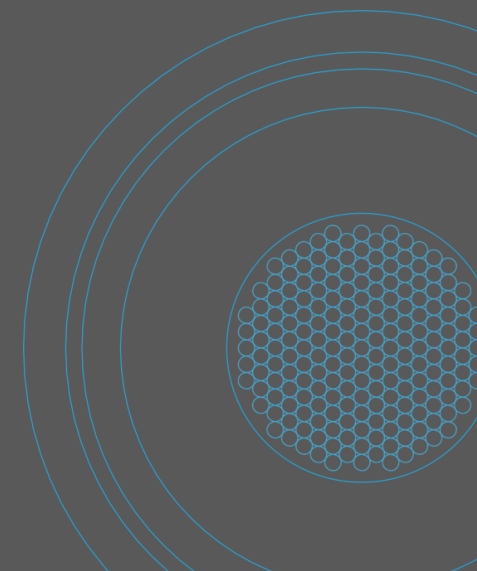




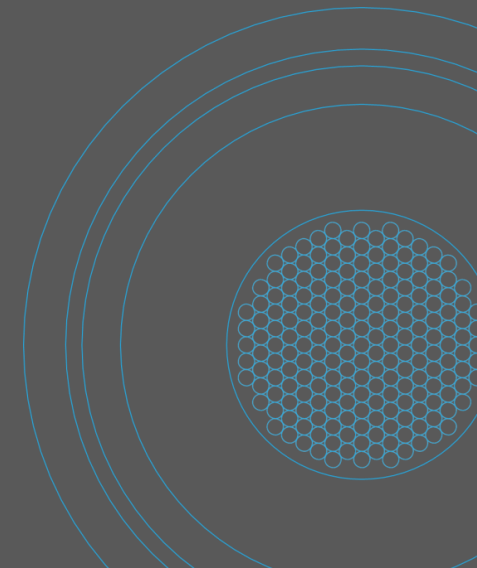
PROTOP
CABLE SYSTEM LIFECYCLE
CAPABILITY STATEMENT

CABLE SYSTEM DESIGN – VERIFICATION
PROJECT / CONSTRUCTION MANAGEMENT
CABLE INSTALLATION – CABLE TESTING
MONITORING – CONDITION ASSESSMENT
MAINTENANCE – REFURBISHMENT
TRAINING





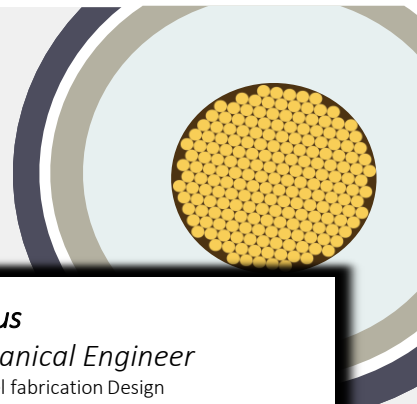
PEOPLE  TIME  COST  QUALITY



PROTOP CABLE ENGINEERING TEAM



PROTOP's cable engineering personnel are a multi-skilled team made up of cable engineers with experience ranging from 5 to 50+ years that cover all specialised areas of power cables. PROTOP has the resources available to cover all areas of cable projects.



Nic Moffa
Director

- Renewable Energy specialist
- Cable rating and verification
- Project/Construction Management
- Civil and Structural Engineering
- Underground Cables & O/H Lines



Henry Kent
Specialist Cable Engineer

- Cable Installation
- Trenchless Technologies
- Risk assessments
- Cable Maintenance & Refurbishment



George Bucea
Specialist Cable Engineer

- Cable Manufacturing
- Cable Design, Testing & Maintenance
- Oil-filled Cable
- Mentoring and tutoring



Paul Connelly
Specialist Cable Engineer

- Cable Testing and Jointing
- Submarine Cable
- Oil-filled Cable
- Maintenance planning/coordinator



Various

Mechanical Engineer

- Steel fabrication Design
- CAD drafting
- Cable Installation Design
- Project Engineering & Management
- Site Engineering & Supervision



Maribel Ulep
Electrical Engineer

- Cable Ratings
- Administrative Support
- Document Control
- Quality Reporting
- Risk & Safety Management

Lelio Bibbo Consulting Engineers

Civil & Structural Engineers

- Termination Steel Structure Design
- Joint Bay Structural Design
- Equipment Pit Structural Design



Various

Civil Engineer and planning

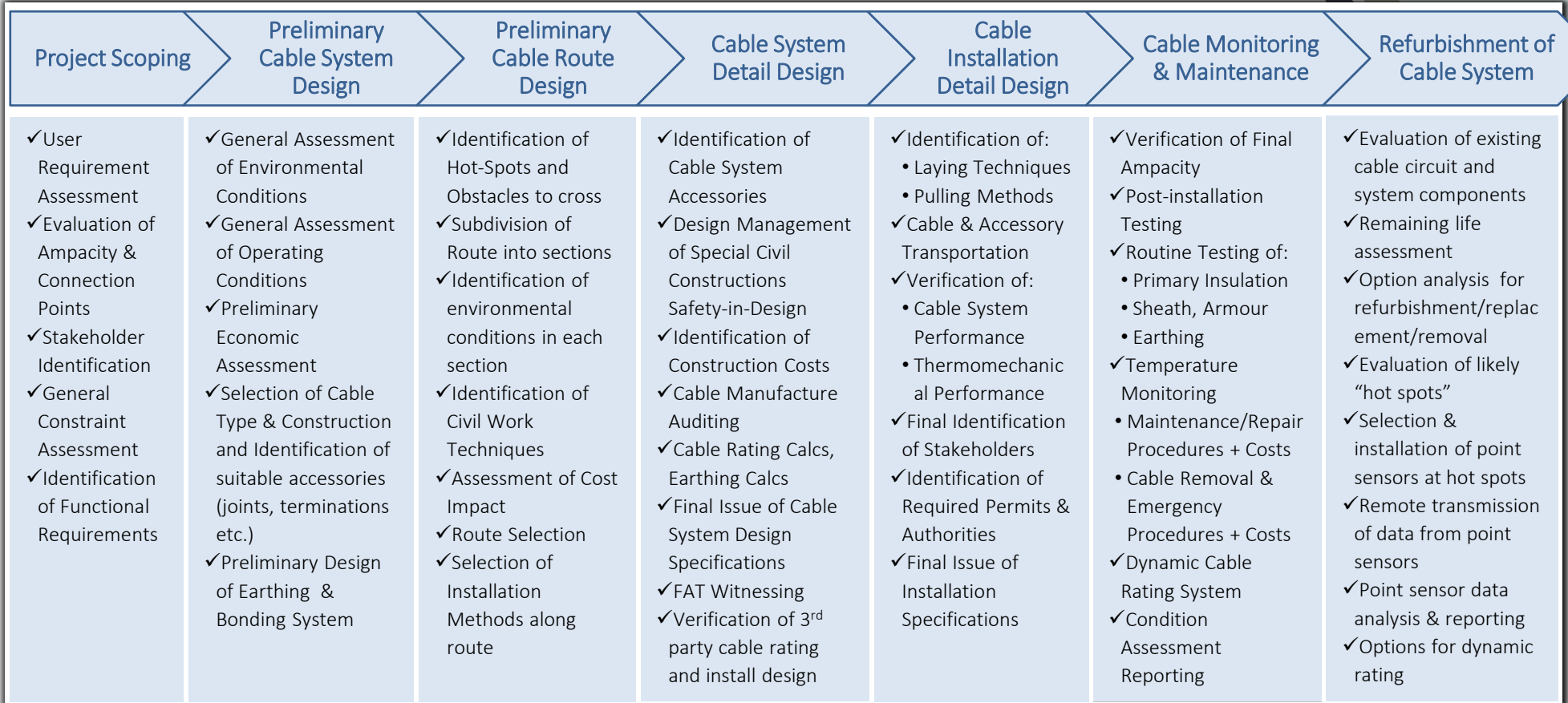
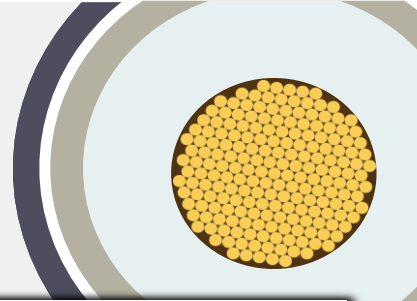
- Civil Engineering Design
- AutoCAD Drafting
- Cable Installation Design
- Quality Control & Reporting
- Site Engineering and Supervision
- Planning approvals



PROTOP CABLE SYSTEM LIFECYCLE SERVICES SUMMARY

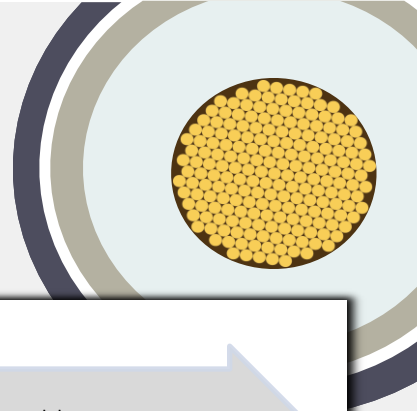


Through its in-house resources and strategic alliances with cable manufacturers, installers and specialists, PROTOP has the full capability required to design, verify ampacity and monitor performance of power cable systems from 11kV “Distribution Systems” to highest voltage “Transmission Systems”, up to 330kVAC and 500kVDC.





PROTOP can liaise with the Asset owner to develop the Scope of Work in coordination with Asset Strategy, Regulatory, Financial Operational and Engineering requirements.



Project Scoping



User Requirement Assessment

- Assessment of the requirements for the cable system including ampacity and location of connection points;

Stakeholder Identification

- An initial identification of the relevant stakeholders for the project that may impact the rating and route of the cable system;

General Constraint Assessment

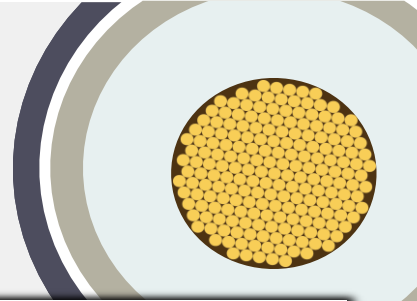
- An assessment of any constraints affecting the configuration of the cable system, including evaluation of the quality, cost and timing requirements;

Identification of Functional Requirements

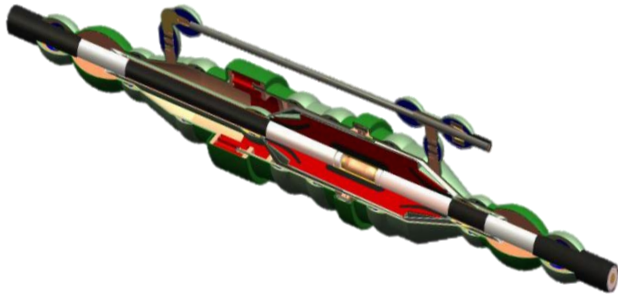
- Identification of technical parameters and functional requirements of the cable system.



PROTOP can provide all the engineering resources for preliminary cable system design. This includes the provision of Civil, Mechanical, Electrical Engineers and Engineering Drafters.



Preliminary Cable System Design



Environmental & Operating Conditions

- Assessment of the operating conditions of the cable system and its surrounding environment;

Preliminary Economic Assessment

- Assessment of the economic viability of the proposed cable system;

Cable & Accessory Selection

- Selection among existing cables; and
- Selection of accessories including Condition Monitoring System, terminations, joints, inspection pits and cable movement controls;

Preliminary Cable Cross Section Design

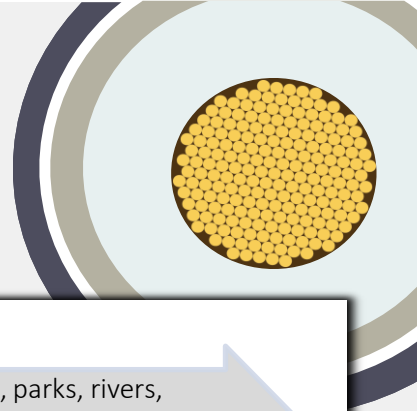
- Economic optimisation of conductor area for cable cross section design and material selection;

Preliminary Earthing Design

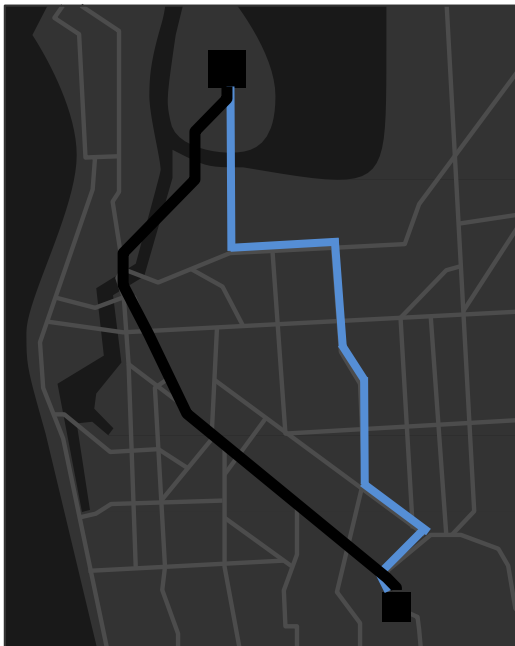
- Assess appropriate system configurations for Earthing & Bonding (solid; single point; mid-point or, cross bonding).



PROTOP can perform the route option analysis between the two connection points. This includes the identification of stakeholders, physical, environmental and political constraints, which may affect the configuration and route of the electrical connection.



Preliminary Cable Route Design



Hot-Spots and Obstacles to Cross

- Identification of obstacles including roads, railways, parks, rivers, archaeological sites, thermal proximities, electrical proximities, existing underground services & trees; and
- Assessment of EMF sensitivity and soil thermal resistivity;

Subdivision of Route into Sections

- Division of selected route into sections of appropriate length; and
- Further assessment of environmental conditions in each section;

Civil Work Techniques

- Identification of possible civil work techniques such as: earthworks, road/rail crossings, pit installations, concrete works, bridges, river crossings, special civil/mechanical installations;

Installation Methods

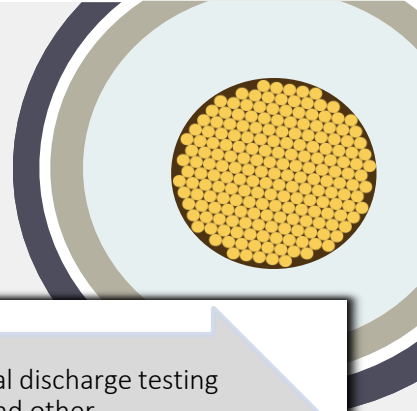
- Identification of appropriate installation methods such as: conventional open trenching, ducting, trenchless technology (HDD, pipe jacking, micro-tunnelling, ploughing), open cable trays and other configurations;

Cost Impact Assessment

- Cost estimates of works required & installation methods;
- Evaluation of crossing vs. diversion costs; and
- Evaluation of environment, property & other constraint costs.



PROTOP can produce full cable system design and provide all the services required for the issue of any documentation related to a cable installation or refurbishment project.



Cable System Detail Design



Cable Accessory Design

- Selection/Design of link boxes, terminations, joints, partial discharge testing pits, condition monitoring system, communication pits and other instrumentation pits;

Special Civil Constructions

- Design management of any special civil constructions required for the execution of the chosen cable route;

Cable Manufacture Auditing + FAT Witnessing

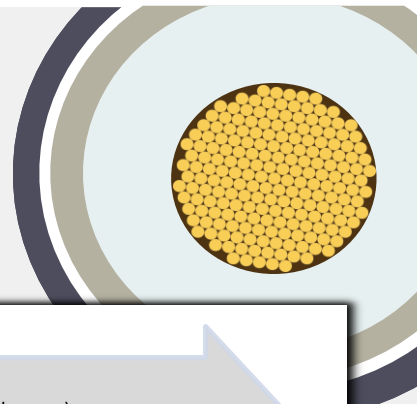
- Preparation of documentation and execution of factory audit and factory acceptance test witnessing;

Cable System Design

- Cable System Design Specifications;
- Insulation Coordination;
- Issue of Cable System Drawings;
- Issue of Cable Installation Drawings;
- Issue of Cable Accessory Drawings;
- Issue of Cable Rating Calculations, Earthing Calculations;
- Cable System and Installation Design VERIFICATION



Full cable system design includes the identification of all aspects and conditions of a cable route and the economical, practical and technical implications influencing the installation strategies and methodologies. PROTOP provides Cable Design Verification on third party design and rating calculations



Cable Installation Detail Design



Installation Techniques (Methods)

- Coordination of Cable & Accessory Transportations
- Cable lay configuration/formation (flat, vertical, trefoil, etc.);
- Cable pulling techniques;
- Burial methods & backfilling;
- Thermal, expansion chamber, snaking & vibration controls;

Cable System Performance

- Evaluation of cable system performance & thermomechanical performance;
- Verification of Cable System Specifications;
- Cable Rating Simulations;

Installation Specifications

- Preparation of installation specifications for construction contractor;
- Preparation of tender documentation including project management requirements;
- Establishment of KPIs;

Cable rating design VERIFICATION

- Assessment of design documentation and cable rating calculation to verify third party cable system installation design.
- Execution of cable modelling to identify cable performance and verify rating calculations made by third parties



PROTOP also uses innovative technologies to monitor the temperature, strain and acoustic signals of underground and subsea cables using Distributed Temperature Sensing, Distributed Strain Sensing, Distributed Acoustic Sensing and/or retrofitting sensing equipment to locate hotspots and provide further insight by interpreting the results. PROTOP can also arrange sheath fault locating and issue frequent condition assessment reports.



Monitoring & Maintenance of Cable System

Post-Installation Testing	<ul style="list-style-type: none"> Commissioning tests including continuity, partial discharge, sheath, earth, resistance, etc.;
Routine Testing	<ul style="list-style-type: none"> Routine testing of primary insulation, metallic components (sheath, armour), anti-termite protection and earthing;
Temperature, Strain and Acoustic Monitoring	<ul style="list-style-type: none"> Distributed Temperature Sensing (DTS), Distributed Strain Sensing (DSS) and Distributed Acoustic Sensing (DAS) interpretation;
Condition Assessment Reporting	<ul style="list-style-type: none"> Frequent reporting on the condition of the cable system and location of hot-spots, areas of concern along cable route;
Dynamic Cable Rating System	<ul style="list-style-type: none"> Assistance with implementation of a Dynamic Cable Rating System;
Maintenance/ Repair Procedures + Costs	<ul style="list-style-type: none"> Preparation of Operation & Maintenance Manual; Provision of repair procedures; and Development of maintenance program.
Cable Removal & Emergency Procedures + Costs	<ul style="list-style-type: none"> Issue of Cable removal methodology; Issue of Emergency Response Plan; and Issue of Emergency Procedures.

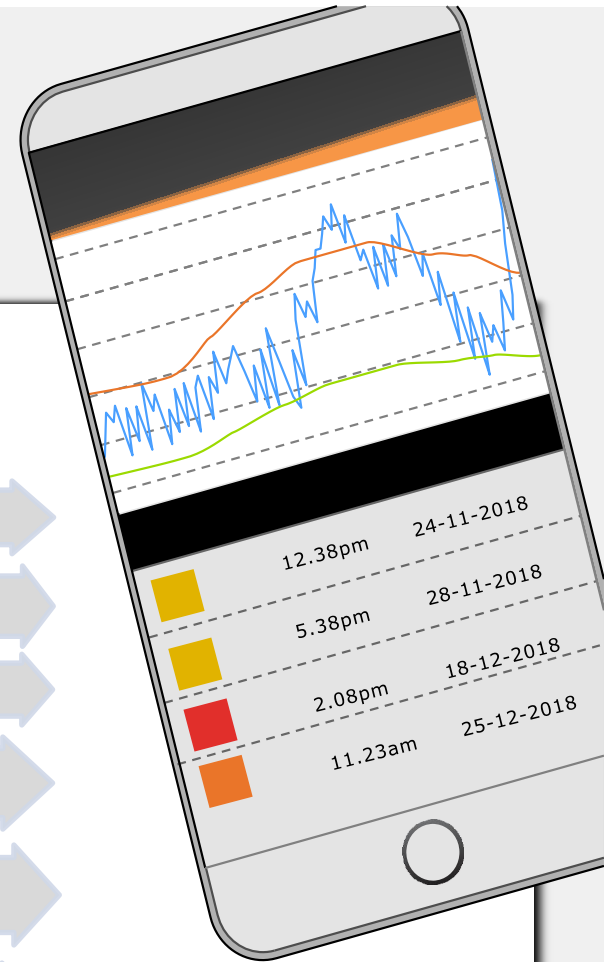


CABLE SYSTEM LIFECYCLE - PARTIAL DISCHARGE CONDITION ASSESSMENT

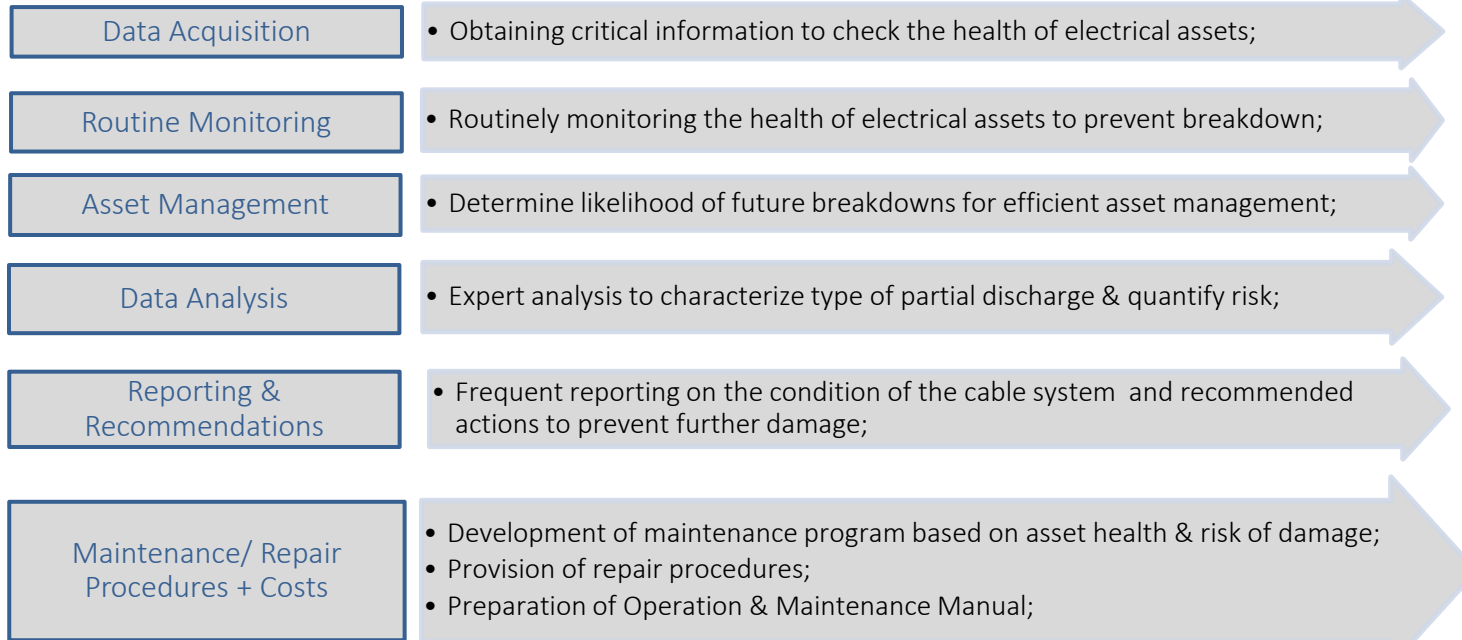


PROTOP uses cutting edge technologies to monitor partial discharge in any electrical equipment from 3 kV to 600 kV (both AC and DC) including cable systems (cables, joints, terminations), GIS, switchgear, transformers and electrical machines (motors, generators, turbines, etc.)

PROTOP can provide end to end asset management and condition assessment including data acquisition, data analysis, routine testing, reporting & provision of maintenance/repair procedures.

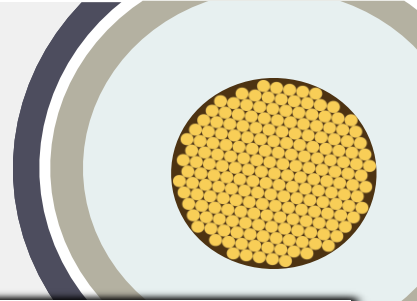


Partial Discharge Condition Assessment Monitoring





PROTOP can assess failed tests in order to characterise type of cable failure and establish the root cause of failure as well as determining the best course of action to bring the cable circuit back into service.



Cable Failure Investigations



Sheath Testing & Cable fault locating

- Sheath testing for accurate fault diagnosis
- Determining location of fault and potential repair

Cable Dissection

- Dissection of cable and joints in PROTOP laboratory to determine any departures from cable specification and/or jointing procedures.

Repair & Maintenance Procedures

- Recommendations for further testing;
- Repair procedures
- Modifications to preventative maintenance program;

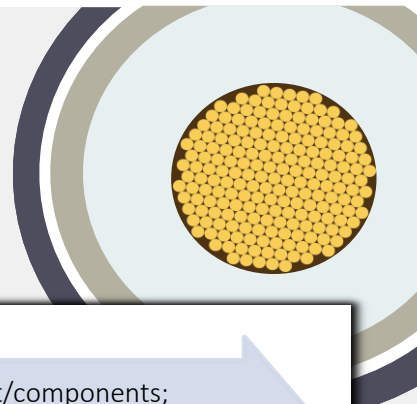
Quality Assurance

- Provision of quality documentation
- Supervision of Jointing and Termination works to ensure quality of workmanship;





PROTOP can evaluate the condition of existing cable circuit, assess the remaining life and make an assessment on the best option for refurbishment/replacement/removal. PROTOP can also identify the locations of likely hot-spots along the cable route by installing point sensors at strategic locations and interpreting the remotely transmitted data to make recommendations for the mitigation of hot-spots.



Refurbishment of Cable System



Existing Cable Evaluation

- Evaluation of existing cable circuit/components;
- Assessment of remaining life of cable; and
- Investigation on thermal characteristics;

Refurbishment Option Analysis

- Cable Refurbishment vs. Replacement Evaluation; and
- Cost Estimates;

Likely "hot-spots"

- Location of likely hot-spots along cable route; and
- Recommendations for mitigation of hot-spots;

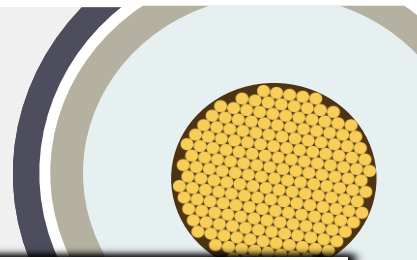
Point Sensor Recommendations

- Recommendation for point sensor locations;
- Remote transmission of data from point sensors to control rooms e.g. via radio; and
- Analysis of data from point sensors.

CABLE SYSTEM LIFECYCLE - PREVIOUS WORKS AT A GLANCE



PROTOP employs several of Australia's leading resources in the field of HV/EHV cables and has gained industry expertise through contribution to various cable projects around Australia and worldwide. The following is a snapshot of some of the key projects where PROTOP provided cable system expertise to various clients in recent years:



2023-24

- ENERVEN – Cultana Solar Farm 275kV cable connection – FAT witnessing and cable rating design review - SA
- Epic Energy (Project Manager - contract) Mannum Solar Farm - Stage 2 – 30MWAC
- G+T Lawyers – Expert witness report 33kV cable failure investigation - NSW
- ENERVEN - Eraring BESS 700MW – Cable Rating review - NSW
- Partial Discharge (PD) monitoring with PryCam® System (Prysmian patent) - NSW



2022

- Daly's Construction/Powerlink – 275kV structural design for Cable Sealing Ends supports at Wandoan South and Juandah Substations (QLD)
- ENERVEN– Design Verification for a 275kV cable connection from AGL Battery Energy Storage System and Torrens Island Power Station (SA)



2021

- Ferrycarrig – Cable Failure Investigation Including Dissection of 33kV Cable and Joints to Determine Root Cause of Cable Failure (NSW)
- Prysmian Australia – Quality Control & Site Supervision During Delivery & Installation of 33kV Cable & Accessories for Port Augusta Renewable Energy Park (SA)
- Prysmian Australia – Cable rating reviews
- John Beever Australia – Quality Control During Testing & Commissioning (MSWF Project) (VIC)

2020

- John Beever Australia – Quality Control & Site Supervision During Installation of 220kV Underground Cable Connection for Acciona Energy Mortlake South Wind Farm (MSWF) (VIC)
- Prysmian Australia – Full Scope Design for Cable Installation of 220kV Underground Connection for NEOEN Victorian Big Battery (VIC).



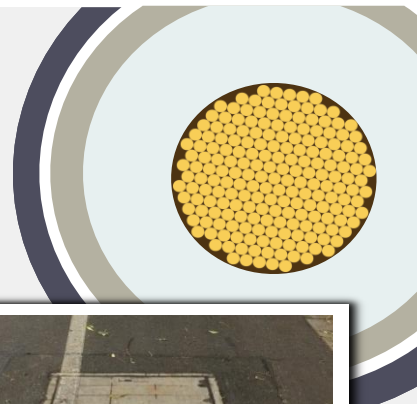
CABLE SYSTEM LIFECYCLE - PREVIOUS WORKS AT A GLANCE



PROTOP experience started in **1991** with wind farm developments, cable reticulations, connection to the grid and construction management.

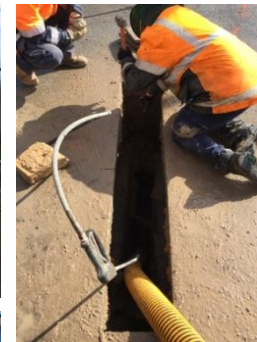
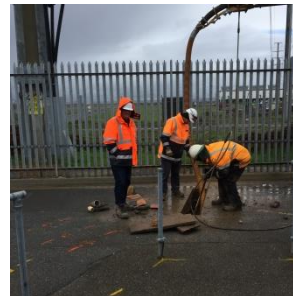
Our employees and associates have a long-standing experience; involved in major cable projects in Australia and worked with Transmission and Distribution Service Providers since the '60s.

More projects below from PROTOP Engineering Services:



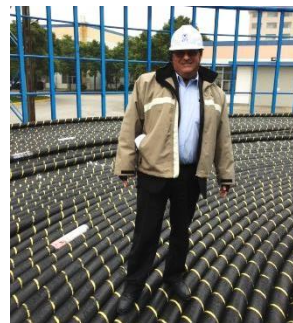
2019

- John Beever Australia – Full Scope Design for Cable Installation of 220kV Underground Connection for Acciona Energy Mortlake South Wind Farm (MSWF)(VIC).
- RJE Global – Verification of Cable Losses Calculations for various Wind Farm Projects including installation of Medium Voltage reticulation cables (33kV).



2018

- ElectraNet – Magill to East Terrace 275kV Cable Link Box Relocation – Engineering Contract Specifications, Review of Link Box Design, EMTP Analysis, Technical Drawings;
- Snowy 2.0 Project – Review of Cable Technical Specifications and Preparation of Technical Schedules;
- ElectraNet – Preparation of Cable Functional Requirements, Technical Schedules, Typical Underground Cable Arrangements;
- ENERVEN – Pot-holing to confirm location of existing cable



2017

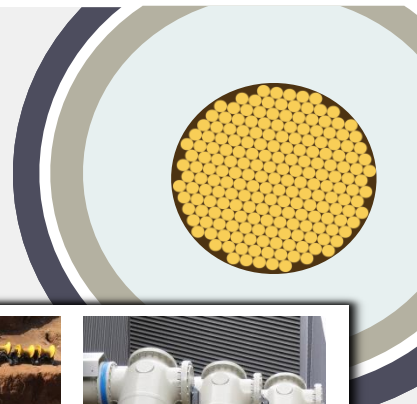
- RJE Global – Factory Acceptance Test Witnessing (ZTT Factory in China) for 33kV subsea cable from Cape Jervis to Kangaroo Island;
- RJE Global – Review of Technical Specification for 132kV cable installation at Cadia Gold Mine (NSW)
- Downer – Engineering/Project Management Consultancy (Substations & Line Engineering)



CABLE SYSTEM LIFECYCLE - PREVIOUS WORKS AT A GLANCE



PROTOP personnel have over 150 years of combined cable expertise gathered in Australia and internationally. The following is a snapshot of some of other key projects where PROTOP personnel provided cable system expertise in a less recent past:



2016

EPPS-T2T Alliance – 275kV Cable Relocation – Site Safety Management;
LS Cable/CDS – submarine and underground cable consultancy

PRIOR 2016

Prior first establishment, PROTOP'S current personnel was involved in various projects, some of these are worth mentioning here:

- ElectraNet – Adelaide Central Reinforcement (ACR) 275kV underground cable from TIPS to City West – Options Analysis, Cable Route Design, Condition Monitoring System, Supervision of Cable Installation, routine cable patrol and cable assessment strategy; PROTOP Director was the Project Manager of this highly successful project.
- Winner of NATIONAL AIPM project of the year above \$100M award, GIS award, AIPM South Australian Project of the year 2012, Engineering Excellence award, planning Excellence Award and ministerial award.
- Snowy Hydro – Cable Condition & Remaining Life Assessment and Replacement Options for 330kV Cables;
- ElectraNet – Preparation of “In-House Standard” for 11kV to 132kV cables for use within substations;
- Snowy Hydro – Witness acceptance testing and installation of 330kV cables at Tumut 1 Power Station;
- Factory Acceptance Test Witnessing on 33kV, 132kV, 275kV and 330kV cables;
Condition assessments of cable damaged during handling, installation and operation
- Cable damage and failure investigations on Distribution and transmission circuits.

