyber-attacks, to detect weaknesses and make the system more resilient.

S2-6, “MR_System Solutions for Asset Management” Mr. Kobus De Villiers (Managing Director, MR South Africa)

The MR South Africa company was introduced. The focus of this presentation laid on the asset management of power transformers and the increase of the transformers life time. A risk matrix to determine the assets risk status was displayed and the correlation of transformer age and increased monitoring necessity was underlined. Several examples of monitoring devices were presented and also the additional effort to maintain these devices was pointed out.

1-6 Session 3: Distributed Renewable Energy Technologies: Are we ready?

Chair person: Dr. Tomohiko Ikeya (Associate Vice President, Materials Science Research Laboratory, CRIEPI, Japan)

(The following is a summary of the session by the session chair)

S3-1, “Secondary battery energy storage systems for enabling use of renewable energy to realize a zero-CO2-emission society”, Dr. Tomohiko Ikeya (Associate Vice President, Materials Science Research Laboratory, CRIEPI, Japan)

Dr. Tomohiko Ikeya addressed that secondary battery energy storage system (ESSs) for unstable renewable energy sources are expected to be installed to realize a zero-CO2 emission society. However, several fires in lithium ion secondary battery ESSs have been reported that were particularly severe

because the battery capacities were large, and thus large amounts of flammable electrolytes were stored in a small area. The fire safety of secondary batteries should be improved to facilitate the widespread installation necessary for a zero CO2 emission society. The fire safety of secondary batteries should be improved to facilitate the widespread installation necessary. The development of all-solid-state batteries is desirable because they are not flammable. The questions from audiences were why the redox-flow batteries was not selected, and what is required for the large capacity Li ion battery system against fire accident. Dr. Tomohiko Ikeya answered that it should be equipped with auxiliary pumping system, and it is important that it should be required avoiding excess amount of capacity and controlling operating voltage and temperature of batteries sensitively.

S3-3, "Development a System Dynamic Model for Utilities Revenue Evaluation under Distributed Energy Resources", Dr. Desmond Ighravwe (University of Johannesburg, South Africa)

The proliferation of distributed energy resources (DER) has started causing a change in a utility firm's revenue. As the households' standard of living improves, utility firm revenue will continue to reduce. Hence, this article used a system dynamics (SD) modelling approach to evaluate the impact of DER on utility firm revenue. During the modelling of households were considered. Aa the end of 2050, the utility firm revenue will reduce by 6%. The proposed model has the capacity to be used to simulate different scenarios for a utility firm's revenue. An audience made a question and required a comment concerning the today's situation of electric power utility system in the south Africa.

S3-2, "The future of infrastructure: Challenges & opportunities for utility companies", Dr. Felix Cebulla (Senior Expert, Corporate Technology, Strategy &Technology, innogy SE, Germany)

Dr. Felix Cebulla told that traditionally, many business models of utility companies are based around the planning, construction, and covers, for examples, electricity, gas, and heat networks as well as communications and water infrastructure. Infrastructures themselves and the way in which they are financed, built and operated will change considerably in the coming years. Little is currently known about the way they interact with politics and society, how boundaries between today's infrastructures. In any cases, a major part of utilities' traditional business will be challenged by new market participants bringing new concepts and technologies into play. His talk aimed to sharpen the view on this perspective by highlighting the results of current innogy project that consist two parts. Part one reviews on past/former infrastructure developments, emphasizing life cycles, maturities, and vale drivers. Building on that, the second part the analyses potential risks and opportunities for utilities. He showed the unique schematic image of each relationship in his presentation.

S3-4, "The Grid Interconnection Study of Renewable Energy in the Distribution system to ensure Safe Grid Integration: Case Study of PV Grid Connected in Indonesia", Mr. Dimas Bangun Fiddiansyah (Division Project Management Office (PMO) & Manager of Project Management and Integration for Sumatera Projects, PT. PLN (Persero), Indonesia)

Indonesia government has a policy to promote renewable energy development to provide green electricity generation to diversify generation resources and reduce greenhouse gas emissions. Hence, the guidelines of grid interconnection study describe the application, review, and approval procedures and technical requirements for the connection of renewable energy generation plant (REGP) to the distribution systems. Thus, these requirements also apply to any over supply power from private sector/industries that operate on-site REGP. Consequently, the REGP that connected to the distribution systems, if not properly designed, may adversely affect the safety, reliability and power quality of the

distribution system itself.

S3-5, "Status and Future of Renewable Energy Technology Development and Application in KEPCO", Mr. Seong Jegarl (Director & Chief Researcher, Renewable Energy Research Group, KEPCO RI, Korea)

Korean government set '3020 strategy' to support renewable energy supply, and KEPCO is also performing renewable energy R&D project and business about wind and solar energy. For wind power, KEPCO Research Institute (KEPRI) has developed the technologies of offshore wind farm design, suction bucket foundation, offshore substation and condition monitoring, and applied these to 60MW offshore wind farm at west coast of Korea. KEPCO set the strategy for R&D and business by two directions of solar power business; to make more power at same area and increase power generation site. KEPRI is developing and demonstrating the technologies of Utility-scale AgroPhotovoltaic (UAPV), underwater salt-farm PV, road-integrated PV (RIPV) and innovative PV cell like perovskite. KEPRI has plans to develop, as future of renewable energy technologies, floating windfarm and PV, MMB (Multi-purpose mobile base), PV O&M optimization and asset management, reflection PV, and renewable co-location complex model (wind farm-floating PV-fishery farm complex), etc. An audience asked which technologies were most expected to be installed.

Mr. Seong Jegarl replied that "We had introduction and discussion of new technologies, business models and problems to install renewable energy to reduce CO2 emission. We should be fast walkers toward a zero-emission society, and we should never walk back."

1-7 Session 4: Advanced distribution automation in the 4IR era

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

(The following is a summary of the session by the session chair)

S4-1, "Plant simulation, visualization and control platform based on OPC and Simatic WinCC", Mr. Rotimi Agbebi, (Siemens, South Africa)

A simulation platform can describe the real plant behavior and visualize to test control logics. Siemens has developed a rapid simulation platform for process monitoring and control with communication based on OPC (OLE for Process Control). A platinum refining reactor developed using MATLAB and Simulink S-Functional blocks can communicate its process input & output variables through OPC interface of SICAM PAS/PQS gateway. As a test result, it was found that the communication protocol between MATLAB and Simatic WinCC can be effective and feasible.

S4-2, "Improvement of power system analysis tools (CPAT) for planning, operation and control/protection studies under a large penetration of photovoltaic generations", Hideo Koseki (Senior Research Scientist, CRIEPI, Japan)

CRIEPI has developed CPAT which is an integrated software package applicable to large-scale power system analysis, and has improved the CPAT to clarify the grid impact of PV. The features of the CPAT are same as the high performance and confidence, the development of analysis models for various power facilities, and the initiatives for internationalization. As an example, the CPAT was used for verification analysis of static voltage rising situation and the simulation results was very similar to actual telemeter values when a blackout by earthquake was occurred in the Hokkaido area, Japan, on

September 6, 2018. In order to clarify the grid impact of PV on transient stability, CRIPEI has developed the various PV models and electric characteristics were looked into a substation to a distribution network. CRIEPI has also been promoting the build-in of the IEEE standard control system model widely used overseas into the CPAT.

S4-3, "The implementation of smart asset management system to monitor the health index of power distribution assets: case study of PLN's EAM in Indonesia", Mr. Dimas B. Fiddiansyah (Engineer, PLN, Indonesia)

PLN proposed the EAM platform, a centralized application that would organize distribution assets, to ensure the lifetimes with maximum technical performance. As local applications are not integrated with a uniform platform or other corporate application, the local applications are just being applied to the decentralized units in PLN. The first project for single platform of PLN, called as Dreamap, has launched since 2014, and made some improvement in KPI outputs like losses and energy sales. By the success of Dreamap, PLN has initiated Maximo, a customized platform with the functions of asset register and health index assessment. Finally, the EAM program has been rolled out since June in 2019 and involved across PLN units in Indonesia.

1-8 Session 5: 4IR's impact on revenue collection and non-technical losses

Chair person: Mr. Vally Padayachee (Executive Officer, PIESA, South Africa)
(The following is a summary of the session by the session chair)

S5-1 "Energy Storage on Municipal Grids - Why this makes sense", 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?

S5-2 "Security Testing for Preventing Backdoor Threat in Smart meter Implementation in Indonesia", 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.

S5-3 "Carbon Market Risk Analysis & Defense based on Hybrid Simulation - a Perspective from Cyber Physical Social Systems in Energy", 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

S5-5 "Incorporating Embedded Generation onto Municipal Networks", 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 ell excess power to the grid
    - ✓ Change in legislation

S5-6 "Is the technological revolution opening up new avenues for rogue entities to exploit?", 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 channeling 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

S5-7 “Pilot project, migration of an in-home common base prepayment metering solution to a spilt pre-payment smart metering online solution”, Mr. Harold Hayes(Global Head - Utility Business Solutions, Smart Energy, Landis+Gyr (Pty) Ltd)

- 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

1-9 Closing Remarks

- Eng. Bukhosi Siso (Chairman, PIESA)
- Dr. Takao Watanabe (Secretary General, IERE Central Office)

1-10 Safari Tour

Safari tour in Pilanesberg National Park was carried out on October 31.

2. Announcement

2020 IERE - CSIRO Brisbane Hydrogen Workshop

The world is seeking technological pathways to support the decarbonisation of electricity, transport, and industrial sectors. Hydrogen has emerged as a real opportunity in this context: it can be used as a transport fuel, as a long-term energy storage medium, and as a vector for distribution of renewable energy from those countries with significant resources to those with fewer resources. While hydrogen can play a role in supporting electricity grids with greater penetration of variable renewable energy it also offers the opportunity for the electricity sector to be coupled more closely with transport and industry to support significant decarbonisation around the globe.

About this event

[Main Theme] Hydrogen: Enabling the Clean Energy Transition
[Date] June 9 - 12, 2020
[Venue] Stamford Plaza Brisbane, Australia
[Host] CSIRO
Please refer to the following URL;
https://www.iere.jp/events/workshop/2020-brisbane/index.html
Abstract deadline: March 4, 2020

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