

aramco



power

power services catalog



Introduction

Saudi Aramco’s Power Systems (PS) organization is successfully providing reliable and dependable electric supply and operation & maintenance services to the Company’s critical hydrocarbon facilities, offices and communities. This rich experience over the past 8 decades makes PS one of the most competent and dependable power supplier and service providers in the Kingdom. We are now transitioning PS into Aramco Power (AP), a commercially focused organization which will continue to serve Saudi Aramco and will expand its services to external customers with the same quality, zeal and commitment. Our services are not limited to normal power operations and maintenance support, they extend to performing detailed engineering investigations, evaluations of highly complicated and sophisticated system designs, project development, power generation, energy management and training services. Working with the one of the world’s largest industrial customers in the Kingdom gives us the ability, resources and experience to serve other small, medium and large industrial and commercial customers. PS currently operates and maintains a massive and complex electricity network comprised of overhead lines, underground & subsea cables spanning 293,000 km in length, 800 plus substations with voltage range from

480V to 230kV and 6,700 transformers to ensure highly reliable power supply to a myriad of hydrocarbon facilities, office complexes and communities.

Our real assets are, a family of 1,100 highly educated and trained professionals, with PhD, master, bachelor degrees and trade certifications. Our professionals have a a combined experience of 8,800 years in the world class power operations & maintenance of T&D networks, power generation, power business development and information technology. Our dedicated engineering and technical services teams provide continuous support to our operations departments to ensure uninterruptible power supply and offer expedient and long-lasting solutions to complex engineering problems.

We manage Saudi Aramco’s power supply network Kingdom wide through the state-of-the-art Power Control Centers (PCC) in Dhahran, embedded within the Oil Supply Planning & Scheduling (OSPAS) premises, which is the beating heart of Saudi Aramco.

We are determined to provide exactly the same level of services to our potential customers as we are delivering to our current customers because high quality, reliability and long term commitment is in our DNA.



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power operations & maintenance services

- Operation & Maintenance Services
- Power Network & Dispatch Management

Operation and Maintenance Services

Supplying reliable power and steam to Saudi Aramco facilities and communities is made possible by our highly trained engineers and technicians by using state-of-the-art tools and technologies, which is our competitive edge over others. Our expertise cover operation and maintenance of overhead lines, power assets, equipment, underground and submarine cables for all voltages. We extend same high class services to our customers which include:

- Switching of electrical circuits (on/off) including breakers racking in and racking out
- Preventive, routine and corrective maintenance for:
 - Transformers
 - Breakers and switchgears
 - Protective and control devices
 - Underground and Overhead power cables up to 230 kV
 - Distribution switches and auxiliary devices
 - Subsea power cables
- Safe operations including electrical system isolation/ lock&tag



- Remote operations of substations
- Testing, applying and calibrating of new and existing relay settings
- Testing electrical equipment
- Locate in service faulty cables and perform high voltage cable splicing



Power Network and Dispatch Management

Our centralized and plant level power control and dispatch centers are best in class and pivotal to the smooth operations of power transmission networks. We measure the performance of power transmission and distribution network by using leading industry Key Performance Indicators (KPIs) like SAIDI, SAIFI, Reaction time, load forecast accuracy, number of voltage dips and network losses etc. We offer:

- Review of Operations procedures to reduce electric stresses associated with frequent energizations on equipment
- Rent and operate mobile transformer, substations and other test equipment needed for normal or emergency situations
- Execution of power systems Automation and Smart Grid projects
- Establish local Dispatch Center for the electrical system of the plant
- Monitoring of power transmission and distribution network



power engineering & technical services

- Power Systems Reliability Assessment Studies
- Arc Flash and Electrocution Protection
- Power Management System (PMS) and Load Shedding
- Power System Relay Setting Management Services
- High Voltage Equipment Management
- Smart Grid and Substation Automation
- Power Generation Services
- Project Development and Support Services
- Electrical Equipment Testing and Laboratory Services

Power Systems Reliability Assessment Studies

Our reliability assessment team has vast experience in project design review and operational problem troubleshooting. This team is continuously conducting systems studies for existing facilities to ensure compliance with the design parameters and to identify unforeseen problems through simulation studies. We conduct studies by using Electric Transient Analysis Program (ETAP), Power Systems Simulator for Engineers (PSSE) and Power Systems Computer Aided Design (PSCAD).

- Standard studies:
 - Load flow
 - Simple and dynamic motor starting
 - Voltage drop
 - Symmetric and asymmetric short circuit calculations
- Specialized studies:
 - Insulation coordination during lightening and switching surges
 - Electromagnetic transients for Troubleshooting



Arc Flash and Electrical Protection

Electric arc flash and electrocution safety is a big challenge due to potential fatal exposure to electric energy release during accidental electric shocks and arc flashes. Saudi Aramco's zero tolerance for arc flash hazards helped us develop systems, processes and safety culture. Our subject matter experts can extend below services to our customers:

- Conduct arc flash studies
- Plan and conduct safety audits to comply with international engineering benchmarks and PPE standards
- Provide guidance for remote racking and operations
- Implement Saudi Aramco engineering, administrative and PPE protections standards against fatal arc flash incidents
- Develop, print and apply arc flash labels to show safe electrocution and mark arc flash operation boundaries

Power Management System (PMS) and Load Shedding

Saudi Aramco's complex hydrocarbon operations are critical to the global energy supply chain with extreme financial consequences of an outage. As a result, our power engineers have designed an islanding and load shedding system to ensure sustainability of the power generation during either incidental islanding or sustained shortage of power generations in the grid. Our services in this area include:

- Conduct pre-feasibility and feasibility studies for PMS taking into consideration plant power and steam requirements
- Design, review and implement power management and load shedding systems
- Troubleshoot the existing power management systems
- Support PMS commissioning



Power System Relay Setting Management Services

Aramco Power engineering team design, implement and manage power protection system for Saudi Aramco's complex power network. Below services are provided to our customers following IEEE guidelines:

- Calculate relay settings
- Conduct complete coordination studies
- Review design packages
- Investigate and troubleshoot protection mis-operations

High Voltage Equipment Management

We provide support for planning, design, operation, maintenance and reliability analysis of high voltage assets like transformers, power cables, power lines, gas insulated switchgears (GIS), metalclad switchgears, motor control centers and ring main units (RMUs). Our services include:

- Prepare, review and develop Standard Operating Procedures for equipment operation and repairs to improve design and maintenance
- Investigate electrical incidents and conduct root cause analysis of HV equipment failure
- Ensure the equipment condition and reliability is included in the after sale services provided by the manufacturer
- Develop scenarios and participates in emergency drills for special HV electrical equipment
- Develop equipment condition assessment programs and evaluate preventive maintenance test procedures
- Test, verify and recommend new technologies for High Voltage networks



Smart Grid and Substation Automation

Aramco Power's Systems Automation Group has implemented power substation automation (PSA) based on the International Standard Communication Protocol IEC 61850. It consistently reviews the standard specifications for design optimization to reduce cost. PSA provides central data platform for different clients such as Power Control Centers (PCC), engineering and administration. To protect the PSA against cyberattacks, we have implemented stringent procedures for periodic testing, verification and certifications. These high standard services include:

- Review design packages for all electrical control and monitoring systems both for transmission and distribution networks
- Provide technical assistance to troubleshoot power failures
- Ensure all security measures in compliance with organization's security procedures and standards
- Evaluate and deploy cybersecurity industry procedures such as NERC-CIP to ensure the security of all operating systems and applications for all electrical control and monitoring systems
- Develop and implement Disaster Recovery Plan

Power Generation Services

Our high caliber Generation Services team specializes in troubleshooting gas turbines, power generators, Heat recovery steam generating (HRSG), steam generators and supplementary firing systems. Our i-power advisory center, specialized in the co-generation power system monitoring and control is helping the operations department run the cogeneration facilities more efficiently. This center is a hub for predictive failure diagnosis for proactively preventing cogeneration plants' failures. This team can:



- Provide engineering support to power and cogeneration plants
- Conduct interruption incident investigations and root cause analyses
- Conduct power generation plants' reliability and availability assessments
- Assess new technologies to power generation and cogenerations
- Support development of engineering standards, material specifications, best practices and procedures for optimizing cogeneration facilities
- Establish power generation and operation network diagnostic center to monitor real time data and proactively advise of possible power equipment failure to save cost
- Conduct optimization studies to improve equipment operational efficiency.
- Support interruption incident investigations and root cause analyses
- Conduct data trending for the reliability and availability assessments



Power Development and Support Services

Highly qualified professionals of Aramco Power with international industry experience are fully capable to provide comprehensive project support from the conceptual stage to all the way to energization of power and generation systems. We can:

- Provide full value engineering and technical support associated with new projects construction and upgrades designs
- Supervise new equipment commissioning and energization activities
- Evaluate local manufacturers' facilities to assess their capabilities and standards before purchase of products and services
- Review design packages against standard requirements and determine the discrepancies



Electrical Equipment Testing and Laboratory Services

It is a newly established best in class electrical equipment testing laboratory in the Kingdom and first of its kind in the GCC region in partnership with trusted industry leaders. Its aim is to promote a high quality power tools and equipment testing culture across the region. This lab offers:

- Testing the insulation of live line tools (gloves, hot sticks, etc.)
- Testing and analyzing the transformer insulation oil
- Provide at site technical training and skill development
- Calibration of meters and test equipment





new energy and energy-saving services

- New Energy Services
- Energy Solutions, Audit & Saving Services

New Energy Services

We lead, review, manage and conduct new or retrofit renewable projects right from design to operation and maintenance. Our services include:


- Project consulting services
- Project Techno-economic evaluation
- Full Engineering, Procurement and Construction (EPC) services for new and renovation of renewable energy system
- Project optimization
- System sizing including batteries
- Site surveys
- Geographical Information System(GIS) mapping
- Remote Monitoring System Access services
- Scope of work development
- Contractor oversight and coordination
- Full cycle operation and maintenance
- System performance reporting
- Project financial analysis and contractors cost estimation
- Renewable technology consultancy
- Grid integration study
- Training and development



Energy Solutions, Audit & Saving Services

We at Aramco Power provide energy solutions consulting and advisory pertaining to generation assets, industrial and non-industrial facilities to improve efficiency and reduce energy consumption and cost. Our team of certified energy professionals offers:

- Energy audits and detailed efficiency assessment studies
- Measurement and Verification of Energy Efficiency projects performances
- Technology evaluation and manage energy saving projects
- Energy saving project development and provide turnkey solutions
- Compliance reporting for government Standards and Regulations
- Business case development including secure funding and deployment of cost effective technologies, systems and practices
- Energy efficiency investment and project management services



power energy business services

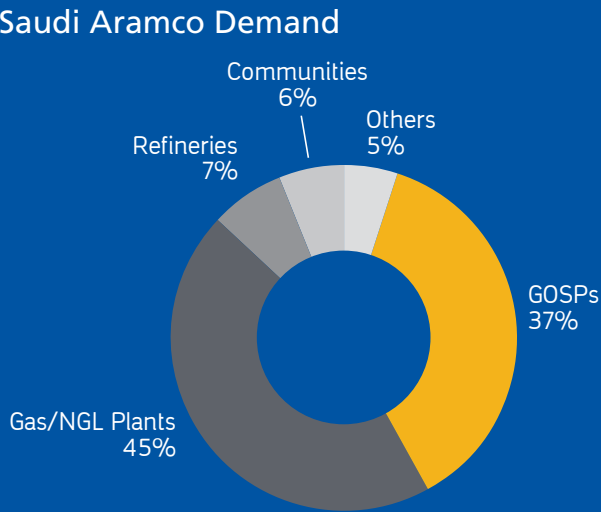
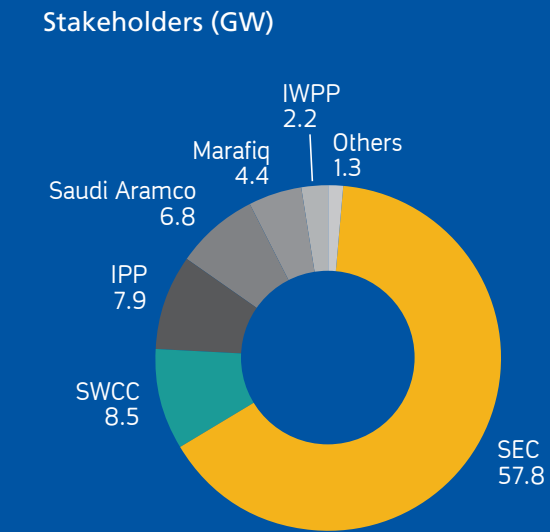
- Energy Balancing, Data Management and Reporting
- Business Development & Consulting Services
- Training and Development Services

Energy Balancing, Data Management and Reporting

Accurate accounting, balancing and reporting of energy components from input to output is a crucial part of the energy business. Our data experts are experienced in establishing full chain of data management from collection to developing dashboards for making timely and informed business decisions. We are specialist in:

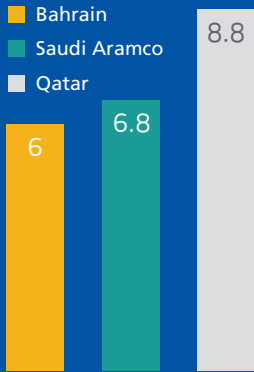
- Developing E-Tolead and E-Tarsheed, power hub(kingdom wide) dashboards for Power generation and demand reporting
- Providing Tutorials for dashboard development
- Creating Power Control Center (PCC) video walls
- Analyzing generation and demand data for energy balancing and developing forecasting models
- Developing KPIs and management reports
- Training services for big data management

Saudi Aramco Generation position in KSA and GCC



Kingdom Generation Capacity

~6.8GW



Total Demand

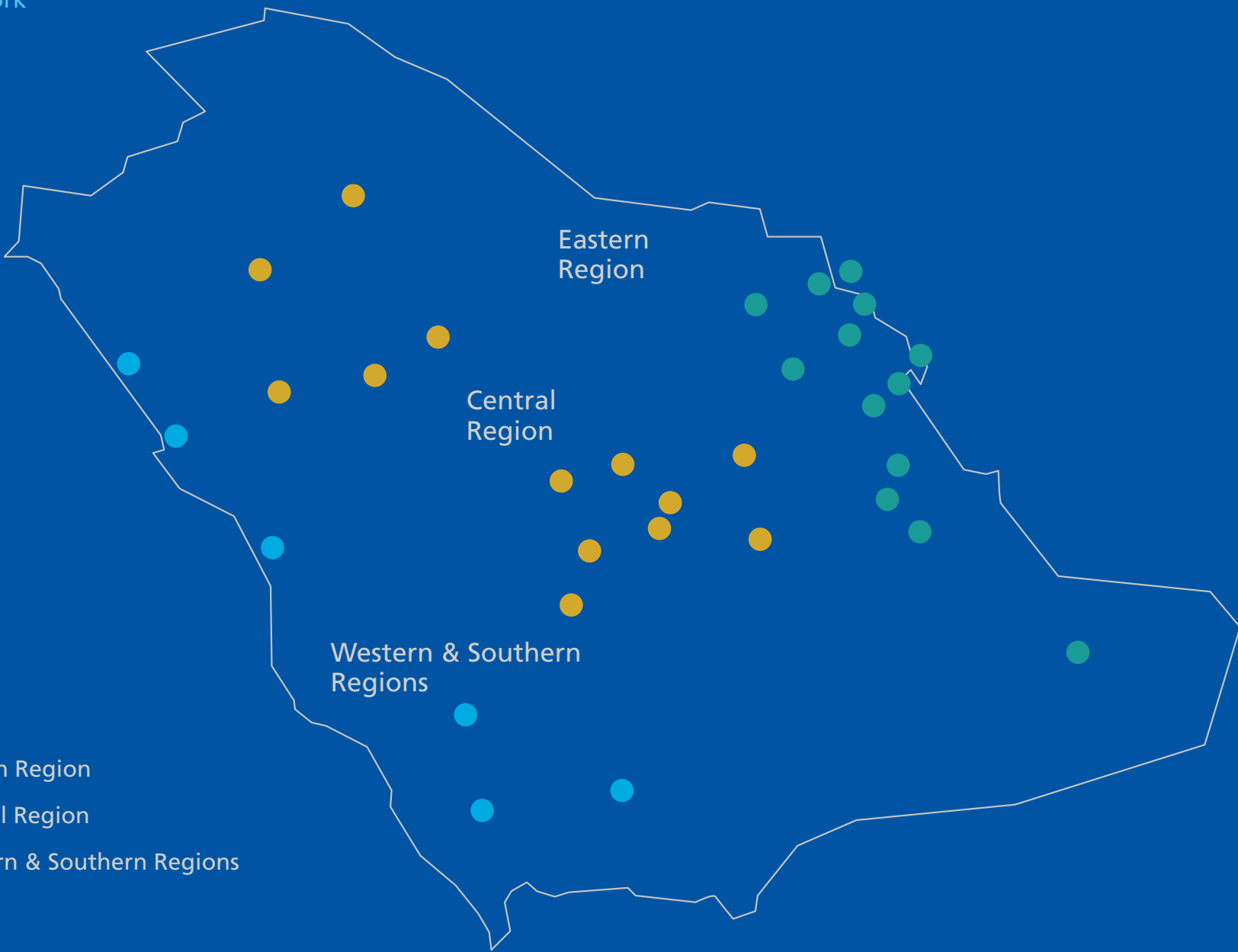
3652MW

Spill Power

~1300MW

Operating Network

- Eastern Region
- Central Region
- Western & Southern Regions



Business Development & Consulting Services

Our business acumen and capabilities with specialized industry knowledge and experience can provide support from idea translation to reality, a complete value chain. Our specialized services include:

- Contract management
- Building Retrofits Consultancy
- Support power project Implementation
- Business case development
- Planning and economic analysis
- Energy Efficiency Enhancement, ESCO projects
- Feasibility studies for power and steam investment projects
- Utility power supply agreements development and management
- Financial modeling for energy project
- Power systems capital planning and master plan development
- Conceptual design & cost estimation
- Portfolio Optimization
- Kingdom Generation and Demand forecasting
- Technology assessment, analysis and piloting

- Training course on integrated resources planning
- Economic & technical consultations on IRP and energy optimization
- Consultation on technical and economic feasibility for the interconnection on new power plants
- Assessment of future energy policy impact on SA and the Kingdom's power sector
- Develop and support new trends in efficiency for the power and water sector
- Support MEIM activities (Utility industry restructure, PSI, REPDO, etc.)
- Coordination for joint ventures formation and management
- Negotiations and deal closing for power projects
- Regulatory affair advisory
- Cybersecurity application and management
- Financial and management accounting frameworks
- Quality assurance for power generation projects
- Energy markets analytics

Training and Development Services

Saudi Aramco's Power Systems, now Aramco Power, has built a world-class operational infrastructure over the decades and accumulated a wealth of knowledge and capability to support the Kingdom's economic development, which places us as a leader in the global energy market. Building skills and capabilities is important for everyone in any organization to meet the challenges of today and tomorrow. We offer below in-house and partnered arranged courses, training and development services to meet the requirements of the power industry, which shows our dedication for knowledge transfer in the Kingdom. Our partners are National Power Academy (NPA), GCC and leading international institutions.

Power systems engineering and operations & maintenance certifications, on-job and class room trainings:

- Substation automation cybersecurity
- Power system protection courses
- Smart grid and substation automation courses
- Power systems specialist courses
- Cable test van training courses
- PDI/safety training workshop
- Job Safety analysis
- Intense electrical system operator (ESO) training
- Power factor testing methods (Doble) courses

- High voltage equipment maintenance
- DILO SF6 filling and reclaiming equipment
- SEL relays
- Potential testing and grounding
- Transformer testing
- Skills development for using OMICRON, MPRT and Freja three-phase relay tests
- In-house design and fabricate GE relays training simulator
- Emergency response planning
- Islanding and load shedding
- ETAP software and application
- Reliability centered maintenance training
- Developing electrical system related educational material (videos/leaflets/brochures)
- Root cause analysis for power systems problems and issues

Energy education and outreach programs by organizing workshops for:

- Energy Audits
- Energy Analytics and Reporting
- Monitoring and Verification (M&V)
- Demand data gathering and analytics
- Generation and demand forecasting techniques
- Power generation analysis and reporting
- Transmission and distribution systems asset investment and replacement strategies

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Building 3107, LIP, Dhahran
Tel: 876-6655
Email: g-aramcopower@aramco.com