フィリピン共和国
国家電化庁（NEA）

フィリピン共和国
配電系統運用システム・管理技術普及促進事業
業務完了報告書

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独立行政法人
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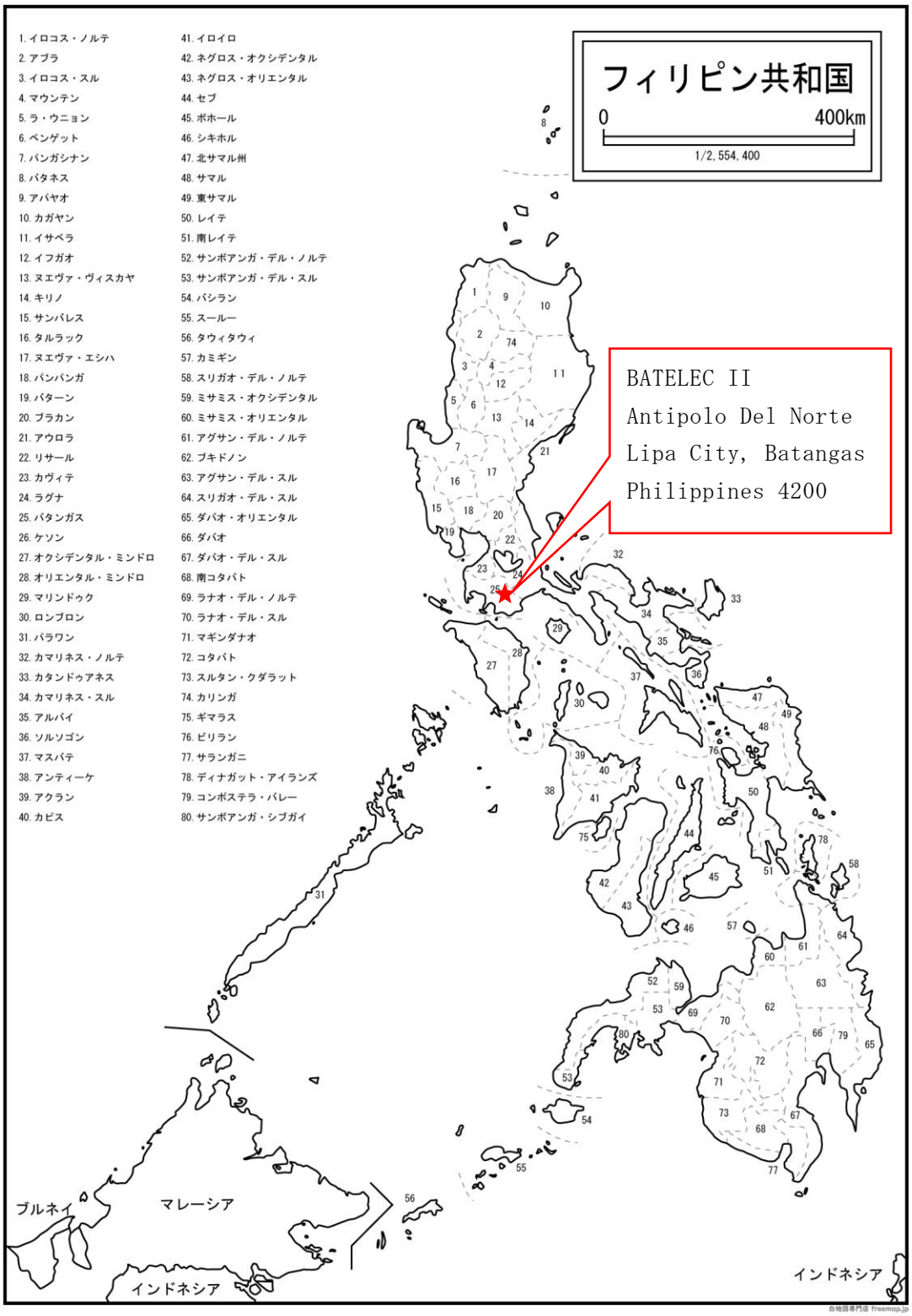
略語表

略語	正式名称	日本語名称
ADB	Asian Development Bank	アジア開発銀行
ADMS	Advanced Distribution Management System	高度配電管理システム
BATELEC II	Batangas II Electric Cooperative, Inc.	バテレック II ※電化協同組合
CB	Circuit Breaker	遮断器
CCGT	Combined Cycle Gus Turbine	ガスタービン・コンバインド・サイクル発電
DA	Distribution Automation	配電自動化
DMS	Distribution Management System	配電管理システム
DOE	Department of Energy	エネルギー省
DNMS	Distribution Network Management System	配電系統運用システム
DR	Demand Response	デマンドレスポンス
EC	Electric Cooperative	電化協同組合
EMS	Energy Management System	エネルギーマネジメントシステム
ERC	Energy Regulatory Commission	エネルギー規制委員会
FIT	Feed in Tariff	固定価格買取制度
FLISR	Fault location, isolation and service restoration	事故点標定、分離、復旧
FS	Feasibility Study	実現可能性調査
GUI	Graphical User Interface	グラフィカルユーザーインターフェース
IPP	Independent Power Producer	独立系発電事業者
MEA	Metropolitan Electricity Authority	タイ首都圏配電公社
MERALCO	Manila Electric Railroad And Light Company	マニラ電力会社
METI	Ministry of Economy, Trade and Industry	経済産業省
MOM	Minutes of Meeting	議事録
MOU	Minutes of Understanding	覚書
NEA	National Electrification Administration	国家電化庁
NETI	National Electrification Training Institute, NEA	NEA 研修部門
O&M	Operating and Maintenance	運用保守
ORED	Office of Renewable Energy Development, NEA	NEA 再生可能エネルギー開発室

PCS	Power Conditioning System	パワーコンディショナー
PENELCO	Peninsula Electric Cooperative, Inc.	ペネルコ ※電化協同組合
PELCO II	Pampanga II Electric Cooperative, Inc	ペルコ II ※電化協同組合
PV	Photovoltaic	太陽光発電
RPS	Renewable Portfolio Standard	再生可能エネルギー利用割合基準
SAIDI	System Average Interruption Duration Index	平均停電継続時間指標
SAIFI	System Average Interruption Frequency Index	平均停電回数指標
SCADA	Supervisory Control and Data Acquisition	監視制御システム
TOR	Terms of Reference	委託事項

地　図



出所：白地図専門店（http://www.freemap.jp/）

第1章 要約

1.1. 要約

1.1.1. 本事業の背景（対象国の開発課題含む）

フィリピン国（以下比国）経済は、2012 年以降 2020 年と 2021 年を除き 2022 年まで実質 GDP が 6%以上の伸びを示しており、安定的な成長を続けている。一人当たり GNI も IMF 統計によると 2022 年には 3,950 ドルとなり、高所得国への仲間入りを目指す水準にある。比国は豊富で安価な若年労働力を有し、かつ国民全般が高い英語力を有するなど、高い経済成長のポテンシャルも兼ね備えている。

経済成長にあわせてエネルギー需要の増大が見込まれているが、電力インフラ整備が遅れており、経済成長に不可欠な信頼度の高い電力供給システムの整備が急務となっている。

1.1.2. 本事業の普及対象技術

本事業の中核となる「配電系統運用システム・管理技術」は、配電系統を常時監視し、配電線事故発生時には事故区間の検出・切り離しを自動的に行い、その後、健全区間は遠方操作にて復旧することが可能となる配電自動化システム・運用（計画・制御）技術で実現される。このシステム・技術の適用により、事故発生時の停電・復旧時間を短縮し、事故点の早期特定による事故点除去作業の効率化を図る。

1.1.3. 本事業の目的／目標

本事業では、信頼度の高い電力供給システムを構築するために、比国に適した配電系統制御システム・運用技術導入の提案を行うものである。したがって現地の電力設備の状況、ニーズとともに、電気事業に関する規制・制度も踏まえて、政府関係者、配電事業者のキーパーソンに提案システム・技術の優位性、システム導入の効果を理解して頂き、将来的には比国への普及を目指すことを目的とする。

1.1.4. 本事業の実施内容

NEA（National Electrification Administration、国家電化庁）と協議の上、財務および技術的基盤の高い EC（Electric Cooperative、電化協同組合）を選定した上で、当該 EC の中核都市を対象に導入を推進する。これにより、比国都市部の配電系統構成、運用方式、ニーズなどを踏まえた標準的なシステムを構築する（パイロットプロジェクト）。これをパイロットモデルとして、比国内の他配電事業者（EC および民間配電会社）に対して、NEA の協力を得て横展開を図る。なお、本事業にてセミナーを通じた比国内の配電事業者へのアプ

ローチを行う。

1.1.5. 本事業の結果／成果

本事業では、本邦受入活動、フィリピンの全 EC ならびに NEA を対象とした現地セミナー等を通じてフィリピン電力セクター関係者（DOE（Department of Energy、エネルギー省）、NEA、EC）に対する信頼度の高い配電自動化システム・運用技術の理解促進を図ることができた。

パイロットプロジェクトとして、対象となる EC である BATELEC II（Batangas II Electric Cooperative、Batangas Province に電力供給を行う２つ EC の内の１つ）の２配電線（Antipolo 配電線、Padre Garcia 配電線）に配電自動化システムならびに自動化開閉器を 7 台設置した。当該配電線にて遠方監視制御、ならびに停電発生時の事故区間分離等の運用を可能にした。Antipolo 配電線で約 7 カ月間、Padre Garcia 配電線も含めた 2 配電線で約 5 カ月間にわたり実証を行った結果、停電時間低減等の有意な成果を得ることができ、本システム・技術が比国の電力システムにおいても適用可能で、且つ、その機能を有効に発揮できることが示されたことを NEA に報告した。

また、本システムの導入を通じて、BATELEC II へ計画・制御といった運用技術の教育・訓練も行い、本システムを BATELEC II が自律的に活用することで、配電線の設備計画、ならびに配電系統の切替操作により停電範囲の縮小、作業効率の向上を実現する制御技術の基盤を構築することができた。バタンガス州リパ市の BATELEC II 管轄内にある中規模都市の郊外でも、実証を行った地域と同様に停電回数や停電時間の短縮化は地元住民から強く要望を受けているとのことであり、今回導入した運用技術の効果について、先方から十分な好評を得ることができた。

1.1.6. 現段階におけるビジネス展開見込み

東京電力グループが日本で培ってきた配電系統の計画・制御技術と、本事業で有効性を検証した配電自動化システムを基盤とし、BATELEC II を始めとした比国 EC に対してシステム導入の展開を図る。

1.1.7. ビジネス展開見込みの判断根拠

NEA、BATELECII が本事業で導入した配電自動化システム・運用（計画・制御）技術に対し高い評価および関心を示していることから、比国 EC に対してシステム導入のニーズがあるものと考えられる。

1.1.8. ビジネス展開に向けた残課題と対応策・方針

本事業では、当面、主に NEA 傘下の EC をターゲットとしている。中核都市で電気事業

を担う EC では、電力供給の信頼度向上の重要性は理解し、ある程度の設備投資は可能であると想定される。一方で、配電自動化システムを導入するにあたっては、多額の初期投資が必要となることから、事業展開を行っていくためには現地事業者の価格ニーズに合わせたシステムの提供が求められる。

1.1.9. 今後のビジネス展開に向けた計画

2023 年現在、フィリピンには 121 の EC が存在している。配電自動化システムについて、本事業で停電時間削減の有効性を検証したことを示し、周辺 EC においても横展開を図る。

配電関係システムの構築は、1 回のシステム導入では完結せず、経済の発展や地域のニーズに応じて、アップグレードしていくのが適切な進め方である。このような観点から、初期システムにて横展開を図り、各ターゲットの発展状況に応じて機能の付加、システムアップグレード（システム高度化）を目指す。

1.1.10. ODA 事業との連携可能性

事業展開は B to B を基本とするが、NEA が災害時などの全 EC の状態監視を目的として計画している DMS（Distribution Management System、配電管理システム）導入に関しては、技術協力プロジェクトとの連携も考慮したい。

1.2. 事業概要図

フィリピン共和国　配電系統運用システム・管理技術普及促進事業
東光高岳、東京電力パワーグリッド

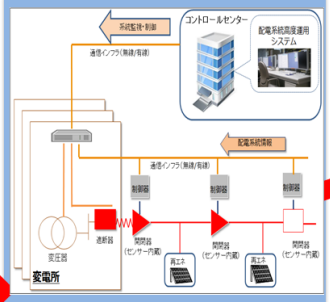
フィリピン共和国の開発ニーズ

- **電力供給信頼度向上**
  ・継続的な経済発展および海外企業の積極的な誘致のため、停電が多く、不安定な電力供給の信頼度向上が必要
- **再生可能エネルギー導入への対応**
  ・再エネ導入促進の政策のもと、出力が不安定な再エネ電源の系統への連系による信頼度低下を防ぐ仕組みが必要

普及促進事業の内容

- 比国の配電系統信頼度の向上のため、本邦の電力会社とメーカーが協働で以下の技術を提案
  ・事故発生時に停電区間を極小化し、速やかに復旧する仕組み
  ・今後促進が進む再エネ電源の大量導入に備え、センサー付開閉器の設置により、リアルタイムで系統状態の監視を行い、系統電圧を適正に維持・管理する仕組み
- 上記の仕組みや技術を理解頂くため、セミナー開催や実配電線路を用いたパイロットプロジェクトを実施

提案企業の技術・製品



信頼度の高い配電系統運用技術

事業のポイント

➢比国の配電事業者は小規模で数が多いので、顧客のニーズをしっかりと把握した上で、提案を行う必要がある
➢実配電線路を活用したパイロットプロジェクトを実施し、提案技術の効果と優位性を示す

フィリピン共和国側に期待される成果

- 提案技術導入により、配電系統の事故発生時に、迅速な事故点の検出とともに、停電時間が大幅に短縮し、供給信頼度が向上する
- 上記仕組みに合わせた、電力系統の計画、運用技術を習得できる
- 再エネの大量導入が進んだ場合、配電系統の運用状況をリアルタイムで把握可能で、安定した電力品質の維持、管理が可能となる

日本企業側に期待される成果

現状

- 本事業で提案する技術・システムの本邦企業の海外での導入実績は極めて少ない
- これまでは、電力会社などによるコンサルティング活動が主流で、システム・機器は、欧米の競合企業と比較して、機能や価格面での優位性を示せなかった

今後

- 本事業実施により、同国で必要とするレベルや資金力に応じた提案を可能とする
- 本邦電力会社とメーカーの協働により、欧米競合メーカーに対する優位性を示す
- システムの導入後、アップグレードやO&Mなど継続的なビジネス展開を狙う

第2章 本事業の背景

2.1. 本事業の背景

比国経済は、2012 年以降 2020 年と 2021 年を除き 2022 年まで実質 GDP が 6%以上の伸びを示しており、安定的な成長を続けている。一人当たり GNI も IMF 統計によると 2022 年には 3,950 ドルを超え、高所得国への仲間入りを目指す水準にある。比国は豊富で安価な若年労働力を有し、かつ国民全般が高い英語力を有するなど、高い経済成長のポテンシャルも兼ね備えている。

一方、GDP に占める投資は近年、増加傾向にあるが、近隣諸国に比して低い水準に留まる。低調な投資は製造業の振興を含む産業構造の転換の制約になっており、豊富な労働力を背景とした経済成長の達成、これに伴う貧困の削減のため、内外からの投資促進が極めて重要である。経済成長にあわせてエネルギー需要の増大が見込まれているが、電力インフラ整備が遅れており、経済成長に不可欠な信頼度の高い電力供給システムの整備が急務となっている。

このためには、外務省の対フィリピン国別開発協力方針（2018 年 4 月）に記載があるように、持続的経済成長の達成に必要な基盤強化ならびに海外からの直接投資の促進を導く投資環境の改善に向けて、質の高いインフラの整備に取り組む必要がある。

インフラ基盤の 1 つである電力供給の現状と課題として、以下があげられる。

① 電力供給信頼度の向上

電力供給の信頼度は、首都マニラでは年々改善傾向にあるが NEA 傘下の EC では、SAIFI（System Average Interruption Frequency Index、平均停電回数指標）が 16.3 回、SAIDI（System Average Interruption Duration Index、平均停電継続時間指標）が 1,154 分（NEA アニュアルレポート 2014）であり、低い水準に留まっていた。この信頼度データは、工事などに伴う計画停電は含まれていない。

比較対象として、東京電力では SAIFI 0.06 回、SAIDI 6 分（2015 年度）であり、また、同じ東南アジアのタイ MEA（Metropolitan Electricity Authority、首都圏配電公社）では、SAIFI0.99 回、SAIDI30.7 分（2019 年度 Annual report）となっており、比国の供給信頼度は相対的に低いことがわかる。日本ならびにタイでは配電自動化システムの導入など配電インフラの導入が進んでいることも踏まえると、比国の供給信頼度に関する課題は電力インフラ特に配電設備の整備の遅れに起因すると考えられる。

比国政府は、海外企業の工業誘致を柱とする工業化計画を進めており、安定した電力供給の実現が必要条件となる。

② 配電系統への再エネ大量導入への対応

比国 DOE は、再エネ導入を推進することとしている。2012 年には FIT 制度（Feed In Tariff、固定価格買取制度）も導入した。しかし、再エネの系統への大量連系に伴う電力品質の維持管理の知見が乏しく、対応技術の導入が急務となっている。

③ スマートグリッド関連技術導入への対応

2020 年 2 月に DOE がスマートグリッドポリシーとして、「安全性」、「信頼度」、「効率化」、「適応性/持続可能性」、「強靭化」、「消費エンパワーメント」の 6 つの指針に基づき方針を打ち出している。方針の中には、DMS、DA（Distribution Automation、配電自動化）、FLISR（Fault location, isolation and service restoration、事故点標定・分離・復旧）といった本事業と関連している項目が含まれている。

地方の電力インフラ整備に関しては、NEA が推進主体になり、予算の策定・配分・実施の責任を負っている。NEA は電力供給信頼度の評価指標として、SAIFI、SAIDI を用いており、目標値を設定して傘下 EC の評価指標としている。

また、2008 年に再生可能エネルギー法(共和国法 9513 号、以下「再エネ法」)が制定されて以降、政府は、電力の供給力確保や二酸化炭素排出量削減に向けた方策の 1 つとして、再エネ事業を加速していくとしており、 NREB（ National Renewable Energy Board、国家再生可能エネルギー委員会）が主体となって、「国家再生可能エネルギー計画」(NREP: National Renewable Energy Plan、DOE が策定)を推進している。NREP では、再エネ発電設備を 2010 年の 544 万 kW から 2030 年にはおおよそ 3 倍に当たる 1,530 万 kW にすることを目指している。

再エネ開発促進のため、再エネ法では財政的インセンティブと非財政的インセンティブが定められており、前者は各種税制優遇措置等、後者は FIT 制度や RPS 制度である。

FIT については、2008 年の再エネ法に伴い導入され、FIT ルール（2010 年、ERC 決議 No.16）、REPA/RESA（REPA: Renewable Energy Payment Agreement、RESA: Renewable Energy Supply Agreement)契約ひな型等に基づき実施されている。

2012 年に ERC により買取価格と導入目標が公表されたが、太陽光と風力については電源接続の申込みが急増し導入目標が達成された。その後、2015 年に太陽光と風力の新しい買取価格と導入目標が公表されたが、そのすぐ後に目標は達成されている。

また、DOE は NREB と協力して、再エネ証書および RPS 制度導入の検討を進めている。

これに対して、安定的に配電系統を運用するための監視・制御システムの導入が必要になる。各 EC へのシステム導入に関して、NEA が予算化を進めている。

2.2. 普及対象とする技術、及び開発課題への貢献可能性

2.2.1. 普及対象とする技術の詳細

本事業で対象とする技術は、「信頼度の高い配電系統運用技術」であり、比国の中核都市のみならず地方の住居エリアも含めた信頼度の高い電力供給が求められる地域を対象とする。本技術の中核となる「配電自動化システム」は、配電系統を常時監視し、事故発生時には事故区間の検出・切り離しを自動的に行うとともに、事故区間以外の健全区間を遠方操作にて復旧する制御機能を有する。これらの機能を活用することにより、事故

発生時の停電・復旧時間を短縮し、事故点の早期特定による事故点除去作業の効率化を図る。

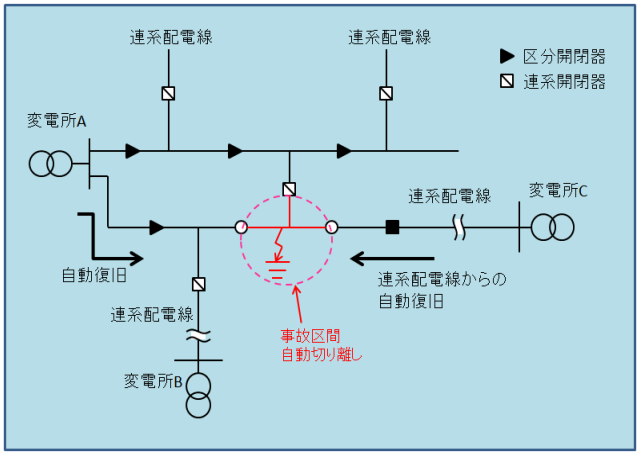


図 2-1　配電系統の事故発生時の状況（本邦での実施例に基づき提案法人作成）

配電自動化システムでは、配電線開閉器にセンサーを内蔵した開閉器を施設するため、電圧・電流のリアルタイムでの計測が可能である。この情報を活用し、近年国内外で急速に導入が進んでいる再生可能エネルギー（以下、「再エネ」）の系統への連系運転状態を系統運用者が推定し管理できることが期待される。

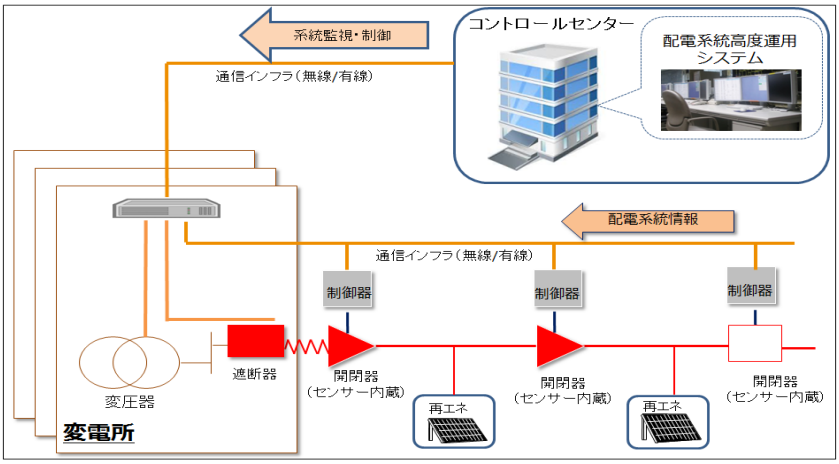


図 2-2　配電自動化システム構成図（本邦での実施例に基づき提案法人作成）

配電系統の事故発生時の停電時間の短縮、再エネ連系時の系統の適切な管理などのためには、配電線の区間設定（開閉器の設置による区間分割）および配電線間の連系強化が必要となる。

配電系統の計画・整備に関しては、東京電力パワーグリッド（PG）の国内外における長年の知見が活用できる。また、実際に配電系統を運用してきた電力会社固有の技術・ノウハウも有効である。

本事業では配電自動化システムの導入効果を最大限に発揮するための「配電系統の計画および制御の運用支援」をパッケージとして提供する。

2.2.2. 開発課題への貢献可能性

① 電力供給信頼度の向上

配電系統の供給信頼度を向上するためには、事故発生の未然防止とともに、事故発生時に停電区間を極小化し健全区間に速やかに送電することが重要である。配電自動化システムの適用により、停電区間の極小化、早期事故復旧が自動的に行われ、停電時間を平均 1/3 程度に減少し、電力供給信頼度を大幅に向上することが可能となる。また、同システムにより事故個所の特定が容易になり、復旧作業の効率化が図れる。

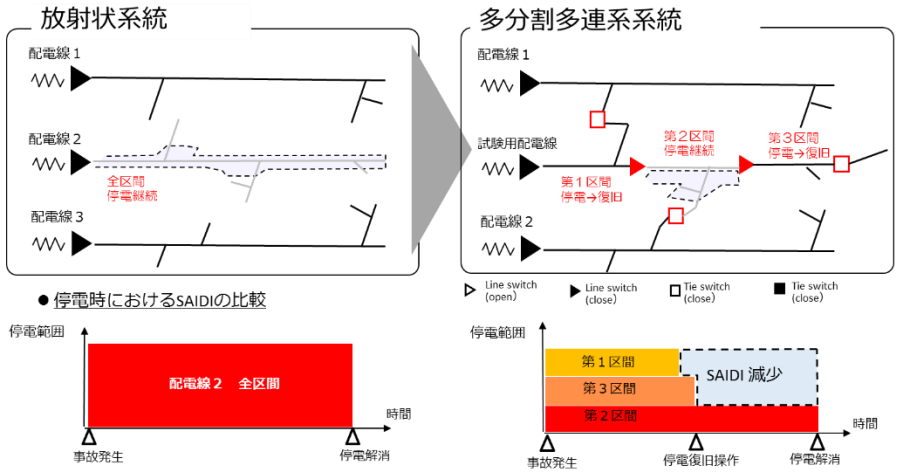


図 2-3　多分割多連系の系統構成の利点（本邦での実施例に基づき提案法人作成）

さらに、図 2-3 に示す通り、配電系統を複数の区間に分割し各区間が他配電線と連系する系統構成（多分割多連系の系統構成）の採用により、配電線工事に際しての計画停電時間の大幅な削減、ならびに配電線稼働率の向上が期待できる。

上記により、需要家庭への電力供給信頼度が大幅に向上し、都市部、工業団地への海外企業の誘致において、強いアピールポイントとなる。一般家庭においても、生活の質の向上につながる。

② 配電系統への再エネ大量導入への対応

開閉器には電圧・電流センサーが内蔵されており、系統のリアルタイム監視が可能である。これにより系統に再エネが大量導入された場合、配電線電圧を適切に維持・管理することが可能となり、比国政府が進めている再エネの導入推進に貢献するとともに、温室効果ガスの削減、将来的な電力供給コスト低減が期待される。

③ スマートグリッド関連技術導入に伴う制度構築への支援

比国政府機関（DOE、NEA）との提案する技術、システム導入の協議を通じて、比国の配電事業が直面している技術的・政策的課題を明らかにする。これに対して、東京電力グループおよび日本の先進的な技術・事例を紹介して、配電系統の信頼度向上およ

び再エネの大量導入に関する課題を明らかにした上で、必要に応じた制度構築への提言およびスマートグリッド技術の円滑な導入のためのロードマップ作成などの支援を行う。

これらの活動を通じて、比国配電事業者の技術力向上、人材育成を図り、我が国の電力関係者への一層の信頼感を醸成する。

第3章 本事業の概要

3.1. 本事業の目的及び目標

3.1.1. 本事業の目的

提案するビジネスは、信頼度の高い電力供給システムを構築するために、比国に適した「信頼度の高い配電系統運用技術」導入の提案を行うものである。したがって現地の電力設備の状況、ニーズとともに、電気事業に関する規制・制度も踏まえて、政府関係者、配電事業者のキーパーソンに提案技術の優位性、システム導入の効果を理解して頂き、将来的には比国全土への普及を目指すことを目的とする。

事業実施に際しては、比国が抱える開発課題の現状を的確に把握すると共に、事業を通じて期待される効果について十分に検討する。また、事業終了後には、提案するビジネスの普及展開が円滑に進むよう必要なコネクション形成・情報収集を行うことに留意する。

3.1.2. 本事業の達成目標（対象国・地域・都市の開発課題への貢献）

本事業の達成目標は、提案する「信頼度の高い配電系統運用技術」が、比国の電気事業が直面している課題（電力供給信頼度の向上、再エネ大量導入への対応、スマートグリッド関連技術導入への対応）に対して極めて有効な解決策となることについて、比国政府、配電事業者のキーパーソンに理解して頂くことである。

特に、現在対応が急務な電力供給信頼度向上については、本邦技術適用により事故発生時の停電区間の最小化、事故点探査の早期化により平均停電時間の大幅な縮減につながることを理解していただくことを目標とする。また、導入システムにて、配電系統の運用状況を把握することが可能になるため、今後再エネが大量に導入される場合においても適切な配電系統運用を実現できることを理解していただく。またスマートグリッド技術導入に関する議論を行い、将来の本邦技術普及に向けた理解活動を実施する。

3.1.3. 本事業の達成目標（ビジネス面）

本事業のビジネス面での達成目標は二点ある。第一に、パイロットプロジェクトや技術セミナーなどを通じて本事業の提案技術である日本の配電系統運用の具体的な優位性を理解してもらうことである。第二に、本邦技術への関心をもつ EC を NEA とも協議の上抽出し、普及対象のターゲットを明確化することである。当面２～３程度の EC（具体的には PENELCO、BATELEC I）を抽出し、先方のニーズを踏まえた上で将来的な導入可能性について協議を行う。

3.2. 本事業の実施内容

「信頼度の高い配電系統運用技術」は、まずは NEA と協議の上、財務および技術的基盤の高い EC の中核都市を対象に導入を推進する。これにより、比国都市部の配電系統構成、運用方式､ニーズなどを踏まえた標準的なシステムを構築する(パイロットプロジェクト)。これをパイロットモデルとして、比国内の他配電事業者（EC および民間配電会社）に対して、NEA の協力を得て横展開を図る。なお、本事業にてセミナーを通じた比国内の多くの配電事業者へのアプローチを図る。

3.2.1. 実施スケジュール

実施スケジュールを図 3.1 に示す。

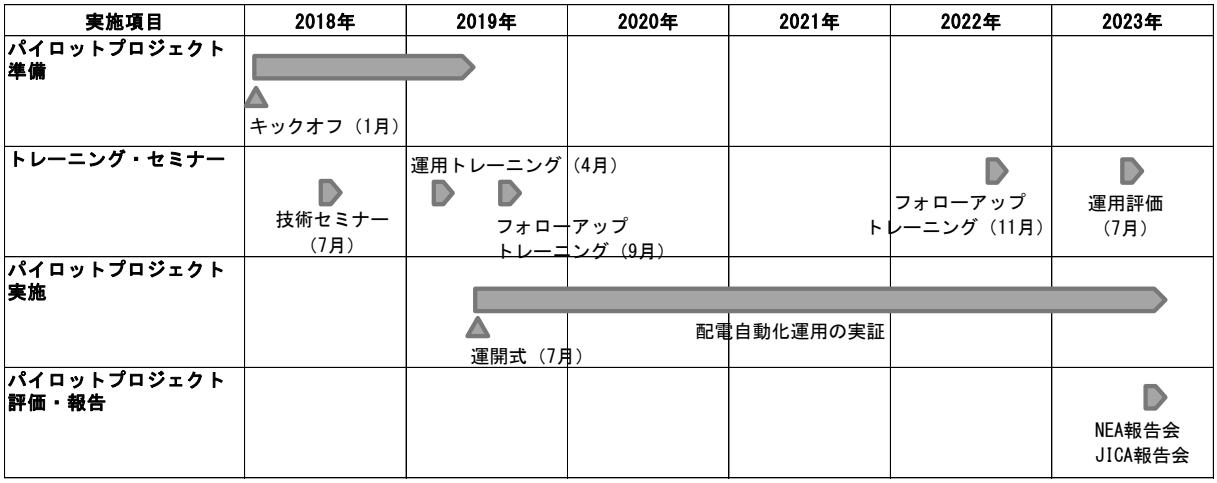


図 3.1　スケジュール（提案法人作成）

当初、2020 年 2 月に事業完了となる計画であったが、2019 年 7 月に運用開始後、現地の設置環境の影響により、開閉器の改良が必要となった。一方、現地では 2020 年 1 月にバタンガス州にあるタール火山の噴火が発生、2019 年に新型コロナウイルス（COVID-19）が発見され、2020 年以降、世界的に感染が拡大した。これら事象の発生に伴い現地活動を継続することが困難な状況となったことから、最終的に配電自動化システムの実証期間を 2023 年 10 月まで延長し、本事業は 2023 年 11 月に完了することとなった。

3.2.2. 実施体制

（１） 現地実施期間の情報

NEA：DOE 監督の下部組織で、EC を通じて地方電化を推進することを目的に設立された。

BATELEC II：バタンガス州リパ市の地方電化協同組合。

（２）本事業の実施体制図を下記に示す。

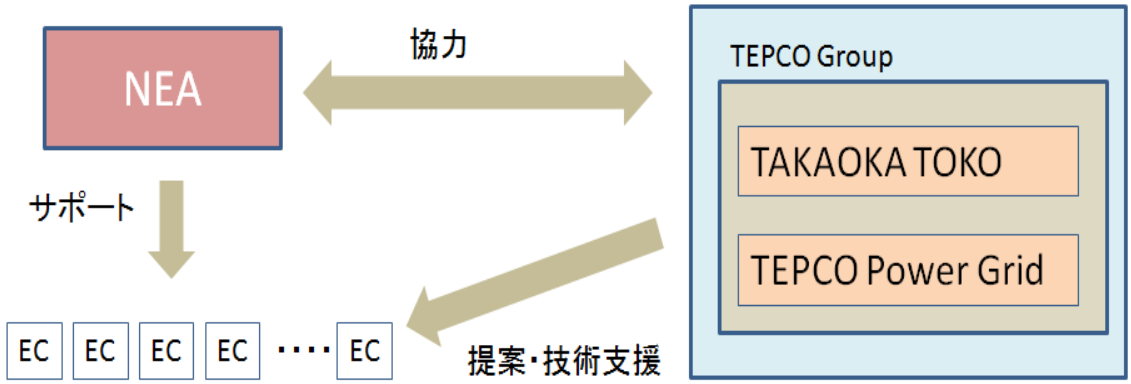


図 3.2　事業実施体制図（NEA との協議に基づき提案法人作成）

（３）業務従事者の役割

東京電力 PG は、配電系統の計画、運用、制御、自動化システムに関する知見を有しており、フィリピンにおける配電系統の信頼度向上のための方策検討、現地および本邦での調査、セミナー対応を行う。また、日本の電気事業者の立場から、比国向け配電自動化システム導入の支援も行う。

東光高岳は、現地調査、技術検討、パイロットプロジェクトに使用するシステム・機器製品の開発・製作、およびセミナー対応を行う。

3.2.3. 実施内容

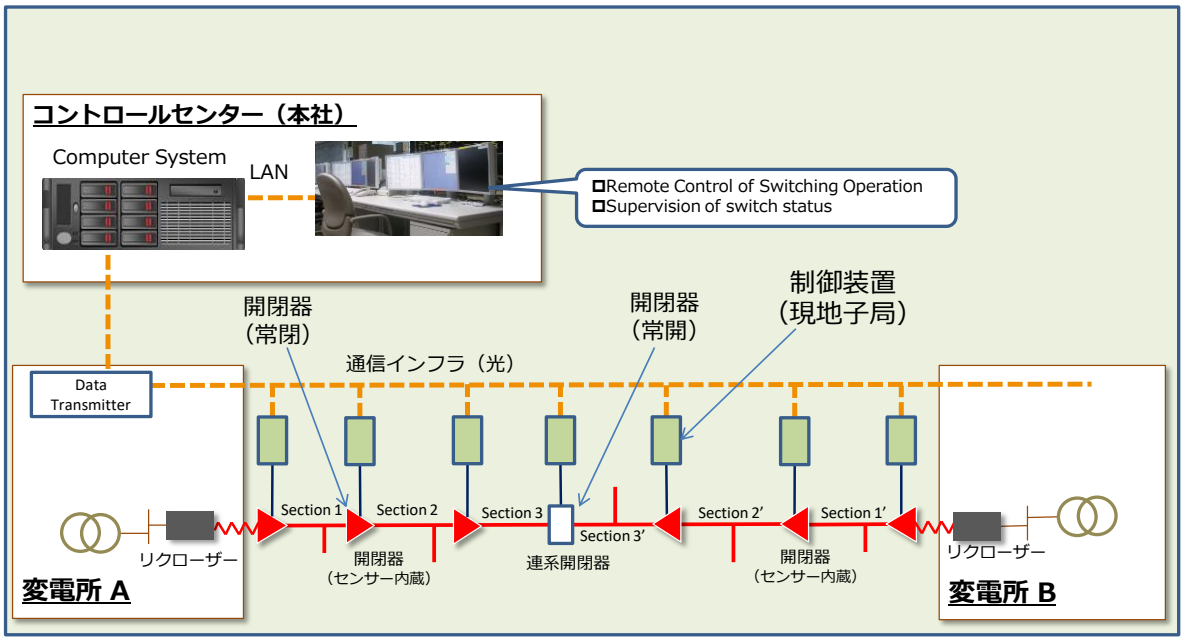
本事業の実施項目（タスク）概要を以下に示す。

タスク 実施すべき 項目		活動計画と実績										実施内容	目標
		第1回 渡航	第2回 渡航	第3回 渡航	第4回 渡航	第5回 渡航	第6回 渡航	第7回 渡航	本邦 活動	第8回 渡航	第9回 渡航	第10回 渡航	
市場性/現地ニーズの確認	計画	●	●	●	●	●	●	●	●	●			・ECの技術レベル、将来構想の把握 ・ターゲットECの抽出 ・各ECでの課題、ニーズ確認 ・各ECとのシステム導入可能性協議	・ターゲットECのニーズを踏まえたシステム導入方針に資する情報収集が出来ていること。 ・さらなる普及につながる、複数ECとの関係が強化されていること。
	実績													
理解促進	計画			●				●	●	●	●		・日本の系統運用技術、本導入技術の優位性理解活動 ・セミナーの開催 ・パイロットプロジェクトの実施 ・本邦活動における各所視察、日本における運用システム説明等	・NEA、複数EC関係者の、日本の配電系統運用技術及びフィリピンへの適合性への理解が深まっており、本事業終了後も継続的な協力体制が構築されていること。
	実績													
技術指導	計画			●	●	●	●	●	●	●			・セミナーの開催 ・他ECとの技術協議 ・パイロットプロジェクト設備の運用方針確認及び運用指導、運用に関する意見交換	・個別技術協議実施のためのコネクションが形成されていること。 ・運用方法を習得してもらい、持続的な運用が可能となっていること。
	実績													
公示調達の流れ・手続き方法の確認	計画	●	●										・ECとの協議による、手続き方法、一般的なスケジュールの確認 ・CAPEX承認手続きについて確認	・普及活動に必要な条件確認ができていること。
	実績													
パイロットプロジェクト準備及び実施	計画	●	●		●	●	●						・NEA、ECとの技術協議 ・設備調査 ・プロジェクトサイトの確定 ・実施のための手続き、工事手配要請 ・パイロット設備構築 ・工事方法指導 ・工事進捗確認	・パイロットプロジェクトが円滑に行われ、現地適合性が確認できていること。 ・実際の公示、運用の実施により導入効果が理解されているとともに、今後の普及に向けた改善点が明確になっていること。
	実績													
運用方針の策定 データ収集方針の決定	計画							●	●	●			・パイロットプロジェクト実施に際しての評価方法の策定 ・データ収集方針の策定 ・実運用による供給信頼度向上（停電時間短縮）効果のデータ収集 ・1需要あたりの年平均停電時間（SAIDI）を重要指標として管理	・実際の効果を把握するには数年レベルの実行が必要であるため、継続的に収集を行う基盤を作る。 ・多くのターゲットECに効果を確認していただくことでさらなる普及の活動に役立てる。
	実績													
導入展開、アクションプランの協議	計画										●		・活動の総括、今後のビジネス展開等の協力体制を含めた意見交換	・NEA支援のもと、ターゲットECへの展開計画を策定。
	実績													

図 3-3　本事業の実施項目（提案法人作成）

NEA との協議の結果、パイロットプロジェクトは、NEA から提案があった BATELEC II のサイトで実施されることとなった。パイロットプロジェクトでは、実際に電力供給している配電線路 2 回線を活用し、提案している配電自動化システムの実証を行う。

パイロットプロジェクト　システム構成図



実施者	役割
東光高岳	機器・システムの提供
東京電力 PG	系統計画・設置工事・制御運用の支援
NEA/BATELEC II	機器・システムの設置工事（通信設備含む）

図 3-4　パイロットプロジェクトのシステム構成図
（NEA、BATELEC II との協議に基づき提案法人作成）

【パイロットプロジェクト（パイロットプロジェクト）概要】

- 目的：BATELEC II の実配電線路に配電自動化システムを導入して運用し、信頼度指標である SAIDI の改善効果を確認する。
- 期間：当初 2018 年 9 月～2020 年 2 月、最終 2018 年 9 月～2023 年 11 月
- 導入内容：配電系統運用システム（一式）、開閉器（7 台）、制御器（7 台）
- 強み：・配電線事故時および計画停電時（工事停電時）の停電範囲極小化
  ・故障捜査の効率化（迅速な事故復旧対応）
  ・遠方監視制御による負荷切替機能（別電源からの電力供給）
  ・故障除去後の遠隔切替による効率化
  ・開閉器内蔵の電圧、電流センサーによる配電系統のリアルタイム監視

■ 評価概要：対象配電線路での事故発生後、システムの活用により事故復旧（停電範囲極小化）していくことを確認し、システム導入前の想定 SAIDI と導入後の想定 SAIDI を比較して効果を示す。なお、システム導入後の SAIDI についても事前に試算しておき、実際の SAIDI の妥当性を評価する。

第4章 本事業の実施結果

4.1. 第 1 回現地活動（2018 年 1 月 16 日～18 日）

4.1.1. 渡航目的

第 1 回現地活動では、以下項目を目的に活動を実施した。

- 事業開始のための NEA 総裁とのキックオフミーティング（事業計画の説明）。
- NEA 技術部門との協議（事業計画の説明、実施内容の確認、パイロットプロジェクト実施先の確定、テクニカルセミナー実施概要説明）。
- パイロットプロジェクト実施に向けた情報収集・技術協議・確認・調整。

4.1.2. 実施工程

第 1 回現地活動では、以下工程で活動を実施した。

1. 2018 年 1 月 16 日（火） NEA 技術部門とのキックオフミーティング
   於：NEA 技術部門会議室
2. 2018 年 1 月 18 日（木） NEA 総裁とのキックオフミーティング 於：NEA 総裁室
3. 2018 年 1 月 18 日（木） NEA 技術部門との実務協議 於：NEA 技術部門会議室
4. 2018 円 1 月 18 日（木） NEA 再エネ局での情報共有 於：NEA 再エネ局会議室
5. 2018 年 1 月 18 日（木） NETI 局長（研修部門）とのセミナー開催の事前協議
   於：NETI 局長室
6. 2018 年 1 月 17 日（水） BATELEC II とのキックオフミーティング
   於：BATELEC II General Manager 室
7. 2018 年 1 月 17 日（水）～18 日（木）
   BATELEC II とのパイロットプロジェクト技術協議 於：BATELEC II 会議室

4.1.3. 第 1 回現地活動の成果

- NEA 技術部門との協議により、事業計画について理解をいただき、今後の NEA からのサポート体制が明確になった。
- NEA 総裁への事業計画説明により、NEA から全面的な協力を得られることになった。

- 第 3 回現地渡航で予定している技術セミナーについて株式会社東光高岳側の考え方（開催概要情報、参加招聘先、費用負担範囲）を伝えることができた。
- 株式会社東光高岳から提示した条件に基づき、パイロットプロジェクトを実施する BATELEC II 以外で、提案技術の普及を目指すターゲットについて、システム導入のポテンシャルや財務状況、アクセス面を考慮した候補 EC を提案してもらうこととした。
- パイロットプロジェクトを実施する EC として BATELEC II を選定し、NEA から同社に公式に通知をしてもらうこととした。
- パイロットプロジェクトを実施する BATELEC II との技術協議により、配電自動化システム導入に資する技術情報や、設置建屋、既設設備などの情報を得た。

4.1.4. 第 1 回現地活動における課題

第 1 回現地活動で、以下の課題を認識した。

- 技術セミナー開催に際しては、可能な限り多くの EC の技術者に参加いただく必要がある。各 EC が技術セミナーに参加するための旅費は各社負担になるため、NEA 主催で EC 関係者が集合する他イベントと組み合わせて技術セミナーを開催することを提案することとした。
- パイロットプロジェクト対象となる実配電線路で予定されている事前増強工事について、当初計画よりも 3 カ月程度遅れていることが判明している。ただし、工事発注手続きは基本的に完了しているとのことで、パイロット設備を導入するまでには、工事が完了させることは可能であるとの見解を得た。引き続き、関連工事の進捗状況確認を実施する。
- 配電自動化システム導入に関し、既設設備との取り合いにおいて通信方式の見直しが必要となることが判明し、入手情報をもとに情報の取り合いについて提案することとした。

4.2. 第 2 回現地活動（2018 年 3 月 6 日～8 日）

4.2.1. 渡航目的

第 2 回現地活動では、以下項目を目的に活動を実施した。

- 次回現地活動で計画している技術セミナーの実施案を提示し、具体的な準備を開始する。全 EC を対象とし、南北ルソンの EC とビサヤ、ミンダナオ島の EC の 2 つのグループに分けて実施する。
- 対象技術の普及ターゲットとなる EC へのアプローチ方法に関する協議を NEA と

実施し、今後の EC への企画提案活動の方針を検討する。

- EC における設備投資の実施決定プロセスや決定後の資機材発注・調達方法に関する情報を収集する。
  - パイロットプロジェクト実施に向けた配電自動化システムの機能理解、および情報収集・技術協議を行う。また、パイロットプロジェクト向けの対象配電線の構成方法の提案を行い、導入予定の配電機器の具体的な配置方法の確認を行う。
  - ADB 訪問により、提案技術普及のための支援スキームに関する情報収集・確認を行う。

4.2.2. 実施工程

第 2 回現地活動では、以下工程で活動を実施した。

1. 2018 年 3 月 6 日（火） NEA 技術部門とのミーティング①
   於：NEA 技術部門会議室
2. 2018 年 3 月 6 日（火） 在比日本国大使館でのミーティング　於：大使館
3. 2018 年 3 月 7 日（水） ADB での情報収集ミーティング　於：ADB 会議室
4. 2018 円 3 月 8 日（木） NEA 技術部門とのミーティング②於：NEA 技術部門会議室
   2018 年 3 月 8 日（木） ローカルパートナー企業 TPI 社とのミーティング於：TPI 会議室
6. 2018 年 3 月 6 日（火）～7 日（水） BATELEC II とのミーティング
   於：BATELEC II 会議室

4.2.3. 第 2 回現地活動の成果

- NEA でのミーティングにより、株式会社東光高岳から提示した技術セミナー概要について了解を得た。今後日程調整、セミナー開催の詳細決定（日本・フィリピン双方のプレゼン内容、時間割、運営方式）の準備に入ることとした。この際、NEA 側からの協力を得ることで合意した。
- NEA でのミーティングにより、傘下の各 EC における設備投資決定のプロセスをヒアリングし、NEA 等上位組織の関与も含めて、計画立案から設備投資実施までのフロー概要を理解した。
- 対象技術普及のターゲットとする EC へのアプローチ方法について NEA から指示を受け、対象 EC、実施スケジュールなどを合意した。EC 訪問する際に、NEA 副総裁に要請文書を送付し調整開始することを決定した。
- ADB とのミーティングにより、EC も受益者として ADB 支援の対象になりうることを確認できた。今後の技術普及活動で必要に応じ、ADB との新規コネクションの活用も視野に入れ対応することとした。ADB においても配電システム運用に関する技術に関心を持っている様子で、適宜情報交換を実施する。

- 本事業での現地協力企業である TPI 社と情報共有ミーティングを実施。第 1 回、2 回を通して、比国関係機関からの支援状況も良好であることを確認し、今後の対応計画、パイロットプロジェクト推進計画等を共有した。引き続き比国内での確実なフォローアップ（NEA や EC 対応）を要請した。
- 在比日本国大使館の商務官に対して、本事業実施の概要について説明し、日本のインフラ輸出事業につながるものと認識いただき、活動についてご理解をいただいた。
- BATELEC II に対して、パイロットプロジェクト実施に向けた配電自動化システム全体の理解向上、およびパイロットプロジェクト対象箇所の情報収集、技術協議、確認、調整を実施し、以下を確認した。
  - 課題懸案について議論を行い、一部情報の取得に時間を要するもの以外について確認が行えた。
  - 前回課題としていた配電自動化システム導入箇所の工事状況について、
    ・Antipolo 変電所およびコントロールセンター建屋の工事は 2018 年 4 月完了
    ・配電線フィーダ増強の工事は 2018 年 8 月完了することが確認できた。
  - 前回課題としていた通信方式の見直しに伴い、通信インタフェースの確認を行い、具体的なインタフェース仕様および通信プロトコルについて確認ができた。
- パイロットプロジェクト対象の配電線路への開閉器導入による線路分割箇所の提案を行い、具体的な分割箇所の確認ができた。

4.2.4. 第 2 回現地活動における課題

第 2 回現地活動で、以下の課題を認識した。

- 技術セミナーを EC の技術者向けの同国の公式イベント（技術者ライセンス更新手続きに必要なポイント加算の対象）にするため、日本側のプレゼンター（提示技術をプレゼンする）は、フィリピン側規制当局から承認を得る必要があることから早急にプレゼンターを決定する必要がある
- NEA から技術セミナーで招聘する EC を 4 地域にわけたいとの要望を受け、地域毎のセミナー開催を打診されているが、当初計画と異なるため早急に対応方針を策定する必要がある。
- 対象となる工事個所について配電自動化システムインストール前に完了するという情報を得たが、BATELEC II 工事担当者より、場合により遅れが発生することがあるとの個別意見があったため、渡航時だけでなく、随時メールなどで工事進捗状況を確認する必要がある。

- 第 1 回渡航時取得情報から、ヒューズ接続した枝線における事故停電も多いことから、配電自動化システムであるが、枝線のヒューズ断をシステム上通知する仕組みを提案できないか検討する必要がある。
- 対象変電所の通信方式が明確になったことで当初構成では実現できないことから、配電自動化システム全体の構成を見直し、提案する必要がある。
  具体的には、変電所設置予定の「中継器」の見直しが必要となる。
- 配電自動化デモンストレーションにおいて、短絡事故時における配電線リクローザーないし変電所 CB トリップではなく、開閉器トリップができないかという要望をいただいた。しかし、今回の開閉器はトリップ機能がないことなどから将来機能として今後の提案とすることとした。

4.3. 第 3 回現地活動（2018 年 6 月 5 日～7 日、6 月 13 日～14 日、7 月 16 日～20 日）

4.3.1. 渡航目的

第 3 回現地活動では、以下項目を目的に活動を実施した。

- 本事業における第 1 回目の技術セミナー開催に向けた NEA との打合せ、ならびにセミナーの開催を実施し、提案技術の有効性を理解していただく。
- 技術セミナーにて、フィリピン NEA から、電力供給の信頼性や今後の配電システムアップグレードの方向性に関する情報収集を実施する。
- 技術セミナーに参集する各 EC とのコネクション形成を図り、今後の普及策検討のための情報を得る。
- パイロットプロジェクトの対象 EC である BATELEC II において、現地での機器試験の実施ならびに機器据え付け箇所の確認を行う。また、パイロットプロジェクトの MOU について、締結へ向けた調整を行う。
- JICA フィリピン事務所に対して技術セミナーの内容説明を行うとともに、NEA の ORED から協力を求められている離島マイクログリッドにおける EMS 導入について、FS やプロジェクト実施に関する資金手当ての可能性について相談を行う。
- ADB 訪問により、提案技術普及のための支援スキームに関する情報収集・確認を行う。

4.3.2. 実施工程

第 3 回現地活動では、以下工程で活動を実施した。

1. 2018 年 6 月 5 日（火）～7 日（木）　技術セミナー開催協議　於：NEA 会議室
2. 2018 年 6 月 6 日（水）　事業進捗の情報共有等　於：JICA フィリピン事務所
3. 2018 年 6 月 13 日（水）～14 日（木）　パイロットプロジェクト実施協議

於：BATELEC II

4. 2018 年 7 月 16 日（月）　技術セミナー開催協議　於：NEA 会議室
5. 2018 年 7 月 16 日（月）　離島マイクログリッド協議　於：NEA 会議室
6. 2018 年 7 月 16 日（月）　事業進捗の情報共有等　於：JICA フィリピン事務所
7. 2018 年 7 月 16 日（月）,18 日（水）　パイロットプロジェクト実施協議
於：BATELEC II
8. 2018 年 7 月 17 日（火）～18 日（水）　技術セミナー開催
於：NEA セミナールーム　対象：南北ルソン島の EC
9. 2018 年 7 月 19 日（木）～20 日（金）　技術セミナー開催
於：NEA セミナールーム　対象：ビサヤ、ミンダナオの EC
10. 2018 年 7 月 20 日（金）　ADB での情報収集ミーティング　　於：ADB 会議室

※技術セミナーの協議のために 2 回の渡航を実施。また、技術的課題の協議のため、メンバーを変えて別途 BATELEC II を訪問。

4.3.3. 第 3 回現地活動の成果

第 3 回現地活動では、技術セミナーの実施等により以下の成果を得た。

- NEA との協議により、株式会社東光高岳から提示した技術セミナーの運営方針（全 EC を対象として、２つのグループに分けて実施）について了解を得た。セミナー実施までの詳細決定（日本・フィリピン双方のプレゼン内容、時間割、運営方式）について、NEA 側からの協力を得ることで合意した。
- 2018 年 7 月 17 日から 20 日まで開催した技術セミナー（2 つのグループに分けて実施）には 121 の EC の内、92 の EC が出席し、日本側からは、配電自動化システムはじめとし、大型変圧器の予防保全技術等の紹介を行うとともに、配電自動化システムのデモも実演して、同技術が信頼度向上に有効なこと、また、将来的な分散型電源の大量導入に向けた基盤インフラとなることについての理解促進を図った。
- また、同セミナーでは各 EC からのアンケートによる情報収集も行っており、本事業後のビジネス展開にも活用していく。
- パイロットプロジェクト対象箇所の現地試験・情報収集・技術協議・調整を実施し、以下が確認できた。
  - -BATELEC II 本社の新設変電所の SCADA ルーム内の機器の配置が予定と変わっていたため、配置の変更に対応するための採寸調査を実施。
  - -Padre Garcia 変電所通信環境について、通信自体は確立したものの取得データが異常なままであったが、パイロットプロジェクトの実施までに配電線事故時に配電系統を停止するリクローザー（配電線事故時の保護装置として使用され

る開閉装置）を別メーカーのものに更新することが判明したため、新規品の据付が終わったあとの９月渡航で再試験を実施する。

- JICA フィリピン事務所との打ち合わせにおいて、比国における無償資金によるプロジェクトの実施は難しくなりつつあるものの、離島マイクログリッドは個別の話となる可能性はあり、補正予算のテーマに取り上げられれば採否に有利にはたらくとの助言をいただく。
- ADB（Asian Development Bank、アジア開発銀行）とのミーティングにより、NEA による申請だけではなく、EC も受益者として ADB 支援の対象になりうることを確認できた。今後の技術普及活動で必要に応じ、ADB へのアプローチについて検討していくこととした。なお、ADB への提案にあたっては、配電自動化という切り口だけでは訴求性が弱いことから、革新的技術を絡めることが肝要との助言をもらった。

4.3.4. 第 3 回現地活動における課題

第 3 回渡航にて、以下の課題を認識した。

- 技術セミナーにおける EC からの参加者とのやりとりにおいて、負荷が一定地域にまとまっている日本と負荷が点在している EC との設備形成上の違いが認識された。したがって、比国に対する技術導入においては、先方の負荷の状況やそれに基づく設備の実態をより詳細に把握したうえで、日本の技術を最適化された方法で導入できるよう検討、提案していく必要がある。
- 供給信頼度の向上に加えて、RPS 法に基づく再生可能エネルギーの導入など、EC が対応すべき複数の課題をより詳しく把握して、日本が提供できる最適な技術の組み合わせも検討する必要がある。
- BATELEC II におけるパイロットプロジェクトの MOU については、NEA 上層部の承認待ちであるが、誰がいつまでに何をやるかのリストを作成し、機材輸出までに責任分解を明確にしていく必要がある。

4.4. 第 4 回現地活動（2018 年 9 月 12 日～14 日）

4.4.1. 渡航目的

第４回現地活動では、以下項目を目的に活動を実施した。

- 2018 年 7 月の技術セミナーで得られた情報を基に、提案技術の普及ターゲットとなる EC を抽出したことから、NEA 技術部へ今後の普及展開、さらなる情報収集に向けた相談を行う。

- 2018 年 7 月の技術セミナーで、参加者に対してプレゼン内容（供給信頼度向上策、ロス低減策、スマートメーター機能等）の理解度を測定するための試験を実施し、結果と分析内容を NEA の研修部に報告する。
- パイロットプロジェクトの対象 EC である BATELEC II において、現地での機器試験の実施ならびに機器据え付け箇所の確認、配電自動化システム導入後の停電実績の取得方法についての協議、多分割多連系の可能性に向けた確認・協議、事故点評定データの取得に向けた確認・協議を行う。加えて、パイロットプロジェクトの役割分担と責任分界について相互で確認を行い、BATELEC II 会長と業務主任者による議事録への署名にて合意に至る。
- 在フィリピン日本大使館に対して、NEA の ORED（Office of Renewable Energy Development, NEA、NEA 再生可能エネルギー開発室）から協力を求められている離島マイクログリッドにおける EMS 導入について、pre-FS 調査など今後の対応について説明するとともに、プロジェクト実施に関する資金手当ての可能性について情報を得る。

4.4.2. 実施工程

第 4 回現地活動では、以下工程で活動を実施した。

1. 2018 年 9 月 12 日（水）　事業進捗の情報共有等　於：JICA フィリピン事務所
2. 2018 年 9 月 12 日（水）～13 日（木）
   パイロットプロジェクト実施協議　　於：BATELEC II
3. 2018 年 9 月 14 日（金）　普及ターゲット EC への今後の展開相談
   於：NEA 会議室
4. 2018 年 9 月 14 日（金）　前回技術セミナーでのテスト結果・分析報告
   於：NEA 会議室
5. 2018 年 9 月 14 日（金）　離島マイクログリッド情報共有
   於：在フィリピン日本大使館

4.4.3. 第 4 回現地活動の成果

- 提案技術の普及ターゲットとなる EC への今後の普及展開、情報収集方法について、NEA 技術部に相談を行い、EC の予算など今後の活動に資する情報が得られたことから、取得情報に基づき、今後ターゲットとし更なる情報収集を進めていく EC を厳選していく。
- 7 月の技術セミナーで参加者に対して実施した試験の結果と分析内容を NEA の NETI に報告した。分析結果から参加者の弱点分野が見えたことから、今後 NETI が注力すべき課題を情報提供することができた。

- パイロットプロジェクト対象箇所の現地試験・情報収集・技術協議・調整を実施し、新設中の Antipolo 変電所に導入された変電リレーにて、配電自動化システムに取得したい情報が未設定であることが判明したことから、先方にロジック等の設定をお願いした。
- パイロットプロジェクト実施当事者である BATELEC II と東光高岳との責任分界等を明確化した工程表と MOU（案）について、機材輸出までに BATELEC II GM、業務主任者が MOU への署名を行うことで双方が了承した。
- 在フィリピン日本大使館との離島マイクログリッドに関する情報共有において、現地での簡易調査の必要性を説明するとともに、現地調査を行うとしても費用等の観点から、他の案件に絡めた出張にならざるを得ないことをお伝えした。先方からは今後の進め方やスケジュールなどが確定したら教えてほしいとの要望があった。

4.4.4. 第 4 回現地活動における課題

第 4 回現地活動にて、以下の課題を認識した。

- 機材輸出の荷受の課題を解消するために、どのような適切な手続きが可能かを引き続き探るとともに、海外引越のような別送扱いの輸送ができないか探っていく。
- パイロットプロジェクトにおける BATELEC II 側の進捗遅れが判明したことから、配電自動化システムの運用開始後の停電実績の取得、実証試験の評価に必要な時間が確保できるよう、機材準備、輸出、据え付けの工程を効率的に詰められるか調整を図る必要がある。
- EC の予算など今後の活動に資する情報が NEA から得られたことから、取得情報に基づき、今後ターゲットとし更なる情報収集を進めていく EC を厳選していく。

4.5. 第 5 回現地活動（2018 年 11 月 7 日～8 日、12 月 6 日～7 日）

4.5.1. 渡航目的

第 5 回現地活動では、以下項目を目的に活動を実施した。

- BATELEC II において、Antipolo 変電所における機器の動作検証を行うとともに、同社がリプレースのため Padre Garcia 変電所に新たに導入した機器に対する通信試験を行う。
- パイロットプロジェクトの役割分担と責任分界について相互で確認する MOU について、BATELEC II 取締役会への付議、承認を進めるよう依頼する。
- 普及ターゲット EC や政府機関の NEA、DOE を訪問して、システムの機能やメリットを説明し有用性をアピールするとともに、低廉な費用で同システムを導入できる配電自動化システムの共用化を受容可能か等の確認を行う。

4.5.2. 実施工程

第5回現地活動では、以下工程で活動を実施した。

1. 2018年11月7日（水）～8日（木）
   パイロットプロジェクト実施協議　於：BATELEC II
2. 2018年12月4日（火）　普及ターゲットECへの売り込み　於：PENELCO
3. 2018年12月5日（水）
   普及ターゲットECへの今後の展開相談　於：エネルギー省（DOE）
   普及ターゲットECへの今後の展開相談、パイロットプロジェクト実施協議
   於：BATELEC II
4. 2018年12月6日（木）　普及ターゲットECへの今後の展開相談
   於：国家電化庁（NEA）
5. 2018年12月7日（金）　事業進捗の情報共有等　於：JICAフィリピン事務所
   普及ターゲットECへの売り込み　　於：PELCO II

※事業終了後の展開を協議するため、独立した複数の機関を訪問し協議を実施。

4.5.3. 第5回現地活動の成果

- BATELEC IIにおいて、現地試験、情報収集、技術協議、調整を実施。Antipolo変電所に導入された変電リレーの通信試験は完了。なお、パイロットシステムに取得したい情報が未設定であることから、先方に必要ファイルの設定をお願いした。Padre Garcia変電所に新設されるリクローザーの工事が完了していなかったことから、通信試験は次回へ持ち越しとなった。
- BATELEC IIと東光高岳との責任分界等を明確化した工程表とMOU（案）について、12月のBATELEC II取締役会で承認を取得してもらうことを依頼し、先方の了解を得た。
- 提案技術の普及ターゲットとなるECを訪問し、システムの有用性について理解を深めてもらうとともに、低廉に同システムを利用できる共用化の考えについて、セキュリティが確保されること等、いくつかの課題がクリアできれば受容できることを確認した。

4.5.4. 第5回現地活動における課題

第5回現地活動にて、以下の課題を認識した。

- Antipolo変電所の機器設定において、開閉器状態、リレー動作、計測情報（電圧、電流）等の必要な情報が設定されていないことから、必要な情報を文書としてまと

めて、BATELEC II 経由で機器代理店に提示し、設定可能なものとできないものの回答とアドレスマップの提示を要求する必要がある。Padre Garcia 変電所のリクローザーにおいて、必要な情報がインストールされていないことが分かり、調査を実施できなかったことから、後日、必要な設定ファイルを入手し、調整後、先方にインストールを依頼する必要がある。また、設定が必要な情報を同様に文書としてまとめて、BATELEC II 経由で代理店に提示する必要がある。必要な文書は作成し、BATELEC II に送付済。

- 配電自動化システムの普及に向けて、今後の活動に資する情報が EC や NEA から得られたことから、取得情報に基づき、次回渡航時に今回渡航で得られた課題や宿題に対する回答を準備し、次回渡航時に更なる理解促進活動を行い、普及につなげていく。

4.6. 第 6 回現地活動（2019 年 2 月 6 日～7 日、3 月 5 日～8 日）

4.6.1. 渡航目的

第 6 回現地活動では、以下項目を目的に活動を実施した。

- パイロットプロジェクトの対象 EC である BATELEC II において、パイロットプロジェクトの導入変電所となる Antipolo と Padre Garcia の両変電所の機器に対する動作検証を前回に引き続いて実施する。
- パイロットプロジェクトにおいて、BATELEC II が敷設する光ファイバ工事の進捗状況を確認するとともに、配電自動化システムを導入するにあたっての運用トレーニングの日程等について調整する。
- 普及ターゲット EC や政府機関の NEA、DOE と面会し、配電自動化システムの機能やメリットを説明し有用性をアピールするとともに、低廉な費用で同システムを導入できるシステム共用化を受容可能か等の確認を行う。また、複数 EC が集まるリージョン会議において提案技術を紹介する機会を得るため、リージョン会議の議長らを訪問し同会議への参加を依頼する。

4.6.2. 実施工程

第 6 回現地活動では、以下工程で活動を実施した。

1. 2019 年 2 月 6 日（水）～7 日（木）　パイロットプロジェクト実施協議
   於：BATELEC II、PESIN、PPI
2. 2019 年 3 月 5 日（火）　DOE、NEA、BATELEC II 三社会合　於：DOE
3. 2019 年 3 月 5 日（火）　パイロットプロジェクト実施協議　於：Bonifacio Global City
4. 2019 年 3 月 6 日（水）　普及ターゲット EC への今後の展開相談　於：PENELCO

5. 2019 年 3 月 7 日（木）　配電自動化システム等の今後の展開相談　於：ADB
6. 2019 年 3 月 7 日（木）
   パイロットプロジェクト実施協議ならびに普及ターゲット EC への今後の展開相談
   於：BATELEC II
7. 2019 年 3 月 8 日（金）　普及ターゲット EC への今後の展開相談　於：BATELEC I

※事業完了後の展開協議のために渡航。また、技術的課題の協議のため、メンバーを変えて別途 BATELEC II を訪問。

4.6.3. 第 6 回現地活動の成果

- BATELEC II での動作検証では、Antipolo 変電所の遮断器については、デモ機を用いた通信設定、接続、同期、データ授受試験を行い、ほぼ全ての試験項目において問題がないことを確認した。Padre Garcia 変電所のリクローザーに対する試験についてもデモ機を用いて、IEC61850 での通信設定、接続、同期試験は成功した。なお、データ授受がうまくいかなかったことから、今後の検証の中で、機械的なデータ授受が期待できない場合は、手動で変電 SCADA 画面の情報を取得し運用する方針を適用することとした。
- BATELEC II が敷設する光ファイバ工事の日程について確認するとともに、運用トレーニングを 2019 年 4 月 8 日（月）の週で実施することで合意した。
- 提案技術の普及ターゲットとなる EC(PENELCO、BATELEC I)を訪問し、配電自動化システムの有用性について理解を深めてもらうとともに、低廉に同システムを利用できる共用化の考えや、セキュリティの確保の仕方等についても説明。なお、複数 EC が集まるリージョン会議の議長 EC となる BATETEC I との協議を通じてにおいて提案技術を紹介する機会が得られることとなった。

4.6.4. 第 6 回現地活動における課題

第 6 回現地活動にて、以下の課題を認識した。

- 動作検証が完了した Antipolo 変電所については、BATELEC II に現地施設されているリクローザーの保護リレーの整定を今回検証した内容でセッティングいただくように依頼した。データ授受試験がうまくいかなかった Padre Garcia 変電所のリクローザーについては、今後、機械的なデータ授受が期待できない場合は、人手で変電 SCADA 画面の情報を取得し運用する方針を適用することとする。
- 配電自動化システムの普及に向けて、複数 EC が集まるリージョン会議において提案技術を紹介する機会が得られることとなったことから、次回渡航時に複数 EC に対して提案技術の紹介を行い、より多くの EC に対する理解促進、普及につなげていく。

4.7. 第 7 回現地活動（2019 年 4 月 8 日～12 日、5 月 26 日～31 日）

4.7.1. 渡航目的

第 7 回現地活動では、以下項目を目的に活動を実施した。

- BATELEC II において、配電自動化システムを導入するにあたっての運用トレーニングを実施する。
- パイロットプロジェクトの対象変電所である Antipolo 変電所にシステムのサーバを据え付け、もう一方の Padre Garcia 変電所に通信機器収容盤を据え付ける。
- パイロットプロジェクト向けに BATELEC II が敷設する光ファイバ工事の進捗状況を確認するとともに設備の運用開始式調整を行う。また、訪日研修の調整を行う。
- 複数 EC が参加するリージョン会議に参加し、配電自動化システムの機能やメリットを説明し有用性をアピールするとともに、低廉な費用で同システムを導入できる配電自動化システムの共用化を受容可能か等の確認を行う。

4.7.2. 実施工程

第 7 回現地活動では、以下工程で活動を実施した。

1. 2019 年 4 月 8 日（月）～12 日（金）　パイロットプロジェクト運用トレーニングの実施
   於：BATELEC II
2. 2019 年 5 月 26 日（日）～29 日（水）
   パイロットプロジェクトサーバ据付工事、BATELEC II とのパイロットプロジェクト運開式、訪日研修の調整
   於：BATELEC II
3. 2019 年 5 月 28 日（火）　MERALCO への配電自動化システム普及活動
   於：MERALCO 本社
4. 2019 年 5 月 29 日（水）　JICA フィリピン事務所とのパイロットプロジェクト運開式、訪日研修の調整
   於：JICA フィリピン事務所
5. 2019 年 5 月 30 日（木）　DOE とのパイロットプロジェクト運開式、訪日研修の調整　於：DOE
6. 2019 年 5 月 30 日（木）　リージョン IV 会議における普及活動　於：Quezon City
7. 2019 年 5 月 31 日（金）　リージョン III 会議における普及活動　於：San Fernando

※配電自動化システムの設置とそれに伴う運用研修をメンバー変えて別途実施。

4.7.3. 第 7 回現地活動の成果

- 配電自動化システムを導入するにあたっての運用トレーニングを実施し、研修対象者のコアメンバー3 名に対して集中的かつ繰り返しによるデモ実演を行い、短期間での指導者育成を実施した。
- パイロットプロジェクトの対象 EC である BATELEC II において、パイロットプロジェクトの対象変電所である Antipolo 変電所に自動化システムサーバを据え付け、Padre Garcia 変電所に通信機器収容盤の据え付けを完了した。また、7 台の制御器が全く取り付けられていなかったことから、東光高岳立ち会いの下、1 台の取り付けを BATELEC II に実施させ、他の 6 台も速やかに取り付けるよう促した。
- BATELEC II が布設する光ファイバ工事が、同社自らの施工から外部発注に変更となり、7 月 15 日の週に敷設が完了するとの情報を得た。また、運開式の開催日を 7 月 2 日で確定した。
- リージョン IV と III の会合に出席し、配電自動化システムの有用性について理解を深めてもらうとともに、低廉に同システムを利用できる共用化の考えや、セキュリティの確保の仕方等についても説明し、今後のシステム開発に参考となる情報を取得した。

4.7.4. 第 7 回現地活動における課題

第 7 回現地活動にて、以下の課題を認識した。

- BATELEC II 側の工事進捗が思うように進まず当初計画よりも運開に遅れが出ていることから、実証データが多く採録されるであろう雨季に本格的に入る前に運開にもっていくため、BATELEC II に対する進捗確認をより細かく行い、速やかな運開につなげる必要がある。
- リージョン会議に参加していた BATELEC II 以外の EC は、パイロットプロジェクトの実証結果に対する関心が非常に高く、彼らはその結果をもって配電自動化システムの導入を判断したいという考えを持っていることが分かった。よって、同システムの普及に向けては、BATELEC II における配電自動化システムを速やかに運開し、実証データを収集、その実証結果をもって他の電力会社へシステムの有効性を訴求する必要がある。

4.8. 第 8 回現地活動（2019 年 7 月 1 日～3 日、9 月 9 日～14 日、9 月 30 日～10 月 2 日、10 月 9 日～14 日）

4.8.1. 渡航目的

第８回現地活動では、以下項目を目的に活動を実施した。

- BATELEC II において、パイロットプロジェクトの運開式を実施し、本プロジェクトの内容と意義を比国内や日本において発信する。
- BATELEC II において、先方が施工する光ファイバならびに電柱移設の工事完了を受けての運用開始試験を行い、システムの運用を開始する。
- 運開後１ヶ月ほど経過した時期を踏まえて、運用トレーニングのフォローアップを実施するとともに、実証の評価に必要な運用データの取得ならびにデータ内容の確認を行う。
- NEA へパイロットプロジェクトの進捗状況を報告し今後の取組スケジュールを協議するとともに、同庁にて現在、全 EC の停電情報を集約するシステムの導入を検討しているとの情報を踏まえ、今後配電自動化システムの展開に絡めて同システムの構築に関与できるかを探るための情報収集を行う。

4.8.2. 実施工程

第８回現地活動では、以下工程で活動を実施した。

1. 2019 年 7 月 1 日（月）～7 月 2 日（火）　パイロットプロジェクト運開式の実施　於：BATELEC II
   2019 年 7 月 3 日（水）NEA へのパイロットプロジェクト進捗報告ならびに今後の展開のための情報収集　於：NEA
2. 2019 年 7 月 30 日（火）～8 月 3 日（土）
   配電自動化システムの運用開始試験の実施　於：BATELEC II
3. 2019 年 9 月 9 日（月）～9 月 14 日（土）
   配電自動化システム運用開始後のフォローアップならびに不具合調査　於：BATELEC II
4. 2019 年 9 月 12 日（木）　NEA における DMS 導入に関する情報収集　　於：NEA
5. 2019 年 9 月 30（月）～10 月 2 日（水）
   配電自動化システム不具合発生に対する開閉器取外し協力依頼　於：BATELEC II
6. 2019 年 10 月 9 日（水）～10 月 14 日（日）
   配電自動化システム不具合対応（開閉器取外し、解体調査）　於：BATELEC II

※運用開始式とその後に発生した不具合原因調査のため複数回渡航。

4.8.3. 第 8 回現地活動の成果

- BATELEC II で実施した運用開始式には、DOE、NEA、JICA フィリピン事務所にも出席いただき、運開式の様子と本プロジェクトの意義等についてフィリピン全国紙で発信された。

- BATELEC II が布設する光ファイバ工事が完了するとともに、パイロットプロジェクト対象の配電線路における停電を伴う電柱移設工事が完了したことから、現地にて運用開始試験を実施し、8 月 2 日からシステム運用を開始した。


図 4.1　運用開始に向けた試験

- BATELEC II における配電自動化システムの運用が開始し、運開後 1 カ月ほどが経過した段階を踏まえ、4 月に実施した運用トレーニングのフォローを行った。また、実証評価を行うために必要なシステムに蓄積された運用データを取得するとともに特異なデータに対する事象把握ならびに現場での対応内容を聴取した。さらに、配電線路の停電を伴わずに区間の切り替えを行えるループ切替の実施方法について研修を実施した。
- NEA が検討している停電情報を集約するシステムの導入については、現在システムの要求仕様に関する TOR を作成中であるとの情報を入手し、こちらから提案したシステムストラクチャーに対して NEA として受容可能であるとの回答を得た。

4.8.4. 第 8 回現地活動における課題

第 8 回現地活動にて、以下の課題を認識した。

- 運用開始後、開閉器において制御器からの開放指令に対する不応動が発生したことから、2019 年 10 月 10 日の送電系統側の計画停電に合わせて、開閉器と制御器を BATELEC II の作業員に取り外してもらい、調査を実施。結果、開閉器に原因があると考えられることから、改修方法を検討することとした。

4.9.　本邦受入実施

4.9.1. 本邦受入活動の目的

本プロジェクト対象国の政府関係者等を日本に招聘し、スマートグリッド関連技術のプレゼンによる紹介と東京電力 PG の電力供給設備や東光高岳の工場見学を通じて、提案し

た製品・技術に対する理解を深めてもらい、日本の電力セクターで実施されている幅広いプラクティスを学んでいただくとともに、対象国が抱える課題やニーズの解決に本邦の技術や運用が有効であることを認識していただく。技術紹介のプレゼン資料は参考資料として別途添付。

4.9.2. 活動工程

日付	受入活動
2019 年 7 月 8 日（月）	オリエンテーション
	JICA 表敬訪問
2019 年 7 月 9 日（火）	東電 PG・本社　会社概要、配電高度化
	東電 PG・本社　スマートメーター（AMI）
	東電 PG・研修センター　間接活線工法デモ
2019 年 7 月 10 日（水）	東電 PG・銀座制御所・永代橋変電所　配電自動化システム、地下変電所
	東電 PG・銀座制御所　ラップアップ
2019 年 7 月 11 日（木）	東光高岳・蓮田工場　ショールーム（EMS、自動開閉器・制御器）製造ライン（柱上自動開閉器）
	東光高岳・小山工場　配電自動化システム・デモ、大型変圧器・システム・断路器製造ライン
2019 年 7 月 12 日（金）	東光高岳・本社　EV 急速充電器、EMS、変電 SCADA、タップ切替器付柱上変圧器
	東光高岳・本社　ラップアップ

4.9.3. 参加メンバー

DOE、NEA、BATELEC II

4.9.4. 本邦受入結果

比国最大規模の EC でありパイロットプロジェクト実施機関である BATELEC II は、東京電力 PG にて実運用している配電自動化システムの現場を見学したことにより、同社に導入されたシステムの運用、操作のみならず、現場作業員が実施する事故点探査の運用や安全確保などについても理解を深めていた。この成果に基づき、同社の実態により即した運用方法を自主的に確立することが期待できる。

また、最新の機器技術や電力事業におけるプラクティスなどに対して高い関心が示されたことから、本活動が目指した目標は十分に達成できたと考えられる。

参加者の所属がエネルギー政策立案省庁、規制官庁、配電事業者という様々な立場からの参加であったことから、研修項目が電力機器技術から電力事業者としての経営方針や最新のプラクティスなど広範かつ多岐に渡った内容であったにも関わらず、参加者は自身の感じる問題意識からほぼすべての研修項目に対して高い関心を示した。積極的な質問も多く

出ていたことから、本邦研修で新たな知見を習得しようとする前向きかつ旺盛な姿勢が感じられた。特に新技術に対する関心は非常に高く、理解度も十分にあり、それぞれの立場で先端技術をどのように導入することが可能か、導入することによってどのような経営改善、供給信頼度の向上につなげることが可能かといった考えを常に持ち研修に臨んでいたことから、本邦研修の内容は参加者にとって非常に充実した、有用な内容であったと認識できる。

4.10. 第 9 回現地活動（2022 年 4 月 11 日～14 日、6 月 19 日～24 日、11 月 16 日～20 日、2023 年 4 月 2 日～5 日、5 月 7 日～12 日、7 月 9 日～15 日）

4.10.1. 渡航目的

第 9 回現地活動では、以下項目を目的に活動を実施した。

- 第 8 回渡航以降、タール火山噴火、COVID-19 感染拡大に伴うフィリピン政府渡航禁止のため現地渡航が叶わぬ状況であったが、2022 年 2 月にフィリピンにおける入国制限が緩和され、現地での機材調査改修作業が可能となった。BATELEC II のコントロールルームに設置してあるシステムの環境設定変更ならびに通信ログの収集解析、2022 年 1 月に BATELEC II の協力により柱上の LBS に取り付けた振動計に保存してあるデータ回収等の不具合調査を実施する。加えて、BATELEC II に不具合調査の状況、ならびに改修方針を説明し、理解と引き続きの協力依頼を行う。
- 不具合調査・改修作業として、東光高岳小山工場で正常稼働しているクライアント PC を BATELEC II のコントロールルームに設置し、不具合の発生状況を調査する。また、改修したサーバーシステム用ドライバーの更新作業を実施する。
- 改修した LBS の再設置工事に伴い、施工に関する注意喚起を行い不具合の再発防止を図る。また、改修したクライアント PC を BATELEC II のコントロールルームに再設置し、配電自動化運用を再開する。運用再開にあたり、配電自動化運用に関するトレーニングを実施し、誤操作等による人身災害、設備事故の防止を図る。
- 運用開始後、約 4 ヶ月経過した時期を踏まえて、BATELEC II の GM に不具合改修完了を報告し、NEA 立会いのもと実施する稼働確認の事前協議を行う。併せて、本事業実施に伴い NEA、JICA フィリピン事務所、東光高岳の 3 者で締結した MOM の更新、事業報告会に関する事前協議を行う。
- NEA、BATELEC II、JICA フィリピン事務所の立会いのもと、納入機材の稼働確認を行う。また、NEA、JICA フィリピン事務所、東光高岳の 3 者 MOM の更新、JICA フィリピン事務所から NEA への機材譲渡、報告会に関する協議を行う。

- 運用開始後、約 7 カ月経過した時期を踏まえて、実証評価に向け、平常時および配電線事故時において取得された実証データ確認、BATELEC II に運用定着状況のヒアリングを行う。また、パイロットプロジェクトの配電系統上にある負荷（電気の需給地点）の変動を調査するため徒歩巡視する。
- 本事業で得られる成果を活用した付加価値の創造を検討する。

4.10.2. 実施工程

第 9 回現地活動では、以下工程で活動を実施した。

1. 2022 年 4 月 11 日（月）～4 月 14 日（木）
   パイロットプロジェクトシステムおよび機材の不具合調査　於：BATELEC II
2. 2022 年 6 月 19 日（日）～6 月 24 日（金）
   パイロットプロジェクトシステムの不具合調査　於：BATELEC II
3. 2022 年 11 月 16 日（水）～11 月 20 日（日）
   運用トレーニングならびにパイロットプロジェクトシステム運用再開　於：BATELEC II
4. 2023 年 1 月 23 日（月）～1 月 26 日（木）
   LBS 設置ならびにパイロットプロジェクトシステム全面再開　於：BATELEC II
5. 2023 年 4 月 2 日（日）～4 月 5 日（木）
   不具合改修完了報告ならびに稼働確認の事前協議　於：BATELEC II
6. 2023 年 5 月 7 日（日）～5 月 12 日（金）
   納入機材の稼働確認　於：BATELEC II
7. 2023 年 7 月 9 日（日）～7 月 15 日（土）
   取得された実証データ確認、運用定着状況のヒアリング　於：BATELEC II

※設備不具合調査ならびに改修とその後の設備譲渡に関する渡航を複数回にわたり実施。また、2023 年 1 月の稼働再開後、BATELEC II が実運用のデータを取得し、配電自動化の効果の評価につなげた。

4.10.3. 第 9 回現地活動の成果

- 2022 年 2 月にフィリピンにおける入国制限が緩和され、現地作業にてコントロールルームの設置環境の確認、LBS に設置した振動計データの取得等、不具合調査ならびに改修作業を実施することが可能となった。現地調査を踏まえ、継続して日本国内での調査および改修作業を実施した。

図 4.2　機材調査

- 2022 年 11 月、日本国内で改修作業を終えた機材をフィリピン現地に輸送し、東京電力 PG、東光高岳立会いのもと BATELEC II による施工により設置を完了した。開閉器設置時には施工に関する注意喚起を行い、施工品質向上に努めた。
- 運用開始前に BATELEC II へ運用トレーニング（事故時および平常時の配電線切替操作、ループ運用等）を再実施し、人身災害や設備事故等が発生することなく運用を再開することができた。一方で、現地お客さま都合による工事停電範囲縮小に伴い、Antipolo 配電線のみ工事を実施することになり、部分的な運用再開となった。
- 2023 年 1 月、Padre Garcia 配電線への開閉器設置工事を実施し、2 配電線全面での運用を再開した。
- 2023 年 5 月、NEA、BATELEC II、JICA フィリピン事務所が立会いのもと、システム、制御器、LBS 他、納入機材の正常稼働を確認いただき NEA から稼働確認書を受領した。
- NEA、JICA フィリピン事務所、東光高岳の 3 者 MOM の更新に関する協議を行い、修正手続きを進めることとなった。
- JICA フィリピン事務所より、JICA から NEA への機材譲渡に関する協議を実施いただき、後日、NEA と JICA との間で手続き書類の取り交わしを行うこととなった。
- 本事業の報告会に関する協議を行い、NEA から 8 月上旬に開催される NEA WEEK の中で報告することを提案いただき、関係者と調整を進めていくこととなった。

  図 4.15　NEA、BATELEC II、JICA 立会いのもと実施した稼働確認
- 2023 年 7 月、実証評価に向けて、BATELEC II で採録した平常時および事故時のデータを共有いただき、システム導入後に発生した事象の詳細を確認した。また、BATELEC II へのヒアリングを通じて、運用定着状況の確認およびトレーニングメニュー等のニーズの把握を行った。

- パイロットプロジェクトの２配電線について、配電系統上にある負荷（電気の需給地点）の変動や電気の使用実態を確認するため、両配電線を徒歩で調査し、ヒアリング等によって得られたデータと整合してその実態を調査した。それによると、システムから得られた電流値パターン（日負荷曲線）と実際の電気の使われ方が酷似（住宅地特有、工業商業地特有のパターン等）していたことから、本データの信憑性を裏付けることが出来た。
  また沿道に下図のような開発中の住宅地が点在していることを把握したため、後日の BATELEC II ヒアリングにおいて本計画が設備構築へ織り込み済みであることも確認した。よって今後開発の進捗に伴って負荷（電流値）が増加することとなるため、本パイロットシステムによるモニタリングも可能となった。

4.10.4. 第 9 回現地活動における課題

第 9 回現地活動にて、以下の課題を認識した。

- MOM の修正手続きにおいて、NEA からの指示により BATELEC II から NEA へレターを発出した。今後、MOM の修正に向けて、NEA 内で手続きを実施いただくことになった。ただし、その後 JICA を含めて NEA と協議をした結果、MOM の修正は行わず、締結時のままで事業継続は可能との合意を得た。
- 機材譲渡に向けて、NEA で技術部門を統括する副長官から納入機材の動作確認書への署名をいただいた。

4.11. 全体総括（NEA 報告会）

4.11.1. NEA 報告会の目的

提案法人、ならびに実証で実際に設備を運用した BATELECII から本事業のカウンターパートである NEA に対し、活動の総括として、本事業概要、実証評価、本事業後のビジネス展開計画等について報告を行った。報告会資料は、参考資料として別途添付。

4.11.2. NEA 報告会の実施概要

日時：2023 年 10 月 4 日 10:30 から 12:00 まで
場所：オンラインで実施
出席者：NEA
　　BATELECII
アジェンダ：

・Opening Ceremony
・Opening Message
・Reporting of the JICA Project
・Comments/Feedbacks

4.11.3. NEA 報告会の成果

- NEA のキーパーソンに供給信頼度の改善（実証配電線における平常時および配電線事故時の SAIDI）を中心に実証評価について報告し、提案する配電自動化システム・運用技術を導入したことによる効果をご理解いただいた。
- 本事業後のビジネス展開計画についても関心を示していただき、今後、NEA、EC に対して提案を実施していく。

第5章 本事業の総括（実施結果に対する評価）

5.1. 本事業の成果（対象国・地域・都市への貢献）

「企業機密情報につき非公表」

5.2. 本事業の成果（ビジネス面）、及び残課題とその解決方針

「企業機密情報につき非公表」

5.2.1. 本事業の成果（ビジネス面）

「企業機密情報につき非公表」

5.2.2. 課題と解決方針

「企業機密情報につき非公表」

第6章 本事業実施後のビジネス展開の計画

6.1. ビジネスの目的及び目標

6.1.1. ビジネスを通じて期待される成果（対象国・地域・都市の社会・経済開発への貢献）

「企業機密情報につき非公表」

6.1.2. ビジネスを通じて期待される成果（ビジネス面）

「企業機密情報につき非公表」

6.2. ビジネス展開計画

6.2.1. ビジネスの概要

「企業機密情報につき非公表」

6.2.2. ビジネスのターゲット

「企業機密情報につき非公表」

6.2.3. ビジネスの実施体制

「企業機密情報につき非公表」

6.2.4. ビジネス展開のスケジュール

「企業機密情報につき非公表」

6.2.5. ビジネス展開後の展望

「企業機密情報につき非公表」

6.2.6. 投資計画及び資金計画

「企業機密情報につき非公表」

6.2.7. 競合の状況

「企業機密情報につき非公表」

6.2.8. ビジネス展開上の課題と解決方針

「企業機密情報につき非公表」

6.2.9. ビジネス展開に際し想定されるリスクとその対応策

「企業機密情報につき非公表」

6.3. ODA 事業との連携可能性

6.3.1. 連携事業の必要性

「企業機密情報につき非公表」

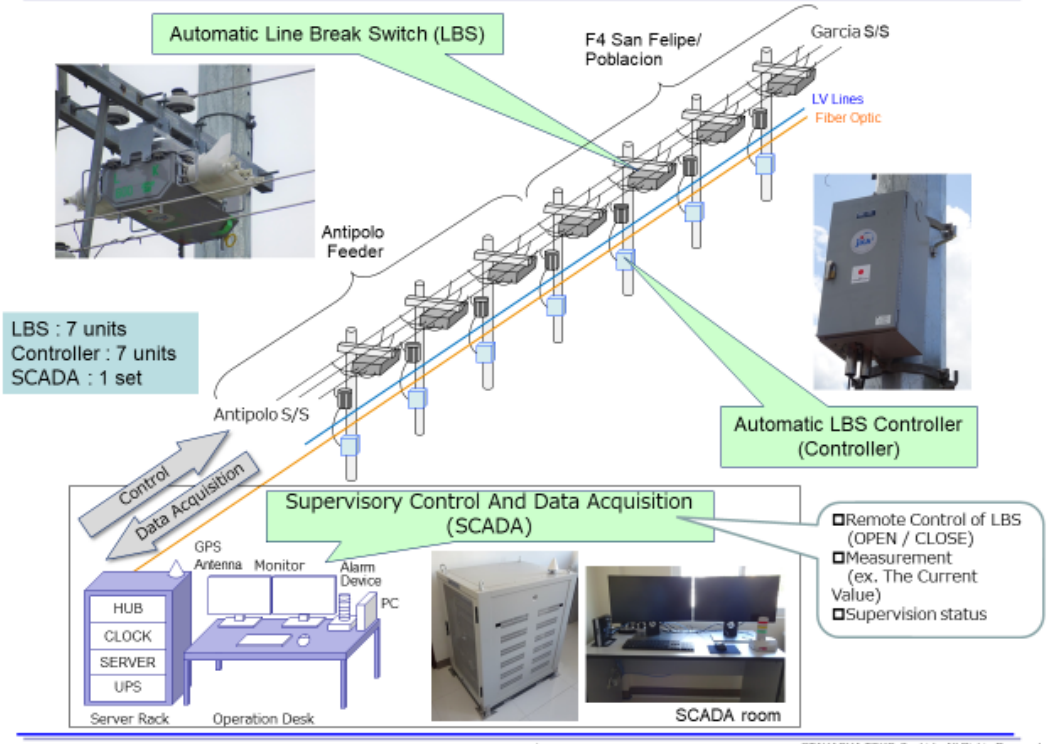
6.3.2. 想定される事業スキーム

「企業機密情報につき非公表」

● 添付１　本邦受入時のプレゼン資料

➢ DAS 紹介

System Configuration of Pilot Project



Symbol List on SCADA

Name (Symbol)	Symbol	Color	Status
Transformer		White (fixed color)	
Recloser(FCB)		Gray	
Substation Inside Line		White (fixed color)	
Distribution Line Segment		Gray	Initial status or controller communication error
		Red	Energized
		Green	Outage
		Yellow	Accidental power outage
Tie LBS		Gray	Initial state or controller communication error
		Red	Close
		Green	Open
		Yellow	Operation prohibited
Section LBS		Gray	Initial state or controller communication error
		Red	Close
		Green	Open
		Yellow	Operation prohibited

① Y lock

② "Manual" switch or "OFF" breaker symbols.

③ Lockout

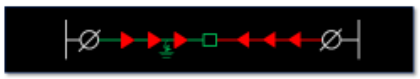
Demonstration Cases

①Fault (in 2nd section)
②Planned Outage (in 2nd section)

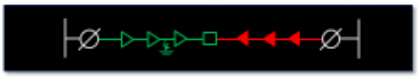
Demonstration case 1 - Fault (in 2nd section)

- Original operation system configuration

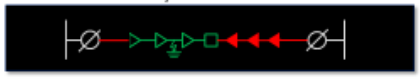
- Fault occurs / No voltage (FCB trips)



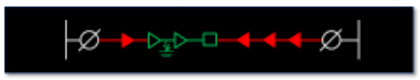
- LBS1-3 : Detect no voltage / Automatically open



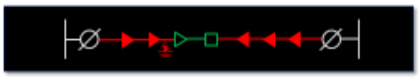
- FCB : Automatically recloses



- LBS1 : Automatically closes / 1st section is energized

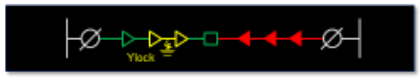


- LBS2 : Automatically closes

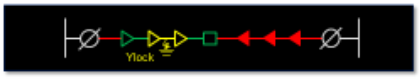


- Fault remains / No voltage (FCB re-trips)

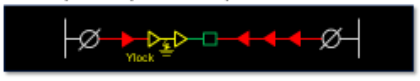
- LBS1,2 : Detect no voltage / Automatically open
- 2nd section : Identified as the fault section
- LBS2 : Lockout (Ylock)



- FCB : Automatically recloses again



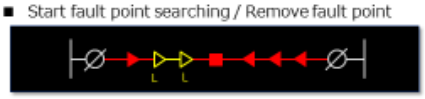
- LBS1 : Automatically closes
  LBS2 (Lockout) : Remain open



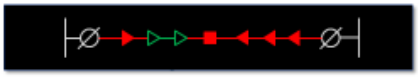
Demonstration case 1 - Fault (in 2nd section)

- Healthy sections are energized from another feeder by SCADA operation

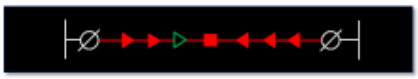
- Safety measures of 2nd section
  - Field crew sets LBS2,3 to lockout
    -> LBS can not be closed during lockout
- Start fault point searching / Remove fault point



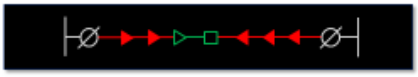
- Finishing of fault point removal
  -> Field crew unsets LBS2,3 to lockout
  -> LBS can be closed
  -> SCADA operator unsets faulted segment setting



- Operation to restore power in 2nd section from SCADA



- Operation to stop the power in 3rd section from SCADA

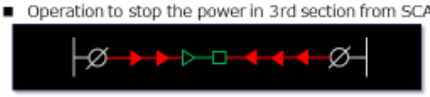


- Operation to restore the power in 3rd section from SCADA
  -> Restoration of the original system

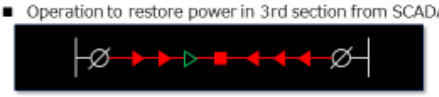
Demonstration case 2 – Planned Outage (in 2nd section)

- Original operation system configuration

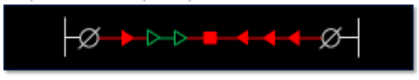
- Operation to stop the power in 3rd section from SCADA



- Operation to restore power in 3rd section from SCADA

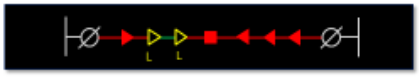


- Operation to stop the power in 2nd section from SCADA

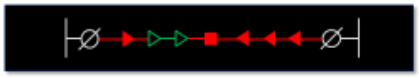


- Safety measures of 2nd section
  Field crew sets LBS2,3 lockout
  ->LBS can not be closed during lockout

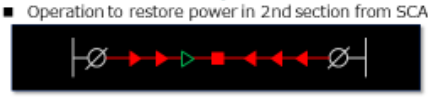
  -> Start work



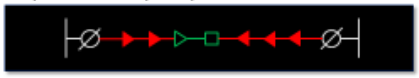
- Finishing of work
  -> Field crew unsets LBS2,3 lockout
  -> LBS can be closed



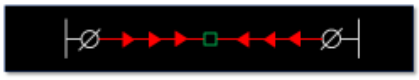
- Operation to restore power in 2nd section from SCADA



- Operation to stop the power in 3rd section from SCADA



- Operation to restore the power in 3rd section from SCADA
  -> Restoration of the original system



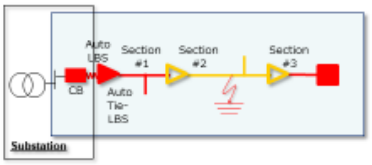
Introduction of Distribution Automation System (DAS)

◆DAS for Minimizing Outage Impact

When Fault occurs, Fault Section in the Distribution Network can be automatically localized by using DAS. Accordingly, other Healthy Sections in the same Network can be restored within a few minutes.

System Configuration

Distribution Automation System (DAS)



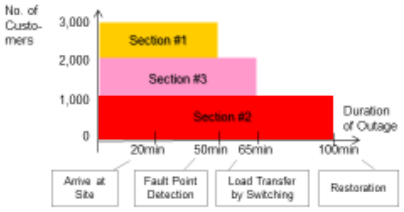
Automatic Line Break Switch (LBS)

Automatic LBS Controller (Controller)

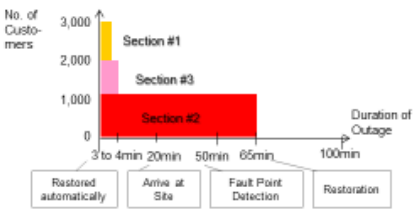
[Line Status] Red : energized section
Yellow: faulted section

[LBS Status] hollowed symbol : open
filled symbol : closed

Before DAS



After DAS



➢ EMS（Energy Management System）紹介

Energy Management System (EMS)

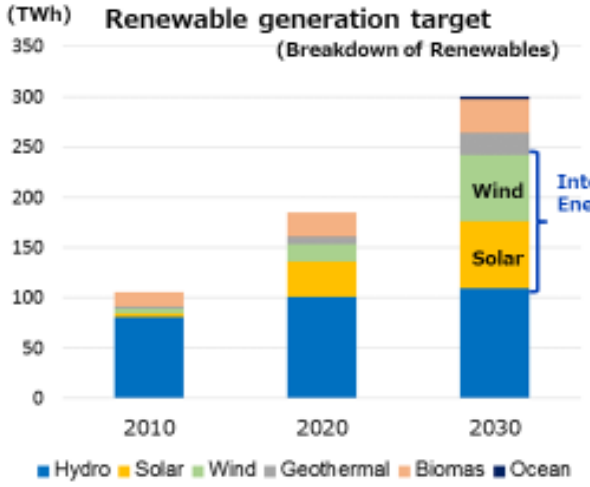
Deployment of Hybrid Renewable Energy System in Nii-jima Islands

TAKAOKA TOKO Co.,Ltd.
TEPCO Power Grid, Inc.
July 12th ,2019

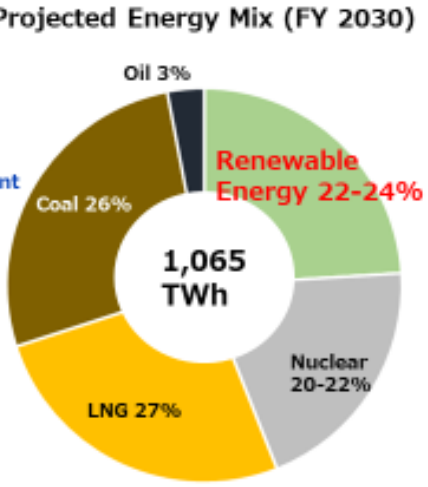
24%

Project Background

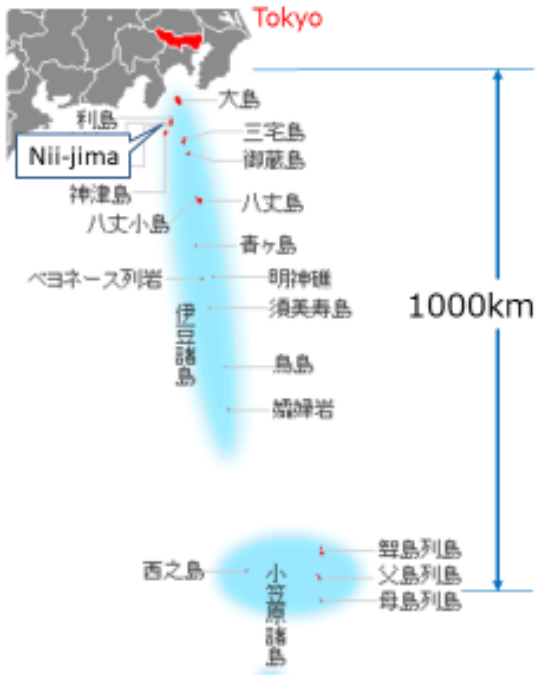
- ✓ Japan has developed renewable generations by introducing FIT scheme, and aims to supply 22-24% of total power demand by RE in 2030.
- ✓ Niijima project intends to develop key technologies to realize future power system in Japan



Source: Japan's energy plan, METI



Remote Islands Area in TEPCO PG



- ✓ TEPCO PG is responsible for power generation & distribution in these islands

General Information	
No. of islands	11
Service Area	340.3㎢
Population	27,800
Electricity Sales	165.6GWh
	(0.06% in total demand)
Generation	54,270 kW (48 units)
Diesel	50,920 kW (46 sites)
Geothermal	3,300 kW (1 site)
Hydro	50 kW (1 site)

Source: Let's go to the Japanese Island, website

TEPCO PG Nii-jima Office

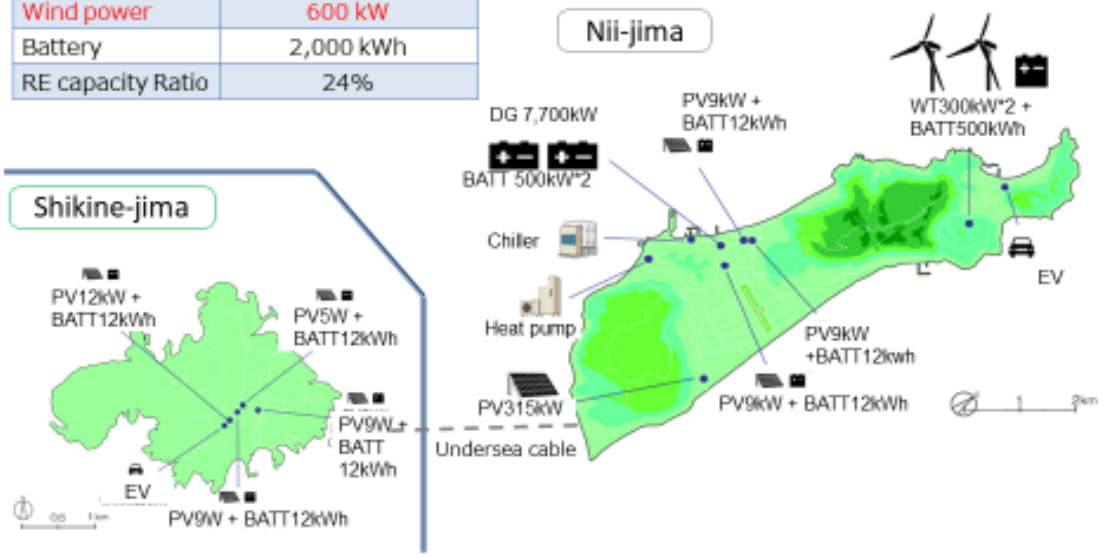
Generation facilities

Gensets (DG)	7,700 kW 2,500 x 1, 2,000 x 1, 1,200 x 1, 1,000 x 2
Solar PV	500 kW
Wind power	600 kW
Battery	2,000 kWh
RE capacity Ratio	24%

System loads

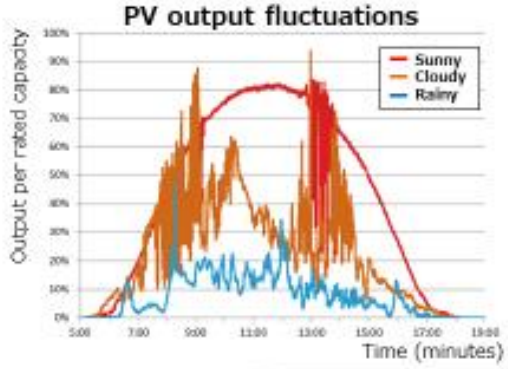
As of 2017

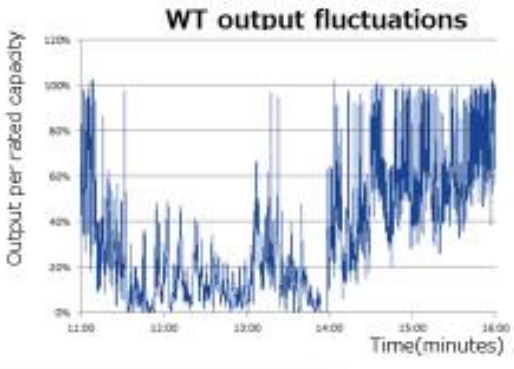
Peak load	4,400 kW
No. of households	1,350
No. of population	2,720

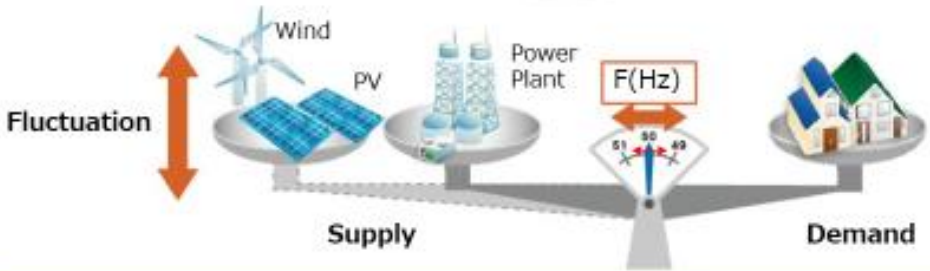


Technical Challenges arisen from RE

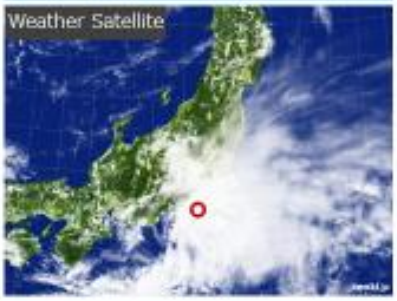
✓ Power grid operation becomes more complicated by intermittent RE



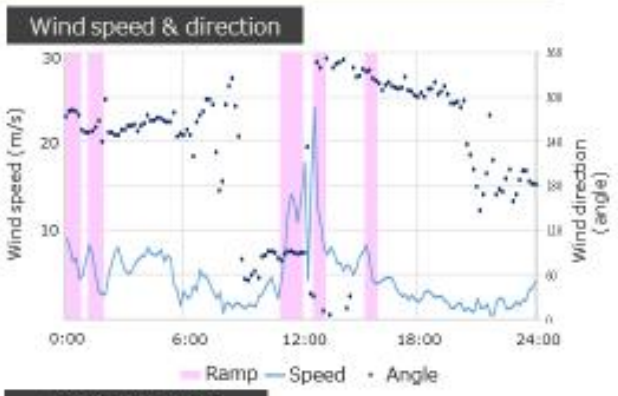


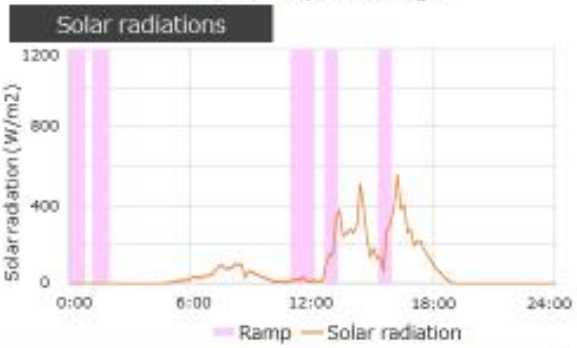


Ramp Variability of Wind & Solar



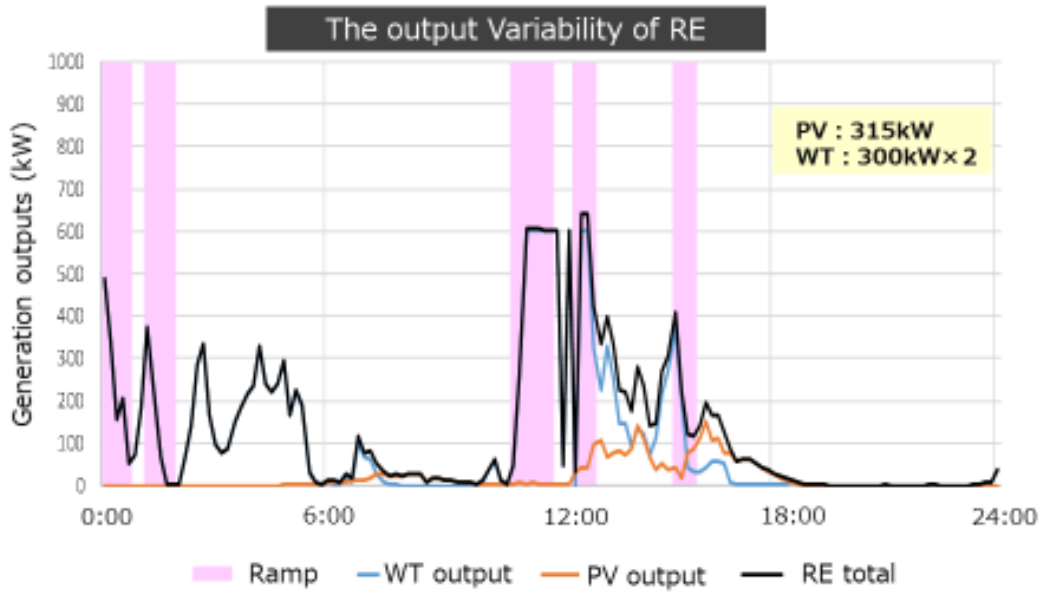
Low pressure passed over Niijima Island around 12am, and the wind speed sharply got strong.





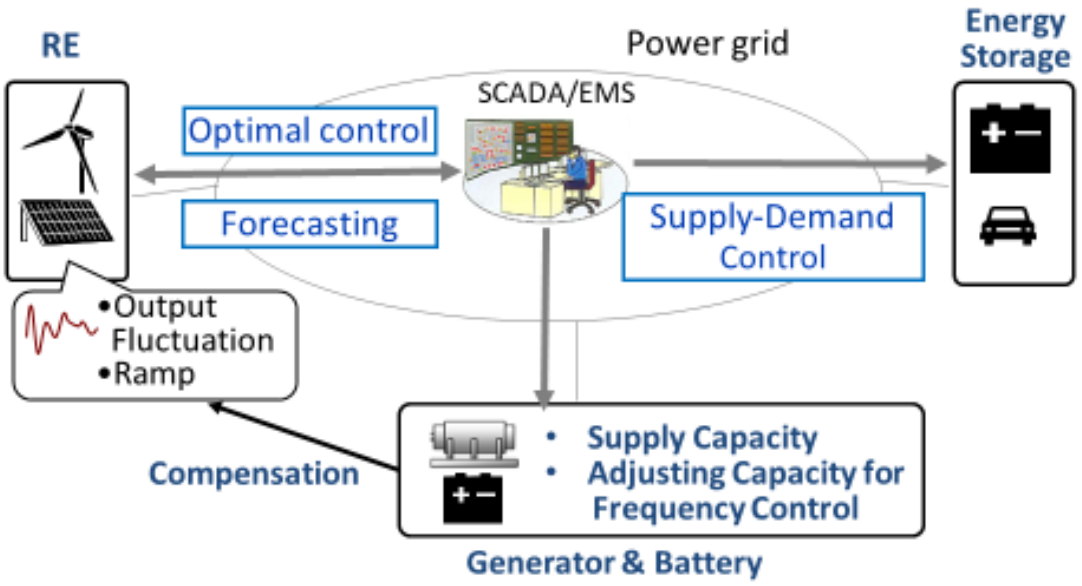
Ramp Variability of Wind & Solar

Sharp weather variation causes over 30% of generation changes within 30 minutes in case of no countermeasures for the intermittence of RE.



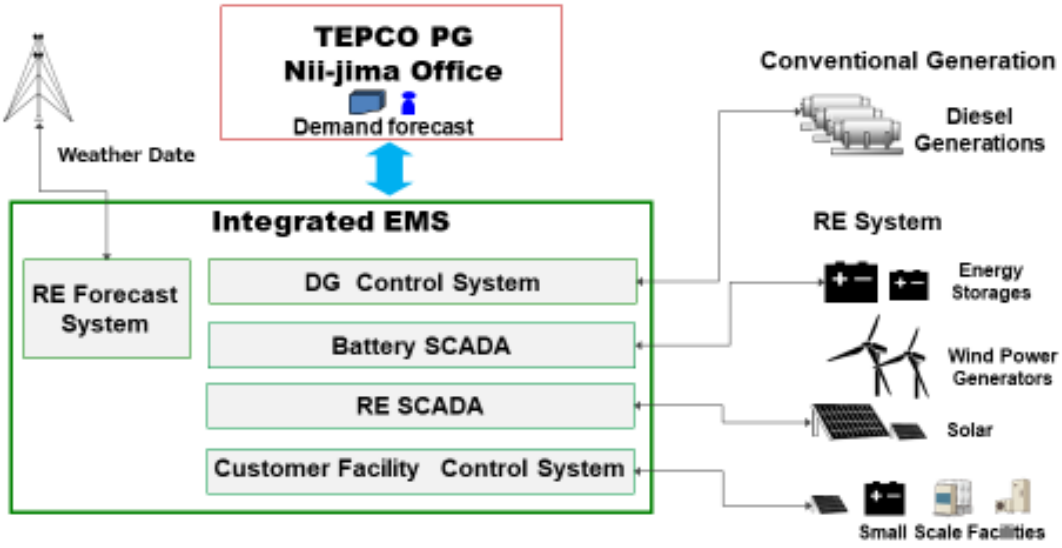
Our approach

Our system maximizes the use of REs by forecasting its fluctuations and optimizing the multiple resources, while ensuring the power stability.



RE Hybrid System in Nii-jima

■ To maximize use of the **RE**, EMS realizes:
* Output prediction, control, and curtailment of wind and solar power generation
* Cooperative control with existing power source and storage battery



Overview of Facilities #1

(1) Wind Power Generation
- WT: 300kW× 2units
- Battery: 500kWh, PCS 500kW

(2) Solar Power Generation
- PV: 318kW, PCS: 315kW
  (Polycrystalline modules, 1,248 panels)

(3) Large-scale Storage Battery
- Battery: Lithium ion (500kWh × 2)
- PCS: 1,000kW × 2

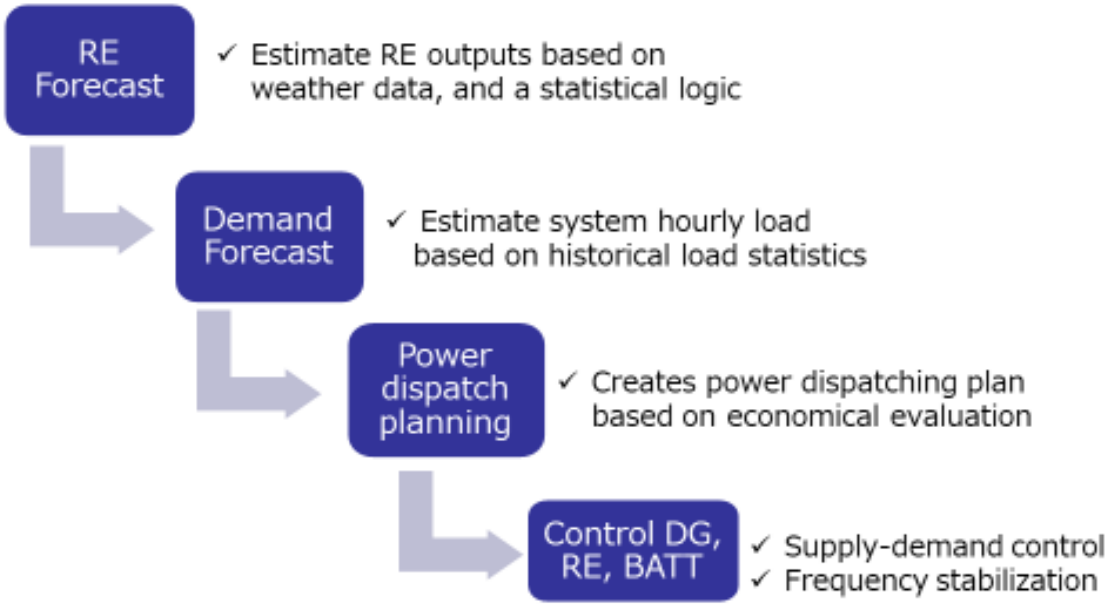
Overview of Facilities #2

(4) Small-type PV and Storage Battery
- PV: 5kW ～ 12kW, 9 sites
- Lithium ion battery: 12kWh (Capacity)
- PCS: 10kW

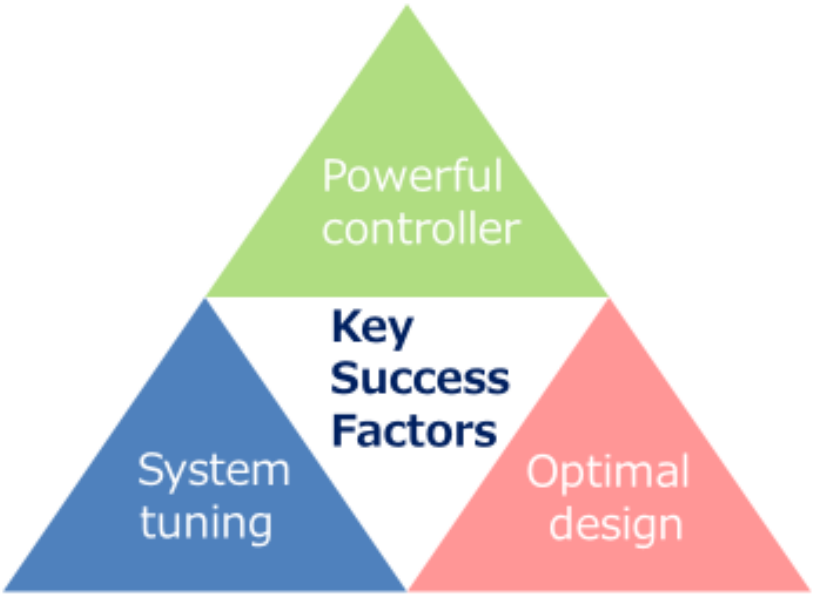
(5) Heat Pump (Mamashita hot springs)
- Heat capability: 56kW
- Power consumption: 16kW

(6) Cooling Facility (Nii-jima fish port)
- Cooling capability: 78kW
- Power consumption: 35kW

Daily Power Dispatch Planning by EMS



Key Success Factors



Thank you for your attention

➢ 変電所 SCADA 紹介

TKTK's Substation SCADA System and Pole-Mounted Distribution Transformer with Automatic Tap Changer

July, 2019
TAKAOKA TOKO Co.,Ltd.

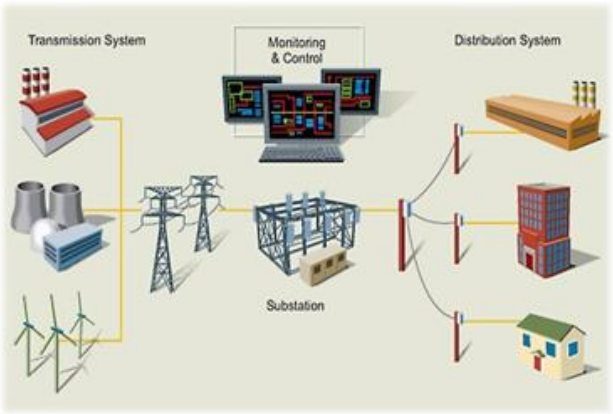
Agenda

1. Overview of SCADA
2. Hardware Structure of TKTK's SCADA
3. Function of TKTK's SCADA
4. Overview of Pole-Mounted Distribution Transformer with Automatic Tap Changer

1. Overview of SCADA

What is the “SCADA” ?

S : Supervisory
C : Control
A : And
D : Data
A : Acquisition



Monitoring and Control of the System by Computer

SCADA Basic Functions

(1)Monitoring

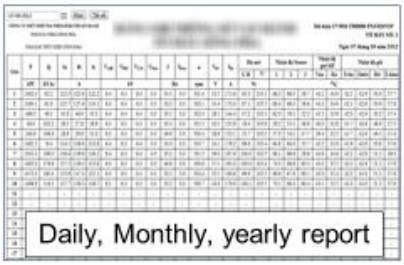
(3) Alarm

(2) Remote control

Central computer

Substation CB, DS

(4) Report



Daily, Monthly, yearly report

Our SCADA Has High Reliability

- We delivered 26 units of substation SCADA to TEPCO and Our SCADA share at TEPCO is 46%.

- We developed two types of SCADA to adapt a lot of clients with different equipment and budget.

1. Standard SCADA

2. Advanced SCADA

TKTK Provides Two Types of SCADA

Standard SCADA	Advanced SCADA
Standard model	High-end model
Standard function	Multifunction
Japanese products and high reliability	SEL Products and Highest Reliability
Made by Mintwave in Japan	Made by ATS in Vietnam
Mintwave is our subsidiary company and offers development, installation and maintenance for TEPCO's SCADA	ATS is our related company and has top share at the SCADA in Vietnam
—	Included Expansion to DAS

Delivery Record for Mintwave

No.	Contens	Country	Year
1	Compact Hydraulic Power Plant	Honduras	2014
2	Distribution Automation System	Philippines	2017-2018
3	Wind Power Generation	Japan	2018

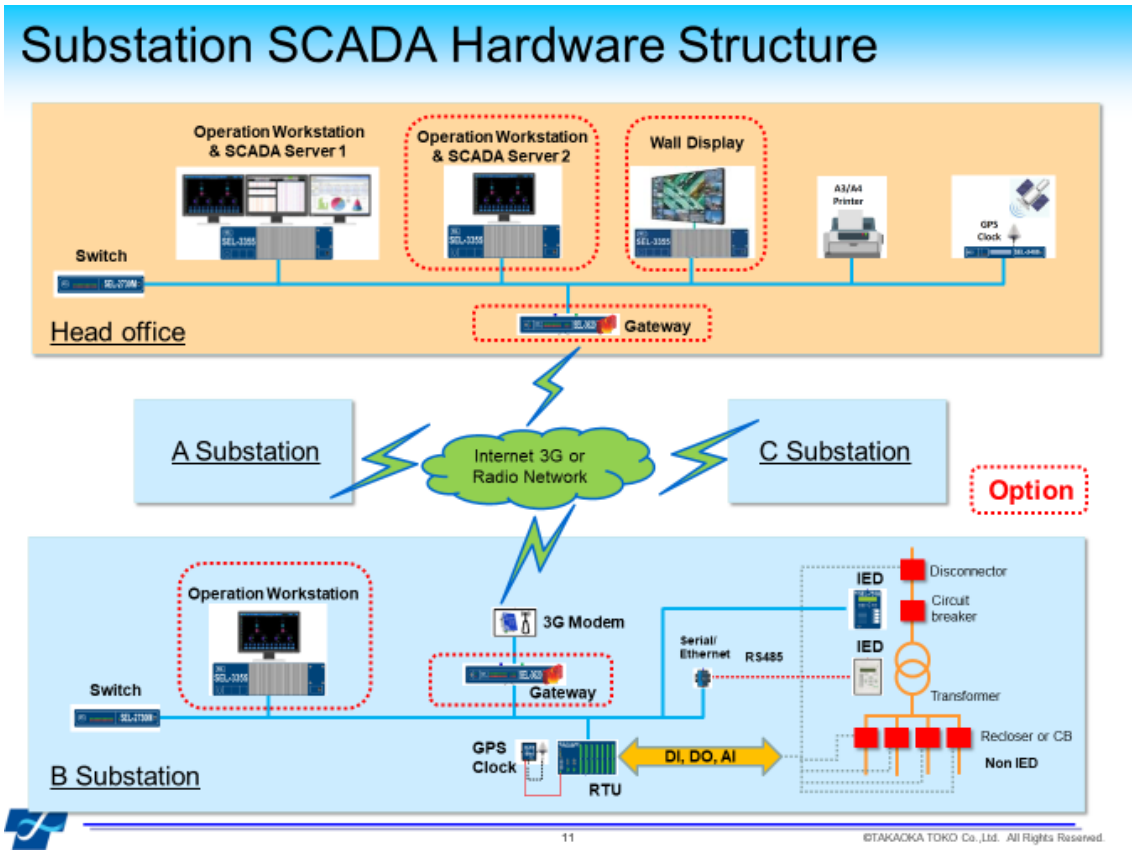
Delivery Record for ATS

Substations

More than 100 substations:

- **500kV Substations**: Cau Bong, Tan Dinh, O Mon, Son La, etc.
- **220kV Substations**: Vinh Long, Thanh My, GIS Tay Ho, etc.
- **110kV Substations**: Intel, Binh Tan, Long My, etc.

2. Hardware Structure of TKTK's SCADA


Substation SCADA Hardware Structure
Operation Workstation & SCADA Server 1
Operation Workstation & SCADA Server 2
Wall Display
A3/A4 Printer
GPS Clock
Switch
Head office
Gateway
A Substation
Internet 3G or Radio Network
C Substation
Option
Operation Workstation
3G Modem
Serial/ Ethernet
RS485
IED
Disconnector
Circuit breaker
IED
Transformer
Switch
Gateway
Recloser or CB
Non IED
GPS Clock
DI, DO, AI
RTU
B Substation
11
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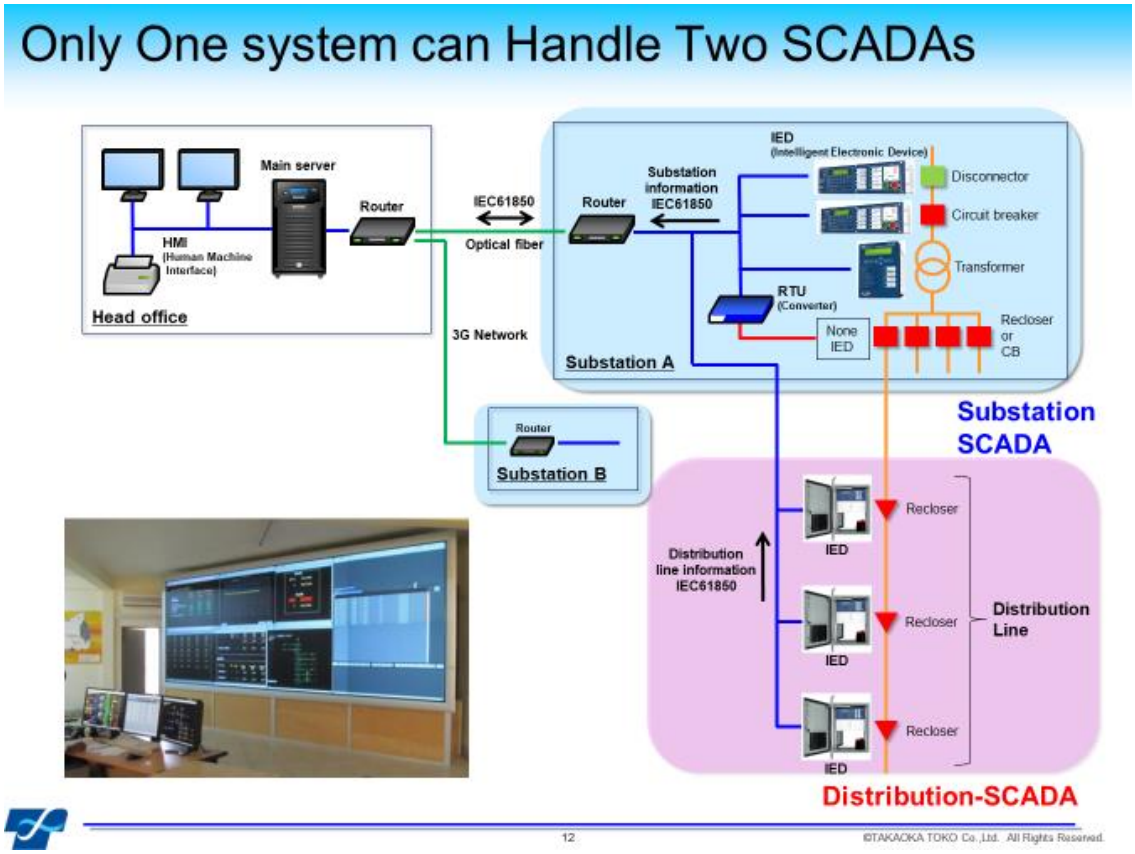
Only One system can Handle Two SCADAs
Main server
Router
HMI (Human Machine Interface)
Head office
IEC61850
Optical fiber
3G Network
Router
Substation information IEC61850
IED (Intelligent Electronic Device)
Disconnector
Circuit breaker
Transformer
RTU (Converter)
None IED
Recloser or CB
Substation A
Router
Substation B
Substation SCADA
Distribution line information IEC61850
Recloser
IED
Distribution Line
Distribution-SCADA
12
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3. Function of TKTK's SCADA

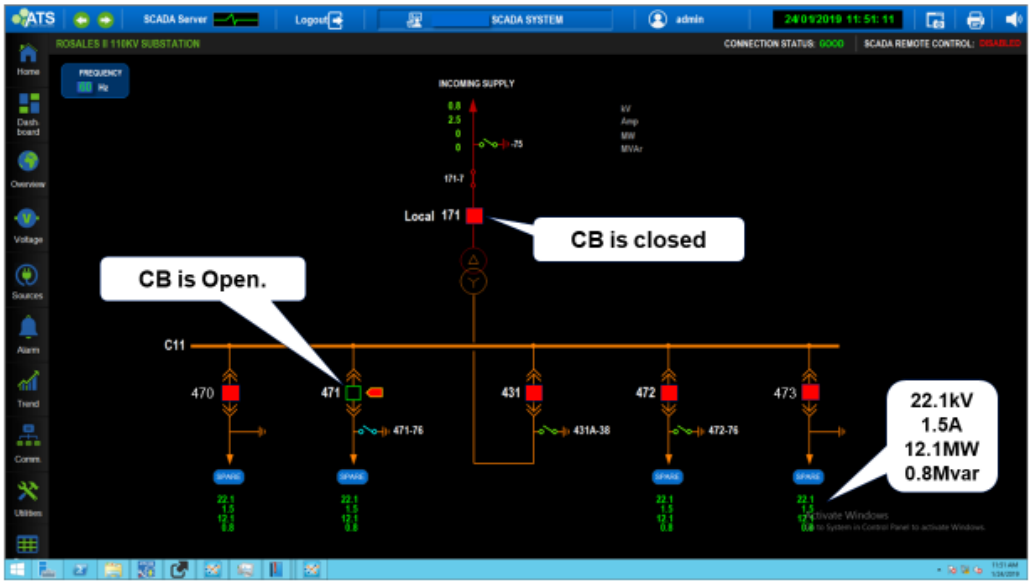
Functions

<Basic Functions>		Standard SCADA	Advanced SCADA
1	Monitoring	O	O
2	Remote Controlling	O	O
3	Alarm Recorder and Manager	O	O
4	Report	O	O
<Useful Functions>			
5	Maintain SCADA data by end-user	O	O
6	Keep the data even though the network is disconnected	O	O
7	Control reclosers on distribution line	O	O
8	Connect cameras into this system	O	O
9	Restrict users on Viewing and Controlling SCADA	O	O
10	Create a daily, monthly and yearly report	O	O
<Special Functions>			
11	Training Function	**Option**	O
12	Pre-Setting Control Sequence	**Option**	O
13	Monitoring substation by smartphone	**Option**	O
14	Expansion to Distribution Automation System	**N/A**	O

<Basic Functions>		Standard SCADA	Advanced SCADA
1	Monitoring	○	○
2	Remote Controlling	○	○
3	Alarm Recorder and Manager	○	○
4	Report	○	○

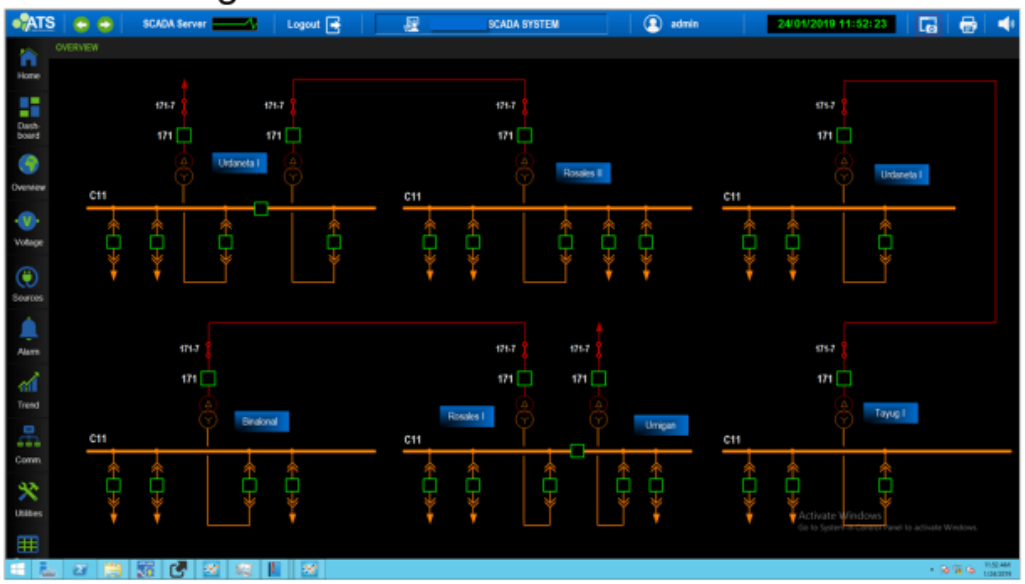
Watch the Status of All Substation Equipment at a Glance

➢ Monitoring



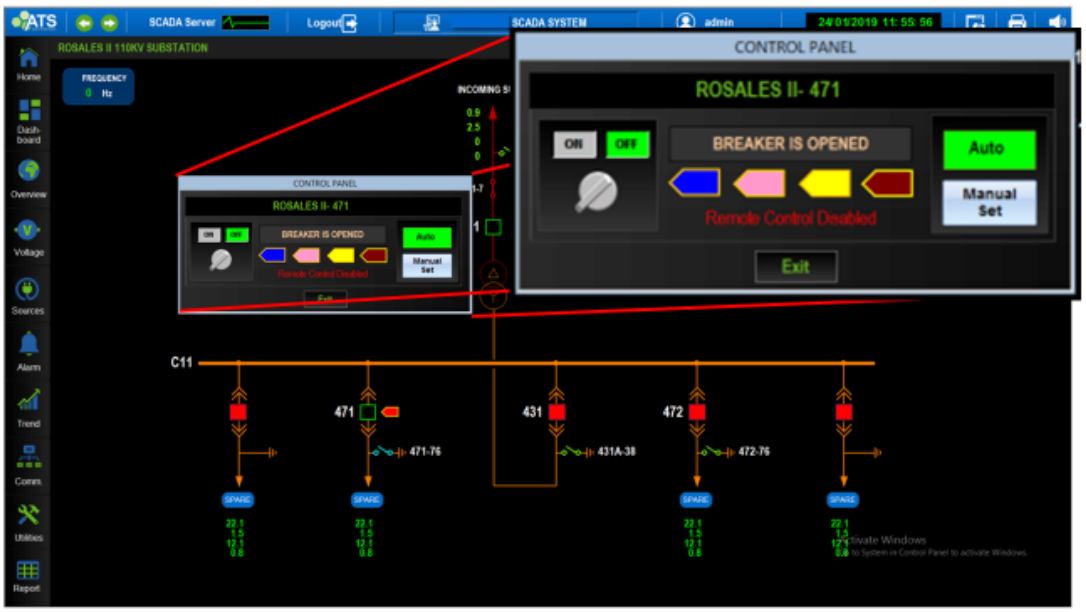
Watch All Substations at a Glance

➢ Monitoring



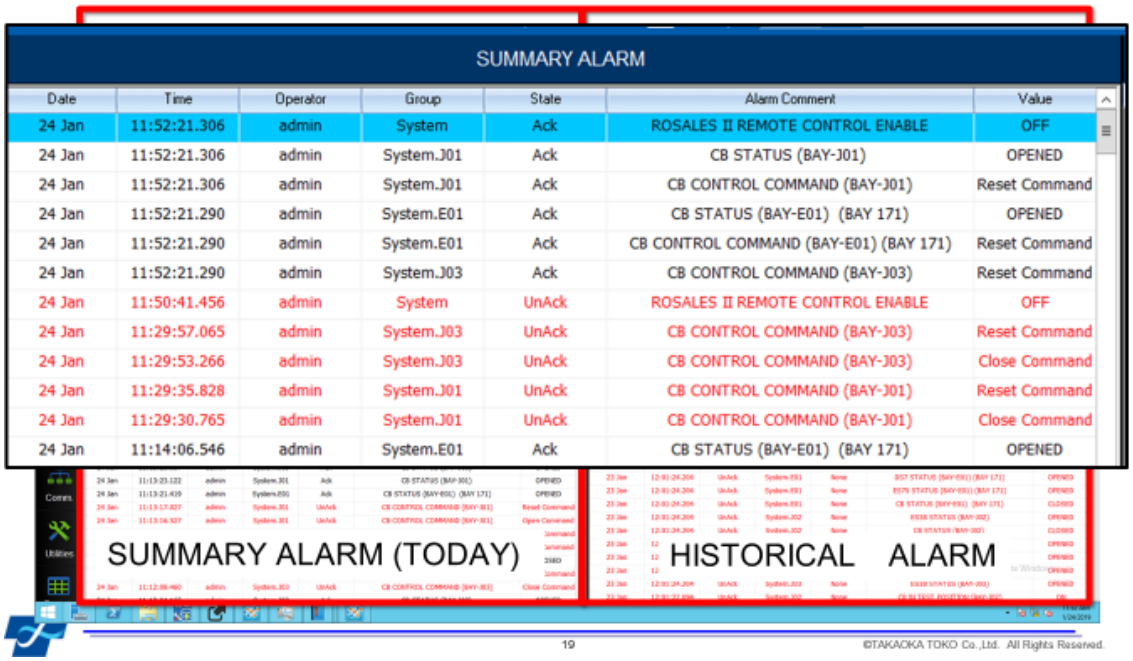
Operate Equipment with Simple Operation

➢ Remote Controlling



Receive All Alarms and Protection Relay Operation

➢ Alarm Recorder and Manager



SUMMARY ALARM

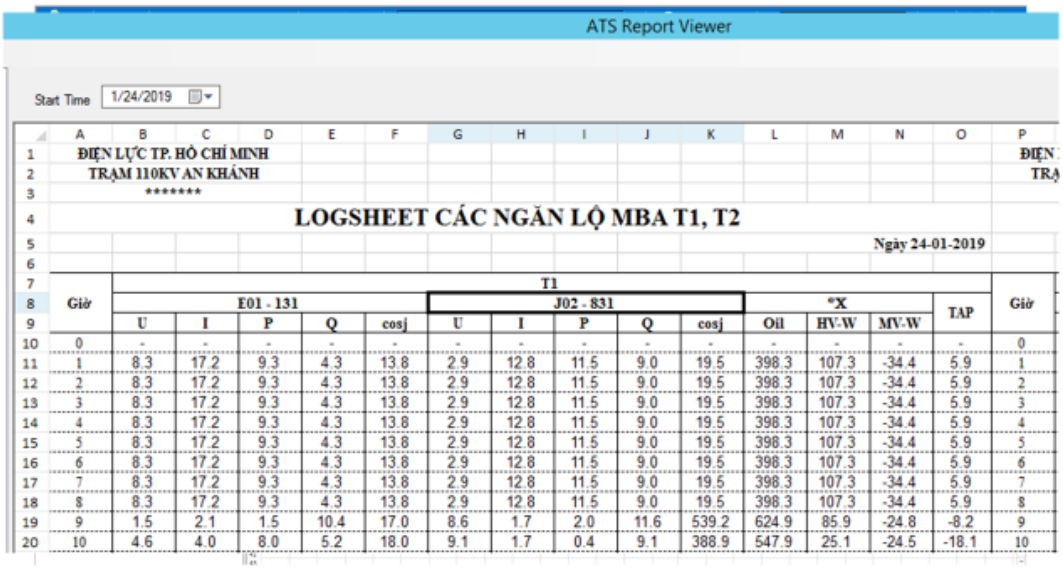
Date	Time	Operator	Group	State	Alarm Comment	Value
24 Jan	11:52:21.306	admin	System	Ack	ROSALES II REMOTE CONTROL ENABLE	OFF
24 Jan	11:52:21.306	admin	System.J01	Ack	CB STATUS (BAY-J01)	OPENED
24 Jan	11:52:21.306	admin	System.J01	Ack	CB CONTROL COMMAND (BAY-J01)	Reset Command
24 Jan	11:52:21.290	admin	System.E01	Ack	CB STATUS (BAY-E01) (BAY 171)	OPENED
24 Jan	11:52:21.290	admin	System.E01	Ack	CB CONTROL COMMAND (BAY-E01) (BAY 171)	Reset Command
24 Jan	11:52:21.290	admin	System.J03	Ack	CB CONTROL COMMAND (BAY-J03)	Reset Command
24 Jan	11:50:41.456	admin	System	UnAck	ROSALES II REMOTE CONTROL ENABLE	OFF
24 Jan	11:29:57.065	admin	System.J03	UnAck	CB CONTROL COMMAND (BAY-J03)	Reset Command
24 Jan	11:29:53.266	admin	System.J03	UnAck	CB CONTROL COMMAND (BAY-J03)	Close Command
24 Jan	11:29:35.828	admin	System.J01	UnAck	CB CONTROL COMMAND (BAY-J01)	Reset Command
24 Jan	11:29:30.765	admin	System.J01	UnAck	CB CONTROL COMMAND (BAY-J01)	Close Command
24 Jan	11:14:06.546	admin	System.E01	Ack	CB STATUS (BAY-E01) (BAY 171)	OPENED

SUMMARY ALARM (TODAY)

HISTORICAL ALARM

Get a Report Automatically

➢ Report



ATS Report Viewer

Start Time 1/24/2019

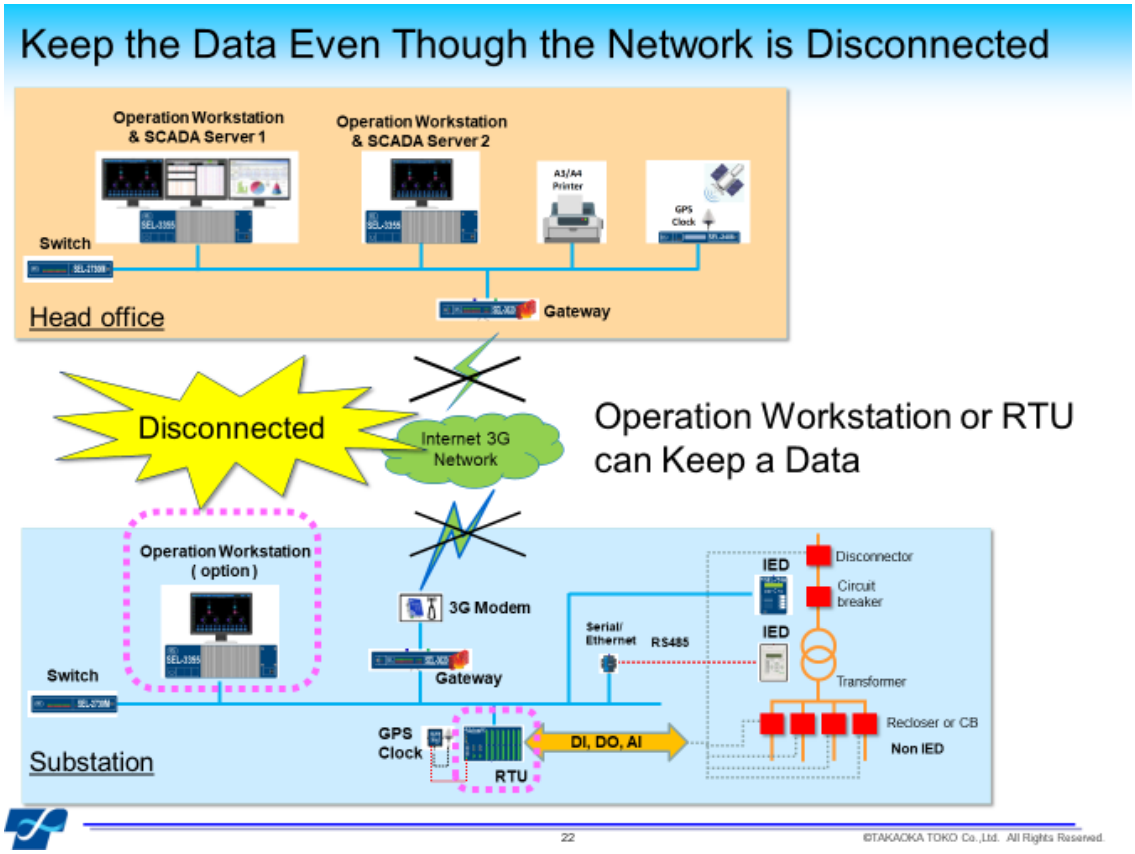
ĐIỆN LỰC TP. HỒ CHÍ MINH
TRẠM 110KV AN KHÁNH
****

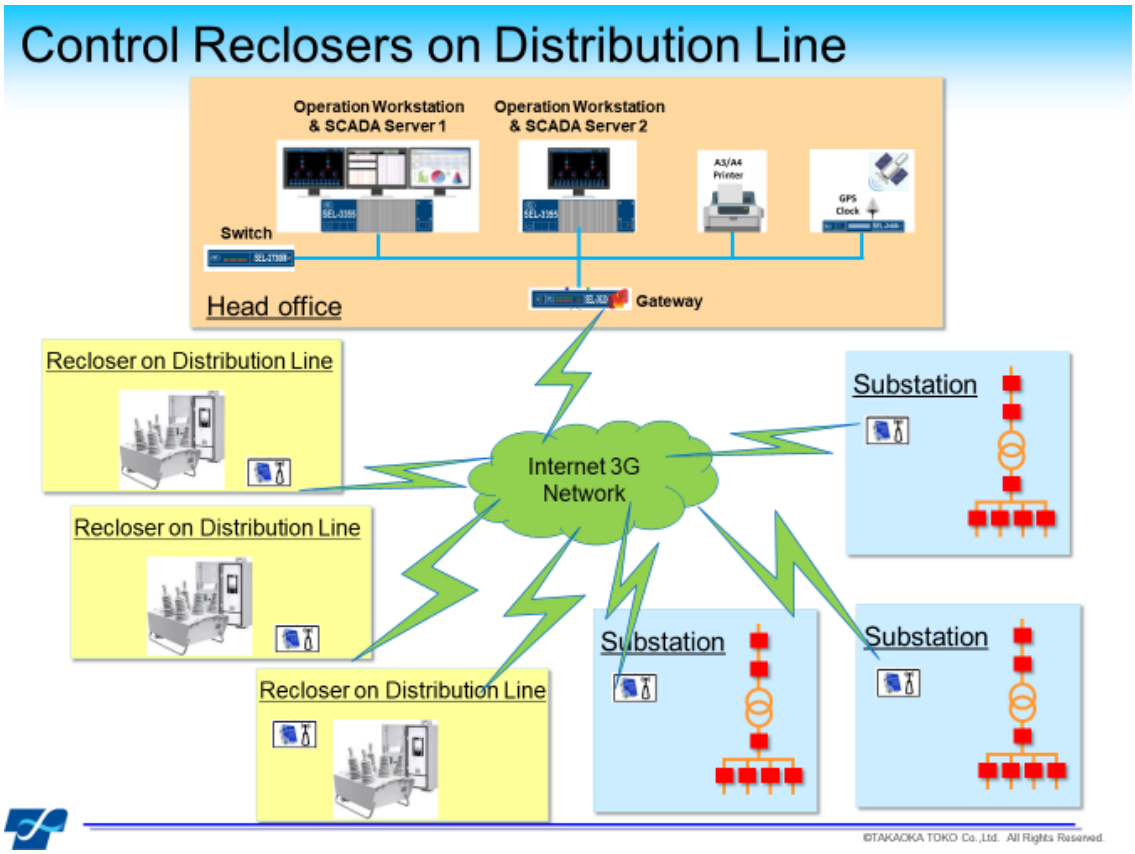
LOGSHEET CÁC NGĂN LỘ MBA T1, T2

Ngày 24-01-2019

Giờ	T1															Giờ
	E01 - 131					J02 - 831					°X			TAP		
	U	I	P	Q	cosj	U	I	P	Q	cosj	Oil	HV-W	MV-W			
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-		0
1	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		1
2	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		2
3	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		3
4	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		4
5	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		5
6	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		6
7	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		7
8	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9		8
9	1.5	2.1	1.5	10.4	17.0	8.6	1.7	2.0	11.6	539.2	624.9	85.9	-24.8	-8.2		9
10	4.6	4.0	8.0	5.2	18.0	9.1	1.7	0.4	9.1	388.9	547.9	25.1	-24.5	-18.1		10

<Useful Functions>		Standard SCADA	Advanced SCADA
5	Maintain SCADA data by end-user	○	○
6	Keep the data even though the network is disconnected	○	○
7	Control reclosers on distribution line	○	○
8	Connect cameras into this system	○	○
9	Restrict users on Viewing and Controlling SCADA	○	○
10	Create a daily, monthly and yearly report	○	○




Control Reclosers on Distribution Line
Operation Workstation & SCADA Server 1
Operation Workstation & SCADA Server 2
A3/A4 Printer
GPS Clock
Switch
Head office
Gateway
Recloser on Distribution Line
Recloser on Distribution Line
Recloser on Distribution Line
Internet 3G Network
Substation
Substation
Substation
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Control Reclosers on Distribution Line
➢ Recloser Control Window
ATS
D- SCADA SYSTEM
RECLOSER 01 - DISTRIBUTION LINE 1
Administrator
SCADA1
MEASUREMENT
ALARM
ALARM LIST
MODEM INFORMATION
ATS Smart Modem
TREND
SEL
SEL-651R
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Connect cameras into this system

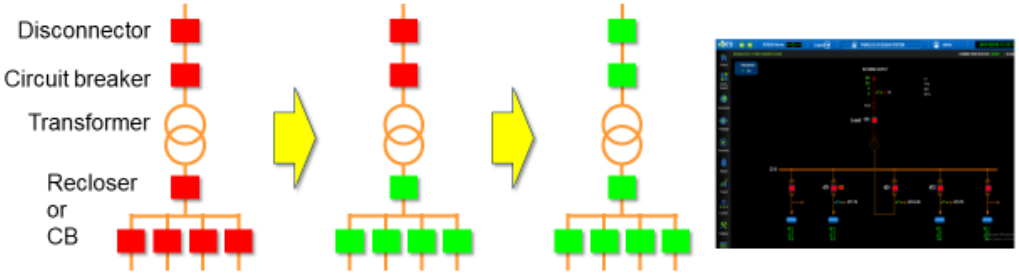
➢ Substation camera surveillance display

<Special Functions>		Standard SCADA	Advanced SCADA
11	Training Function	**Option**	○
12	Pre-Setting Control Sequence	**Option**	○
13	Monitoring substation by smartphone	**Option**	○
14	Expansion to Distribution Automation System	**Not Applicable**	○

Reduce Human Errors by Pre-Setting Control Sequence

- SCADA can enable operator to define device control sequences such as closing and opening CB, etc.
- Once the sequences have been stored, operator can use them at any time.

Stopping operation of a transformer automatically by Pre-Setting Control Sequence



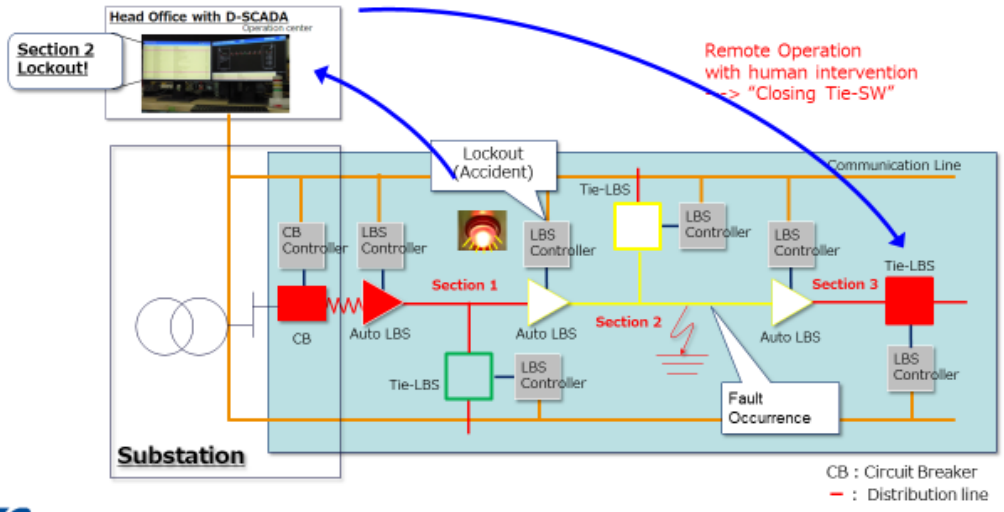
Monitor the Status of the Substation Anywhere

- SCADA has a web application. Users can access the web application with smartphone.
- Users can identify alarms, equipment's status, and real time values such as voltage and current.
- Users can get an alarm message with e-mail from SCADA automatically when alarm occur.

Advanced SCADA Has Expansion to DAS

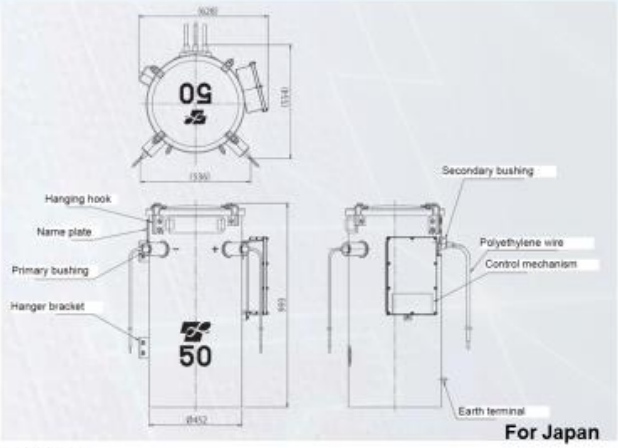
➢ Distribution Automation System (DAS)

DAS can identify and isolate a fault section as well as supervise and control LBS and Recloser.



4. Pole-Mounted Distribution Transformer with Automatic Tap Changer

Pole-Mounted Distribution Transformer with Automatic Tap Changer

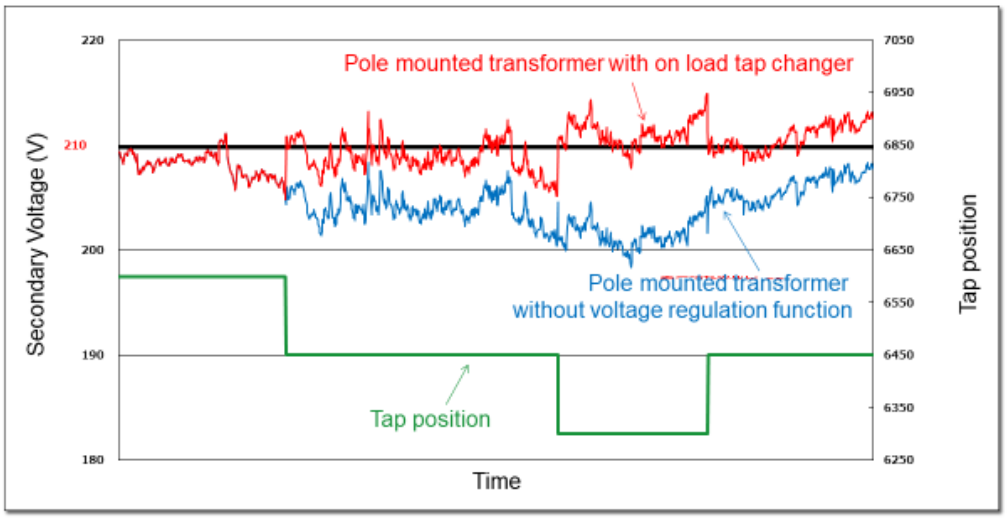


- Always monitoring own secondary voltage
- Automatically changes the tap and adjusts the secondary voltage without blackout

Specification for Philippines	
Rated Voltage	Primary:13200V Secondary:210V/120V
Phase / Capacity	Single-Phase 25kVA
Tap Position (Tap Voltage)	5 taps (13530V, 13200V, 12870V, 12540V, 12210V)
Total weight	390kg

Pole-Mounted Distribution Transformer with Automatic Tap Changer

Automatic Tap Changer can keep Secondary Voltage of the Distribution Transformer within a certain (regulated) voltage range.



Conclusion

1.
-We deal with two types of SCADA,
Standard SCADA and Advanced SCADA.
-You can choose the appropriate one form two SCADAs.
2.
-Our SCADA can supervise and control substation and distribution equipment with one system.
-You will be able to introduce DAS (Japanese distribution automation system) to Advanced SCADA without hardware expansion.
3.
-Our SCADA have unique factions as below.
・Training Function
・Pre-Setting Control Sequence
・Monitoring substation by smartphone
4.
-We are developing the Pole-Mounted Distribution Transformer with Automatic Tap Changer.
-Transformer with Automatic Tap Changer can keep Secondary Voltage of the distribution line within a certain voltage range.

Thank you for your attention.

TAKAOKA TOKO CO., LTD.

[URL] http://www.tktk.co.jp/en
[E-mail] international@tktk.co.jp

● 添付２　NEA 報告会のプレゼン資料

Reporting on the JICA Collaboration Program with the Private Sector for Disseminating Japanese Technologies for Electricity Distribution System and Management

TEPCO Power Grid, Inc.
TAKAOKA TOKO co., Ltd.
Batangas II Electric Cooperative, Inc.

October, 2023

Summary

1. Utilizing JICA's private-public partnership scheme under the cooperation of NEA/BATELEC II, TEPCO PG, TKTK has engaged in the activities concerning the introduction of technologies to realize high supply reliability.
2. Specifically, seminar and site visit in Japan on the said technologies was organized. And PoC of DAS has been conducted to be completed in September 2023.
3. It is confirmed that the system contributes to the improvement of supply reliability and the improvement in daily tasks through the PoC.
4. Capacity Building for operators of DAS has been conducted. Besides, maintenance after the demonstration project was also examined and proposed.
5. TKTK and TEPCO PG found the possibility of management of feeders with interconnection of DER in the future.
6. TKTK and TEPCO PG propose the future plan of dissemination of the technologies to realize high supply reliability in the Philippines.

*NEA; National Electric Administration
*BATELEC II; Batangas II Electric Cooperative
*PG; Power Grid
*TKTK; Takaoka Toko
*PoC; Proof of Concept
*DAS; Distribution Automation System
*DER; Distribution Energy Resources

Agenda

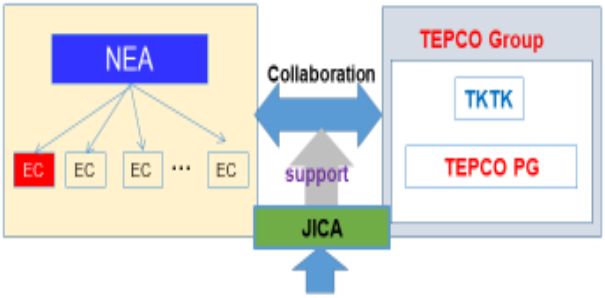
1. Contents of Collaboration Program
2. Applicability of DAS to the Philippines
3. Advantages of Deploying DAS in the Philippines
4. Future Plan

1. Contents of Collaboration Program

1.1 Outline of Collaboration Program

- Theme: Proposal on introduction of technologies to achieve high supply reliability
- Needs of NEA: Higher supply reliability, roadmap towards smart-grid deployment including integration of DER
- Goal of the Collaboration Program:
  - Deepen the understanding of key persons from the Philippines power sector on smart-grid related technologies of Japan
  - Applicability of Japanese smart-grid related technologies and its deployment plan

Implementation structure



Technical cooperation and support of TEPCO Group
- Promotion of understanding of key persons through technical seminar and training in Japan
- Verification of applicability of Japanese smart-grid related technologies through PoC
- Capacity building of operators of DAS at BATELEC II

1.2 Overall Schedule and Activities

Implementation Items	Year					
	2018	2019	2020	2021	2022	2023
Preparation Site Survey	★ Kick-off					
Training & Seminar	Technical Seminar	Site visit in Japan Training for Operators				Training for Operators
Operation of DAS			★ Commissioning Ceremony			
Reporting to NEA						Interim Final ★

1.3 Technical Seminar in the Philippines

- Managers and Experts from NEA and ECs were invited to Technical Seminar held in July 2018.
- Following contents were presented from relevant parties to deepen the understanding of participants regarding technologies to raise supply reliability.

JICA's Activities for Energy Sector in the Philippines (JICA)

JICA Collaboration Program Outline (TKTK)

Technical Presentation (TEPCO Group)

Network Planning Technology of TEPCO (TEPCO PG)
Concept of Smart Grid of TEPCO (TEPCO PG)
Advanced Metering Infrastructure of TEPCO (TEPCO PG)
Loss Reduction Methodologies (TEPSCO)
Operation and Maintenance Equipment (TEPCO Logistics)
Demonstration and Pilot Project (TKTK)
Transformer, Disconnector and Preventive Maintenance Technology (TKTK)

Presentation from NEA

Power Supply Reliability of ECs and Policy of Distribution System Upgrade (NEA)

*TEPSCO; Tokyo Electric Power Service

1.4 Site Visit in Japan

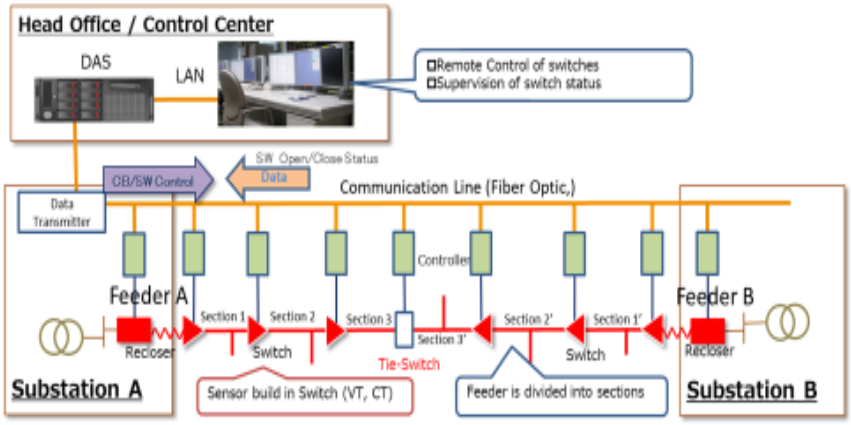
- In 2019, Managers and Experts from DOE, NEA and BATELEC II were invited to site visit in Japan to observe the Practices.

Date	Itinerary	Place
July 8th	Orientation	TKTK HQ
	Courtesy Call to JICA	JICA
July 9th	TEPCO PG Corporate Outline Distribution Advanced Technology Automatic Metering Infrastructure Indirect Live-Line Work	HQ Training Center
July 10th	TEPCO PG Ginza Control Center Wrap-up Meeting	Ginza branch Office HQ
July 11th	TKTK Factory Tour (Switchgear, etc.) TKTK Factory Tour (Large-size Transformer, etc.)	Oyama Hasuda
July 12th	TKTK Energy Management System Step-up Voltage Regulator, etc Wrap-up Meeting	HQ

1.5 Implementation of PoC

- As a component of Collaboration Program, DAS was introduced to two of commercial distribution lines at BATELEC II, one of the ECs, with the aim of improving supply reliability.
- System configuration is as shown below.

  *Implementation period: From January 2018 to August 2023



System Configuration

1.6 Functions of DAS for PoC

	Functions	Contents	Photos
System	Monitoring, Updating and Control	Control and monitoring of OH equipment (LBS)	
	Display, Alarm	Trend monitor (section current/passing current), alarm and recording processing	
	Fault Location, Isolation, Service Restoration	Automatic separation and fault detection (Sequential Reclosing)	
Controller	Control of LBS	Open/Close control of LBS in response to signal from system	
	Data Acquisition	Data acquisition from LBS, storage/transmission to system	
LBS	Load Breaking	Open/Close in response to control signal from controller	
	Data Measurement	Data (voltage/current) measurement by built-in CT/VT	

*LBS; Load Breaking Switch

2. Applicability of DAS to the Philippines

2.1 Applicability of DAS

Das is effective in the Philippines because of the following reason:

- DAS allow operators to remotely monitor the status and performance of the distribution line in real-time.
- Fault Detection is much easier in DAS due to its fault identification capability. It allows the operator to identify what specific segment the fault occurred.
- Transfer of loads from one substation to another improves the reliability of the feeders connected to DAS.

2.2 Operation Records of DAS by BATELEC II

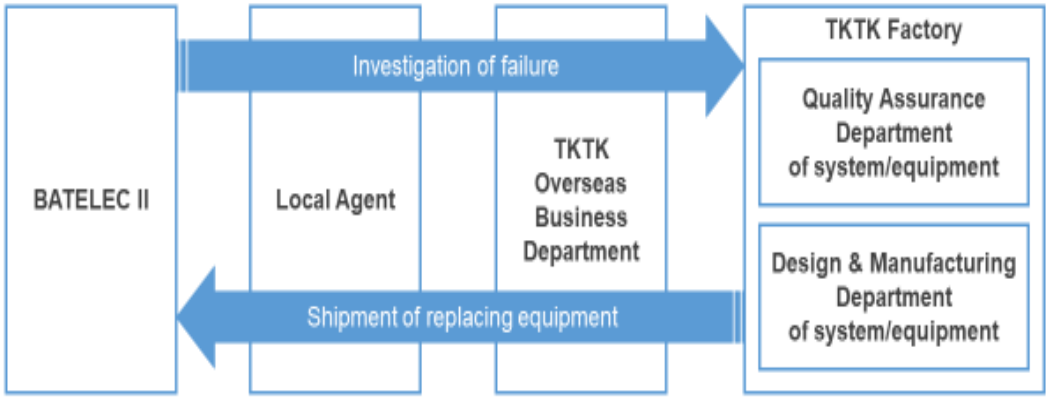
Date	Event	Contents of Operation	Findings
April 29, 2023 07:14 PM	Tripping of fuse cutout at Anilao Labac	Lock current exceeded recorded at PG 0403	Upon inspection, maintenance crew found an animal at primary line that caused fuse cut-out operation Estimated distance of fault – 4.69 kms
May 24, 2023 07:06 PM	Tripping of fuse cutout at Sorrento subdivision	Lock current exceeded recorded at AP 0403	Upon inspection, maintenance crew found an animal at primary line at Sorrento subdivision that caused fuse cut-out operation Estimated distance of fault – 4.83 kms
May 31, 2023 03:37 PM	Tripping of fuse cutout at Avida subdivision	Lock current exceeded recorded at AP 0402	Upon inspection, maintenance crew found a tree touching the primary line at AVIDA subdivision that caused fuse cut-out operation Estimated distance of fault – 2.42 kms

2.3 Capacity Building for Operation of DAS

- In order to effectively utilize DAS, an operator proficiency is necessary and important, so we conducted an education and a training at appropriate timings.
- For the effective education and training, the following programs were provided at before DAS installation, after installation, and several years passed, as well as these programs closely related to daily operations.
  1. Normal operation for everyday
  2. Temporary operation to recover from power outage due to an accident and/or a failure
  3. Planned interruption and restoration operation due to construction, etc.
  4. Loop current calculation for uninterruptible switching

2.4 Maintenance of System/Equipment after the Collaboration Project

- Service flow below is under consideration.
- The primary contact point of BATELEC II: Local agent to be appointed by TKTK
- Local agent report to TKTK for investigating the failure cause and delivering to BATELEC II the equipment to be replaced.



3. Advantages of deploying DAS in the Philippines
Not disclosed due to company confidentiality

4. Future Plan
Not disclosed due to company confidentiality

Thank you for your attention!

Republic of the Philippines
National Electrification Administration (NEA)

Republic of the Philippines Promotion Project of System for Distribution Grid Operation and Management Technology Work Completion Report

October 2023

Japan International Cooperation Agency (JICA)

TAKAOKA TOKO CO., LTD.
TEPCO Power Grid, Inc.

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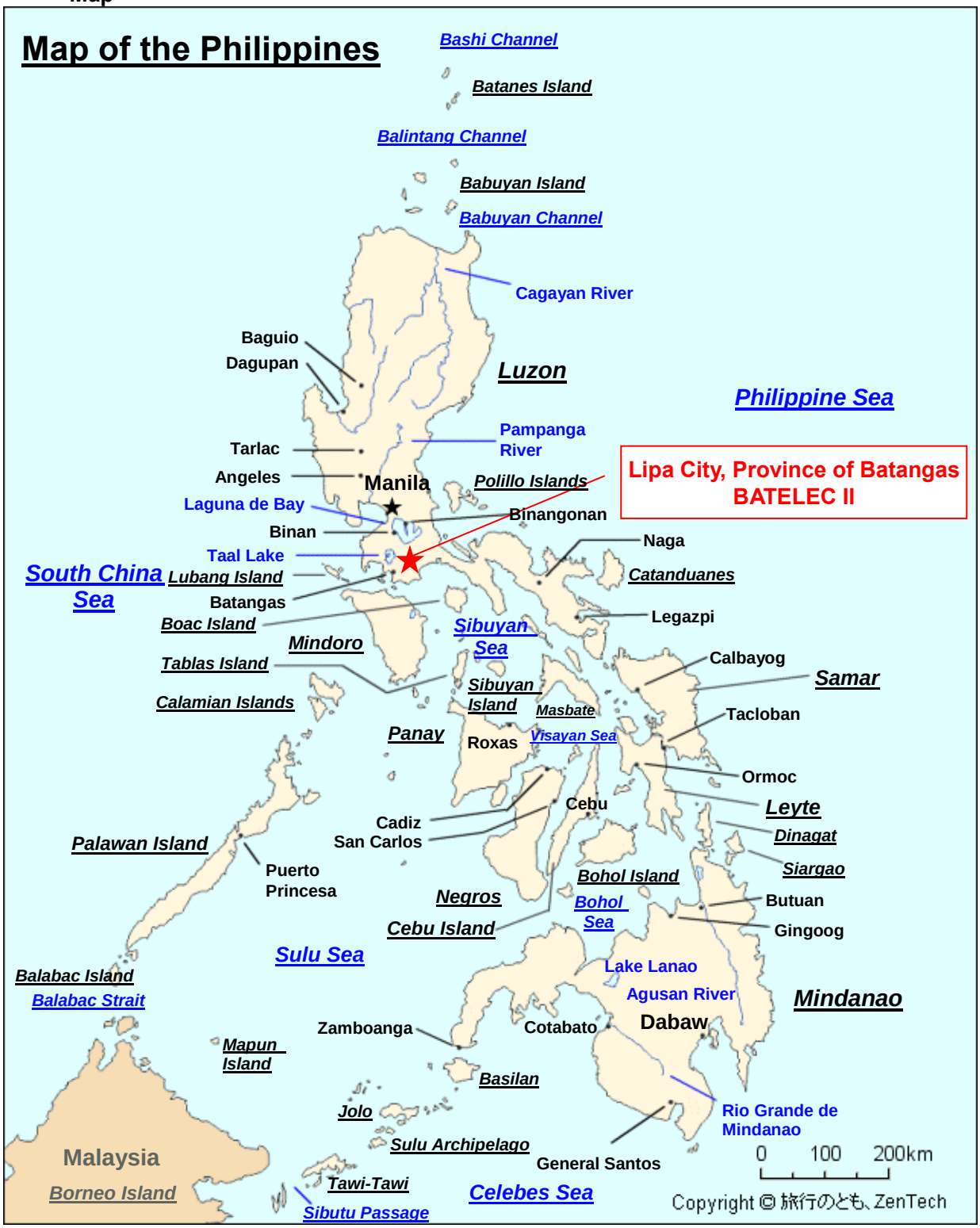
Contents

Table of abbreviations

abbreviations	Official Name
ADB	Asian Development Bank
ADMS	Advanced Distribution Management System
BATELEC II	Batangas II Electric Cooperative, Inc.
CB	Circuit Breaker
CCGT	Combined Cycle Gus Turbine
DA	Distribution Automation
DMS	Distribution Management System
DOE	Department of Energy
DNMS	Distribution Network Management System
DR	Demand Response
EC	Electric Cooperative
EMS	Energy Management System
ERC	Energy Regulatory Commission
FIT	Feed in Tariff
FLISR	Fault location, isolation and service restoration
FS	Feasibility Study
GUI	Graphical User Interface
IPP	Independent Power Producer
MEA	Metropolitan Electricity Authority
MERALCO	Manila Electric Railroad And Light Company
METI	Ministry of Economy, Trade and Industry
MOM	Minutes of Meeting
MOU	Minutes of Understanding
NEA	National Electrification Administration
NETI	National Electrification Training Institute, NEA
O&M	Operation and Maintenance
ORED	Office of Renewable Energy Development, NEA
PCS	Power Conditioning System
PENELCO	Peninsula Electric Cooperative, Inc.
PELCO II	Pampanga II Electric Cooperative, Inc
PV	Photovoltaic
RPS	Renewable Portfolio Standard
SAIDI	System Average Interruption Duration Index

SAIFI	System Average Interruption Frequency Index
SCADA	Supervisory Control and Data Acquisition
TOR	Terms of Reference

Map



(Created by proposing company using the map of 3kaku-K(http://www.freemap.jp/))

Chapter 1 Summary

1.1. Summary

1.1.1. Background of the project (including development issues in the target country)

The economy of the Republic of the Philippines (hereinafter called the Philippines) has continued to grow steadily, with real GDP increasing by more than 6% from 2012 to 2022 excluding 2020 and 2021. According to IMF statistics, per-capita GDP exceeded $3,950 in 2022, which is at a level where the Philippines can aim at joining the ranks of the semi-developed countries. The Philippines also has the potential for high economic growth, with an abundant and inexpensive young labor force and high English proficiency among its citizens.

Energy demand is expected to increase in line with economic growth, but the development of electricity infrastructure is lagging behind, and the development of a reliable electricity supply system essential for economic growth is urgently needed.

1.1.2. Technology for dissemination of this project

The core technology of this project, "distribution automation system," has a control function that constantly monitors the distribution system, automatically detects and disconnects the faulty section when a fault occurs, and restores the sound section by remote operation. This technology reduces the power outage and restoration time when a fault occurs, improves the efficiency of the fault point removal work by swift identification of the fault point, and realizes a highly reliable power supply.

1.1.3. Purpose/objective of the project

In this project, in order to construct a reliable power supply system, we propose the introduction of "highly reliable operational technology for distribution system" suitable for the Philippines. Therefore, the purpose of the project is to make government officials and key persons of power distribution companies understand the superiority of the proposed technology and the effects of introducing the system based on the situation and needs of local electric power distribution companies, as well as regulations and systems related to the electric power industry, and to aim for its spread in the Philippines in the future.

1.1.4. Contents of implementation of the project

"Highly reliable operational technology for distribution system" will be introduced in core cities of EC with a high financial and technical basis, after consultation with NEA. As a result, a standard system based on the distribution system configuration, operation method, and needs of urban areas in the Philippines will be constructed (pilot project). Using this as a pilot model, it will be applied to other power distribution companies (EC and private power distribution companies) in the Philippines with the cooperation of NEA. In this project, we have approached many power distribution companies in the Philippines through seminars.

1.1.5. Results/accomplishments of the project

In this project, we were able to promote the understanding of "highly reliable operational technology for distribution system" among parties involved in Philippine power sector (DOE, NEA, EC) through invitation program in Japan and local seminars. As a pilot project, seven automatic switchgears were installed on two distribution lines (Antipolo distribution line, Padre Garcia distribution line) of the EC (BATELEC II) to enable remote monitoring and control from the system and to separate the fault-

affected section at the time of a power failure. A demonstration operation was carried out for seven months on the Antipolo distribution line and for five months in total including the Padre Garcia distribution line. As a result of the demonstration, significant data on the reduction of the power outage time was obtained, and it was shown that this technology can be applied to the power system in the Philippines and that the function can be effectively demonstrated, and the result was shared with NEA.

In addition, through the introduction of this system, BATELEC II was provided with education and training on operation, and we were able to provide operation Know-how that reduces the power outage range and improves work efficiency by switching distribution systems using this system, not only for power outages by faults but also for scheduled power outages for construction. Even in the suburbs of medium-sized cities such as Lipa City, Province of Batangas, the reduction of the number of power outages and the duration of power outages has been strongly requested by local residents, and the effect of the introduced operation technology received a favorable reputation from the other party.

1.1.6. Prospects for business development at this stage

Based on the planning and operation technology of the distribution system that the TEPCO Group has cultivated in Japan and the distribution automation system that has been verified for its effectiveness in this project, we developed the system for introduction to ECs in the Philippines including BATELEC II.

1.1.7. Basis for determining business development prospects

Since NEA and BATELEC II have shown high interest in the planning and operation technology of the distribution system introduced in this project, it is considered that there is a need for the introduction of the system to ECs in the Philippines.

1.1.8. Remaining issues and measures and policies for business development

For the time being, this project is mainly targeting ECs under NEA. The EC, which is responsible for the electric power distribution in core cities, understands the importance of improving the reliability of power supply and assumes that some capital investment is possible. On the other hand, the introduction of distribution automation systems requires a large initial investment. Therefore, it is necessary to provide a system that meets the price needs of local business operators in order to carry out project development.

1.1.9. Plan for future business development

As of 2022, there are 121 Electric Cooperatives (ECs) in the Philippines. As for the distribution automation system, this project shows that the effectiveness of the power outage time reduction has been verified, and wider dissemination is also planned in the peripheral ECs.

The construction of a distribution system is not complete in a single equipment introduction, and it is appropriate to upgrade the system according to economic development and local needs. The initial system will be widely disseminated, with the aim of adding functions and upgrading the system (advancement of the system) according to the development status of each target.

1.1.10. Possibility of cooperation with ODA projects

Business development will be based on B to B, but we will consider the collaboration with technical cooperation projects by JICA regarding the introduction of DMS (Distribution Management System), which NEA is planning to monitor the status of all ECs in the event of a disaster.

1.2. Project overview diagram

Republic of the Philippines Operational System for Distribution System and Management Technology Promotion Project
TAKAOKA TOKO CO., LTD., TEPCO Power Grid, Inc.

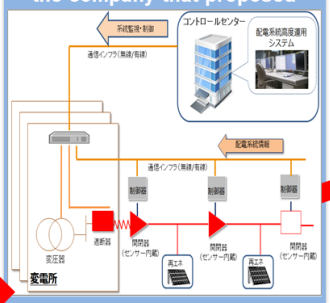
Development needs of the Republic of the Philippines

- **Improvement of power supply reliability**
  - In order to continue economic development and actively attract overseas companies, it is necessary to improve the reliability of unstable power supply due to frequent power failures.
- **Response to the introduction of renewable energy**
  - Under the policy of promoting the introduction of renewable energy, it is necessary to have a system to prevent the decrease in reliability due to the interconnection of renewable energy sources with unstable output.

Contents of the promotion project

- In order to improve the reliability of distribution systems in the Philippines, Japanese electric power companies and manufacturers jointly propose the following technologies.
  - System to minimize the section of power outage in the event of an accident and restore power promptly
  - In preparation for the mass introduction of renewable energy power sources, which will be promoted in the future, a system that monitors the system status in real time by installing a switchgear with a sensor and properly maintains and manages the system voltage
- Seminars and a pilot project using actual power distribution lines were held to familiarize people with the above system and technologies.

Technology and products of the company that proposed



Highly reliable operational technology for distribution system

Points of the project

- Power distribution companies in the Philippines are small and numerous, so it is necessary to make proposals based on a firm understanding of customer needs.
- Implement a pilot project utilizing actual power distribution lines to show the effectiveness and superiority of the proposed technology.

Results expected for the Republic of Philippines

- With the introduction of the proposed technology, in the event of an accident in the distribution system, the rapid detection of the accident point and greatly shortening the power outage time will improve the supply reliability.
- Power system planning and operation technology can be obtained in accordance with the above system.
- When a large amount of renewable energy is introduced, the operation status of the distribution system can be grasped in real time, and stable power quality can be maintained and managed.

Results expected for Japanese companies

Current status

- Very few Japanese companies have introduced technologies and systems proposed in this project overseas.
- In the past, consulting activities by electric power companies and others have been mainstream, and systems and equipment have failed to show superiority in terms of function and price compared with their Western competitors.

Future

- The implementation of the project will enable proposals to be made in accordance with the level and financial power required in the country.
- Show superiority over European and U.S. competitors through cooperation between Japanese power companies and manufacturers.
- After introducing the system, aim for ongoing business development, including upgrade and O & M.

Chapter 2 Background of the project

2.1. Background of the project

The economy of the Philippines has continued to grow steadily, with real GDP increasing by more than 6% for 7th consecutive year from 2012 to 2002 excluding 2020 and 2021. According to IMF statistics, per-capita GDP exceeded $3,950 in 2022, which is at a level where the Philippines can aim at joining the ranks of the semi-developed countries. The Philippines also has the potential for high economic growth, with an abundant and inexpensive young labor force and high English proficiency among its citizens.

Investment in GDP, on the other hand, has been on the rise in recent years, but remains at a lower level than that in neighboring countries. Sluggish investment is a constraint to the transformation of the industrial structure, including the promotion of the manufacturing industry. In order to achieve economic growth with an abundant labor force and to reduce poverty, it is extremely important to promote investment from home and abroad. Energy demand is expected to increase in line with economic growth, but the development of electricity infrastructure is lagging behind, and the development of a reliable electricity supply system essential for economic growth is urgently needed.

To this end, as stated in the aid policies for each country of the Ministry of Foreign Affairs, efforts must be made to improve the fragile infrastructure, including improving the investment climate, promoting direct investment from abroad, strengthening export industries, and reducing income inequality.

The following are the current status and issues of power supply, which is the foundation of infrastructure.

(1) Improvement of power supply reliability

In Manila, the capital city, the reliability of power supply has been improving year by year, but in the Electric Cooperative (EC) under the National Electrification Administration (NEA), SAIFI (system average interruption frequency index) is 16.3 times and SAIDI (system average interruption duration index) is 1,154 minutes (NEA Annual Report 2014), remaining at a low level. The reliability data does not include planned power outages for construction work.

(Reference: Data of TEPCO in FY2015, SAIFI 0.06 times, SAIDI 6 minutes)

The Philippine government is proceeding with an industrialization plan that aims to attract foreign companies to the country, and achieving a stable power supply is a necessary condition.

(2) Response to the interconnection of a large amount of renewable energy sources to the distribution system

The Department of Energy of the Philippines (DOE) has decided to promote the introduction of renewable energy. The FIT system was also introduced in 2012.

However, there is a lack of knowledge on the maintenance and management of power quality associated with mass interconnection of renewable energy sources, and the introduction of technology to cope with this situation is urgently needed.

(2) Response to the introduction of smart grid-related technologies

In February 2020, the DOE announced a policy as a smart grid policy based on six guiding principles: “safety,” “reliability,” “efficiency,” “adaptability/sustainability,” “resilience,” and “consumer empowerment.” The policy includes items related to the project such as DMS, DA, and FLISR.

The National Electrification Administration (NEA) is the driving force for the development of local electricity infrastructure and is responsible for formulating, allocating, and implementing budgets. The NEA uses SAIFI (annual average number of power outages per consumer) and SAIDI (annual average time of power outages per consumer) as performance indicators of power supply reliability, and sets target values to be used as performance indicators for the electrification cooperatives (ECs) under its

umbrella.

Since the enactment of the Renewable Energy Act (Republic Act No. 9513, hereinafter "Renewable Energy Act") in 2008, the government has announced that it would accelerate renewable energy projects as one of the measures to secure power supply and reduce the amount of carbon dioxide emissions. The National Renewable Energy Board (NREB) has taken the lead in promoting the "National Renewable Energy Plan" (NREP: developed by DOE). The NREP aims to increase its renewable energy generation capacity from 5.44 million kW in 2010 to 15.3 million kW by 2030, which is roughly a factor of 3 times.

In order to promote renewable energy development, the Renewable Energy Act stipulates financial incentives and non-financial incentives. The former includes various tax breaks, and the latter includes feed-in tariff (FIT) and renewable portfolio standard (RPS).

FIT was introduced in accordance with the Renewable Energy Act of 2008 and implemented based on FIT rules (2010, ERC Resolution No. 16) and REPA/RESA (REPA: Renewable Energy Payment Agreement; RESA: Renewable Energy Supply Agreement) contract models.

In 2012, the Energy Regulatory Commission (ERC) announced purchase prices and introduction targets, and applications for power connections by solar and wind power increased sharply and introduction targets were met. New purchase prices and introduction targets for solar and wind power were subsequently announced in 2015, and the targets were met shortly thereafter. Additional applications for solar and wind power are not expected to be offered in the future.

DOE is also working with NREB to consider the introduction of renewable energy certificates and RPS systems.

For this purpose, it is necessary to introduce a monitoring and control system to stably operate the distribution system. NEA is considering the budgeting for the introduction of the system to each EC.

2.2. Technology targeted for dissemination and their potential to contribute to development issues

2.2.1. Details of technology targeted for dissemination

The technology to be targeted in this project is "highly reliable operational technology for distribution system," and it will be targeted at areas where reliable power supply is required, including residential areas in rural areas as well as core cities in the Philippines. The core technology of this project, "distribution automation system," has a control function that constantly monitors the distribution system, automatically detects and disconnects the fault-affected section when a fault occurs, and restores the sound section by remote operation. By utilizing these functions, the power outage and restoration time in the event of a fault is shortened, and the efficiency of the fault point removal work is improved by swift identification of the fault point.

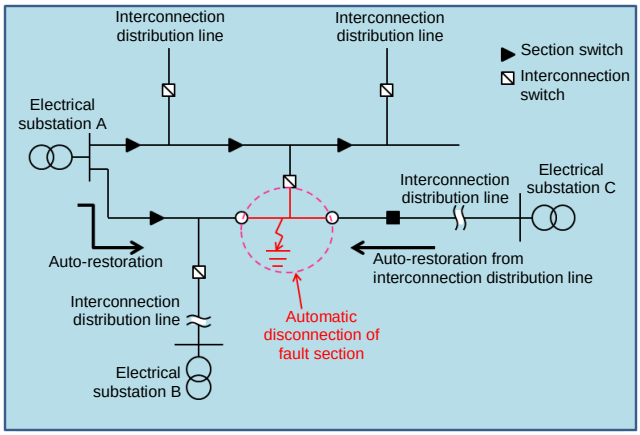


Figure 1 Conditions of the distribution system at the time of a fault (created by proposing company based on the practices in Japan)

The "distribution automation system" has a sensor built into the distribution line switchgear and can measure voltage and current. This may assist system operators in estimating the status of interconnected operation of renewable energy systems, which have been rapidly introduced at home and abroad in recent years, and assist in the operation of an optimal distribution system that appropriately manages the voltage of the distribution system and reduces power loss.

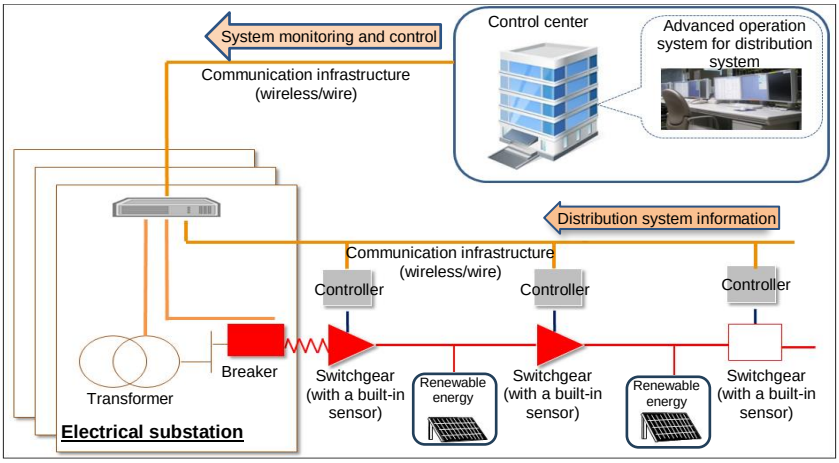


Figure 2 Diagram of distribution automation system (created by proposing company based on the practices in Japan)

In order to shorten the power outage time in the event of an fault in the distribution system and to properly manage the system in the case of renewable energy source interconnection, it is necessary to sectionalizing of the distribution lines (section division by installing switchgear) and to strengthen the interconnection between the distribution lines.

With regard to the planning and construction of the distribution system, long-standing knowledge of TEPCO Power Grid, Inc. in Japan and overseas can be utilized. In addition, technologies and know-how specific to the electric power company that has actually operated distribution systems are also effective.

In this project, "planning and operation support of distribution system" was provided as a package in order to maximize the effect of introduction of "distribution automation system."

2.2.2. Potential to contribute to development issues

(1) Improvement of power supply reliability

In order to improve the reliability of the supply of distribution systems, it is important to prevent occurrence of faults and to minimize power outage sections and quickly distribute electricity to sound sections when faults occur. By applying the "distribution automation system," the power supply reliability can be greatly improved by minimizing the power outage sections and performing swift fault recovery automatically, reducing the power outage time to about 1/3 on average. The system also makes it easier to identify the location of the fault, thereby improving the efficiency of recovery work.

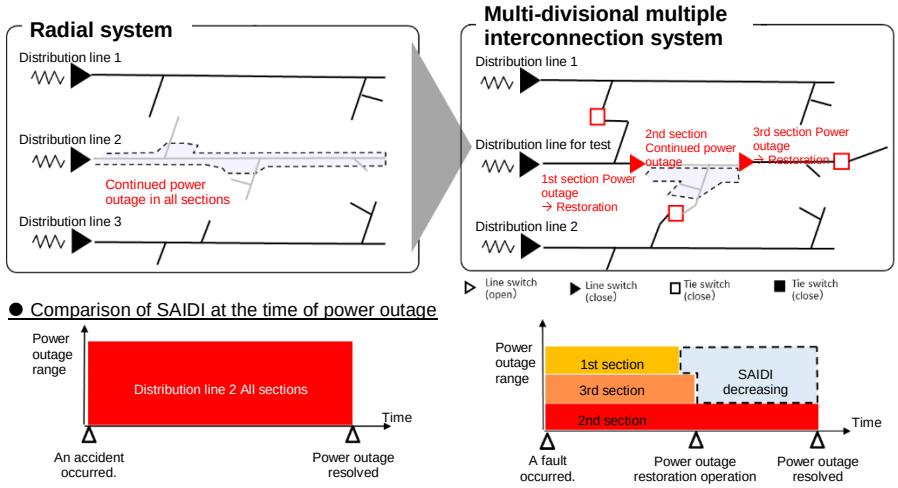


Figure 3 Advantages of the system structure of a multi-divisional multiple interconnection
(created by proposing company based on the practices in Japan)

Furthermore, by adopting a system structure in which the distribution system is divided into multiple sections and each section is connected with other distribution lines, it is expected that the scheduled power outage time in the distribution line construction will be greatly reduced and the distribution line operation rate will be raised.

As a result, the reliability of power supply to households will be greatly improved, and this will serve as a strong appeal point for attracting overseas companies to urban areas and industrial parks. It is also expected to improve the quality of life in ordinary households.

(2) Response to the interconnection of a large amount of renewable energy to the distribution system

Voltage and current sensors are built into the switchgear of the "distribution automation system" enabling real-time monitoring of the system. This makes it possible to properly maintain and manage the distribution line voltage when a large amount of renewable energy sources is introduced into the system.
This is expected to contribute to the introduction of renewable energy sources promoted by the Philippine government, reduce greenhouse gas emissions, and reduce future electricity supply costs.

(3) Support for the build-up of system for the introduction of smart grid-related technology

Through discussions on the introduction of proposed technologies and systems with the government agencies in the Philippines (DOE, NEA), the technical and policy issues that the power distribution business is facing in the Philippines was clarified. In response, we will introduce advanced technologies and examples from the Tokyo Electric Power Group and Japan, clarify issues related to the improvement of the reliability of distribution systems and the mass

introduction of renewable energy sources, and provide support such as proposals for the build-up of system as necessary and the preparation of a roadmap for the smooth introduction of smart grid technology.

These activities improve technical skills and develop human resources of power distribution companies in the Philippines, and build a greater sense of trust in the parties involved in power industry in our country.

Chapter 3 Overview of the project

3.1. Purpose and objective of the project

3.1.1. Purpose of the project

In order to construct a reliable power supply system, this project proposes the introduction of "highly reliable operational technology for distribution system" suitable for the Philippines. Therefore, the purpose of the project is to make government officials and key persons of power distribution companies understand the superiority of the proposed technology and the effects of introducing the system based on the situation and needs of local electric power facilities, as well as regulations and systems related to the electric power industry, and to aim for its spread in the Philippines in the future.

In the implementation of the project, we accurately grasped the current state of development issues that the Philippines is facing and fully examine the expected effects through the project. In addition, it should be noted that, after the completion of the project, necessary connection formation and information collection will be carried out so that the dissemination and development of the proposed business will proceed smoothly.

3.1.2. Achievement goals of this project (contribution to development issues in target countries, regions, and cities)

The achievement goal of this project is to make the key persons of the Philippine government and power distribution companies understand that the proposed "highly reliable operational technology for distribution system" is a very effective solution to the problems (improving the power supply reliability, responding to the interconnection of a large amount of renewable energy, and responding to the introduction of smart grid-related technologies) faced by the electricity-related business in the Philippines.

In particular, with regard to the improvement of the reliability of power supply, which is an urgent matter to be dealt with at present, it is our goal to make it clear that the application of Japanese technology will lead to a significant reduction in the average power outage time by minimizing the power outage section at the time of an fault and speeding up the fault point search. In addition, we had them understand that appropriate distribution system operation can be realized even when a large amount of renewable energy is introduced in the future, because the introduced system would be able to grasp the operation status of the distribution system. Furthermore, discussions will be held on the introduction of smart grid technology, and activities aimed at understanding will be conducted for the future dissemination of technology in Japan.

3.1.3. Achievement goals of this project (business side)

There are two achievement goals for business side of this project. First, with regard to the technology proposed in this project, the specific advantages of Japan's power distribution system operation should be understood through the pilot project and technical seminars. Second, ECs interested in Japanese technologies should be selected in consultation with NEA, and targets for dissemination should be clarified. About 2 or 3 ECs (specifically, PENELCO, BATELEC I) will be selected for the time being,

and discussions will be held on the possibility of introduction in the future based on their needs.

3.2. Contents of implementation of the project

"Highly reliable operational technology for distribution system" is introduced in core cities of EC with a high financial and technical base, after consultation with NEA. As a result, a standard system based on the distribution system configuration, operation method, and needs of urban areas in the Philippines is constructed (pilot project). Using this as a pilot model, it is applied to other power distribution companies (EC and private power distribution companies) in the Philippines with the cooperation of NEA. In this project, we approached many power distribution companies in the Philippines through seminars.

3.2.1. Implementation schedule

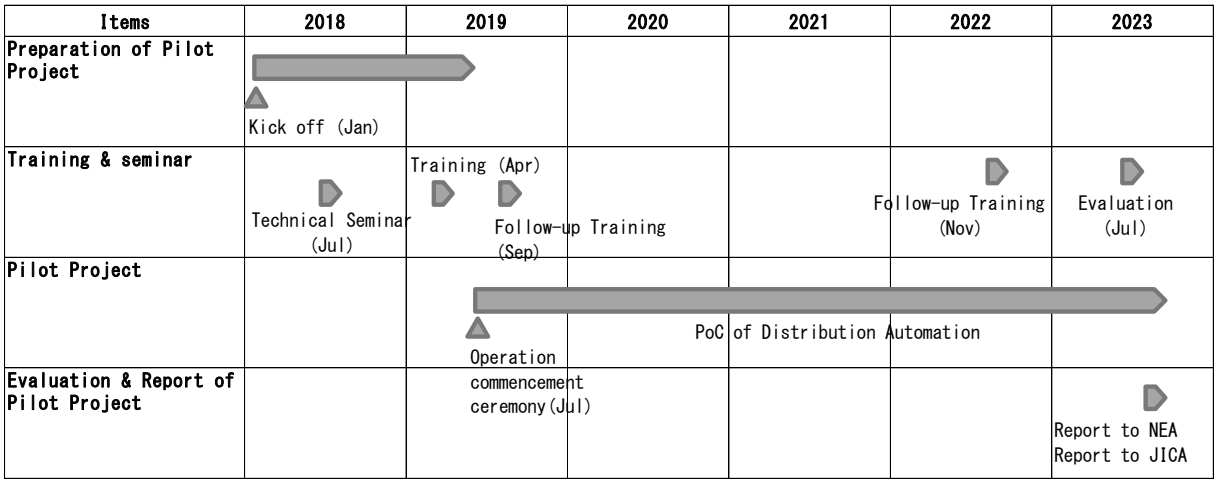


Figure 3.1 Initial schedule (created by proposing company)

3.2.2. Implementation system

The following is a diagram of the implementation system of this project.

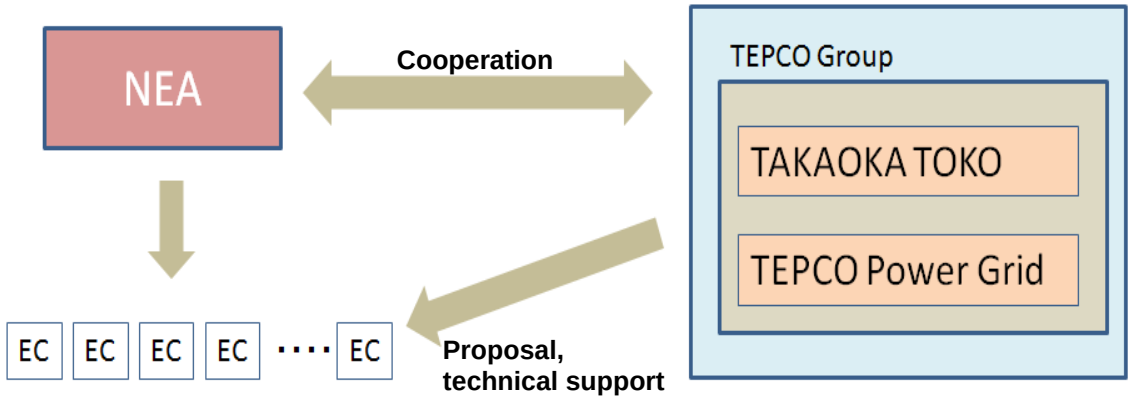


Figure 3.2 Project implementation system diagram (created by proposing company through the discussion with NEA)

3.2.3. Details of implementation

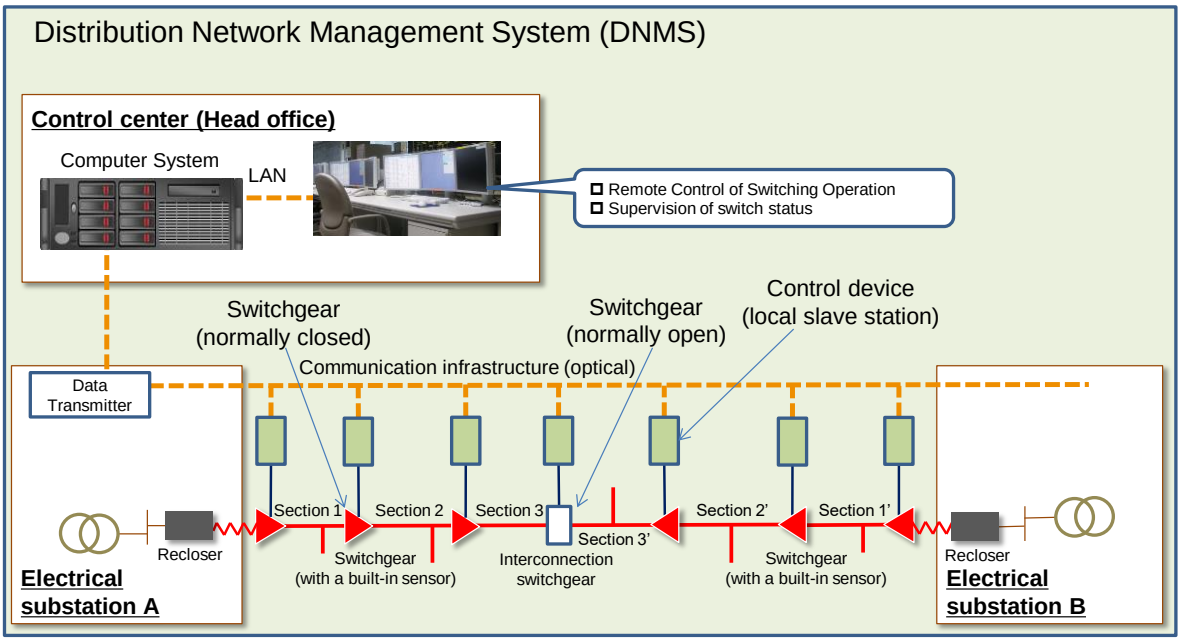
The following is an outline of the items (tasks) to be implemented in this project.

Task Items to be implemented	Activity plan										Details of implementation	Goal
	1st trip	2nd trip	3rd trip	4th trip	5th trip	6th trip	7th trip	Japan's activities	8th trip	9th trip		
Review the marketability and local needs	●	●	●	●	●	●	●	●	●		• Understanding the EC's technical level and future plans • Selection of target Ecs • Confirmation of issues and needs at each EC • Discussion on system introduction feasibility with each EC	• Information that contributes to the system introduction policy based on the needs of the target EC can be collected. • Relationships with multiple ECs leading to further dissemination are strengthened.
Promotion of comprehension			●				●	●	●	●	• Activity for understanding the superiority of the Japan's system operation technology and introduction of this technology • Holding seminars • Implementation of the pilot project • Visits to various places by Japan's activities, explanation of operation system in Japan, etc.	• Consultations are underway for concrete introduction. • NEA and parties involved in several ECs have a better understanding of Japan's operational technology for distribution system and its suitability for the Philippines, and a continuous cooperation system is established even after the completion of this project.
Technical guidance			●	●	●	●	●	●	●		• Holding seminars • Technical consultations with other Ecs • Operation policy confirmation and operation guidance of pilot project facilities, and exchange of opinions on operation	• A connection for implementation of individual technical consultation has been established. • The operation method is mastered, and continuous operation is possible.
Flow of public procurement Confirmation of procedures	●	●									• Confirmation of procedures and general schedule in consultation with the EC • Confirmation of CAPEX approval procedures	• The conditions necessary for dissemination activities are confirmed.
Pilot project preparation and implementation	●	●		●	●	●					• Technical consultation with NEA and EC • Facility survey • Decision of project site • Procedures for implementation and requests for construction arrangements • Construction of pilot facilities • Construction method guidance • Confirmation of construction progress	• The pilot project is carried out smoothly and the local suitability is confirmed. • The effect of the introduction is understood through actual construction and operation, and improvement points for future dissemination are clarified.
Formulation of operational policies Determination of data collection policy							●	●	●		• Formulation of evaluation methods for pilot project implementation • Determination of data collection policy • Collection of data on the effects of supply reliability improvement (reduced power outage time) through actual operation • Management of annual average power outage time (SAIDI) per demand as a key indicator	• To understand the actual effect, it is necessary to carry out the performance at the level of several years, so the foundation for continuous collection is established. • Confirming the effect by many target ECs will make use of further dissemination.
Introduction and development, and discussion of action plans										●	• Exchange of opinions, including a summary of activities and a cooperative system for future business development	• Formulation of development plans to target ECs with NEA support

Figure 3-3 Implementation Items for the Project (created by proposing company)

In the pilot project, two actual distribution lines was used in consultation with the target EC (BATELEC II) to construct the proposed distribution automation system.

System configuration diagram of the pilot project



Implementer	Role
TAKAOKA TOKO CO., LTD.	Provision of equipment and systems
TEPCO Power Grid, Inc.	Support for system planning and installation work
EC/NEA	Installation work of equipment and systems (including communication facilities)

Figure 3.4 System configuration diagram of the pilot project (created by proposing company based on the practices in Japan)

[Overview of pilot project]

- Purpose: To confirm the improvement effect of SAIDI, which is a reliability index, by introducing target technologies (systems and equipment) and operating actual distribution lines.
- Period: September 2018 to October 2023
- Details of introduction: Operational system for distribution system (complete set), switchgear (7 units), controller (7 units)
- Advantage:
  - Minimization of power outage range during distribution line faults and scheduled outage (construction outage)
  - Efficiency improvement of fault location (rapid power restoration)
  - Load switching function by remote monitoring control (power supply from another distribution line)
  - Efficiency improvement by remote switching after fault removal
  - Real-time monitoring of the distribution system by voltage and current sensors with built-in switchgear
- Evaluation overview: After a fault occurs on the target distribution line, confirm the power restoration (minimizing the power outage range) by utilizing the system, and show the effects of the system by comparing the assumed SAIDI before the system introduction with the assumed SAIDI after the system introduction. In addition, estimate the SAIDI after the system introduction in advance to evaluate the validity of the actual SAIDI.

Chapter 4 Implementation Results of the Project

4.1. 1st Field Activities

4.1.1. Purpose of Trip

Activities were carried out for the following purposes:

- A kick-off meeting (explanation of the project plan) with the NEA Administrator to start the project.
- Consultation with NEA Technical Division (explanation of the project plan, confirmation of implementation details, decision of pilot project site, outline explanation of technical seminar).
- Information gathering, technical consultation, confirmation and coordination for implementation of the pilot project.

4.1.2. Implementation Process

The following were implemented in the 1st field activities:

1. Tuesday, January 16, 2018: Kickoff meeting with NEA Technical Division
   At NEA Technical Division conference room
2. Thursday, January 18, 2018: Kickoff meeting with NEA Administrator at NEA Administrator office
3. Thursday, January 18, 2018: Working-level talks with NEA Technical Division at NEA Technical Division conference room
4. Thursday, January 18, 2018: Information sharing at the NEA Renewable Energy Bureau at the NEA Renewable Energy Bureau conference room
5. Thursday, January 18, 2018: Prior consultation with the Director of the NETI (Training Division) for holding a seminar At NETI Director's office
6. Wednesday, January 17, 2018: Kickoff meeting with BATELEC II
   At the BATELEC II General Manager office
7. Wednesday, January 17 to Thursday January 18, 2018
   Pilot project technical consultation with BATELEC II at BATELEC II conference room

4.1.3. Results of the 1st Field Activities

The following results were obtained in the 1st trip:

- Consultation with the NEA Technical Division provided an understanding of the project plan and clarified the future support system from NEA.
- Explaining the project plan to the NEA Administrator resulted in obtaining full cooperation from the NEA.
- We were able to convey our company's view (information on the outline of the seminar, invitation destination to participate, and the range of cost sharing) on the technical seminar scheduled for the 3rd trip to Philippines.
- Based on the conditions proposed by our company, it was decided that they would propose candidate ECs as targets for disseminating the proposed technology other than BATELEC II, which would conduct the pilot project, in consideration of the potential of system introduction, financial conditions, and access aspects.
- BATELEC II was selected as the EC to carry out the pilot project, and NEA officially notified the EC.

- Through technical discussions with BATELEC II, which conducts the pilot project, technical information contributing to the introduction of distribution automation system was obtained, as well as information on buildings for installation and existing facilities.

4.1.4. Issues for the 1st Field Activities

The following issues were recognized in the 1st trip:

- It is necessary that as many EC engineers as possible participate in the technical seminars. Since the travel expenses for each EC to participate in the seminar will be borne by the respective ECs, it is proposed that the technical seminar be held in combination with other events where parties involved in EC gather under the auspices of NEA.
- It has been found that the preliminary reinforcement work scheduled for the actual distribution line to be the target of the pilot project is about three months behind the initial plan. However, the construction order procedure has been basically completed, and we obtained a view that it is possible to complete the construction before the pilot facilities are introduced. We continue to check the progress of related construction.
- With regard to the introduction of distribution automation system, it was found that the communication system should be revised in connection with the existing facilities, and it was decided to propose the connection of information based on the obtained information.

4.2. 2nd Field Activities

4.2.1. Purpose of Trip

Activities were carried out for the following purposes:

- Present a proposal for implementation of the technical seminar planned for the next field activities and start concrete preparations.
- Hold discussions with NEA on how to approach EC as a target for the dissemination of target technologies, and study a direction for planning and proposing activities for EC in the future.
- Collect information on the decision process to implement capital investment in the EC and on the method of ordering and procuring materials and equipment after the decision is made.
- Understand the functions of distribution automation system for implementation of the pilot project, and conduct information collection and technical discussions. In addition, propose the configuration method of the target distribution line for the pilot project and confirm the specific placement method of the distribution equipment to be introduced.
- Collect and confirm information on support schemes for the dissemination of proposed technologies by visiting ADB.

4.2.2. Implementation Process

The following were implemented in the 2nd field activities:

1. Tuesday, March 6, 2018 Meeting with NEA Technical Division (1)
   At NEA Technical Division conference room
2. Tuesday, March 6, 2018: Meeting at the Embassy of Japan in the Philippines
3. Wednesday, March 7, 2018: Information collection meeting in ADB at the ADB conference room
4. Thursday, March 8, 2018: Meeting with NEA Technical Division (2)At NEA Technical Division conference room
5. Thursday, March 8, 2018: Meeting with local partner company TPI at TPI conference room
   Tuesday, March 6 to Wednesday March 7, 2018: Meeting with BATELEC II at BATELEC II conference room

4.2.3. Results of the 2nd Field Activities

The following results were obtained in the 2nd trip:

- In the meeting at NEA, agreement was reached on the outline of the technical seminar presented by our company. In the future, the schedule would be adjusted and preparations would be made for detailed decision of holding the seminar (presentation contents of both Japan and the Philippines, timetable and management system). We agreed to gain the cooperation from the NEA for this occasion.
- In the meeting at the NEA, we conducted an interview on the process of capital investment decision in each EC under the umbrella, and understood the outline of the flow from planning to capital investment implementation, including the involvement of higher organizations such as the NEA.
- We received instructions from NEA on how to approach EC as a target for the dissemination of target technologies, and established future actions. On the occasion of visiting EC, it was decided to send a written request to the NEA Vice-President to initiate coordination.
- In the meeting with ADB, we confirmed that ECs could be eligible for ADB assistance as beneficiaries. For future technology dissemination activities, we will take measures with a view to utilizing new connections with ADB as necessary. ADB also appears to be interested in technologies related to the operation of distribution systems and we will transmission/receiving information as appropriate.
- Information-sharing meeting was held with TPI, a local cooperative company in the project. Through the first and second activities, it was confirmed that the status of support from the relevant organizations in the Philippines was also good, and plans for future activity and pilot project promotion plans were shared. We requested to continue secure follow-up (handling by NEA and EC) in the Philippines.
- The outline of the implementation of this project was explained to the commercial officers of the Embassy of Japan in the Philippines, and they recognized that this project will lead to Japan's infrastructure export business, and understood the activities.
- We provided BATELEC II with a better understanding of the entire distribution automation system for the implementation of the pilot project, as well as information collection, technical consultation, confirmation, and coordination of the pilot project target areas, and confirmed the following:
  - Discussions were held on pending issues and confirmation was made on issues other than those requiring time to acquire some information.
  - Regarding the construction status of the DNMS introduction areas, which was the issue of the previous activity,
    - Construction of Antipolo Substation and control center building completed in April 2018.
    - It was confirmed that the construction of the distribution line feeder reinforcement was completed in August 2018.
  - In accordance with the revision of the communication method, which was the issue of the previous activity, the communication interface was confirmed, and concrete interface specifications and communication protocols were confirmed.
- We proposed the line division points by introducing switchgear to the target distribution line of the pilot project, and confirmed the concrete division areas.

4.2.4. Issues for the 2nd Field Activities

The following issues were recognized in the 2nd trip:

- In order to make the technical seminar an official event in the country for EC engineers (subject to accumulating points required for the update procedure of the engineer's license), the Japanese presenter (give a presentation of the technology) needs to obtain approval from the Philippine regulatory authority, so it is necessary to decide the presenter as soon as possible.
- In response to a request from the NEA to divide the EC invited to technical seminars into four regions, we are approached to hold seminars in each region. However, since this is different from the initial plan, it is necessary to formulate a response policy as soon as possible.
- We received information that the construction of the target area will be completed before the installation of distribution automation system. However, the BATELEC II construction staff gave a specific opinion that delays may occur in some cases. Therefore, it is necessary to check the progress of the construction not only at the time of a trip but also by e-mail from time to time.
- Based on the information obtained at the time of the 1st trip, many power outages by faults occur at branch lines with fuse connection. Therefore, it is necessary to consider whether a system for notifying blowout of a fuse of branch lines can be proposed even though it is distribution automation system.
- It is necessary to review and propose the overall configuration of the distribution automation system, since the communication system of the target substation has been clarified and it cannot be realized by the initial configuration.
  Specifically, it will be necessary to review the “transponders” scheduled to be installed at substations.
- In the power distribution automation demonstration, we received a request for the possibility of switchgear trip instead of the trip of the distribution line recloser or SG at the time of a short circuit fault. However, since this switchgear does not have a trip function, it will be proposed as a future function.

4.3. 3rd Field Activities

4.3.1. Purpose of Trip

Activities were carried out for the following purposes:

- Hold meetings with NEA for the first technical seminar of this project and hold seminars to have them understand the effectiveness of the proposed technology.
- At the technical seminar, collect information on the reliability of power supply and the direction of future power distribution system upgrade from the Philippine NEA.
- Establish connections with each EC attending the technical seminar and obtain information for future dissemination measures.
- At BATELEC II, the target EC of the pilot project, conduct on-site equipment test and confirm equipment installation sites. In addition, make an adjustment for conclusion about an MOU of the pilot project.
- In addition to explaining the contents of the technical seminar to JICA Philippines Office, hold a consultation about the possibility of financial arrangement for FS and project implementation regarding the introduction of EMS on remote island microgrids, for which ORED in NEA has requested cooperation.
- Collect and confirm information on support schemes for the dissemination of proposed technologies by visiting ADB.

4.3.2. Implementation Process

The following were implemented in the 3rd field activities:

1. Tuesday, June 5 to Thursday, June 7, 2018: Consultation on holding a technical seminar at NEA conference room
2. Wednesday, June 6, 2018: Information sharing on project progress at JICA Philippines Office
3. Wednesday, June 13 to Thursday, June 14, 2018: Consultation on pilot project implementation
   At BATELEC II
4. Monday, July 16, 2018: Consultation on holding a technical seminar at NEA conference room
5. Monday, July 16, 2018: Consultation on remote island microgrids at NEA conference room
6. Monday, July 16, 2018: Information sharing on project progress at JICA Philippines Office
7. Monday, July 16 and Wednesday, July 18, 2018: Consultation on pilot project implementation
   At BATELEC II
8. Tuesday, July 17 to Wednesday, July 18, 2018: Held a technical seminar
   At NEA seminar room Target: EC in north and south of Luzon
9. Thursday, July 19 to Friday, July 20, 2018: Held a technical seminar
   At NEA seminar room Target: EC in Visayas, Mindanao
10. Friday, July 20, 2018: Information collection meeting in ADB at ADB conference room

4.3.3. Results of the 3rd Field Activities

In the 3rd field activity, the following results were obtained through the implementation of technical seminars, etc.:

- At the meeting with the NEA at the time of the follow-up trip, agreement of the management policy of the technical seminar presented by our company was obtained. We came to an agreement on gaining the cooperation of the NEA for the detailed decision of the seminar (presentation contents of both Japan and the Philippines, timetable, and management system).
- Through the technical seminar, we basically reached an understanding of participants about overall distribution technology in Japan and the effectiveness of the proposed technology.
- Field tests of the pilot project target areas, information collection, technical discussions, and coordination were conducted, and the following were confirmed:
  - The layout of equipment in the SCADA room of the new substation at BATELEC II headquarters had changed from the plan, so a measurement survey was conducted to accommodate the change in layout.
  - Regarding the communication environment of the Padre Garcia Substation, although the communication itself was established, the acquired data remained abnormal. However, it was found that the recloser will be updated to another manufacturer's recloser before the implementation of the pilot project, so a retest will be carried out at the time of the trip in September after installation of the new product is complete.
- In the meeting with the JICA Philippines Office, we were advised that although it is becoming difficult to implement grant-aid projects in the Philippines, remote island microgrids may be an individual topic, and that if they are mentioned in the supplementary budget theme, it will be advantageous to adoption judgment.
- In the meeting with ADB, we confirmed that not only applications by NEA but also ECs could be eligible for ADB assistance as beneficiaries. We will consider an approach to ADB as needed in future technology dissemination activities. In the proposal to ADB, we were advised that innovative technologies should be involved, since the viewpoint of distribution automation alone is not a sufficiently appealing point.

4.3.4. Issues for the 3rd Field Activities

The following issues were recognized in the 3rd trip:

- In the communication with the EC participants in the technical seminar, it was recognized that there was a difference in the facility formation from Japan, where loads are concentrated in specified areas, and EC, where loads are scattered. Therefore, it is necessary to consider and propose the introduction of Japanese technology in an optimized manner, after grasping in more detail the situation of the load on the other party and the actual conditions of the facilities based on the load.
- In addition to improving supply reliability, it is necessary to grasp in more detail the multiple issues to be addressed by the EC, such as the introduction of renewable energy sources based on the RPS Law, and to consider the optimal combination of technologies that Japan can offer.
- The MOU for the pilot project with BATELEC II is awaiting approval from the upper ranks of NEA, but it is necessary to make a list to show who will do what by when and to clarify the boundary of responsibility by the time the equipment is exported.

4.4. 4th Field Activities

4.4.1. Purpose of Trip

Activities were carried out for the following purposes:

- Hold consultations toward future dissemination and deployment to the NEA Technical Department and further collection of information since ECs which are targeted for dissemination of the proposed technologies were extracted, based on the information obtained at the Technical Seminar in July 2018.
- Report the results and analysis of the tests conducted on the participants at the Technical Seminar in July 2018 to the Training Department of NEA.
- Conduct on-site equipment tests and confirmation of equipment installation sites, hold discussions on how to obtain power outage results after the introduction of distribution automation system, hold confirmation and discussions on the possibility of multi-division multi-link systems, and hold confirmation and discussions on the acquisition of fault point identification data at BATELEC II, the EC subject to the pilot project. In addition, confirm mutually the demarcation of roles and responsibilities of the pilot project, and reach agreement by signing the minutes by the BATELEC II President and the operation chief.
- Explain to the Japanese Embassy in the Philippines about the implementation of EMS on remote island microgrids, for which NEA's ORED has requested cooperation, and future responses including a pre-FS survey, and obtain information on possible funding for project implementation.

4.4.2. Implementation Process

The following were implemented in the 4th field activities:

1. Wednesday, September 12, 2018: Information sharing on project progress was held at JICA Philippines Office.
2. Wednesday, September 12 to Thursday, September 13, 2018
   Discussion on pilot project implementation at BATELEC II
3. Friday, September 14, 2018: Consultation on future deployment to ECs which are targeted for dissemination At NEA conference room
4. Friday, September 14, 2018: Report of results and analysis of the test at the previous technical seminar At NEA conference room
5. Friday, September 14, 2018: Information sharing on remote island microgrids
   At Embassy of Japan in the Philippines

4.4.3. Results of the 4th Field Activities

The following results were obtained in the 4th trip:

- Consultations were held with the NEA Technical Department on the future dissemination and deployment of the proposed technology to ECs which are targeted for dissemination, and information collection methods, and based on the obtained information that contributes to future activities such as budgets allocation of ECs, ECs whose information will be collected further as targets will be carefully selected.
- Reported the results and analysis of the tests conducted on the participants at the Technical Seminar in July to the NETI of NEA. As the analysis results showed the weak areas of the participants, it was possible to provide information on the issues that NETI should focus on in the future.
- Field tests, information collection, technical discussions, and coordination were conducted at the target sites of the pilot project, and it was found that the substation relay installed at the new Antipolo Substation had not set the information that we wanted to obtain in the distribution automation system, so we asked the company to set the logic, etc.
- With regard to the process sheet and MOU (draft) that clarify the responsibility demarcation point between BATELEC II and TAKAOKA TOKO that are parties to implementation of the pilot project, the two parties agreed that BATELEC II GM and the operation chief would sign the MOU by the time of equipment export.
- We explained to them about the necessity of a simplified on-site survey for sharing information on remote island microgrids with the Embassy of Japan in the Philippines and that even if an on-site investigation is to be conducted, it would have to be a business trip associated with other projects from the viewpoint of costs. They requested us to notify them when the future plan and schedule are confirmed.

4.4.4. Issues for the 4th Field Activities

The following issues were recognized in the 4th trip:

- In order to solve the issue of receipt of equipment export, we will continue to explore what appropriate procedures are possible and also explore whether it is possible to conduct unaccompanied transportation such as overseas moving.
- As delay in the progress of BATELEC II in the pilot project was found, it is necessary to adjust the process of equipment preparation, export, and installation in an efficient manner so that the time required for obtaining the power outage results and evaluating the demonstration test after the commissioning of distribution automation system can be ensured.
- Based on the information obtained from NEA that contributes to future activities, such as budgets of ECs, we would carefully select ECs that we will target and further collect information from in the future.

4.5. 5th Field Activities

4.5.1. Purpose of Trip

Activities were carried out for the following purposes:

- Verify the operation of the equipment of the Antipolo Substation at BATELEC II and conduct communication tests on the equipment newly installed at the Padre Garcia Substation for replacement.
- Request discussions on and approval of the MOU to mutually confirm the demarcation of roles and the responsibility demarcation point of the pilot project in the BATELEC II Board of Directors.

- Visit the ECs which are targeted for dissemination, NEA and DOE, which are government agencies, to explain the functions and advantages of the system emphasizing its usefulness, and to confirm whether it is acceptable to share distribution automation system, which enables the introduction of the system at a lower cost.

4.5.2. Implementation Process

The following were implemented in the 5th field activities:

1. Wednesday, November 7 to Thursday, November 8, 2018
   Discussion on pilot project implementation at BATELEC II
2. Tuesday, December 4, 2018: Marketing to ECs which are targeted for dissemination at PENELCO
3. Wednesday, December 5, 2018
   Consultation on future deployment to ECs which are targeted for dissemination at Department of Energy (DOE)
   Consultation on future deployment to ECs which are targeted for dissemination and discussion on pilot project implementation At BATELEC II
4. Thursday, December 6, 2018: Consultation on future deployment to ECs which are targeted for dissemination At National Electrification Administration (NEA)
5. Friday, December 7, 2018: Information sharing on project progress was held at JICA Philippines Office
   Marketing to ECs which are targeted for dissemination at PELCO II

4.5.3. Results of the 5th Field Activities

The following results were obtained in the 5th trip:

- Field tests, information collection, technical discussions, and coordination were conducted at BATELEC II. Communication tests of the substation relay installed at the Antipolo Substation were completed. Since the information to be obtained in the pilot system has not been set, we requested them to set the necessary file. Work on the new recloser to be installed at Padre Garcia Substation had not been completed, so the communication test had to be carried over to the next time.
- We requested them to obtain approval for a process sheet and MOU (draft) that clarify the responsibility demarcation point between BATELEC II and TAKAOKA TOKO in the Board of Directors of BATELEC II in December, and obtained their understanding.
- We visited the ECs which are targeted for dissemination of the proposed technologies to deepen their understanding of the usefulness of the system, and also confirmed that the idea of sharing the system, which can be used at a lower cost, can be accepted if some issues, such as ensuring security, can be resolved.

4.5.4. Issues for the 5th Field Activities

The following issues were recognized in the 5th trip:

- Since necessary information such as switch status, relay operation, measurement information (voltage and current), etc. are not set in the equipment setting of Antipolo Substation, it is necessary to compile the necessary information as a document and present it to the equipment distributor via BATELEC II, and to request an answer of what can and cannot be set and a presentation of an address map. Since it was found that the required information was not installed in the recloser of Padre Garcia Substation, and the investigation could not be carried out, it is necessary to obtain the required configuration file at a

later date, adjust it, and ask them to install it. The information that needs to be set up must also be compiled into a document and presented to a distributor via BATELEC II. Required documents have been prepared and sent to BATELEC II.

- Toward the dissemination of distribution automation system, based on the information obtained from ECs and NEA that will contribute to future activities, we will prepare answers to issues and challenges obtained in this time's trip and will conduct further activities to promote understanding in the next trip, leading to dissemination of the system.

4.6. 6th Field Activities

4.6.1. Purpose of Trip

Activities were carried out for the following purposes:

- In BATELEC II, the EC subject to the pilot project, the operation verification of the equipment of both Antipolo Substation and Padre Garcia Substation, which are the substations for the pilot project, would be carried out following the previous introduction.
- Confirm the progress of the optical fiber work by BATELEC II for the pilot project and adjust the schedule of the operation training for introducing distribution automation system.
- Meet the ECs which are targeted for dissemination, NEA and DOE, which are government agencies, to explain the functions and advantages of the distribution automation system emphasizing its usefulness, and to confirm whether it is acceptable to share the system, which would enables the introduction of the system at a lower cost. In addition, in order to have an opportunity to introduce the proposed technologies at the regional conference of ECs where multiple ECs gather, see the chairs of the region conference and request them to participate in the meeting.

4.6.2. Implementation Process

The following were implemented in the 6th field activities:

1. Wednesday, February 6 to Thursday, February 7, 2019: Discussion on implementation of the pilot project At BATELEC II, PESIN, PPI
2. Tuesday, March 5, 2019: Meeting of three entities of DOE, NEA, and BATELEC II at DOE
3. Tuesday, March 5, 2019: Discussion on pilot project implementation in Bonifacio Global City
4. Wednesday, March 6, 2019: Consultation on future deployment to ECs which are targeted for dissemination at PENELCO
5. Thursday, March 7, 2019: Consultation on future deployment of distribution automation systems, etc. at ADB
6. Thursday, March 7, 2019
   Discussion on pilot project implementation and consultation on future deployment to ECs which are targeted for dissemination At BATELEC II
7. Friday, March 8, 2019: Consultation on future deployment to ECs which are targeted for dissemination at BATELEC I

4.6.3. Results of the 6th Field Activities

The following results were obtained in the 6th trip:

- In the operation verification in BATELEC II, the circuit breaker of Antipolo Substation was tested for communication setup, connection, synchronization, and data transmission/receiving using the demonstration equipment, and it was confirmed that there were no problems in almost all test items. With regard to the testing of the recloser of Padre Garcia Substation, testing of communication setup, connection, and synchronization under IEC 61850 using the demonstration equipment was successful. Since the data transmission/receiving was not successful, a direction was adopted that if mechanical

data transfer is not expected in future verification, the information on the substation SCADA display would be obtained and operated manually.

- Confirmed the date of the optical fiber construction work by BATELEC II and agreed that the operation training would be carried out in the week of Monday, April 8, 2019.
- We visited the ECs (PENELCO, BATELEC I) which are targeted for dissemination of the proposed technologies to deepen their understanding of the usefulness of the DNMS, and also presented the idea of sharing the system, which can be used at a lower cost, and how to ensure security. In addition, based on the discussion with chair EC (BATELC I), an opportunity was obtained to present the proposed technologies at a region conference where multiple ECs gather.

4.6.4. Issues for the 6th Field Activities

The following issues were recognized in the 6th trip:

- With regard to the Antipolo Substation whose operation has been verified, we requested BATELEC II to set up the local equipment based on the contents verified this time. With regard to the recloser of Padre Garcia Substation where the data transmission/receiving test was not successful, a direction shall be adopted that if mechanical data transmission/receiving is not expected in the future, the information on the substation SCADA screen will be obtained and it will be operated manually.
- Since an opportunity was obtained to present the proposed technologies in a regional conference where multiple ECs gather in order to promote the dissemination of distribution automation system, we will present the proposed technologies to multiple ECs in the next trip, leading to promotion of more ECs' understanding and dissemination of the technologies.

4.7. 7th Field Activities

4.7.1. Purpose of Trip

Activities were carried out for the following purposes:

- Provide operation training for introduction of the distribution automation system at BATELEC II.
- Install a system server in Antipolo Substation, the substation subject to the pilot project, and install the communications equipment housing board at Padre Garcia Substation.
- Confirm the progress of the optical fiber construction work by BATELEC II for the pilot project and coordinate the commissioning ceremony. In addition, coordinate the invitation program in Japan.
- Attend a regional conference where multiple ECs attend to explain the functions and advantages of the distribution automation system emphasizing its usefulness, and to confirm whether it is acceptable to share D-SCADA, which enables introduction of the system at a lower cost.

4.7.2. Implementation Process

The following were implemented in the 7th field activities:

1. Monday, April 8 to Friday, April 12, 2019: Implementation of pilot project operation training
   At BATELEC II
2. Sunday, May 26 to Wednesday, May 29, 2019
   Pilot project server installation work, pilot project commissioning ceremony with BATELEC II, and coordination of training in Japan At BATELEC II
3. Tuesday, May 28, 2019: DNMS dissemination activities to MERALCO
   At MERALCO Head Office
4. Wednesday, May 29, 2019: Pilot project operation commissioning ceremony with JICA Philippines Office and the coordination of visit program in Japan At JICA Philippines Office
5. Thursday, May 30, 2019: Pilot project operation commissioning ceremony with the DOE and the coordination of training in Japan at DOE

6. Thursday, May 30, 2019: Dissemination activities at the Region IV Conference in Quezon City
7. Friday, May 31, 2019: Dissemination activities at the Region III Conference in San Fernando

4.7.3. Results of the 7th Field Activities

The following results were obtained in the 7th trip:

- Operation training for the introduction of distribution automation system was provided and intensive and repetitive demonstrations were provided to 3 core members of training targets to implement the capacity building of leaders in a short period of time.
- In BATELEC II, the EC subject to the pilot project, the distribution automation system server was installed in Antipolo Substation, the substation subject to the pilot project, and the installation of the communication equipment housing board in Padre Garcia Substation was completed. In addition, since 7 controllers were not installed at all, we have BATELEC II install 1 controller in the presence of TAKAOKA TOKO, and urged them to promptly install the other 6 controllers.
- We received information that the optical fiber construction work by BATELEC II had been changed from its own construction to an outsourcing and the laying work would be completed in the week of July 15. The date of commissioning ceremony was fixed on July 2.
- We attended the Region IV and III Conferences to deepen their understanding of the usefulness of the distribution automation system, presented the idea of sharing the system, which can be used at a lower cost and how to ensure security, and obtained information that would be helpful for future system development.

4.7.4. Issues for the 7th Field Activities

The following issues were recognized in the 7th trip:

- Since the construction progress of BATELEC II is not smooth as expected and the commissioning has been delayed compared to the initial plan, it is necessary to confirm the progress of the activities of BATELEC II in more detail and realize the prompt commissioning before the rainy season when a large volume of demonstration data will be collected.
- It was found that ECs other than BATELEC II who attended the region meeting were very interested in the demonstration results of the pilot project and wanted to use the results to determine the introduction of the distribution automation system. Therefore, in order to disseminate the system, it is necessary to promptly commence the operation of the distribution automation system in BATELEC II, collect demonstration data, and use the demonstration results to showcase the effectiveness of the system to other electric power companies.

4.8. 8th Field Activities

4.8.1. Purpose of Trip

Activities were carried out for the following purposes:

- Hold the commissioning ceremony of the pilot project in BATELEC II and disseminate the content and significance of the project in the Philippines and Japan.
- Carry out the commissioning test upon completion of the optical fiber work by the company and the electric pole relocation work in BATELEC II and commence the operation of the system.
- Based on the period of about 1 month after the commissioning, implement the follow-up of the operation training, obtain the operation data necessary for the evaluation of the demonstration, and confirm the data content.
- In addition to reporting the progress of the pilot project to NEA and discussing the schedule of future efforts, based on the information that NEA is currently considering the introduction of a system that aggregates power outage information of all ECs, collect information to find out whether it is possible to

be involved in the construction of the system in connection with the deployment of the DNMS in the future.

4.8.2. Implementation Process

The following were implemented in the 8th field activities:

1. Monday, July 1 to Tuesday, July 2, 2019: Pilot project commissioning ceremony at BATELEC II
2. Wednesday, July 3, 2019
   Report on pilot project progress to NEA and information collection for future deployment at NEA
3. Tuesday, July 30 to Saturday, August 3, 2019
   Commissioning test of the DNMS at BATELEC II
4. Monday, September 9 to Saturday, September 14, 2019
   Follow-up and failure investigation after the commissioning of the DNMS at BATELEC II
5. Thursday, September 12, 2019: Information collection concerning the introduction of the DMS in NEA at NEA
6. Monday, September 30 to Wednesday, October 2, 2019
   Request for cooperation for switch removal in response to the occurrence of the DNMS failure at BATELEC II
7. Wednesday, October 9 to Sunday, October 14, 2019
   Response to the DNMS failure (switch removal and dismantling investigation) at BATELEC II

4.8.3. Results of the 8th Field Activities

The following results were obtained in the 8th trip:

- The commissioning ceremony held at BATELEC II was attended by the Department of Energy (DOE), NEA, and JICA Philippines Office, and the commissioning ceremony and the significance of the project were publicized in national newspapers in the Philippines.
- Upon the completion of the optical fiber construction work by BATELEC II and the completion of the electric pole relocation work accompanied by power outage on the distribution line subject to the pilot project, the commissioning test was carried out on the site, and the system operation commenced from August 2.

Figure 4.1 Testing for the commissioning

- Based on the stage when about 1 month had passed since the commissioning of the DISTRIBUTION AUTOMATION SYSTEM in BATELEC II, the operation training provided in April was followed up. In addition, the operational data accumulated in the system necessary for the demonstration evaluation was obtained, the event corresponding to the peculiar data was grasped, and an interview survey was conducted on the content of the response in the field. In addition, training was provided on how to

implement loop switching, which enables switching of sections without power outage of distribution lines.

- With regard to the introduction of a system for aggregating power outage information under consideration by NEA, information was received that a TOR on the system requirements specification is currently being prepared, and a response was received that the proposed system structure was acceptable to NEA.

4.8.4. Issues for the 8th Field Activities

The following issues were recognized in the 8th trip:

- Since the construction progress of BATELEC II was not as smooth as expected and the commissioning has been delayed compared to the initial plan, it was necessary to confirm the progress of BATELEC II in more detail and lead to the prompt commissioning in order to realize the commissioning before the rainy season when a large volume of demonstration data will be collected.
- It was found that ECs other than BATELEC II who attended the region meeting were very interested in the demonstration results of the pilot project and wanted to use the results to determine the introduction of the distribution automation system. Therefore, in order to disseminate the system, it is necessary to promptly commence the operation of the distribution automation system in BATELEC II, collect demonstration data, and use the demonstration results to demonstrate the effectiveness of the system to other electric power companies.

4.9. Acceptance in Japan

4.9.1. Purpose of Invitation Program in Japan

Invite government officials from the target countries of the project to Japan to deepen their understanding of the proposed products and technologies through tours of the electric power supply facilities of TEPCO PG and the plants of TAKAOKA TOKO, to learn about the wide range of practices implemented in the Japanese electric power sector, and to recognize the effectiveness of Japanese technologies and operations in solving the issues and needs of the target countries.

4.9.2. Activity Process

Date	Activities
Monday, July 8, 2019	Orientation
	Courtesy visit to JICA
Tuesday, July 9, 2019	TEPCO PG, Head Office, Company overview, advanced power distribution
	TEPCO PG, Head Office, Advanced Metering Infrastructure (AMI)
	TEPCO PG, Training Center, Indirect live wire construction demonstration
Wednesday, July 10, 2019	TEPCO PG, Ginza Control Station, Eitaibashi Substation, distribution automation system, underground substation
	TEPCO PG, Ginza Control Station, Wrap-up
Thursday, July 11, 2019	TAKAOKA TOKO, Hasuda Plant, showroom (EMS, automatic switch and controller), manufacturing line (pole automatic switch)
	TAKAOKA TOKO, Oyama Plant, distribution automation system demonstration and manufacturing lines of large transformers, systems and disconnecting switches

Friday, July 12, 2019	TAKAOKA TOKO, Head Office, EV rapid charger, EMS, transformer SCADA, pole transformer with tap changer
	TAKAOKA TOKO, Head Office, Wrap-up

4.9.3. Participants

DOE, NEA, BATELEC II

4.9.4. Results of Acceptance in Japan

BATELEC II, the largest EC and pilot project implementation organization in the Philippines, visited the site of the distribution automation system actually operated by TEPCO PG, and gained a better understanding of not only the operation and handling of the system installed at the company, but also the operation and safety assurance of the fault point identification conducted by the site technicians. Based on these results, it is expected that the company will voluntarily establish an operation method that is more appropriate for the actual conditions of the company.

In addition, high interest was shown in the latest equipment technology and practices in the electric power business; therefore, it is considered that the purpose of the activities was sufficiently achieved.

As the participants belonged to various entities such as energy policy-making agencies, regulatory agencies, and electricity distributors, the participants showed a high level of interest in almost all of the activity items due to their own awareness of the issues, even though the activity items covered a wide and diverse range of topics ranging from electric power equipment technology to management policies as electric power utilities and latest practices. Many positive questions were asked, indicating a positive and vigorous attitude toward acquiring new knowledge through the invitation program in Japan. In particular, they were very interested in new technologies, had a good understanding of them, and participated in the activity while always thinking about how they could introduce advanced technologies in their respective positions, and how they could improve their management and their supply reliability through the introduction; therefore, the contents of the invitation program in Japan were very fulfilling and useful to the participants.

4.10. 9th Field Activities

4.10.1. Purpose of Trip

Activities were carried out for the following purposes:

- Since the travel restrictions in the Philippines were relaxed in February 2020 and it became possible to conduct on-site failure investigation and repair work, we conducted failure investigations, including the environment setting change of the system in the control room of BATELEC II, collection and analysis of communication logs, and collection of data stored in the vibration meter attached to the LBS on the pole in cooperation with BATELEC II in January 2022. In addition, explain to BATELEC II the status of the failure investigation and the repair direction, and request their understanding and continued cooperation.
- As part of the failure investigation and repair work, install a client PC operating normally at the TAKAOKA TOKO Oyama Plant in the control room of BATELEC II to investigate the occurrence of the failure. In addition, carry out the work to update the driver for the server system repaired.
- In response to the re-installation work of the repaired LBS, call attention on the construction to prevent recurrence of the failure. Re-install the repaired client PC in the control room of BATELEC II and resume the power distribution automation operation. In order to resume the operation, provide training on the power distribution automation operation to prevent personal injuries and equipment faults caused by incorrect operation or the like.

- About 4 months after the commissioning, notify the GM of BATELEC II of the completion of the repair of failure, and hold discussions prior to the operation confirmation conducted in the presence of NEA. In addition, hold prior discussions on the updating of the MOM concluded between NEA, JICA Philippines Office, and TAKAOKA TOKO in connection with the implementation of the project and the project report meeting.
- In the presence of NEA, BATELEC II, and JICA Philippines Office, confirm the operation of the delivered equipment. In addition, hold discussions on the renewal of the three-party MOM between NEA, the JICA Philippines Office, and TAKAOKA TOKO, the transfer of equipment from the JICA Philippines Office to NEA, and the report meeting.
- After the period of about 7 months after the commissioning passed, we confirmed the demonstration data obtained in normal times and at the time of the distribution line fault and hold hearings on the record of operation in BATELEC II toward the demonstration evaluation. In addition, conduct patrols on foot to investigate the fluctuation of the load on the distribution system (supply and demand points of electricity) of the pilot project.
- Consider the creation of added value by utilizing the results obtained through the project.

4.10.2. Implementation Process

The following were implemented in the 9th field activities:

1. Monday, April 11 to Thursday, April 14, 2022
   Failure investigations on the pilot project system and equipment at BATELEC II
2. Sunday, June 19 to Friday, June 24, 2022
   Failure investigations on the pilot project system at BATELEC II
3. Wednesday, November 16 to Sunday, November 20, 2022
   Operation training and the pilot project system operation resumption at BATELEC II
4. Monday, January 23 to Thursday, January 26, 2023
   LBS installation and the pilot project system full-scale resumption at BATELEC II
5. Sunday, April 2 to Thursday, April 5, 2023
   Completion report of repair of failure and discussions prior to the operation confirmation at BATELEC II
6. Sunday, May 7 to Friday, May 12, 2023
   Operation confirmation of the delivered equipment at BATELEC II
7. Sunday, July 9 to Saturday, July 15, 2023
   Confirmation of the obtained demonstration data and hearings on the operation establishment status at BATELEC II

4.10.3. Results of the 9th Field Activities

The following results were obtained in the 9th trip:

- In April 2022, travel restrictions in the Philippines were relaxed, and it became possible to carry out on-site failure investigations and repair work, such as confirming the installation environment of the control room and obtaining data on the vibration meter installed on the LBS. Based on the on-site investigation, the investigations and repair work were conducted continuously in Japan.


Figure 4.2 Equipment investigation

- In November 2022, the equipment that had been repaired in Japan was transported to the Philippines, and the installation was completed by BATELEC II in the presence of TEPCO PG and TAKAOKA TOKO. At the time of installation of the switch, attention on the construction was called to improve the work quality.
- Operation training (re-training on power distribution line switching operation and loop operation in case of fault and normal operation) was provided to BATELEC II before the commissioning, and operation was resumed without any personal injury or equipment failure. On the other hand, as the power outage area reduced due to customer requests, only the Antipolo distribution line was constructed and the operation was partially resumed.

- In January 2023, the switch installation work was carried out on the Padre Garcia distribution line, and operation was resumed on the entire 2 distribution lines.
- In May 2023, in the presence of NEA, BATELEC II, and the JICA Philippines Office, we got them to confirm the normal operation of the systems, controllers, LBS, and other delivered equipment, and received an operation confirmation from NEA.
- Discussions were held on the updating of the three-party MOM between NEA, JICA Philippines Office, and TAKAOKA TOKO and a decision was made to proceed with the revision procedures.
- JICA Philippines Office held discussions on the transfer of equipment from JICA to NEA, and later it was decided to exchange procedural documents between NEA and JICA.
- Discussions were held on the project reporting session, and NEA proposed that the project be reported at NEA WEEK in early August, and it was decided to proceed with coordination with the relevant parties.
- In July 2023, for the purpose of the pilot project evaluation, the data in normal times and at the time of fault collected in BATELEC II were shared to confirm the details of events that occurred after the system introduction. In addition, through hearings with BATELEC II, the operation establishment was confirmed and the needs for training menus or the like were grasped.
- With regard to the 2 distribution lines of the pilot project, in order to confirm the fluctuation of the load on the distribution system (supply and demand points of electricity) and the actual condition of electricity use, both distribution lines were investigated on foot, and the actual condition was investigated in accordance with the data obtained through hearings and the like. According to the data, the current value pattern obtained from the system (daily load curve) and the actual use of electricity were very similar (such as patterns specific to residential areas and industrial and commercial areas), which confirmed the credibility of the data.
  Since it was found that residential areas under development as shown in the figure below were scattered along the road, it was also confirmed that the construction plan had already been factored into the construction of power facilities through hearings with BATELEC II at a later date. Therefore, since the load (current value) will increase with the progress of development in the future, monitoring by the pilot system is also possible.

4.10.4. Issues for the 9th Field Activities

The following issues were recognized in the 9th trip:

- In the MOM amendment process, BATELEC II issued a letter to NEA under instructions from NEA. In the future, we would get NEA to implement procedures toward the amendment of the MOM. However, as a result of subsequent discussions among NEA, JICA and TAKAOKA TOKO, it was agreed that the MOM would not be amended and the project could continue as it was at the time of conclusion of MOM.
- We got BATELEC II to collect data in normal times and at the time of fault, while the number of distribution line faults where re-retransmission was successful, in which DISTRIBUTION AUTOMATION SYSTEM was most effective, was lower than expected. Based on the collected data, we will consider analyzing the events of other distribution line fault cases and system utilization in normal times, and carry out evaluation.

4.11. 10th Field Activities

4.11.1. Purpose of Trip

The proposing company and BATELECII, which actually operated the equipment in the demonstration, reported to NEA, the counterpart of this promotion project, about the promotion project overview, demonstration evaluation, business development plan after the promotion project, etc. as a summary of the activities. The reported material is attached as reference material at the end of this report.

4.11.2. Implementation Process

Date & time: 4th October, 2023 10:30-12:00
Place: by on-line
Participants from Philippines side:
NEA
BATELECII
Agenda:
-Opening Ceremony
-Opening Message
-Reporting of the Promotion Project
-Comments/Feedbacks

4.11.3. Results of the 10th Field Activities

Report on the demonstration evaluation with a focus on improving supply reliability (SAIDI during normal times and distribution line faults on the demonstration distribution lines) to key personnel at NEA. Besides, discussion was made concerning the effects of introducing the proposed distribution automation system and operation technology and have them understand the effectiveness of distribution automation system.

Chapter 5 Overview of the project (evaluation of implementation results)

5.1. Results of the project (contribution to target countries, regions, and cities)

Not disclosed due to company confidentiality

5.2. Results of this project (business side), remaining issues and solution policies

Not disclosed due to company confidentiality

5.2.1. Results of this project (business side)

Not disclosed due to company confidentiality

5.2.2. Issues and solution policies

Not disclosed due to company confidentiality

Chapter 6 Plan for business development after implementation of this project

6.1. Purpose and objective of the business

Not disclosed due to company confidentiality

6.1.1. Expected results through the business (contribution to social and economic development in target countries, regions, and cities)

Not disclosed due to company confidentiality

6.1.2. Expected business results (business side)

Not disclosed due to company confidentiality

6.2. Business development plan

Not disclosed due to company confidentiality

6.2.1. Business overview

Not disclosed due to company confidentiality

6.2.2. Business targets

Not disclosed due to company confidentiality

6.2.3. Business implementation system

Not disclosed due to company confidentiality

6.2.4. Business deployment schedule

Not disclosed due to company confidentiality

6.2.5. Outlook after business deployment

Not disclosed due to company confidentiality

6.2.6. Investment plan and financial plan

Not disclosed due to company confidentiality

6.2.7. Competition status
Not disclosed due to company confidentiality

6.2.8. Business development issues and solutions
Not disclosed due to company confidentiality

6.2.9. Assumed risks of business development and countermeasures
Not disclosed due to company confidentiality

6.3. Possibility of cooperation with ODA projects

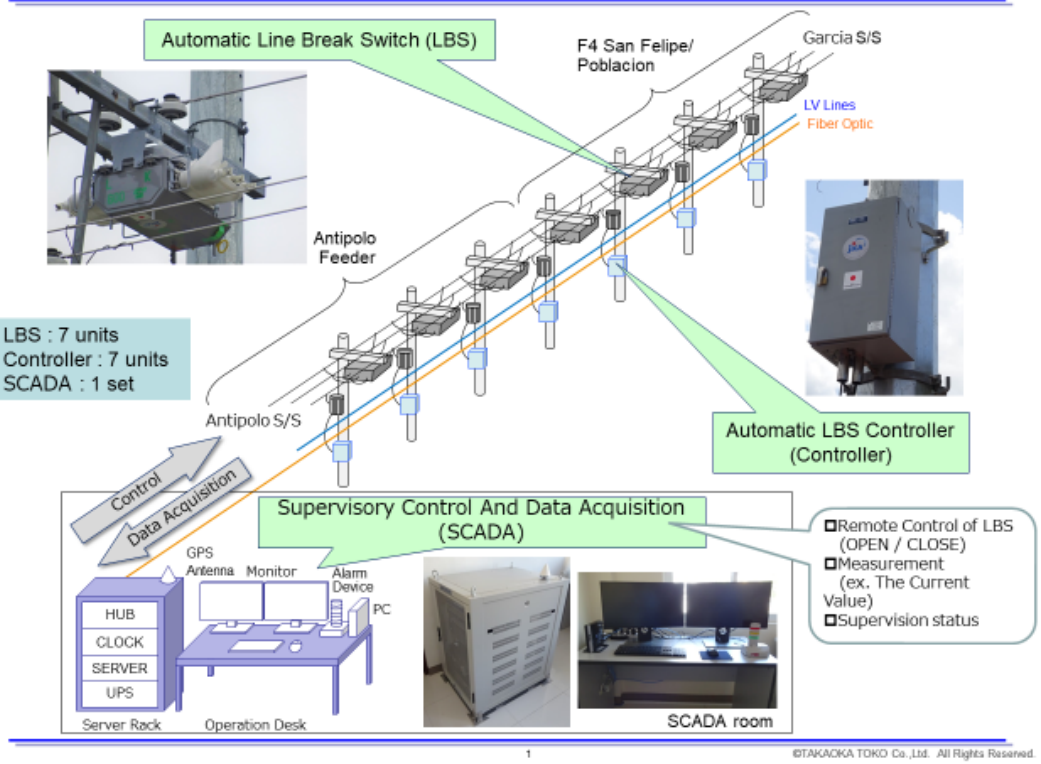
6.3.1. Necessity of cooperative projects
Not disclosed due to company confidentiality

6.3.2. Expected business scheme
Not disclosed due to company confidentiality

- Attachment 1　Presentation material for Invitation Program

➢ Introduction of DAS

System Configuration of Pilot Project



Symbol List on SCADA

Name (Symbol)	Symbol	Color	Status
Transformer		White (fixed color)	
Recloser(FCB)		Gray	
Substation Inside Line		White (fixed color)	
Distribution Line Segment		Gray	Initial status or controller communication error
		Red	Energized
		Green	Outage
		Yellow	Accidental power outage
Tie LBS		Gray	Initial state or controller communication error
		Red	Close
		Green	Open
		Yellow	Operation prohibited
Section LBS		Gray	Initial state or controller communication error
		Red	Close
		Green	Open
		Yellow	Operation prohibited

① Y lock

② "Manual" switch or "OFF" breaker symbols.

③ Lockout

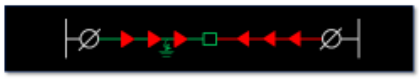
Demonstration Cases

①Fault (in 2nd section)
②Planned Outage (in 2nd section)

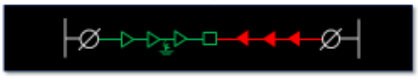
Demonstration case 1 - Fault (in 2nd section)

- Original operation system configuration

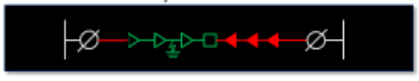
- Fault occurs / No voltage (FCB trips)



- LBS1-3 : Detect no voltage / Automatically open

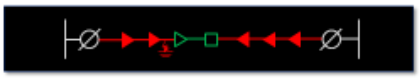


- FCB : Automatically recloses



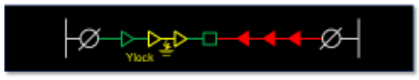
- LBS1 : Automatically closes / 1st section is energized

- LBS2 : Automatically closes

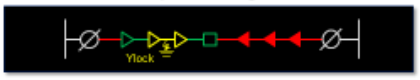


- Fault remains / No voltage (FCB re-trips)

- LBS1,2 : Detect no voltage / Automatically open
- 2nd section : Identified as the fault section
- LBS2 : Lockout (Ylock)



- FCB : Automatically recloses again

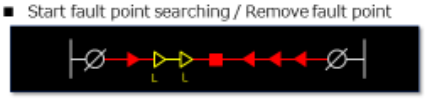


- LBS1 : Automatically closes
  LBS2 (Lockout) : Remain open

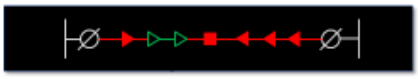
Demonstration case 1 - Fault (in 2nd section)

- Healthy sections are energized from another feeder by SCADA operation

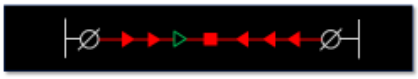
- Safety measures of 2nd section
  - Field crew sets LBS2,3 to lockout
    -> LBS can not be closed during lockout
- Start fault point searching / Remove fault point



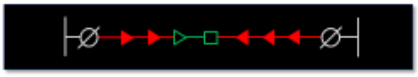
- Finishing of fault point removal
  -> Field crew unsets LBS2,3 to lockout
  -> LBS can be closed
  -> SCADA operator unsets faulted segment setting



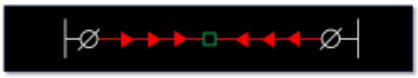
- Operation to restore power in 2nd section from SCADA



- Operation to stop the power in 3rd section from SCADA

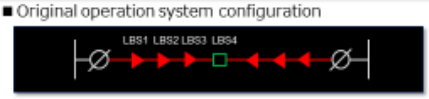


- Operation to restore the power in 3rd section from SCADA
  -> Restoration of the original system

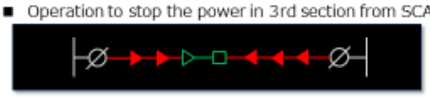


Demonstration case 2 – Planned Outage (in 2nd section)

- Original operation system configuration

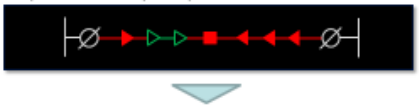


- Operation to stop the power in 3rd section from SCADA



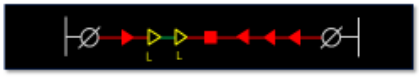
- Operation to restore power in 3rd section from SCADA

- Operation to stop the power in 2nd section from SCADA

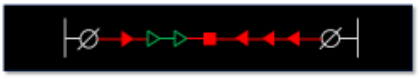


- Safety measures of 2nd section
  Field crew sets LBS2,3 lockout
  ->LBS can not be closed during lockout

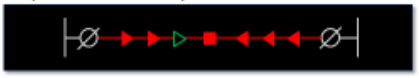
  -> Start work



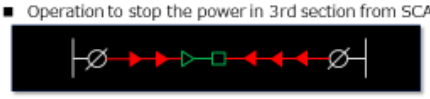
- Finishing of work
  -> Field crew unsets LBS2,3 lockout
  -> LBS can be closed



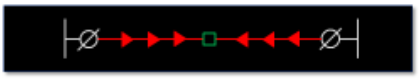
- Operation to restore power in 2nd section from SCADA



- Operation to stop the power in 3rd section from SCADA



- Operation to restore the power in 3rd section from SCADA
  -> Restoration of the original system



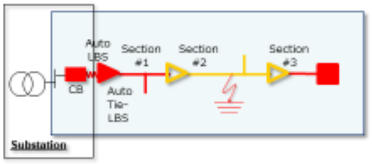
Introduction of Distribution Automation System (DAS)

◆DAS for Minimizing Outage Impact

When Fault occurs, Fault Section in the Distribution Network can be automatically localized by using DAS. Accordingly, other Healthy Sections in the same Network can be restored within a few minutes.

System Configuration

Distribution Automation System (DAS)



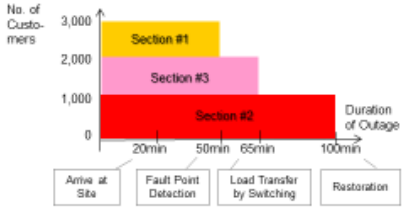
Automatic Line Break Switch (LBS)

Automatic LBS Controller (Controller)

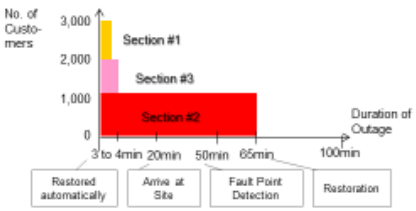
[Line Status] Red : energized section
Yellow: faulted section

[LBS Status] hollowed symbol : open
filled symbol : closed

Before DAS



After DAS



➢ Introduction of EMS (Energy Management System)

Energy Management System (EMS)

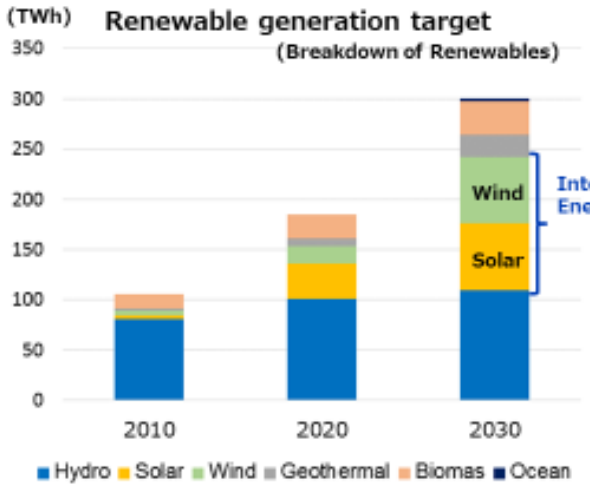
Deployment of Hybrid Renewable Energy System in Nii-jima Islands

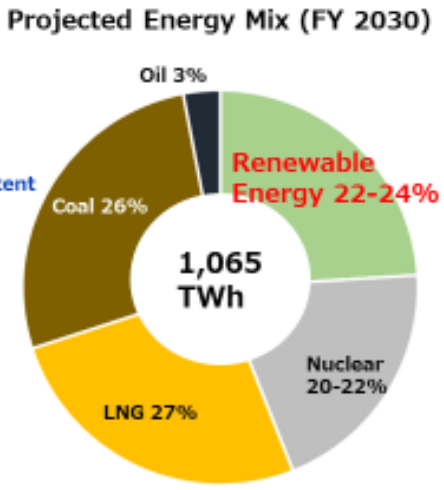
TAKAOKA TOKO Co.,Ltd.
TEPCO Power Grid, Inc.
July 12th ,2019

24%

Project Background

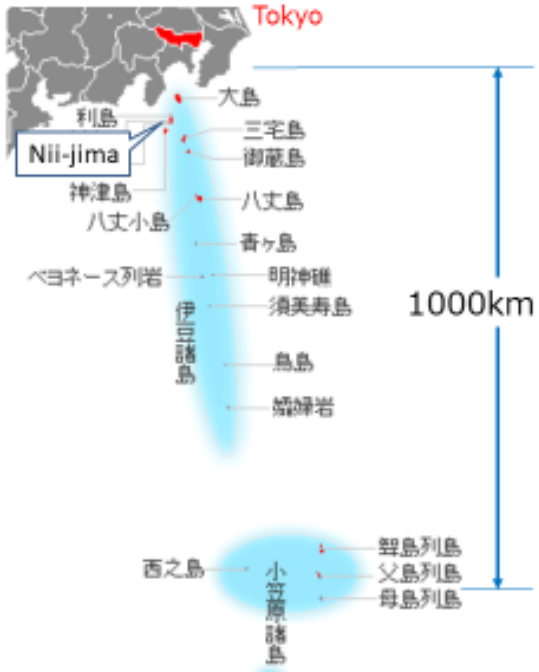
- ✓ Japan has developed renewable generations by introducing FIT scheme, and aims to supply 22-24% of total power demand by RE in 2030.
- ✓ Niijima project intends to develop key technologies to realize future power system in Japan





Source: Japan's energy plan, METI

Remote Islands Area in TEPCO PG



- ✓ TEPCO PG is responsible for power generation & distribution in these islands

General Information	
No. of islands	11
Service Area	340.3㎢
Population	27,800
Electricity Sales	165.6GWh
	(0.06% in total demand)
Generation	54,270 kW (48 units)
Diesel	50,920 kW (46 sites)
Geothermal	3,300 kW (1 site)
Hydro	50 kW (1 site)

Source: Let's go to the Japanese Island, website

TEPCO PG Nii-jima Office

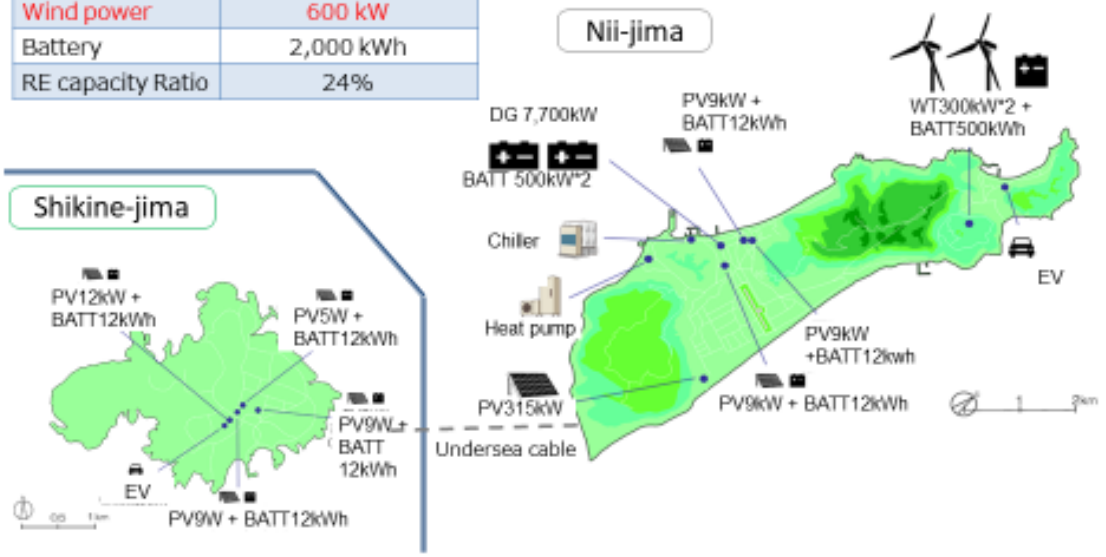
Generation facilities

Gensets (DG)	7,700 kW 2,500 x 1, 2,000 x 1, 1,200 x 1, 1,000 x 2
Solar PV	500 kW
Wind power	600 kW
Battery	2,000 kWh
RE capacity Ratio	24%

System loads

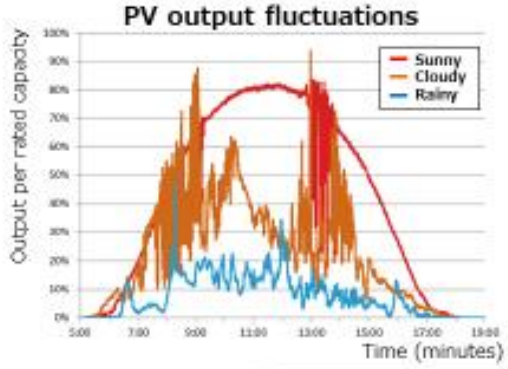
As of 2017

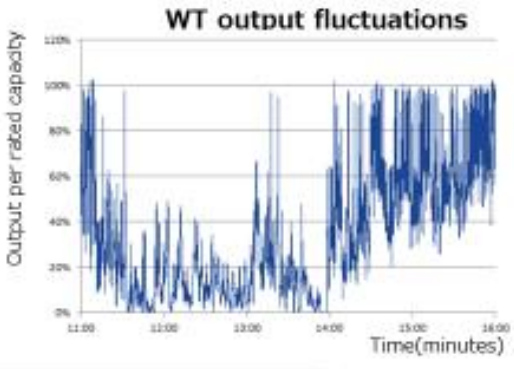
Peak load	4,400 kW
No. of households	1,350
No. of population	2,720

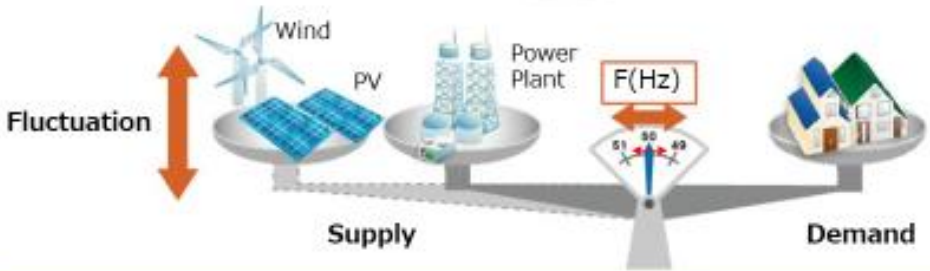


Technical Challenges arisen from RE

✓ Power grid operation becomes more complicated by intermittent RE

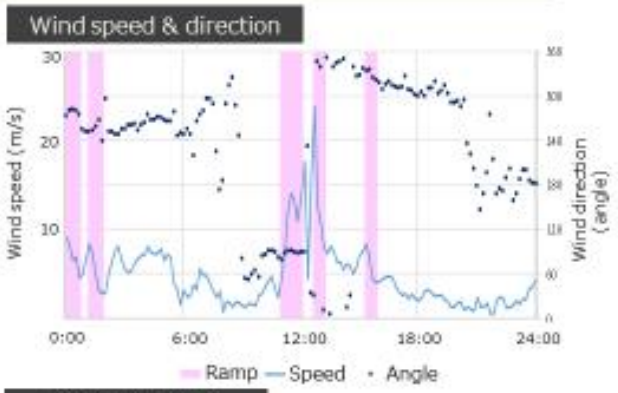


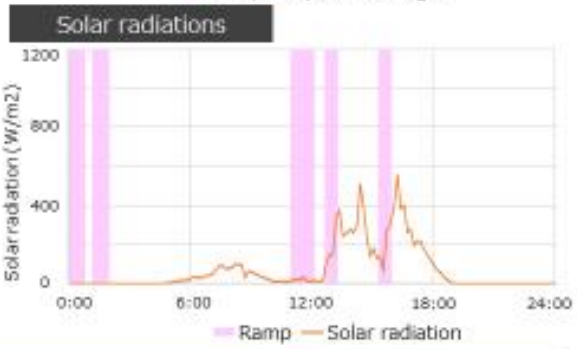




Ramp Variability of Wind & Solar

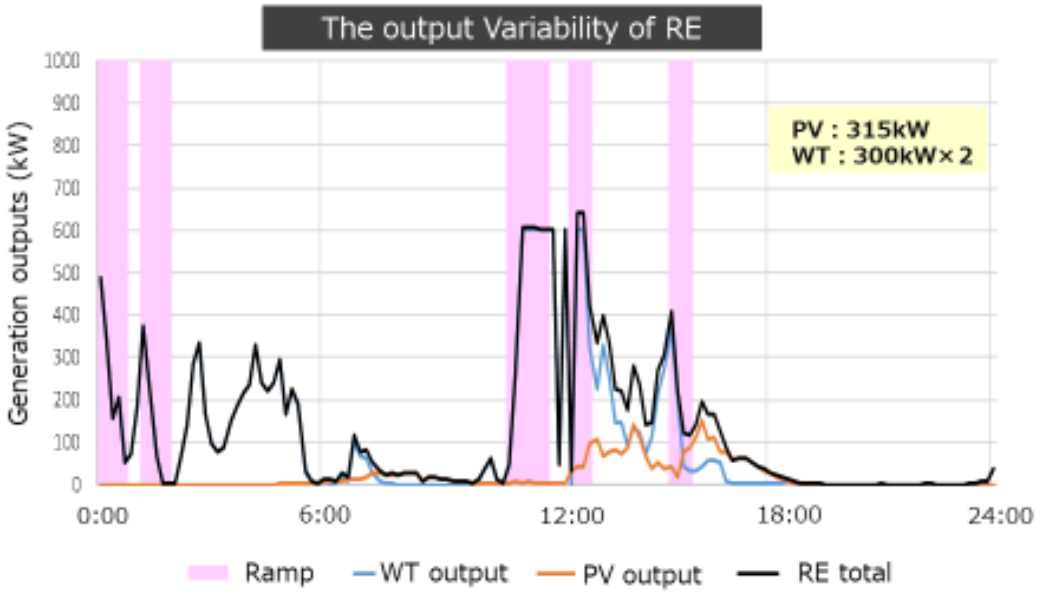
Low pressure passed over Niijima Island around 12am, and the wind speed sharply got strong.





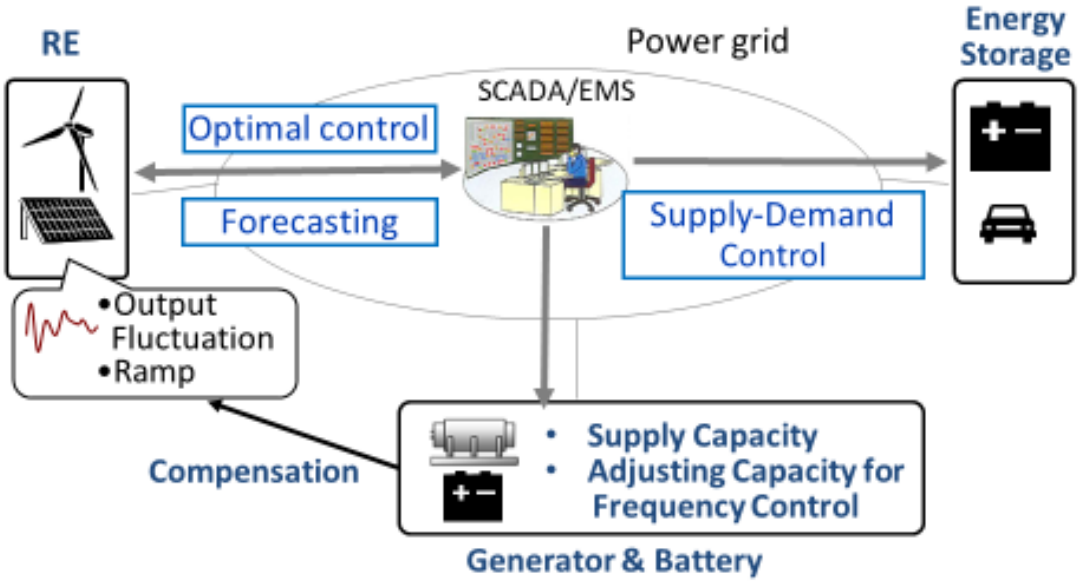
Ramp Variability of Wind & Solar

Sharp weather variation causes over 30% of generation changes within 30 minutes in case of no countermeasures for the intermittence of RE.



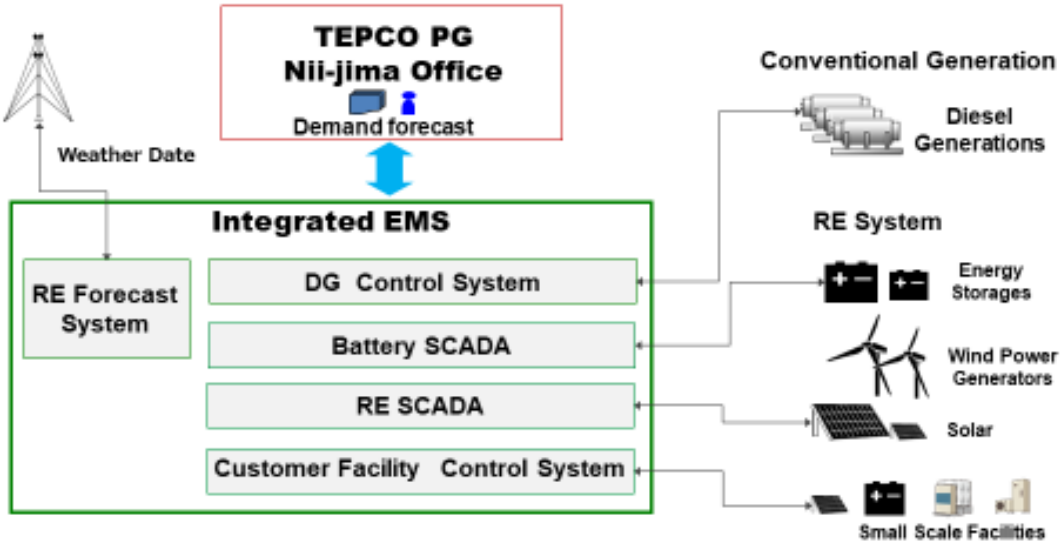
Our approach

Our system maximizes the use of REs by forecasting its fluctuations and optimizing the multiple resources, while ensuring the power stability.



RE Hybrid System in Nii-jima

■ To maximize use of the **RE**, EMS realizes:
* Output prediction, control, and curtailment of wind and solar power generation
* Cooperative control with existing power source and storage battery



Overview of Facilities #1

(1) Wind Power Generation
- WT: 300kW× 2units
- Battery: 500kWh, PCS 500kW

(2) Solar Power Generation
- PV: 318kW, PCS: 315kW
  (Polycrystalline modules, 1,248 panels)

(3) Large-scale Storage Battery
- Battery: Lithium ion (500kWh × 2)
- PCS: 1,000kW × 2


(1) Wind Power Generation


(3) Large-scale Storage Battery


(2) Solar Power Generation

Overview of Facilities #2

(4) Small-type PV and Storage Battery
- PV: 5kW ～ 12kW, 9 sites
- Lithium ion battery: 12kWh (Capacity)
- PCS: 10kW

(5) Heat Pump (Mamashita hot springs)
- Heat capability: 56kW
- Power consumption: 16kW

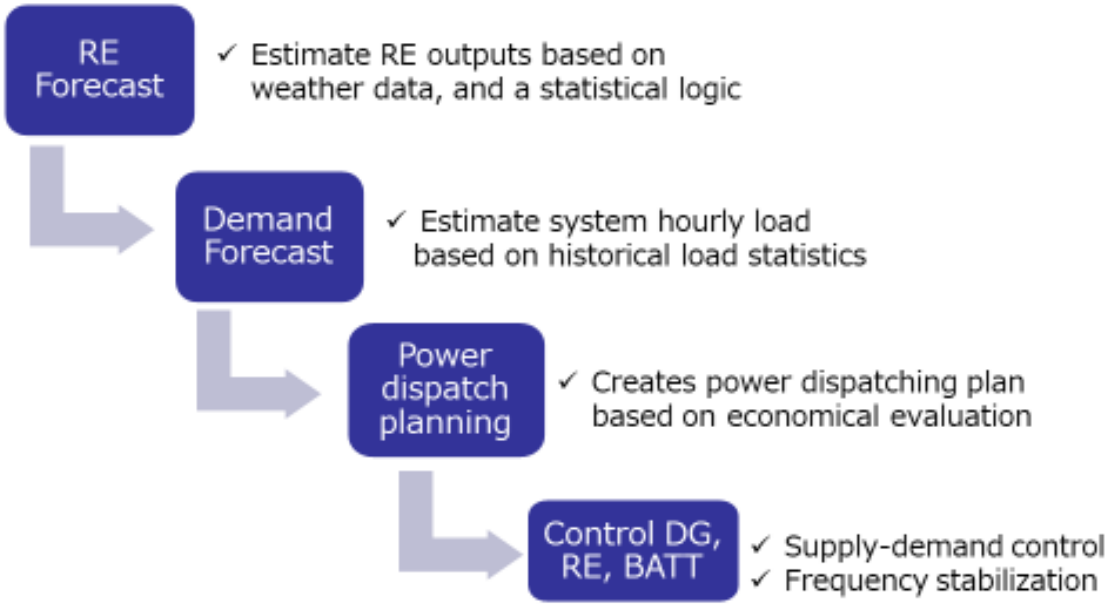
(6) Cooling Facility (Nii-jima fish port)
- Cooling capability: 78kW
- Power consumption: 35kW


(4) Small-type PV Storage Battery (Nii-jima elementary school)

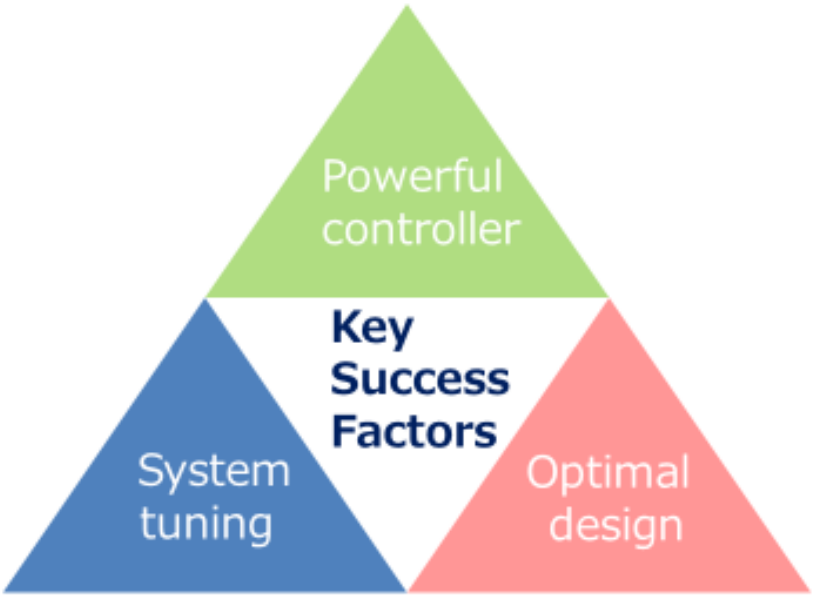

(5) Heat Pump


(6) Cooling Facility

Daily Power Dispatch Planning by EMS



Key Success Factors



Thank you for your attention

➢ Introduction of Substation SCADA

TKTK's Substation SCADA System and Pole-Mounted Distribution Transformer with Automatic Tap Changer

July, 2019
TAKAOKA TOKO Co.,Ltd.

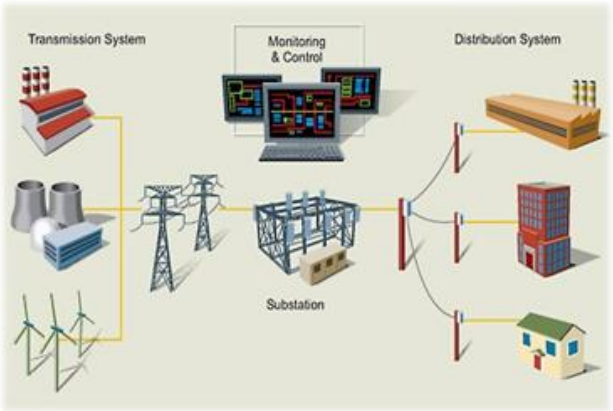
Agenda

1. Overview of SCADA
2. Hardware Structure of TKTK's SCADA
3. Function of TKTK's SCADA
4. Overview of Pole-Mounted Distribution Transformer with Automatic Tap Changer

1. Overview of SCADA

What is the “SCADA” ?

S : Supervisory
C : Control
A : And
D : Data
A : Acquisition



Monitoring and Control of the System by Computer

SCADA Basic Functions

(1)Monitoring

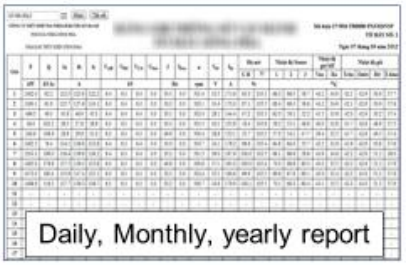
(3) Alarm

(2) Remote control

Central computer

Substation CB, DS

(4) Report



Daily, Monthly, yearly report

Our SCADA Has High Reliability

- We delivered 26 units of substation SCADA to TEPCO and Our SCADA share at TEPCO is 46%.

- We developed two types of SCADA to adapt a lot of clients with different equipment and budget.

1. Standard SCADA

2. Advanced SCADA

TKTK Provides Two Types of SCADA

Standard SCADA	Advanced SCADA
Standard model	High-end model
Standard function	Multifunction
Japanese products and high reliability	SEL Products and Highest Reliability
Made by Mintwave in Japan	Made by ATS in Vietnam
Mintwave is our subsidiary company and offers development, installation and maintenance for TEPCO's SCADA	ATS is our related company and has top share at the SCADA in Vietnam
—	Included Expansion to DAS

Delivery Record for Mintwave

No.	Contens	Country	Year
1	Compact Hydraulic Power Plant	Honduras	2014
2	Distribution Automation System	Philippines	2017-2018
3	Wind Power Generation	Japan	2018

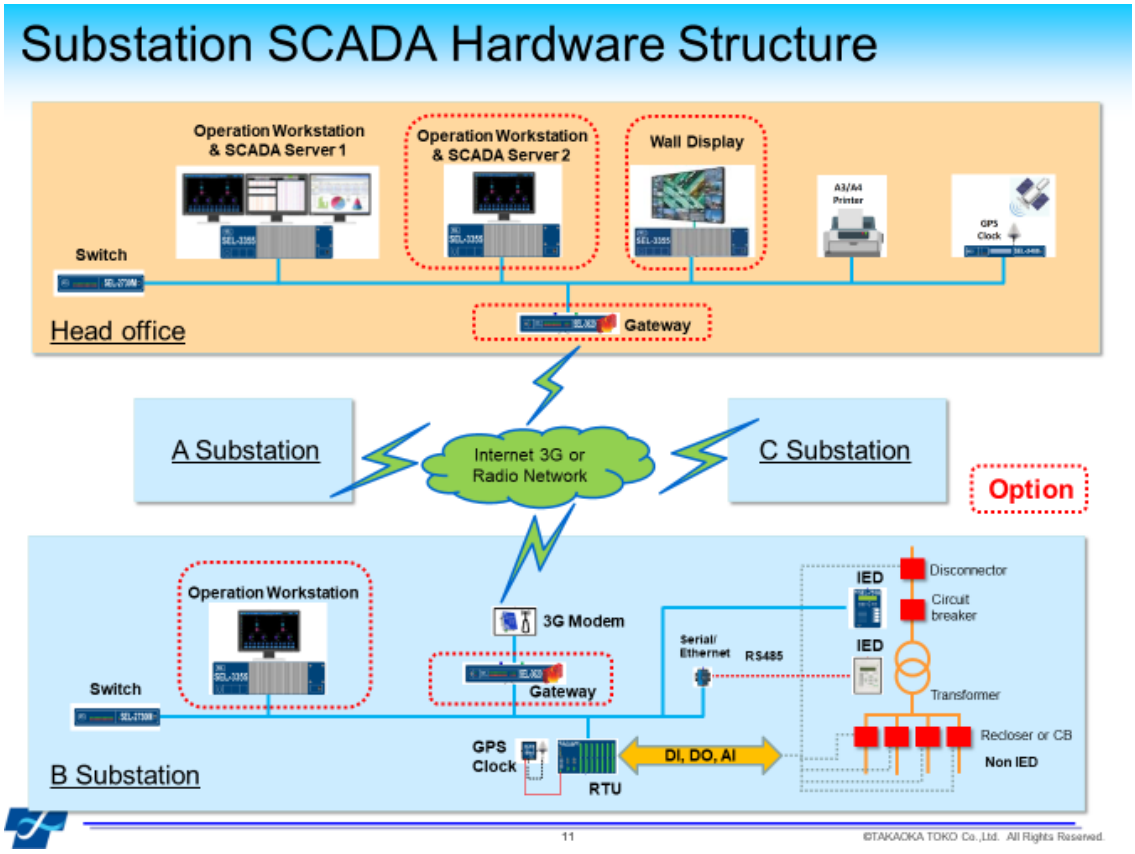
Delivery Record for ATS

Substations

More than 100 substations:

- **500kV Substations**: Cau Bong, Tan Dinh, O Mon, Son La, etc.
- **220kV Substations**: Vinh Long, Thanh My, GIS Tay Ho, etc.
- **110kV Substations**: Intel, Binh Tan, Long My, etc.

2. Hardware Structure of TKTK's SCADA


Substation SCADA Hardware Structure
Operation Workstation & SCADA Server 1
Operation Workstation & SCADA Server 2
Wall Display
A3/A4 Printer
GPS Clock
Switch
Gateway
Head office
A Substation
Internet 3G or Radio Network
C Substation
Option
Operation Workstation
3G Modem
Serial/ Ethernet
RS485
IED
Disconnector
Circuit breaker
Transformer
Recloser or CB
Non IED
Switch
Gateway
GPS Clock
DI, DO, AI
RTU
B Substation
11
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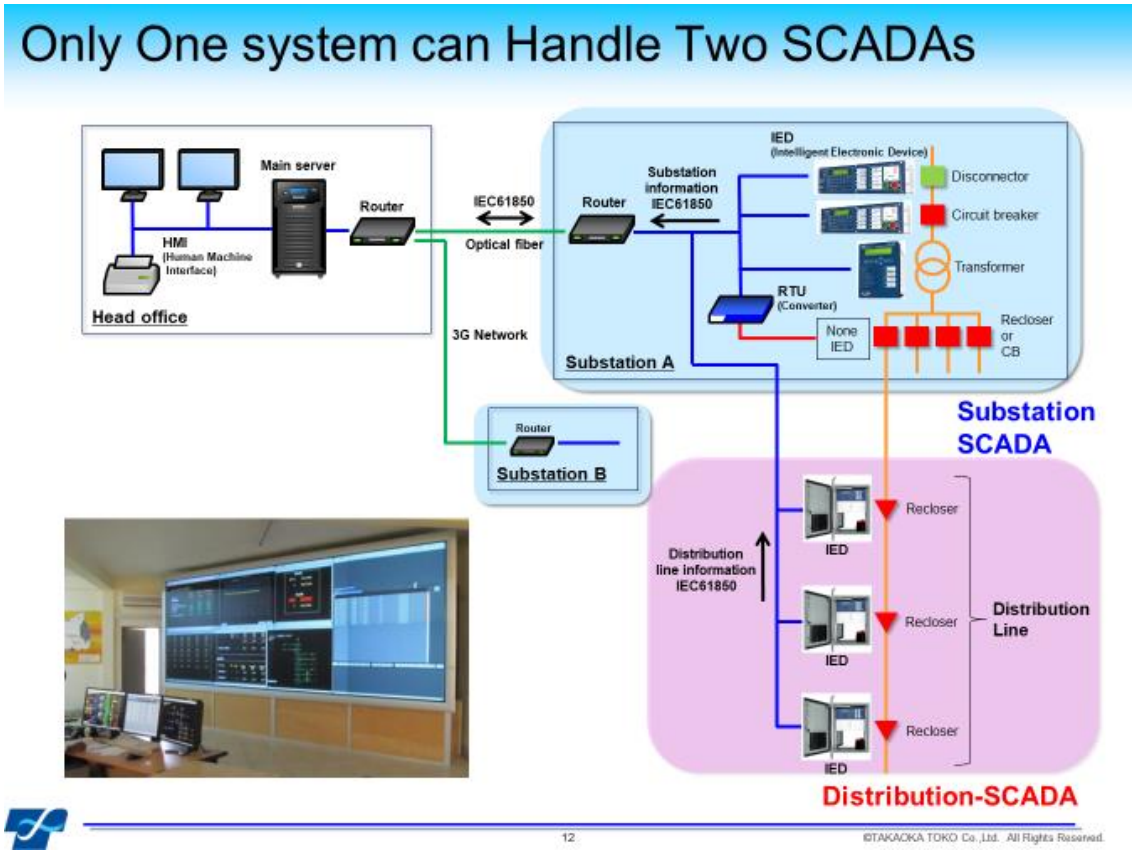
Only One system can Handle Two SCADAs
Main server
Router
HMI (Human Machine Interface)
Head office
IEC61850
Optical fiber
3G Network
Router
Substation information IEC61850
IED (Intelligent Electronic Device)
Disconnector
Circuit breaker
Transformer
RTU (Converter)
None IED
Recloser or CB
Substation A
Router
Substation B
Substation SCADA
Distribution line information IEC61850
Recloser
IED
Distribution Line
Distribution-SCADA
12
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3. Function of TKTK's SCADA

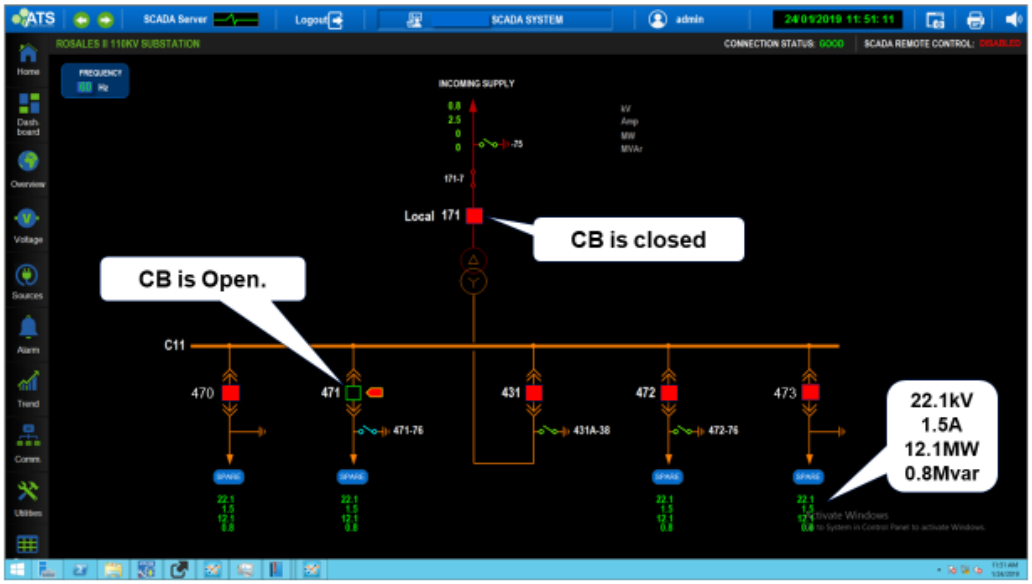
Functions

<Basic Functions>		Standard SCADA	Advanced SCADA
1	Monitoring	O	O
2	Remote Controlling	O	O
3	Alarm Recorder and Manager	O	O
4	Report	O	O
<Useful Functions>			
5	Maintain SCADA data by end-user	O	O
6	Keep the data even though the network is disconnected	O	O
7	Control reclosers on distribution line	O	O
8	Connect cameras into this system	O	O
9	Restrict users on Viewing and Controlling SCADA	O	O
10	Create a daily, monthly and yearly report	O	O
<Special Functions>			
11	Training Function	**Option**	O
12	Pre-Setting Control Sequence	**Option**	O
13	Monitoring substation by smartphone	**Option**	O
14	Expansion to Distribution Automation System	**N/A**	O

<Basic Functions>		Standard SCADA	Advanced SCADA
1	Monitoring	O	O
2	Remote Controlling	O	O
3	Alarm Recorder and Manager	O	O
4	Report	O	O

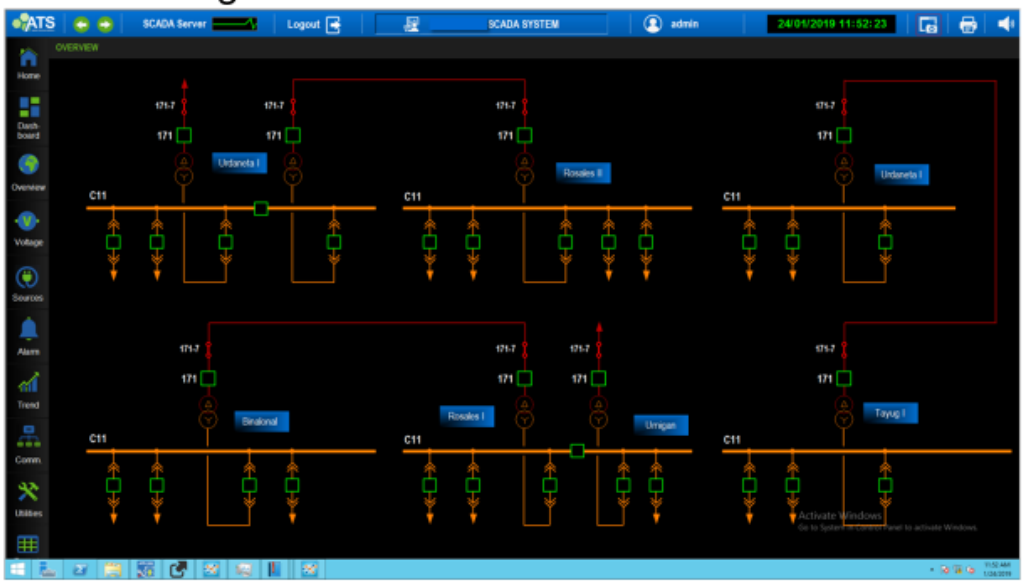
Watch the Status of All Substation Equipment at a Glance

➢ Monitoring



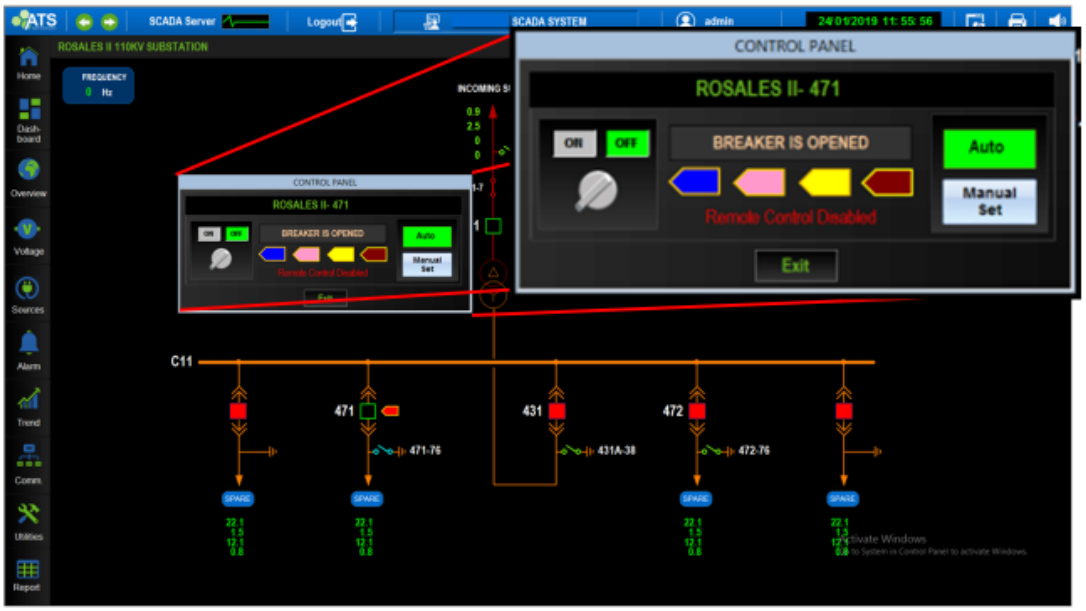
Watch All Substations at a Glance

➢ Monitoring



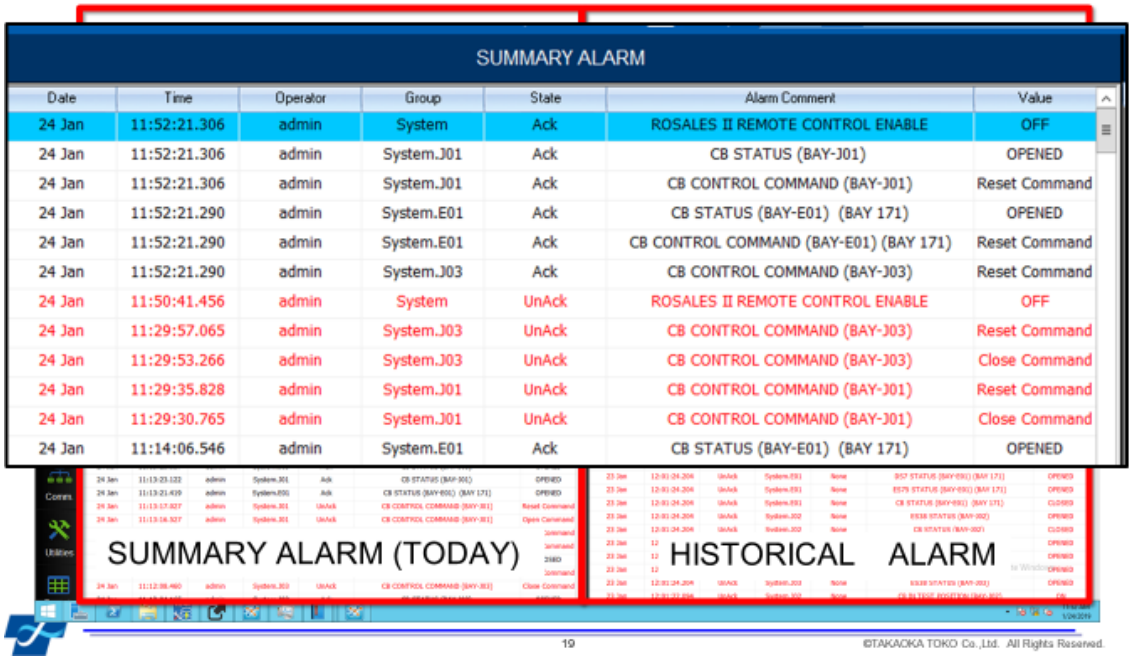
Operate Equipment with Simple Operation

➢ Remote Controlling



Receive All Alarms and Protection Relay Operation

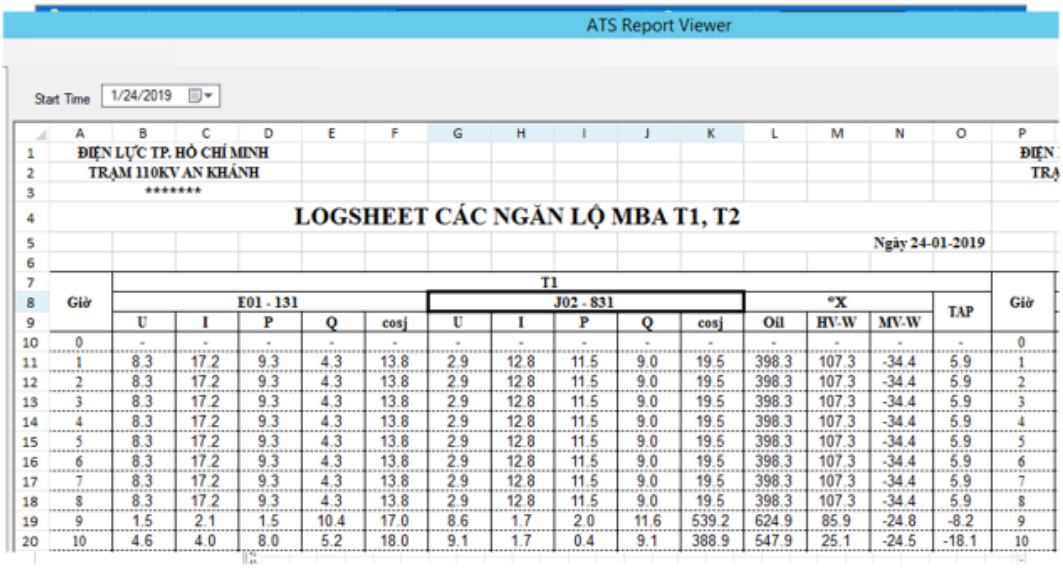
➢ Alarm Recorder and Manager



Date	Time	Operator	Group	State	Alarm Comment	Value
24 Jan	11:52:21.306	admin	System	Ack	ROSALES II REMOTE CONTROL ENABLE	OFF
24 Jan	11:52:21.306	admin	System.J01	Ack	CB STATUS (BAY-J01)	OPENED
24 Jan	11:52:21.306	admin	System.J01	Ack	CB CONTROL COMMAND (BAY-J01)	Reset Command
24 Jan	11:52:21.290	admin	System.E01	Ack	CB STATUS (BAY-E01) (BAY 171)	OPENED
24 Jan	11:52:21.290	admin	System.E01	Ack	CB CONTROL COMMAND (BAY-E01) (BAY 171)	Reset Command
24 Jan	11:52:21.290	admin	System.J03	Ack	CB CONTROL COMMAND (BAY-J03)	Reset Command
24 Jan	11:50:41.456	admin	System	UnAck	ROSALES II REMOTE CONTROL ENABLE	OFF
24 Jan	11:29:57.065	admin	System.J03	UnAck	CB CONTROL COMMAND (BAY-J03)	Reset Command
24 Jan	11:29:53.266	admin	System.J03	UnAck	CB CONTROL COMMAND (BAY-J03)	Close Command
24 Jan	11:29:35.828	admin	System.J01	UnAck	CB CONTROL COMMAND (BAY-J01)	Reset Command
24 Jan	11:29:30.765	admin	System.J01	UnAck	CB CONTROL COMMAND (BAY-J01)	Close Command
24 Jan	11:14:06.546	admin	System.E01	Ack	CB STATUS (BAY-E01) (BAY 171)	OPENED

Get a Report Automatically

➢ Report



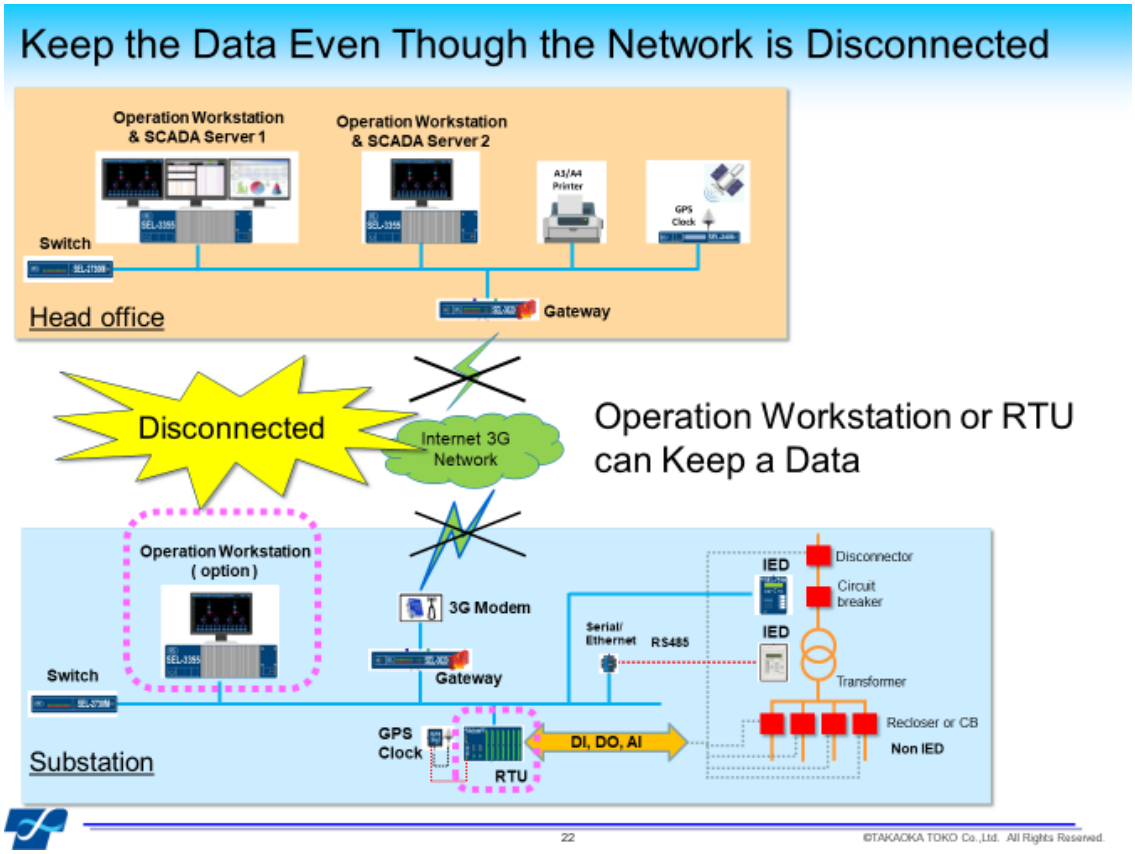
ĐIỆN LỰC TP. HỒ CHÍ MINH
TRẠM 110KV AN KHÁNH
****

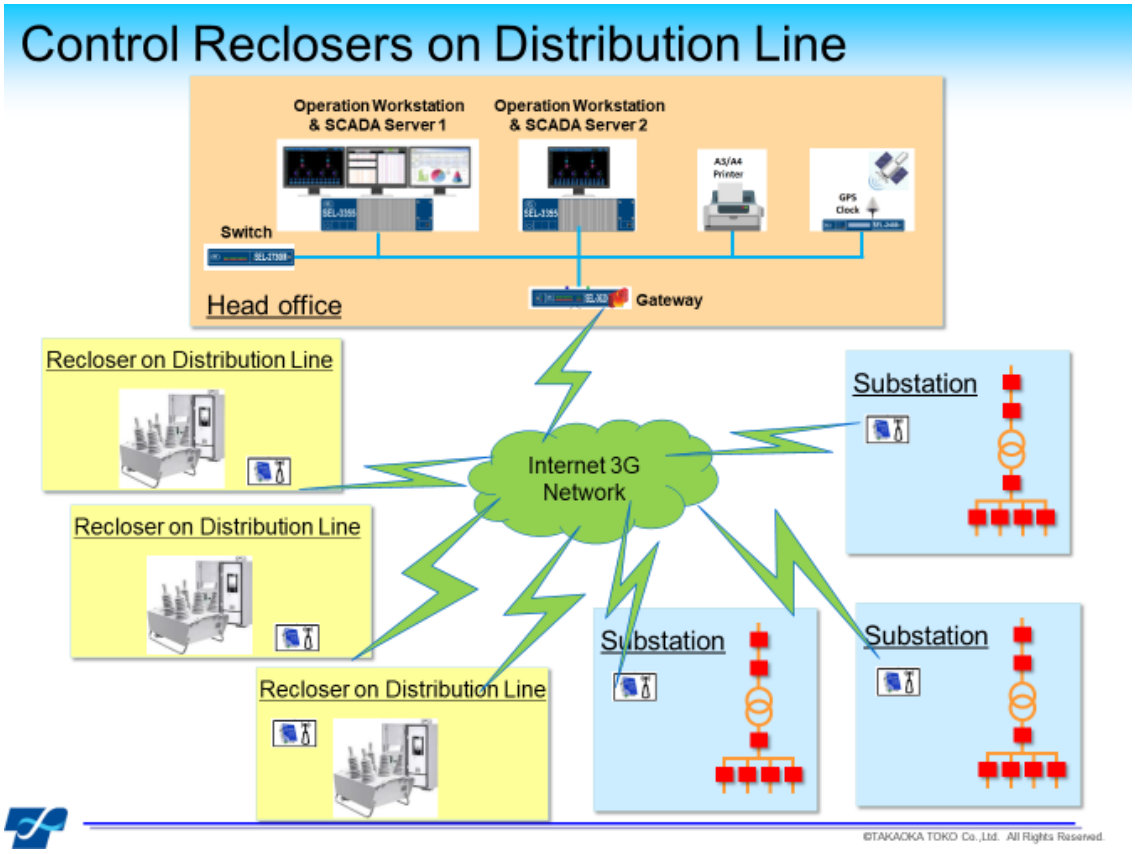
LOGSHEET CÁC NGĂN LỘ MBA T1, T2

Ngày 24-01-2019

Giờ	T1 E01 - 131 U	I	P	Q	cosj	T1 J02 - 831 U	I	P	Q	cosj	*X Oil	HV-W	MV-W	TAP	Giờ
0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
1	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	1
2	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	2
3	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	3
4	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	4
5	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	5
6	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	6
7	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	7
8	8.3	17.2	9.3	4.3	13.8	2.9	12.8	11.5	9.0	19.5	398.3	107.3	-34.4	5.9	8
9	1.5	2.1	1.5	10.4	17.0	8.6	1.7	2.0	11.6	539.2	624.9	85.9	-24.8	-8.2	9
10	4.6	4.0	8.0	5.2	18.0	9.1	1.7	0.4	9.1	388.9	547.9	25.1	-24.5	-18.1	10

<Useful Functions>		Standard SCADA	Advanced SCADA
5	Maintain SCADA data by end-user	○	○
6	Keep the data even though the network is disconnected	○	○
7	Control reclosers on distribution line	○	○
8	Connect cameras into this system	○	○
9	Restrict users on Viewing and Controlling SCADA	○	○
10	Create a daily, monthly and yearly report	○	○




Control Reclosers on Distribution Line
Operation Workstation & SCADA Server 1
Operation Workstation & SCADA Server 2
A3/A4 Printer
GPS Clock
Switch
Head office
Gateway
Recloser on Distribution Line
Recloser on Distribution Line
Recloser on Distribution Line
Internet 3G Network
Substation
Substation
Substation
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Control Reclosers on Distribution Line
➢ Recloser Control Window
ATS
D- SCADA SYSTEM
RECLOSER 01 - DISTRIBUTION LINE 1
Administrator
SCADA1
MEASUREMENT
ALARM
ALARM LIST
MODEM INFORMATION
ATS Smart Modem
TREND
SEL
SEL-651R
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Connect cameras into this system

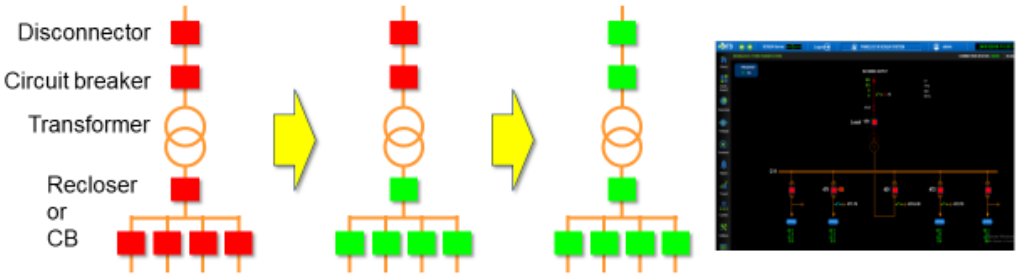
➢ Substation camera surveillance display

<Special Functions>		Standard SCADA	Advanced SCADA
11	Training Function	**Option**	○
12	Pre-Setting Control Sequence	**Option**	○
13	Monitoring substation by smartphone	**Option**	○
14	Expansion to Distribution Automation System	**Not Applicable**	○

Reduce Human Errors by Pre-Setting Control Sequence

- SCADA can enable operator to define device control sequences such as closing and opening CB, etc.
- Once the sequences have been stored, operator can use them at any time.

Stopping operation of a transformer automatically by Pre-Setting Control Sequence



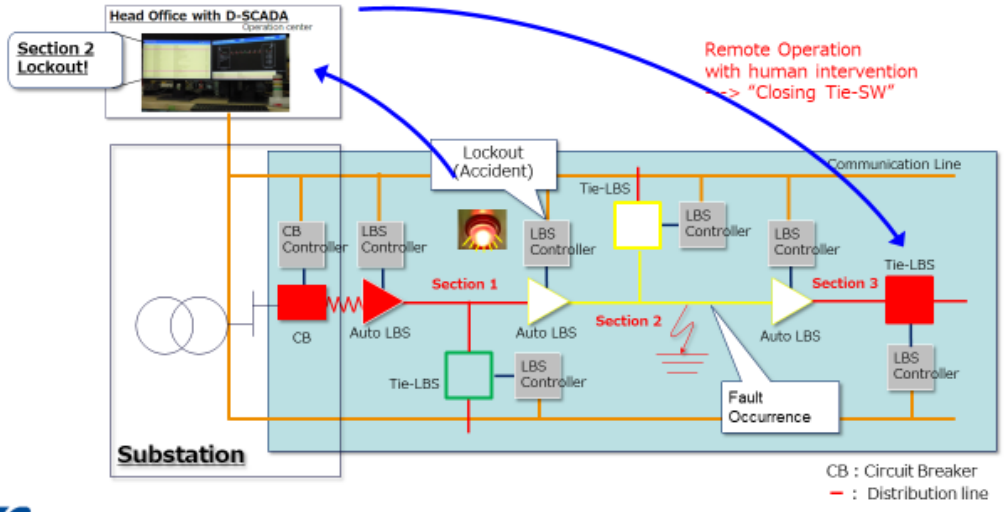
Monitor the Status of the Substation Anywhere

- SCADA has a web application. Users can access the web application with smartphone.
- Users can identify alarms, equipment's status, and real time values such as voltage and current.
- Users can get an alarm message with e-mail from SCADA automatically when alarm occur.

Advanced SCADA Has Expansion to DAS

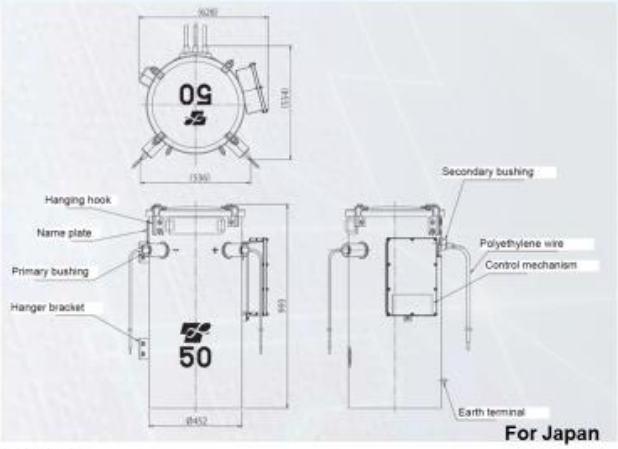
➢ Distribution Automation System (DAS)

DAS can identify and isolate a fault section as well as supervise and control LBS and Recloser.



4. Pole-Mounted Distribution Transformer with Automatic Tap Changer

Pole-Mounted Distribution Transformer with Automatic Tap Changer

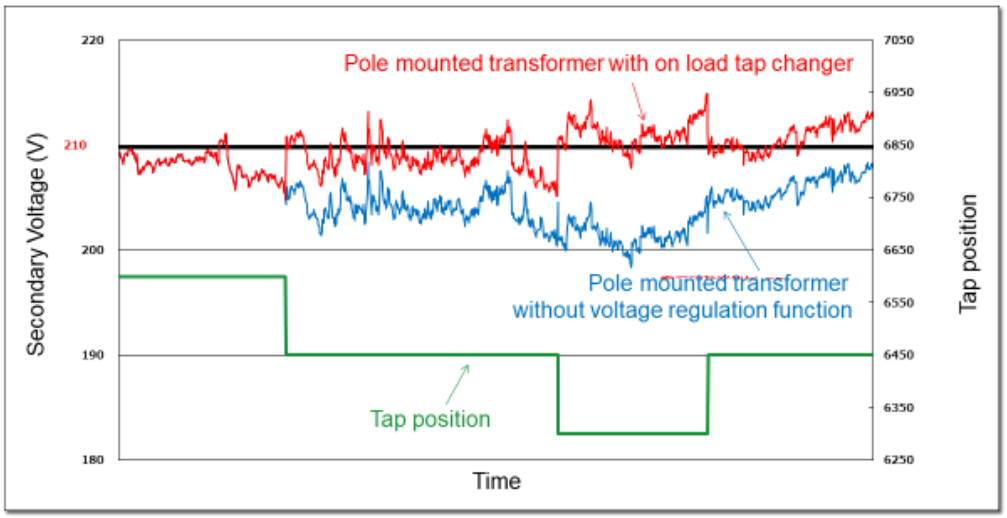


- Always monitoring own secondary voltage
- Automatically changes the tap and adjusts the secondary voltage without blackout

Specification for Philippines	
Rated Voltage	Primary:13200V Secondary:210V/120V
Phase / Capacity	Single-Phase 25kVA
Tap Position (Tap Voltage)	5 taps (13530V, 13200V, 12870V, 12540V, 12210V)
Total weight	390kg

Pole-Mounted Distribution Transformer with Automatic Tap Changer

Automatic Tap Changer can keep Secondary Voltage of the Distribution Transformer within a certain (regulated) voltage range.



Conclusion

1.
-We deal with two types of SCADA,
Standard SCADA and Advanced SCADA.
-You can choose the appropriate one form two SCADAs.
2.
-Our SCADA can supervise and control substation and distribution equipment with one system.
-You will be able to introduce DAS (Japanese distribution automation system) to Advanced SCADA without hardware expansion.
3.
-Our SCADA have unique factions as below.
・Training Function
・Pre-Setting Control Sequence
・Monitoring substation by smartphone
4.
-We are developing the Pole-Mounted Distribution Transformer with Automatic Tap Changer.
-Transformer with Automatic Tap Changer can keep Secondary Voltage of the distribution line within a certain voltage range.

Thank you for your attention.

TAKAOKA TOKO CO., LTD.

[URL] http://www.tktk.co.jp/en
[E-mail] international@tktk.co.jp

● Attachment 2　Presentation material for reporting to NEA

Reporting on the JICA Collaboration Program with the Private Sector for Disseminating Japanese Technologies for Electricity Distribution System and Management

TEPCO Power Grid, Inc.
TAKAOKA TOKO co., Ltd.
Batangas II Electric Cooperative, Inc.

October, 2023

Summary

1. Utilizing JICA's private-public partnership scheme under the cooperation of NEA/BATELEC II, TEPCO PG, TKTK has engaged in the activities concerning the introduction of technologies to realize high supply reliability.
2. Specifically, seminar and site visit in Japan on the said technologies was organized. And PoC of DAS has been conducted to be completed in September 2023.
3. It is confirmed that the system contributes to the improvement of supply reliability and the improvement in daily tasks through the PoC.
4. Capacity Building for operators of DAS has been conducted. Besides, maintenance after the demonstration project was also examined and proposed.
5. TKTK and TEPCO PG found the possibility of management of feeders with interconnection of DER in the future.
6. TKTK and TEPCO PG propose the future plan of dissemination of the technologies to realize high supply reliability in the Philippines.

*NEA; National Electric Administration
*BATELEC II; Batangas II Electric Cooperative
*PG; Power Grid
*TKTK; Takaoka Toko
*PoC; Proof of Concept
*DAS; Distribution Automation System
*DER; Distribution Energy Resources

Agenda

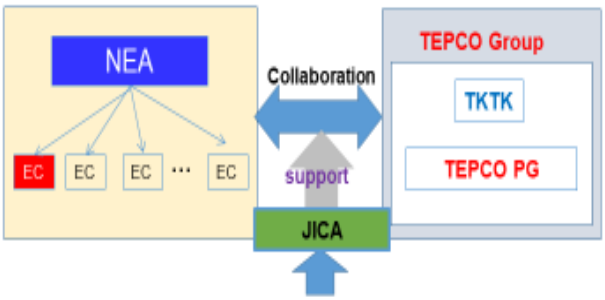
1. Contents of Collaboration Program
2. Applicability of DAS to the Philippines
3. Advantages of Deploying DAS in the Philippines
4. Future Plan

1. Contents of Collaboration Program

1.1 Outline of Collaboration Program

- Theme: Proposal on introduction of technologies to achieve high supply reliability
- Needs of NEA: Higher supply reliability, roadmap towards smart-grid deployment including integration of DER
- Goal of the Collaboration Program:
  - Deepen the understanding of key persons from the Philippines power sector on smart-grid related technologies of Japan
  - Applicability of Japanese smart-grid related technologies and its deployment plan

Implementation structure



Technical cooperation and support of TEPCO Group
- Promotion of understanding of key persons through technical seminar and training in Japan
- Verification of applicability of Japanese smart-grid related technologies through PoC
- Capacity building of operators of DAS at BATELEC II

1.2 Overall Schedule and Activities

Implementation Items	Year					
	2018	2019	2020	2021	2022	2023
Preparation Site Survey	★ Kick-off					
Training & Seminar	Technical Seminar	Site visit in Japan Training for Operators				Training for Operators
Operation of DAS			★ Commissioning Ceremony			
Reporting to NEA						Interim Final ★

1.3 Technical Seminar in the Philippines

- Managers and Experts from NEA and ECs were invited to Technical Seminar held in July 2018.
- Following contents were presented from relevant parties to deepen the understanding of participants regarding technologies to raise supply reliability.

JICA's Activities for Energy Sector in the Philippines (JICA)

JICA Collaboration Program Outline (TKTK)

Technical Presentation (TEPCO Group)

Network Planning Technology of TEPCO (TEPCO PG)
Concept of Smart Grid of TEPCO (TEPCO PG)
Advanced Metering Infrastructure of TEPCO (TEPCO PG)
Loss Reduction Methodologies (TEPSCO)
Operation and Maintenance Equipment (TEPCO Logistics)
Demonstration and Pilot Project (TKTK)
Transformer, Disconnector and Preventive Maintenance Technology (TKTK)

Presentation from NEA

Power Supply Reliability of ECs and Policy of Distribution System Upgrade (NEA)

*TEPSCO; Tokyo Electric Power Service

1.4 Site Visit in Japan

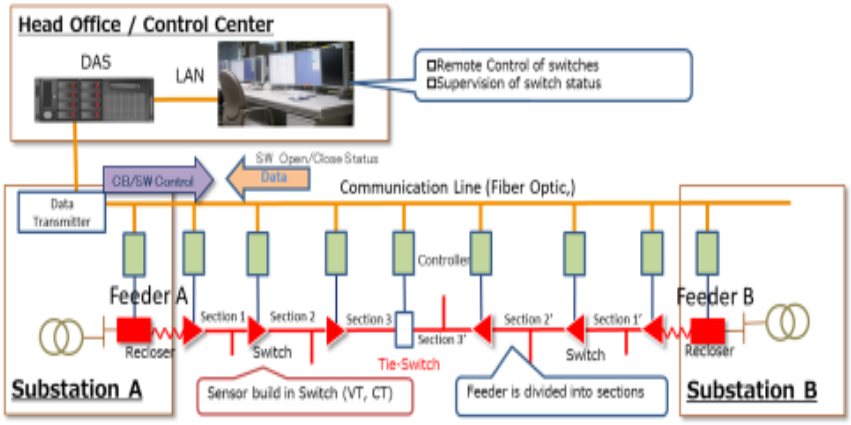
- In 2019, Managers and Experts from DOE, NEA and BATELEC II were invited to site visit in Japan to observe the Practices.

Date	Itinerary	Place
July 8th	Orientation	TKTK HQ
	Courtesy Call to JICA	JICA
July 9th	TEPCO PG Corporate Outline Distribution Advanced Technology Automatic Metering Infrastructure Indirect Live-Line Work	HQ Training Center
July 10th	TEPCO PG Ginza Control Center Wrap-up Meeting	Ginza branch Office HQ
July 11th	TKTK Factory Tour (Switchgear, etc.) TKTK Factory Tour (Large-size Transformer, etc.)	Oyama Hasuda
July 12th	TKTK Energy Management System Step-up Voltage Regulator, etc Wrap-up Meeting	HQ

1.5 Implementation of PoC

- As a component of Collaboration Program, DAS was introduced to two of commercial distribution lines at BATELEC II, one of the ECs, with the aim of improving supply reliability.
- System configuration is as shown below.

  *Implementation period: From January 2018 to August 2023



System Configuration

1.6 Functions of DAS for PoC

	Functions	Contents	Photos
System	Monitoring, Updating and Control	Control and monitoring of OH equipment (LBS)	
	Display, Alarm	Trend monitor (section current/passing current), alarm and recording processing	
	Fault Location, Isolation, Service Restoration	Automatic separation and fault detection (Sequential Reclosing)	
Controller	Control of LBS	Open/Close control of LBS in response to signal from system	
	Data Acquisition	Data acquisition from LBS, storage/transmission to system	
LBS	Load Breaking	Open/Close in response to control signal from controller	
	Data Measurement	Data (voltage/current) measurement by built-in CT/VT	

*LBS; Load Breaking Switch

2. Applicability of DAS to the Philippines

2.1 Applicability of DAS

Das is effective in the Philippines because of the following reason:

- DAS allow operators to remotely monitor the status and performance of the distribution line in real-time.
- Fault Detection is much easier in DAS due to its fault identification capability. It allows the operator to identify what specific segment the fault occurred.
- Transfer of loads from one substation to another improves the reliability of the feeders connected to DAS.

2.2 Operation Records of DAS by BATELEC II

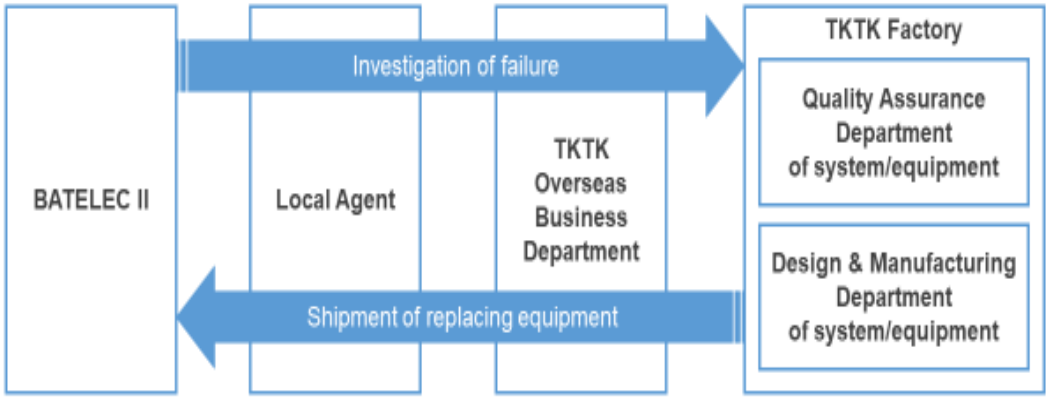
Date	Event	Contents of Operation	Findings
April 29, 2023 07:14 PM	Tripping of fuse cutout at Anilao Labac	Lock current exceeded recorded at PG 0403	Upon inspection, maintenance crew found an animal at primary line that caused fuse cut-out operation Estimated distance of fault – 4.69 kms
May 24, 2023 07:06 PM	Tripping of fuse cutout at Sorrento subdivision	Lock current exceeded recorded at AP 0403	Upon inspection, maintenance crew found an animal at primary line at Sorrento subdivision that caused fuse cut-out operation Estimated distance of fault – 4.83 kms
May 31, 2023 03:37 PM	Tripping of fuse cutout at Avida subdivision	Lock current exceeded recorded at AP 0402	Upon inspection, maintenance crew found a tree touching the primary line at AVIDA subdivision that caused fuse cut-out operation Estimated distance of fault – 2.42 kms

2.3 Capacity Building for Operation of DAS

- In order to effectively utilize DAS, an operator proficiency is necessary and important, so we conducted an education and a training at appropriate timings.
- For the effective education and training, the following programs were provided at before DAS installation, after installation, and several years passed, as well as these programs closely related to daily operations.
  1. Normal operation for everyday
  2. Temporary operation to recover from power outage due to an accident and/or a failure
  3. Planned interruption and restoration operation due to construction, etc.
  4. Loop current calculation for uninterruptible switching

2.4 Maintenance of System/Equipment after the Collaboration Project

- Service flow below is under consideration.
- The primary contact point of BATELEC II: Local agent to be appointed by TKTK
- Local agent report to TKTK for investigating the failure cause and delivering to BATELEC II the equipment to be replaced.



3. Advantages of deploying DAS in the Philippines
Not disclosed due to company confidentiality

4. Future Plan
Not disclosed due to company confidentiality

Thank you for your attention!