



**Power & Renewables**  
Global Engineering and Consulting  
Services

January 2020



# Summary

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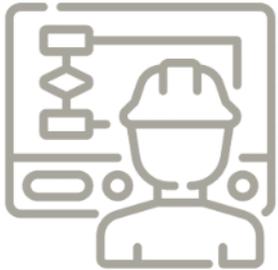
- ❖ Overview on RINA
- ❖ RINA's Power Business Unit
- ❖ RINA - Renewable Energy
- ❖ Solar
- ❖ Wind
- ❖ Energy Storage
- ❖ Testing and Inspections
- ❖ Power Systems
- ❖ Innovation

# Introduction

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With a history going back 150 years, RINA is a global corporation that provides:



## **Consulting Engineering**

Feasibility studies, Design, Project Management and Construction Management, Independent Engineering, Operation & Maintenance.



## **Testing, Inspection and Certification**

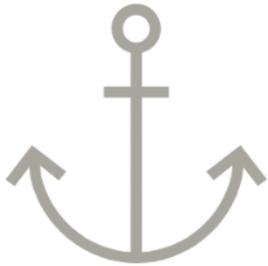
Verification, Certification, Marine Classification, Product Testing, Site and Vendor Supervision, Training.

# Sectors

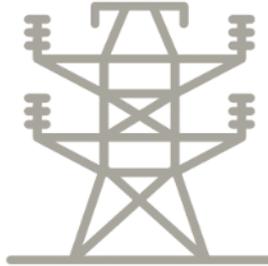
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RINA operates through a network of companies covering the following sectors:



**Marine**



**Energy**



**Transport &  
Infrastructure**



**Industrial  
Innovation**



**Business  
Assurance**

# RINA Today

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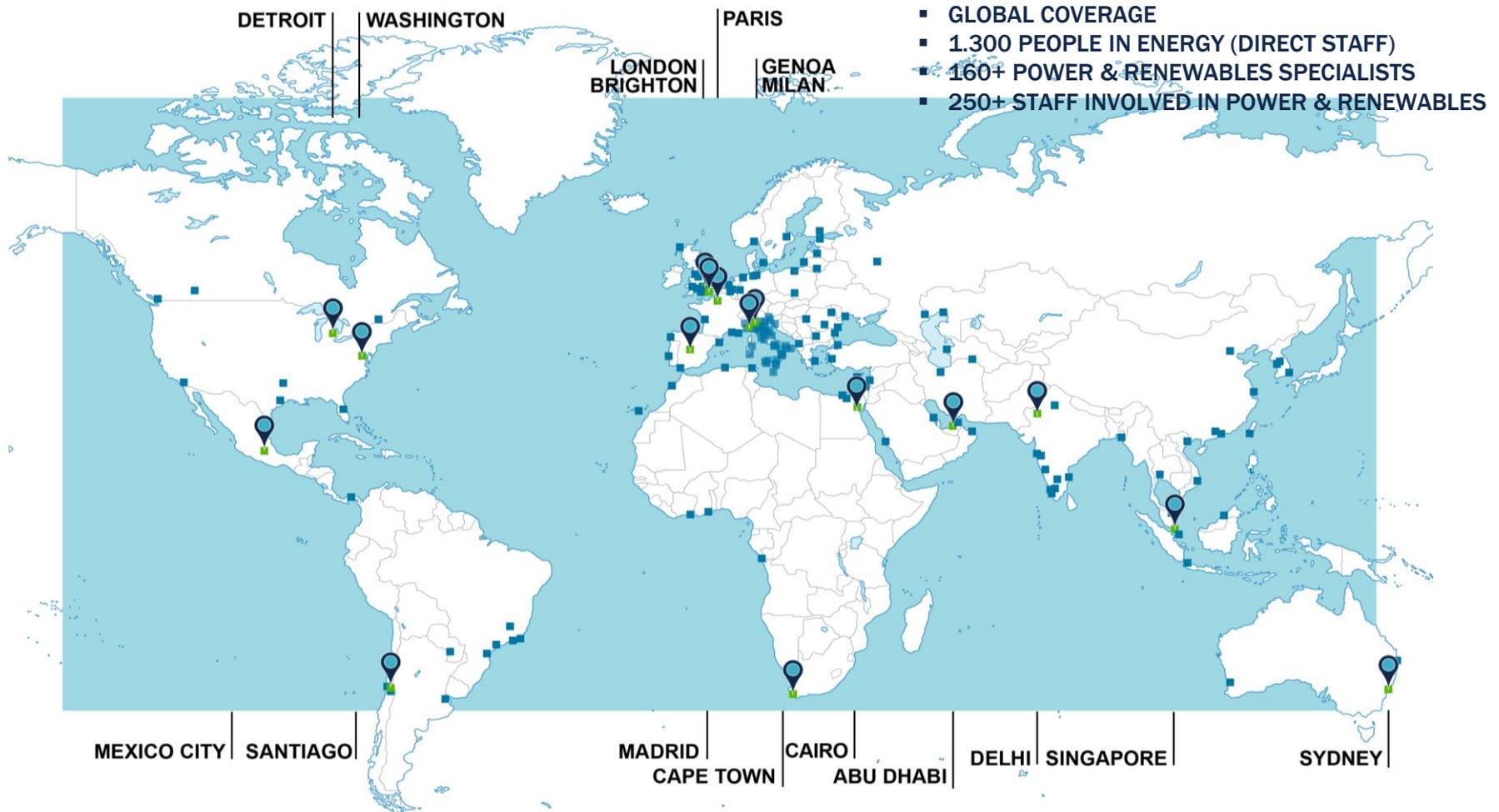
**448**  
Mil.Euro

**170+**  
Offices

**60**  
Countries

**3700**  
Colleagues

# Global presence in Power & Renewables



*RINA's global offices and offices with renewable energy teams*

# Power Business Unit

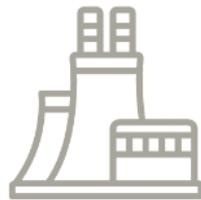
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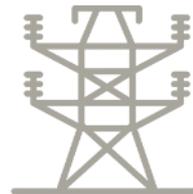
**Power**



Renewables



Conventional  
Power Generation



Power Systems



Environment &  
Sustainability

# Energy – Renewables / 1

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We work with a host of IPPs, developers, contractors, manufacturers, global financial clients & major investors.

We have a proven understanding of the client's mind set and we are regularly engaged to work on complex transactions.

Through our solid commercial know-how and unparalleled technical experience, we provide our clients with solid, reliable advice on what makes a proven solar investment.

## Key Achievements

We have worked on over 3,000 renewable energy projects in more than 50 countries and have the flexibility required for a truly global reach.

RINA have offices across the globe, covering Europe, North, Central and Southern America, EMEA and Asia Pacific and our extended network of consultants allows us to have a deep understanding of local context and regulatory framework.

We are often the "go-to" advisory for complex transactions and have recently been engaged as Lender's Technical Advisor on the 2 GW Ben Ban solar PV project in Egypt as well as having assisted Brookfield on the acquisition of the largest renewable energy portfolio in the world (Terraform).

RINA's Owner's engineering capabilities, integrated, multi-disciplinary engineering team allowed some of the largest operator in delivering a number of utility-scale PV projects and windfarms.

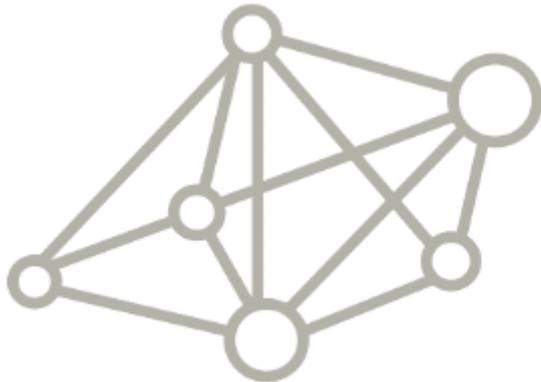
# Energy – Renewables / 2

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Our successes have been achieved by knowledge sharing and hard working teams.

We understand client's needs and have a good understanding of the project life-cycle and the role of the each stakeholder in the process.



## Our Renewables Team

We have an experienced team of 110+ renewable energy specialists (direct staff) spread across RINA's offices.

We have access to additional engineering specialists, construction and project managers within the RINA's power business unit.

Testing and inspection services are provided by our network of qualified surveyors who have experience on renewable energy technologies and relevant manufacturing processes.

Our internal technical recruitment team regularly supports our project teams in identifying local partners, specialists and skills required, and providing manpower supply as needed.

# Energy – Renewables / 3

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Following the acquisition of a number of engineering and consultancy companies over the past few years, RINA has started playing a major role in the global energy transition process.

RINA offers a complete package of technical advisory services for renewable energy operators and prides itself on providing quality through attention to detail, building upon our team's experience in the renewable energy industry.

We can assist client's decision-making by providing tailored advisory packages to meet their specific requirements, and we offer services from initial feasibility through to decommissioning; supporting the progression of a project through its planning, development, construction and operational phases.



# Renewable Energy Services

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## Technology

Ground-mount Solar

Rooftop solar

Concentrated Solar Power (CSP)

Onshore Wind

Offshore wind

Energy Storage

Hydropower

Bioenergy & Renewable heat

## Key Services

Independent Engineering services

Owner's engineering services

Energy yield, resource and performance analysis

Asset management and Optimisation

Impact Assessment and permitting

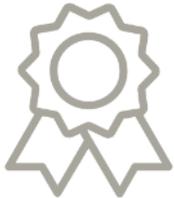
EHSS Compliance & Risk management

Resource efficiency & sustainability services

Vendor Inspection, Quality Audits, QA/QC, Expediting



# RINA's Value Proposition



## **Major Technical Advisory Firm in Renewables**

Preferred technical partner and advisor of major IPPs, developers, commercial banks, development funding institutions and large industrial groups. Involved in major projects and transactions in the renewable energy industry



## **One-Stop Shop**

Covering all renewable energy technologies, transmission and distribution expertise, global coverage and with a strong industrial background enabling us to understand different type of businesses.



## **Leverage our experience on large projects**

Most big infrastructure projects run late and over budget, our ability to simplify complexity of large projects by defining information flow early, implement effective coordination of all the parties minimise such risk.



## **Good understanding of local context**

Thanks to our solid international experience, global network and local partners, we are familiar with national standards, regulatory frameworks, and practical aspects related to running a business and managing people abroad.

# RINA's Value Proposition



## **Thorough Design Review and Verification**

RINA's design review and verification support offers highly trained staff, and specialists who verify that project design complies with all relevant operational, safety, environmental and industry standards.



## **Understanding construction and operational risks**

Experience on site and managing different type of assets, give us the operator's perspective. We involve construction, operations and maintenance experts from the design stage.



## **Permitting, Environmental and Social expertise**

Supporting developers in concept identification, site selection and project development. Advising on the need for EIA / ESIA / SEA, planning and legislative requirements, and other technical studies to achieve environmental authorizations, by understanding local context.



## **Multidisciplinary approach**

When working on large project RINA support encompasses the provision of the staff mobilised on site but give access to a variety of competences that cover all engineering disciplines (civil, electrical, mechanical), all accessible within the group.

# Clients – Renewable Energy



Driving renewable development and technological innovation.

Bankable project and technology advisor trusted by major development funding institutions and lenders.



# Clients – Renewable Energy



Impartial, independent advisory with absolute integrity.

Unparalleled global experience and local expertise.

Flexibility and ability to deliver clear, concise expert advice .

**Brookfield**  
Renewable Energy Partners

**octopus**  
investments



**JCM CAPITAL**  
TORONTO LONDON

**actis**



**BLACKROCK**



**lightsource**bp



**Marubeni**

**ELLIOTT**

Bluefield

**RECURRENT**  
ENERGY



**Allianz**



**neoen**  
renewing energy



**NEXTEnergy**  
CAPITAL



**WIRSOL**  
THE BRAND BELONGING TO WIRCON GROUP





**Services**  
**Solar**



# Services

## Solar – Independent Engineering Services

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RINA supports developers, owners, and financiers in their evaluation of technologies and projects for debt, equity investment, and acquisition or divestiture.

RINA has a deep understanding of the technical, contract, environmental compliance, construction, and operations and maintenance issues that drive project success.

Understanding and mitigating the risks associated with renewable energy projects is critical for developers, lenders and investors alike. As one of the leading and most experienced renewable energy technical advisors, RINA provides comprehensive, flexible and timely due diligence services for the wind and solar industries in PFI/PPP markets.

Our knowledge of best practices, methodologies and market standards, provides our clients with the information needed to make confident decisions.

From pre-finance Analysis through construction and into operations, RINA delivers the objective information needed to thoroughly evaluate the inherent risks, potential upside, and full value of projects.

# Services

## Solar – Owner’s Engineering Services

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We are at the cutting edge of solar PV design solutions.

RINA is assisting IPPs in different geographies, and is involved in the industry’s effort to reduce costs and maximize performance.

Constantly in conversation with major manufacturers.

In-house design department with discipline specialists and draftsmen.

We have carried out conceptual, preliminary and executive design for several large scale solar PV plants.

### Development support

- Feasibility studies
- Site Characterisation
- Resource and energy yield assessment
- Site inspections
- Conceptual and preliminary design
- Grid connection preliminary design and negotiation with TSO
- Verification of compliance with local codes and standards

### Implementation phase

- Engineering design review and validation
- Full construction ITT package (incl. technical specifications, testing procedures, etc.)
- Support in the qualification of suppliers/subcontractors and tenders
- Support in drafting technical aspects of EPC/O&M contracts

# Services

## Solar - Construction services



### Construction management

- Project Management / project management support
- Schedule & budget monitoring
- Site Management
- QA/QC at site
- HSE monitoring and auditing
- Construction monitoring team (site manager, doc. controllers, scheduler, technical inspectors Civil/Mechanical/Electrical/Instrumentation)
- On site progress meetings and meetings with stakeholders
- Engineering team dedicated to the project

### Commissioning and Acceptance

- Commissioning & testing supervision
- Take-over assistance
- Project closing
- Reporting to stake holders



# Services

## Solar – Contractual Support

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RINA is regularly involved in the negotiation of EPC and O&M contracts for large scale PV plants, assisting Lenders, IPPs and EPCs.

We are familiar with current market standards and typical costs.

Extensive experience on Power Purchase Agreement with network operators and large corporations.

### EPC and O&M Contracts

- Compliance with Lender's requirements
- Provide valuable support in the definition of technical annexes and scope of works
- Drafting of performance guarantees, testing methodology and acceptance procedure.
- Compliance with applicable norms and standards
- Interaction with legal and insurance advisors

### Power Purchase agreements

- Knowledge of national electricity markets and policy framework
- Understanding of buy/sell side drivers
- Capability to assess demand/supply balance

### Bid Submission support

- Support in the review of tender documents, identification of key risks and opportunities

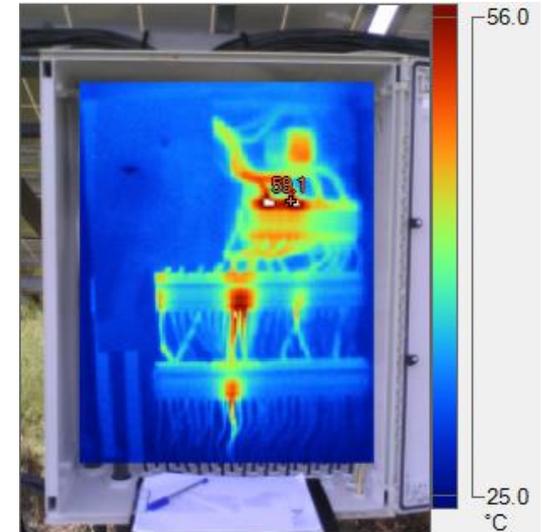
# Services

## Condition and Performance Assessment



### PV Modules - LV equipment

- DC electrical testing: insulation resistance ( $R_{ISO}$ ), Short Circuit Current ( $I_{SC}$ ), Open Circuit voltage ( $V_{OC}$ )
- IR thermography of modules (aerial and ground-based)
- IR thermography on string / combiner boxes, distr. boards
- IV curve tracing (at module and string level)
- Electroluminescence (EL)
- Maximum power test (flash tests)
- PID investigation
- Materials testing, e.g. peel tests
- Accelerated age testing



### Power System Components IR thermography

- Oil analysis
- Partial discharge analysis
- Circuit breaker first trip analysis
- Offline tests as required
- Destructive testing



# Services

## Solar – Asset Management



Understanding of managing solar as an asset class.

At the cutting edge of optimization solutions for large scale solar PV plant.

- Client/country tailored services
- Technical/commercial/cost reporting
- Interface with legal/insurance advisor
- Interface with project stakeholders
- Independent instrumental testing
- Managing retrofits, replacement campaigns
- O&M supervision activity
- O&M tender management
- Standardisation of O&M activities on large portfolios
- Assistance on metering and monitoring systems and meteo stations.
- In-house tools for big data management.
- Claim management



# Case Studies – PV Portfolio Acquisition



## TerraForm PV Portfolio

### 2.6 GW of Solar and Wind

Brookfield Asset Management

USA, India, Chile, South Africa etc.

2017

#### RINA's role:

- Analysis of Portfolio performance (Availability, PR, downtime) to establish suitable P50 forecasts
- Site inspections of a sample of assets to establish construction quality and prevalence of defects
- Valuation of rectification works
- Review of key contracts during operational phase (O&M and Asset Management)
- Advice on technical OPEX assumptions



# Case Studies – PV Rooftop

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## 8MWp commercial rooftop

### portfolio

AIIM

Nigeria

2017

### RINA's role:

- Review of the integrity of metering process
- Energy yield analysis
- Contractual suite
- Maintenance strategy
- Financial technical assumptions and LCOE



# Case Studies – TDD Egypt Ben Ban



## 2 GW Solar Complex

EBRD, Proparco, Islamic  
Corporation for Development  
Egypt  
2015-Ongoing

### RINA's role:

- Lender's technical advisor on 16 plants for a total installed capacity of +1GW
- Defines reference guidelines for EPC and O&M contracts
- Negotiated PPA terms with EETC
- Reviewed compliance of projects with local grid code
- Defined implementation plan with stakeholders



# Case Studies – PV Lender's TDD



## 6MWp floating PV project

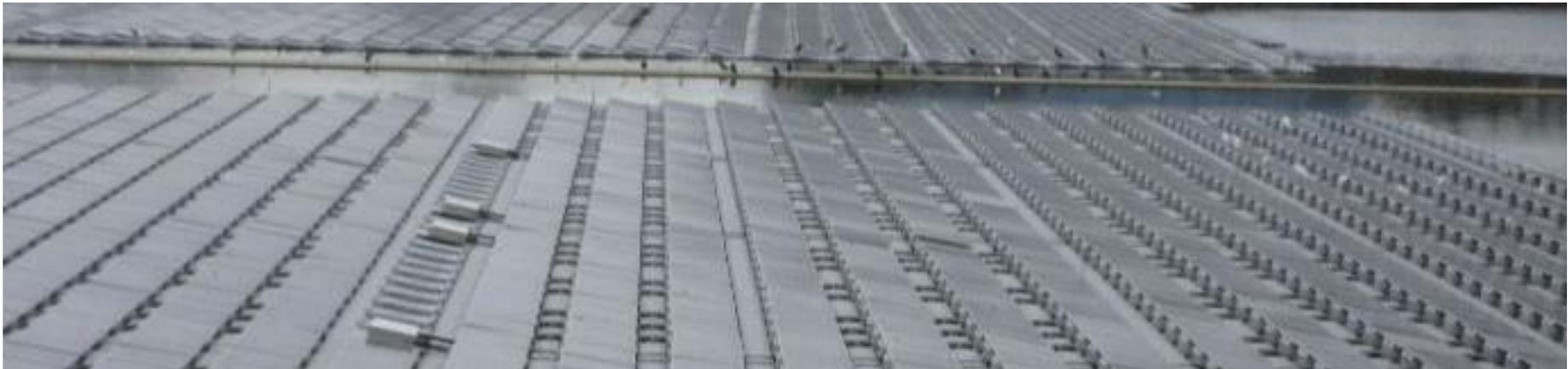
Lightsource, RBS

UK

2012-2016

### RINA's role:

- Technical review of components, including float connections and anchoring design
- Review of existing plants
- Energy yield analysis
- Contractual suite (EPC, O&M, PPA)
- Maintenance strategy including MRA
- Permitting and grid connection review



# Case Studies – PV and Energy Storage 1



## PV-battery energy storage

### hybrid plant

Confidential Client

Corsica, France

2017-ongoing

### RINA's role:

- A combined PV plant and ESS yield analysis and a technical review of the plant functional model, to control both the PV and energy storage elements of the plant using irradiance forecasts to enable the IPP to provide day-ahead electricity export forecasts to the network operator.
- Technology supplier review,
- Plant design review
- Complete contractual suite review



# Case Studies – PV and Energy Storage 2



## Scaling Solar + Storage

World Bank Group  
Sub-Saharan Africa  
2017

### RINA's role:

- Assist the client to convert the existing Scaling Solar program to be applicable for Solar + Storage Plants.
- Review of existing RfQ, RfP and PPA documents
- Understood the considerations of the stakeholders – opened up a consultation with key industry players
- Updated the documentation based on the additional complexities of storage system in line with international standards and good industry practice



# Case Studies – Solar OE



## Paradise Park Solar PV Project - Owner's Engineering Services

Eight Rivers Energy Company (NEOEN)

Jamaica

2018

### **RINA's role:**

RINA was appointed as Owner's Engineer, encompassing the three main phases of development, construction, and commissioning for a 37 MW solar PV project in Jamaica.

The work will ensure that each stage is properly planned, executed, and controlled on behalf of the project backers.

The tender was issued by the Jamaican regulator Office of Utilities Regulation (OUR) in May 2016 at a feed-in rate of USD 0.0854 per kWh, the lowest to date in the country, and at 37 MW, the EREC development is the largest solar project in Jamaica to date.



# Case Studies – Solar OE



## Aura II Solar PV Project - Owner's Engineering Services

ECSA

Honduras

2017

**RINA's role:** RINA was appointed to undertake full-time, on-site construction monitoring and management services, and back-office support for the construction, commissioning and testing periods of a 61.48 MWp project in Honduras. On-site support included the services of one civil engineering professional and one electrical professional (with transmission & distribution experience) to witness the progress and quality of the construction. Engineering support for all areas of the facility and its interconnection were governed under this scope of work. In addition to on-site construction support, home office professionals provided support by reviewing field data & documents, maintaining change orders, and overseeing schedules.





**Services**  
**Wind**



# Services

## Wind – Development Services



From wind measurements to financial model

Owner's Engineering

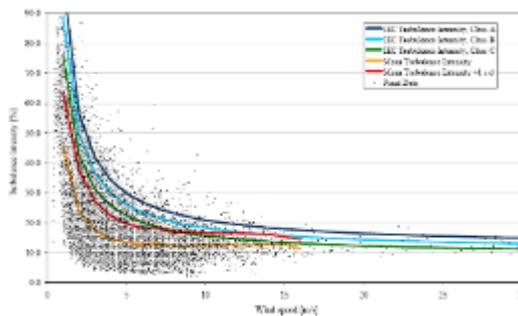
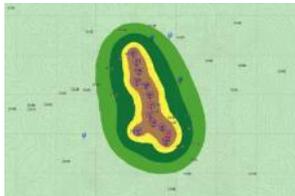
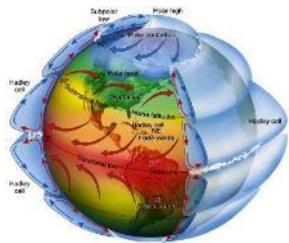
Independent Engineering

Contract negotiation support

Environmental impact assessments and constraint reviews

Minimising the risk of financing wind projects

- Preliminary site inspections
- Wind measurement campaigns
- Energy Yield Assessments
- Geotechnics, metocean and acoustic studies
- Wind farm design
- Wind farm optimisation
- Site suitability
- Civil, structural and electrical engineering
- Authorisation procedure



# Services

## Wind – Construction Services



### Construction management

- Project Management / project management support
- Schedule & budget monitoring
- Site Management
- QA/QC at site
- HSE monitoring and auditing
- Construction monitoring team (site manager, doc. controllers, scheduler, technical inspectors Civil/Mechanical/Electrical/Instrumentation)
- On site progress meetings and meetings with stakeholders
- Engineering team dedicated to the project

### Commissioning and Acceptance

- Commissioning & testing supervision
- Take-over assistance
- Project closing
- Reporting to stake holders

# Services

## Wind – Operational Assessments

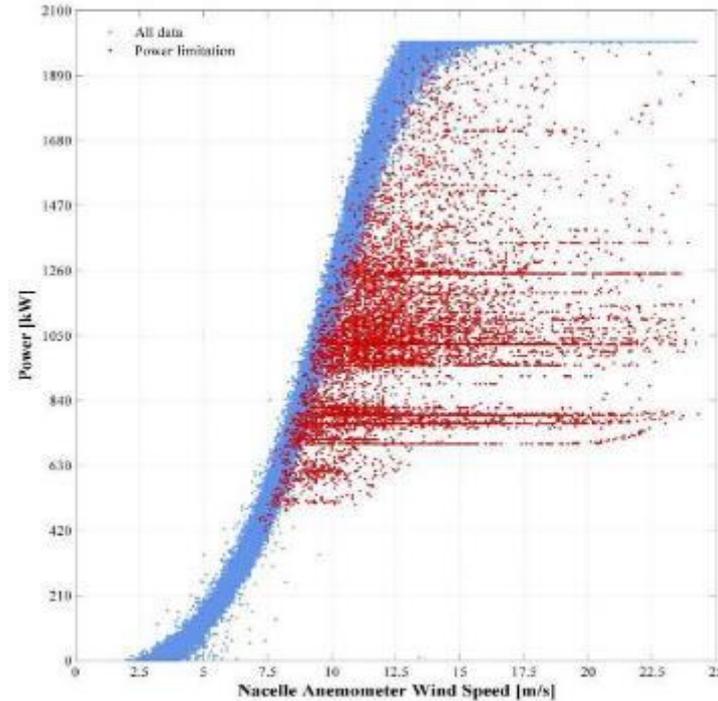
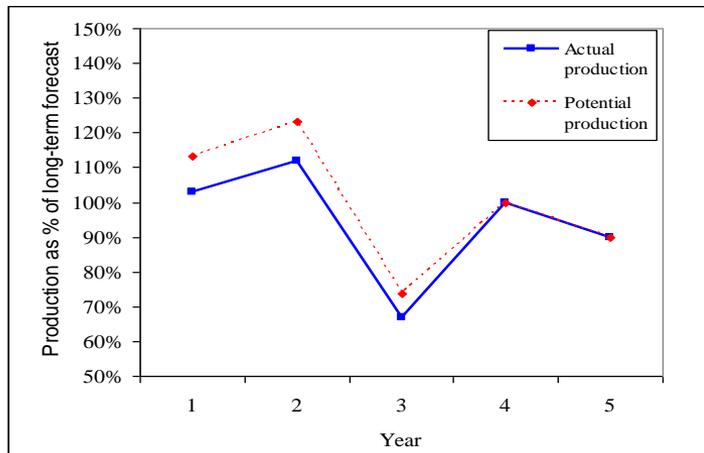


Understanding the real efficiency of the wind farm and knowing the issues.

Quantifying differences between measured energy production and expected production.

Quantifying lost energy production due to grid curtailment.

Improving the value of the wind assets.



### Operational Energy Yield Assessments

- Availability and error-log review
- Long term trend assessment
- Future energy losses
- Power curve performance analysis
- SCADA data analysis

# Services

## Wind – WTG Inspections



At the cutting edge of optimization solutions for large scale wind plants.

Understanding the importance of wind assets through the whole operational life.

Monitoring the health and extending the life of operational wind farms.

GWO certified inspectors.

### Detailed services:

- Detailed visual inspection
- Vibration analysis of the drive train
- Gearbox inspection with endoscope
- Gearbox oil analysis
- Main bearing inspection by endoscope
- Main bearing grease analysis
- Blade external inspections on height using rope access or cherry picker
- Blade external inspections with binocular or long lens camera from the ground
- Blade internal inspections
- Thermal Imaging of electrical components (cabinets, cabling, transformers...)



# Case Studies – Wind OE



## 3 x 100 MW Hornsdale Wind farms – Owner's Engineering Services

Neoen, Australia - 2018

**RINA's role:** RINA was appointed by international developer Neoen to undertake an independent Energy Yield Assessment (EYA) on a large wind portfolio in Southern Australia. The wind farms include a total of more than 90 turbines, with the quantification of wake effects of one project on the other of high importance. The EYA references several primary sources of wind data including masts of different heights and a roaming SoDAR. The finance-grade report includes analysis of on-site met data and reference data, long-term corrections, wind flow and wake modelling and full assessment of P50, P90 scenarios and capacity factors for the three projects. Due to the complex nature of the wind flow and the site specific meteorological conditions at the project location, the analysis was undertaken using an advanced Computational Fluid Dynamics (CFD) flow model resulting in higher confidence in the results and an improved P90/P50 ratio.



# Case Studies – Wind OE



## Blade Failure Assessment - Owner's Engineering Services

Confidential

USA - 2018

**RINA's role:** RINA was retained to perform an independent analysis of blade failures (debonding and delamination) on wind turbines for a 30 MW wind farm in the state of Iowa. RINA will provide a document review, site inspections, communication support with lenders, and support for negotiating warranties. RINA documented failures and damages observed at the blades, provided a review of blade specifications and drawings, reviewed the third party inspection reports, listed a description of damages, and provided procedures for blade monitoring and maintenance, among other services and identified root-cause.



# Case Studies – Wind IE



## Independent Engineer – 60 MW Wind Portfolio

Aviva Investors

UK – 2016-2018

RINA was appointed by global asset management company, Aviva Investors, to provide acquisition due diligence support for a c. 60 MW multi-project wind portfolio in the UK. The transaction consisted of the operational 15 MW Jacks Lane and 10 MW Woolley Hill wind farms alongside the 18 MW Den Brook and 17.5 MW Turncole wind farms which were in construction. RINA undertook a comprehensive review of all technical and commercial aspects including planning issues and land rights as well as WTG supply and O&M contracts, and supported the negotiation of EPC and asset management contracts. Detailed operational energy yield analysis of two projects was undertaken including evaluation of power performance test results for two turbines.



# Case Studies – Offshore Wind



## Inspection services and design approval Wikinger Offshore Windfarm Iberdrola, Germany – 2017-2018

The Wikinger Project is an Offshore Wind development composed of two Wind Farm, namely Wikinger - 70 AD 5-135 WTG wind turbines - and Wikinger South - 13 WTG - with a capacity of 5MW each. Situated at approximately 35km off the German island of Rügen, Wikinger is Germany's deepest water wind power project, with depths ranging between 37 and 43 meters. Services provided include:

- Approval of engineering documents
- QC and site supervision services during manufacturing
- Inspection Services for construction of 29 Offshore Jackets.



# Case Studies – Offshore Wind



## Independent Structural Assessment and Construction Supervisions

Suomen Hyötytuuli, Finland – 2017-2018

Suomen Hyötytuuli Finland is developing the Tahkoluoto Offshore Windfarm project (TOW) consisting in 10 offshore wind turbines to be installed and taken into production on the Southwest coast of Finland, in the vicinity of the Tahkoluoto harbor, part of the Port of Pori. The plant is the first offshore wind farm and RINA provided the following services:

- Condition Survey of each vessel that takes part for the project;
- MWS Supervision during Temporary Phases (Load out, Sea Fastening, Transportation and Installation, Cable Laying);
- independent hydrodynamic analyses on a FEM model for the calculation of wave and current loads on the jack up legs
- Design approval





**Services**  
**Energy Storage**



# Services

## Energy Storage

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Leading storage innovation, having undertaken ten major projects across three continents.

Our expertise covers the complete range of system types and capabilities.

Solid commercial know-how, reinforced with strong technical ability.

Integration with utility scale multi-MW power plants

Moment-to-moment power stability

Flagship Lithium-Ion Plants

Hydrogen Fuel Cell Technology

Enhanced/Firm Frequency response

Initial feasibility, analysis, planning

Functional modelling

Technical due diligence

Factory inspections



# VLC Energy storage projects, UK



## ESS – Enhanced Frequency Response

RINA services included;

- Planning and development
- Functional modelling
  - Informed system sizing, performance and stacked revenue expectations
- Contractor tendering and selection
- Technical due diligence
- Contract drafting, negotiation and execution
  - Contractor functional model sign-off
- Take-over and Intermediate Acceptance

Project revenue stack considered;

- Enhanced Frequency Response (EFR)
- PSH Firm Frequency Response (FFR)
- Arbitrage
- Triad avoidance
- Capacity Market

# Gannawarra Solar-plus-Storage, Australia



## Energy storage – Technical Advisor

- Split project structure: debt financed PV with equity financed ESS
- Undertook due diligence and construction monitoring
- Assessed techno-commercial contractual and design interfaces
- Reviewed the ESS control system with respect to the associated interfaces

## Project use cases:

- PV generation with priority export
- ESS tolling agreement
  - Frequency Control Ancillary Services (FCAS)
  - Arbitrage

# Solar-plus-Storage, Corsica



## Solar-plus-Storage – Lenders Engineer

- Combined PV+ESS plant yield analysis
- Technology, design and contract reviews
- Assessed contractual arrangements and warranty structures against the use-case
- Project functional model and energy management system review

## Project use case:

- Energy time shifting of PV generation
- Export corrections and firming
  - Maintaining accuracy of forecast plant export for evening peaks and minute-to-minute forecasts



# Emirates Stadium – C&I solutions, UK RINA

## ESS – behind the meter

RINA's technical due diligence services included;

- Site inspection to assess construction practicality
- Grid connection arrangements
- Service contract arrangements and technical requirements
- Initial functional modelling and review of financial model technical parameters

# Residential solutions, Africa



## Off-grid residential solar-plus-storage solutions

- Facilitate increased deployment and roll-out across new markets; Rwanda, Kenya, DR Congo
- Review of design assumptions against anticipated uses-cases across the portfolio
- Verified the suitability of the control and overarching Energy Management System
- Assessed key equipment, installation processes, testing procedures

# World Bank Scaling Solar and Storage

## Solar-plus-storage – Creating viable markets

- Developed technical tendering & contractual requirements
- “One stop shop” program to make privately funded grid-connected solar-storage projects possible within 2 years
- Ease of application for inexperienced parties while meeting global financing and performance expectations

# Sarawak Energy Berhad, Malaysia



## Solar-plus-storage – Creating viable markets

Government owned System Operator responsible for generation, transmission and distribution

- Study integration of renewable generation and storage into the existing network
- Proposed solutions which ensured adequate generation capacity and security against a growing demand profile
- Network modelling to evaluate increased security and reduced losses

# Retro-fit assessments, UK



## Energy storage – Feasibility assessment

- Hybrid plant yield analysis
- Project functional model and energy management system review
- Technology, design and contract reviews
- Interface review

## Project use case:

- Energy time shifting
- PPA firming
- Imbalance reduction



# Energy Storage Procurement Feasibility Approach in Mexico



Baja California Sur (BCS) is served by an isolated electricity system in Mexico. It is the only solar project in the Baja Sur system. This has displaced HFO plants but brought instability to the already weak grid on cloudy days. To further facilitate the penetration of solar projects and displace more HFO plants, IFC commissioned a study to investigate benefits of the battery energy storage systems for the Baja Sur system.

RINA assisted IFC/World Bank on a comprehensive study for the evaluation of technological solutions, including potentially hybrid PV-Storage projects whereby the investor decides on the type of battery to install and allows priority use of the battery for grid operations (ancillary services) to CENACE.

Other battery uses such as arbitrage, peak shaving, T&D deferral would be left to the investor's judgment. Ancillary payments would be regulated yet the other battery uses would receive merchant revenues.

# Design and planning of 2 x 200MWac BESS in Italy



RINA is assisting a developer in the permitting of 2 x 200 Mvac battery energy storage systems in Southern Italy.

Activities carried out include detailed design for permitting purposes and preliminary environmental assessment.

The two identical ESSs will be developed to serve the following services and markets:

- Balancing market
- Frequency regulation
- Capacity support
- Voltage regulation
- Black start

It has been assumed that the utilization of the batteries will be one cycle per day, while the primary application will be frequency response.

# Residential storage as a virtual power plant, Australia



RINA carried out a technical due diligence on a portfolio of residential PV and storage systems to be installed and aggregated as a Virtual Power Plant in Western Australia.

Activities included:

- In depth review of any permit and consent, technical documents, studies, blueprints, supply and EPC contracts, O&M contracts, warranty schedules and performance guarantees, etc.
- Analysis of life cycle of battery, inverters, PV system and other major equipment to determine appropriateness of asset life and to verify sustainability of equipment for use case specified.
- High level assessment of probability of delinquency/default on payments in Western Australia,
- Review of the historical and forecast of electricity retail costs in Western Australia (in the South West Interconnected System – SWIS) to form a view on expected annual customer savings over the Project's life (with system compared to without)
- Review of addressable market size both for the area object of the analysis.





**Services**  
**Inspections**

# Services

## Vendor Inspections

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Vendor inspections are surveillance activities carried out at supplier's premises aimed at removing or minimizing the risk of faulty materials entering the supply chain.

RINA verify the conformity with the requirements of applicable international or national codes, standards and technical specifications stated in the contract between client and manufacturer, before the products are dispatched.

Main benefits of vendor inspection are:

- assure the development and continued operation of a project, which depends on the right quality of equipment, products and components delivered by vendors
- verify the conformity with the requirements of applicable international or national codes, standards and technical specifications stated in the contract between client and manufacturer, before the products are dispatched.
- detect eventual defects at source
- determinate in advance the compliance with client expectations, in order to minimize or avoid safety issues and the risk of extra costs, due to subsequent failures at site.

# Services

## Vendor Inspections

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# Services

## Vendor Inspections



Our Inspectors conduct second and third party inspections (3.2 certification) of mechanical parts, electrical components and commodities, according to a client's detailed assignment and applying contractual specifications, codes and international standards. We apply a rigorous vetting process of candidate qualification, selection and monitoring to ensure only the most competent and experienced Inspectors suited to the job are selected.

Inspection can be carried out at different stages of production:

- Pre-Inspection Meeting
- Interim/Progressive Inspections
- Witness/monitor/hold/review points during manufacturing and testing
- Final inspection and acceptance (FAT)
- Data documentation reviews
- System Integration Testing (SIT)
- Pre-Shipment inspection before load out



# Services

## Vendor Inspections

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The main areas of inspection are:

- **Electrical components:** electric motors, actuators, converters, transformers, inverters, switchgears, UPS and MCC panels, etc
- **Wind turbine components:** blades, nacelle, tower, flanges, gearbox, cables etc
- **Solar PV/CSP plant components:** PV modules, mounting structures, tracking systems, mirrors/reflectors, heat collection elements, etc.
- **Rotating equipment:** turbo gas generators and compressors, pumps, etc.
- **Subsea:** Umbilicals, Risers, Flexibles and power cables





**Services**  
**Environment & Social**

# Services

## Environmental & Social / Sustainability

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### Services

- Impact Assessment and Permitting
- EHSS Independent Advisory
- Special E&S Studies
- Project Finance Advisory
- Lenders' Engineering
- Resource Efficiency Studies
- Sustainability and Climate Change
- Institutional & Private Sector Development

### Key Achievements

- 100+ Environmental impact assessment for power plants
- Benban E&S DD on behalf of EBRD (Access, ACWA, Alfanar, EDF/EI Sewedy, First Solar/Orascom, FRV, Infinity, Scatec), Benban Facility Management E&S Management Plans – Hassan Allam
- Livelihood Restoration Plan (LRP), ESIA and ESMP 80 MWp solar PV project in Katsina, Nigeria – Pan Africa Solar / JCM Capital
- EIA Gap Analysis for 1GW Solar PV Project, Turkey
- E&S DD on behalf of EBRD for 250MW of solar PV projects in Jordan (ACWA, FRV, Scatec, SunEdison, Alcazar)
- Lender's E&S on over 1,200 MW of solar PV projects, South Africa for various Equator Principle Finance Institutions

# Services

## Environmental & Social

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Environmental and social impact assessment consists of a multidisciplinary approach, which combines the evaluation of the economic aspects of a project - based on cost-benefit ratios - with the environmental consequences of undertaking the project.

RINA has developed a considerable experience on environmental and social aspects related to wind and solar projects in different regions

### Services

- Impact Assessment and Permitting
- EHSS Independent Advisory
- Special E&S Studies
- Project Finance Advisory – Lenders' Engineering
- Resource Efficiency Studies
- Sustainability and Climate Change
- Institutional & Private Sector Development



# Services Power Systems



# Services

## Power Systems / 1

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With extensive global experience of power generation, transmission, distribution and utilisation projects in many industry sectors, RINA provides a high quality, independent and confidential 'one-stop' service covering low to extra high voltage power systems.

Our consultants have comprehensive experience in protection studies for transmission, distribution and industrial networks.

### **Transmission and Distribution Systems**

System planning, single line diagram development, design, system studies and network analysis (load flow, short circuit, voltage rise and stability), load forecasting, failure investigations, reliability and resilience studies. Rural and urban electrification

Owners engineer services – specification drafting, tender preparation, project supervision, commissioning

### **Substations**

Feasibility and location sitting, outline and detailed primary design, SCADA design, HVAC design, FACT design (SVC, compensation), DC systems design, earthing design.

# Services

## Power Systems / 2

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Power systems are typically analysed in a time or frequency domain, by undertaking power flow, fault level, stability, load shedding, system restart, voltage fluctuation, flicker and harmonic studies.

The foundation block of planning a new project in the power sector is the ability to analyse power systems. Involving the right partner at the planning phase will ensure to optimise the design and avoid costs and time delays associated with incompatible systems or re-engineering.

### **Protection Systems**

Outline and detailed design, grading and settings, failure investigation

### **Asset Integrity**

Plant Equipment

### **Cables**

Design, routing, containment, ratings calculations, failure root cause analysis, Conventional and submarine Cables

### **Connections**

Connection design and specification, completion of regulatory requirements, grid code compliance studies, harmonic measurements and studies,

### **ERACS**

In-house modelling software

# Services Power Systems

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## Key Achievements

- 500+ man years of system planning and design for TNOs and DNOs
- 100+ T&D related grid connection & earthing studies in 2016
- 200+ Grid connection compliance and schemes for Solar PV Plants
- 300+ Power plant design
- 3GW+ Onshore Windfarm Engineering Services
- 120 GW+ Installed capacity power generation plant engineering services
- 500+ substations earthing and lightning protection design schemes
- 100+ Transmission substation project management and supervision
- 1000+ km of overhead transmission lines and 100+ substations for rural electrification

# Case Studies - Power Systems



## Onshore Windfarm Connection studies

Innogy Renewables, UK - 2017

Innogy engaged RINA to carry out detailed power system studies to establish the electrical design for shore wind farm sites across Wales and Scotland with connection capacities between 26 and 96MW, connecting at 33kV and 132kV into various DNO networks. These studies required modelling the DNO network and detailed wind farm components in DIgSILENT Power Factory:

- Load flow and voltage regulation studies
- Short circuit studies
- G5/4-1 harmonic assessment
- Design and settings of wind farm protection
- Lightning and switching transient studies
- Transformer energisation (P28 assessments)
- DRC Schedule 14 (Fault Infeed)
- Voltage and Reactive Power Stability
- Frequency Stability (Load Rejection)



# Case Studies – Power Systems



## Offshore Wind Farm Connection Studies

Scottish Power Renewables, East Anglia One, UK - 2017

SPR are developing several off shore wind farms on the East Anglia Round 3 Development Zone. The East Anglian One development comprises of 102 7MW Siemens Gamesa turbines (714MW) that will connect to the transmission network at the National Grid Bramford 400kV substation.

SPR engaged RINA to carry out detailed power system studies to validate the electrical design for the wind farm, as well as carry out studies for Grid Code Compliance. These studies required modelling the detailed wind farm components in DIgSILENT Power Factory:

- Load flow and voltage regulation studies
- Reactive Power Compensation studies
- Short circuit studies
- G5/4-1 harmonic assessment
- DRC Schedule 14 (Fault Infeed)
- Voltage and Reactive Power Stability
- Frequency Stability (Load Rejection)



# Case Studies – Power Systems



## Supergrid Transformer Replacement Design

Carillion, UK – 2017 Client:

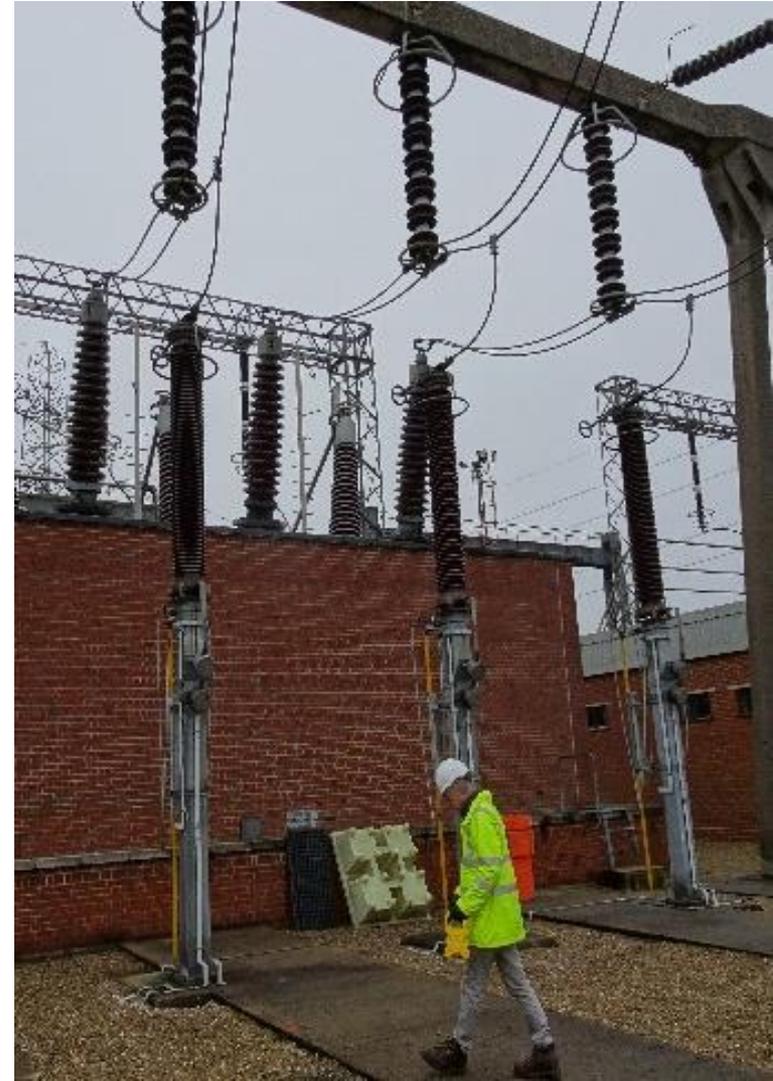
Replacement of West Weybridge SGT5A with a new 1100MVA, 400/275/13kV SGT along with HV equipment and Protection Modifications.

Services Supplied:

- HV Plant installed as part of the scheme included 400kV Current Transformer, 275kV Earth Switch and 275kV Surge Arresters. Interfacing with existing P& C equipment and Installation of new HV Conns protection is also part of the scope.
- Design services included to act as a Principal Designer for installation & commissioning of new SGT5A.

Design packs prepared included:

- HV Plant design packs included Layouts and elevations, MEWP access, Earthing system, Busbars and connectors, Mechanical interlocks and Plant labels



# Case Studies – Power Systems



## Power Systems Consultancy Framework

Scottish & Southern Electricity Networks, UK - 2011 - present

RINA holds a framework agreement with SSE for provision of Planning and Design services for its Future Networks department. Since 2011, RINA has provided continuous presence of 14 consultants in SSE's offices in the UK. The value of the agreement is approx. £1.5M per annum. Other services include:

- System planning 11 kV – 132 kV
- Compliance and OFGEM reporting
- Rechargeable connections – Planning and Design
- Capital works Design
- Harmonic Studies
- Batteries and STOR



# Case Studies – Power Systems

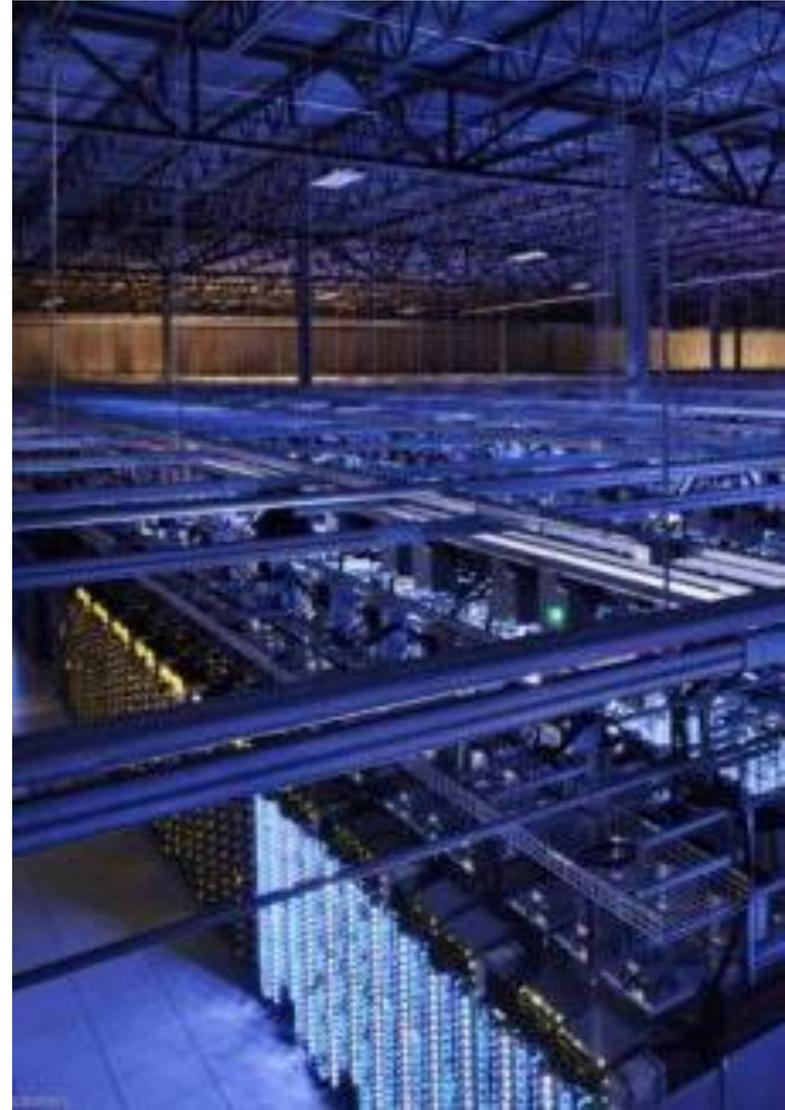


## Data Centres Power Consultancy

Confidential, Europe – 2015-2017

Our client is an international Data Centre consultancy, appointing RINA to provide design services for a 220 kV Gas Insulated Substation for a project in The Netherlands. The project comprised design and preparation of tender packages for the 220 kV GIS Switchgear, four 150 MVA, 220/20 kV Transformers, 20 kV AIS Switchgear, Protection, SCADA, LVAC and DC system, in accordance with IEC and European Standards. Services Supplied:

- Design basis report outlining the scope of design services. Devise Single Line Diagrams of 220 kV GIS Switchgear and 20 kV Switchgear.
- Layout drawings of Electrical Substation, Protection and Control panels, SCADA, LVAC and Batteries, etc.
- Single Line Diagram of LVAC distribution boards and DC distribution boards.



# Case Studies – Power Systems



## Power Systems Consultancy Framework

Electricity Northwest, UK - 2015 - present

RINA holds a framework agreement with ENW for provision of consultancy services for Connection Offers & Mitigation Planning. Since 2015, RINA has provided continuous presence of 4 consultants in ENW's offices in the UK. The consultants respond to over 1GW capacity of connection requests per month. The value of the agreement is approx. £560K per annum. Other services include:

- System planning 11 kV – 132 kV
- Compliance and OFGEM reporting
- Rechargeable connections – Planning and Design
- Capital works Design
- Harmonic Studies
- Batteries and STOR



# Case Studies – Power Systems

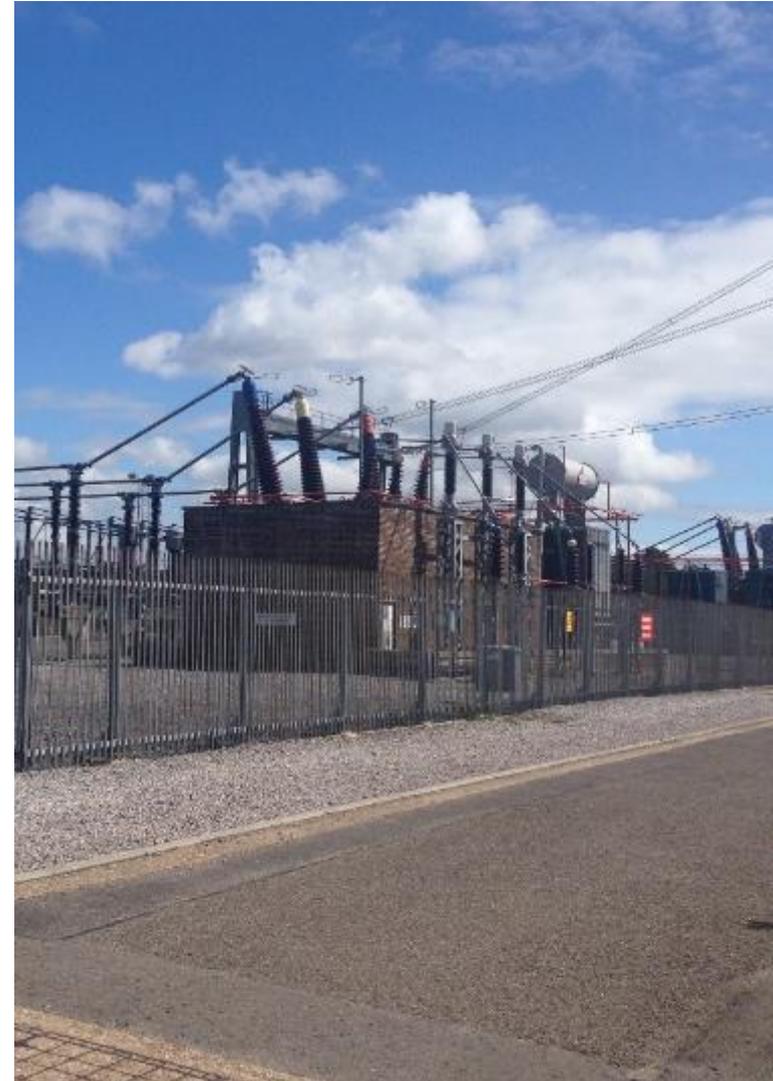


## Substation Earthing Design and Measurement

Dong Energy, UK - 2015-2017

Offshore Wind Farm of 1.2 GW, divided into two subzones of 600 MW capacity each. A new transmission substation is required to connect the first zone to the National Grid 400kV network at Killingholme. Services included:

- Pre-construction soil resistivity measurements
- Full earthing system design for the 400kV substation
- Lightning protection risk assessment study on the GIS building
- Lightning protection system design of outdoor HV equipment, using 3D modelling software
- Electrical and electronic system protection (surge protection)
- Technical report supplied as part of construction documentation
- Design support through project phases from concept to construction



# Case Studies – Power Systems



## Data Centres Power Consultancy

Confidential, Belgium - 2016

Client is an international Data Centre consultancy. RINA was appointed to provide design services for expansion of a 150/30 kV substation in Belgium, as part of an upgrade Project. Services Supplied include:

- Specification for the Power Transformers, 30 kV Switchgear, Earthing Transformers, Earthing materials, HV and LV cables.
- Layout designs for the plant, equipment and cable routing  
Design of protection and control systems for 30 kV Switchgear and Transformers.
- Design of ancillary AC and DC supplies – batteries and low voltage distribution boards.
- Design of Earthing and assessment of Lightning Protection systems.
- Review of tenders for all plant and electrical work
- Attendance at factory acceptance tests.
- Liaison with installation contractors for technical queries and review of the contractor's design.



# Key Clients – T&D



# Key Clients Power Generation





**Services**  
**Digital Innovation and R&D**

# Research & Development



RINA is a key player in European funded research:

- 210+ Industrial innovation Regional, National and EU funded projects, delivered in the past 10 years
- 300+ M€ Global value of industrial innovation EU funded projects, delivered in the past 10 years
- 4th top industrial participant in FP7 across EU, and among the first 20 organizations including universities and research centres across EU\*
- 3rd top industrial participant in H2020 across EU (>40 projects and >12M€ funding)\*\*
- 5000+ partners in Innovation funded projects \*\*\*

\* Final FP7 Monitoring Report

\*\* INTERIM EVALUATION of HORIZON 2020

\*\*\* [www.researchranking.org](http://www.researchranking.org)



# Digital Innovation

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Investing in Energy digitalization implies faster operational decisions, leads to better asset utilization, reduces operating costs and increases efficiency.

Quality data management and analytics make the real difference and investing in digitalization may represent a strategic decision for the bright future of many companies, contractors and operators in the Energy market and, more specifically, in the Power Sector.

CUBE is RINA's Solutions to these new challenges: an open industry platform that provides to our clients RINA's digital services and third parties application.

<https://cube.rina.org/>



## What's on Cube?

- Digital Twin
- Business Intelligence and Reporting
- Cross-industry benchmarking
- Predictive maintenance
- Machine learning and Cognitive services
- Open platform



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