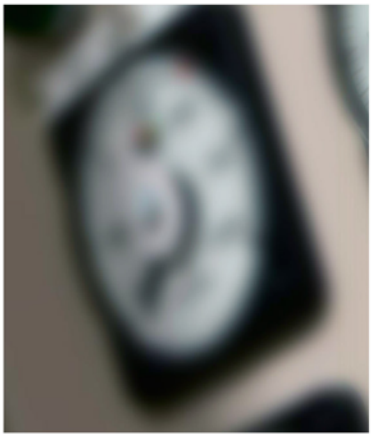
Addressing Risk in Marine Operations

Event Prevention / Event Mitigation



Predictable Performance

ASPIN KEMP & ASSOCIATES

High Reliability Power Plant
Product Guide

Aspin Kemp & Associates' (AKA) high reliability power plant is the world's first DNV certified system to operate in DP3 closed bus configuration. Our technologies improve efficiency in offshore drilling.

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Reduce Marine Operational Risk

Reduced Risk:
AKA's High Reliability Power Plant reduces risk while obtaining improved reliability, increased availability, predictable performance and reduced operating cost objectives.

With a focus on reliability of operations, the intent and objective of risk management is to minimize the potential for a process safety event.

AKA's systems are designed with an overall protection and alarm strategy. By coordinating the protective functions across integrated systems, the effects of common mode failures that can be inherited through multiple system vendors are minimized. A single fault incident will not cause the loss of various systems.

Achieving this risk management strategy is based on:

- A clear and well-defined intent and objective;
- Predictability that increases confidence;
- Simplified design incorporating shared efficiencies that reduce the cost of system operation;
- Support of a basis of confidence with common communication methods that increase understanding; and
- The implementation of defense in depth strategies.

All of these provisions in the integrated design of AKA's systems ensures harmonious coordination of all functions for a predictable system response. Clear protection and alarm information supports reliable decision making during system operation. Implementing these strategies contribute to a clear and well-defined intent and objective, a basis of confidence and defense in depth strategies for the management of risk throughout the life cycle of an AKA system.

Simplicity is probably the most important of all these characteristics. The simplification of the system allows academic studies (FMEA etc.) to be truly effective. Simplicity drives a radical reduction in cross connections and as such it is possible to test for every failure condition. Accurate studies and complete testing is the basis of predictability, and risk management.

Risk Management

Predictable Performance:
AKA engineers a complete set of risk management techniques into each of its systems.

Predictability of Systems

Effective risk management is fully dependent on the predictability of the systems and understanding the interdependencies between systems.

To achieve a predictable system:

- Electrical schematics must be detailed to show all interconnections between functions. The functional schematic format is part of the standard operating process at AKA for all electrical work. This kind of drawing is not typically used by vendors.
- The functionality of each piece of equipment must be compiled into a single functional description of the critical system, often referred to as process knowledge. This cannot be done with typical schematics detailing only physical connections.

From the functional drawings and descriptions, the predictable system can be analyzed and the consequences of various failures can be predicted using Failure Modes and Effects Analysis (FMEA). From this, interdependencies between systems can be derived.

Defence in Depth

Effective risk management is an outcome of implementing multiple prevention and mitigation techniques to provide as low of a risk as reasonably practicable.

Defence in depth strategies ensure that:

- The design is resilient to common mode failures, with appropriate risk event prevention; and
- Mitigation of a risk event is blocked with effective barriers.

Basis of Confidence

AKA's systems are provided with AKA's Integrated Documentation System (IDS™), functional drawings and human machine interfaces, providing the necessary information to increase confidence in predictable operation. These tools present instructional information, system elements defined by function, and the logging and visualization of monitored device statuses in all systems. A clear, unambiguous understanding of the provision and configuration of protective functions and alarms is achieved through a single source, ensuring confident predictable operations.

Simplicity

Simplifying design is based on a comprehensive understanding of the process. AKA puts a great deal of effort into discovering and proving the simple relationships that make the process functional and predictable under all conditions by identifying and removing unnecessary connections, dependencies, permissives, and components. "Simple" design radically increases the accuracy and testability of the Failure Modes and Effects Analysis(FMEA), and improves maintenance efficiencies while making the system obsolescence-proof.

Risk Event Prevention

AKA's High Reliability Power Plant eliminates potential faults through component selection, the reduction of high stress transients in the system, reduced interdependencies, and improved documentation. Methods used by the power plant's systems to improve fault detection capability include:

- Mathematical analysis, modelling and improved coordination studies to increase predictability; and
- Improved monitoring and self-diagnostic capabilities to designate between normal and non-normal operating conditions.

Risk Event Mitigation

AKA's High Reliability Power Plant mitigation techniques include reducing fault consequences and minimizing the recovery time following a fault. The design isolates faulty hardware before the fault can propagate to other devices, escalating a single fault into multiple faults. Systems can operate independently, as distributed intelligence is incorporated into their loads and generators to reduce fault consequences. The distributed intelligence also contributes to minimizing the recovery time following a fault by increasing device availability and reducing interdependence. This permits all resources to respond appropriately, immediately and predictably to a fault condition.

Statistical Analysis

Data Driven:
AKA's knowledge of operational functions comes from analysis founded on measurable properties of the system. AKA supporting tools make this possible.

The measurable properties of AKA's designs are used to decide on changes to make our systems as low risk as reasonably practicable, highly reliable, continuously available and clearly predictable.

Mathematical Models

Mathematical models approximate the true relationship between the outputs and inputs of a product or process, providing information on:

- How to optimize the product or process;
- How to perform a sensitivity analysis, which can be used for tolerance evaluations; and
- How to reduce variation to make the response robust (insensitive) to factors external to the product or process control.

The information gained through mathematical models is used to improve performance characteristics, to reduce risk, and to reduce costs and time associated with product development, design and production.

MathWorks MATLAB

MathWorks MATLAB is a tool used by AKA to analyze data based on the design of our systems. MATLAB carries out system analysis such as short circuit and coordination studies. Through the results of the studies, designs can be altered to improve performance.

Failure Modes and Effects Analysis

Failure Modes and Effects Analysis (FMEA) are done early in the design process, allowing the engineer to improve product/process and quality through design. An FMEA identifies potential failure modes, determines their effect on the operation of the product, and identifies actions to mitigate the failures.

Simplicity minimizes and removes interdependencies. This greatly increases the accuracy of the FMEA study. The consequences of the failure modes are considered as "Risk Events". Based on the risk management strategy, it can be decided if:

- The frequency of the risk event is "acceptable" or "unacceptable"; and
- The consequence of the risk event is "acceptable" or "unacceptable".

Unacceptable risk events are addressed through engineering change management. FMEAs are living documents and are updated throughout the product development process, capturing updated information to ensure revisions do not introduce new failure modes.

Multi-Channel Real Time Data Capture

Predictable Performance:
AKA achieves enhanced performance through predictive analytics across the population of your assets.
Know the curve, push the curve, repeat.

Many of the major systems developed and manufactured by AKA include a human machine interface (HMI) for capturing and displaying multi-channel real time data. This multi-channel real time data capture is integrated into the design of the system and its devices without the need for external interfaces, test points and diagnostic equipment that other suppliers require for this functionality. These HMIs deliver real time data streaming and high speed trending and monitoring of system characteristics.

The HMI is specifically designed to provide an operator with the means to interact with the system. Information from all connected systems is graphically displayed on a number of specifically designed HMI screens arranged in a hierarchical manner. The real time data streaming and high speed trending and monitoring direct the technician to knowledgeably participate in the systems operation and troubleshooting regardless of their technical skillset.

The HMI is equipped with a dual power supply system to meet requirements for redundancy and autonomous control. This supply is capable of a wide range of voltage inputs and can accommodate future changes in vessel control power system

Adding AKA's control products to a design is enough to change the way that the whole power plant is commissioned and operational.

Components:

- HMI screen to display process status, and provide fault indication;
- Rack computer to allow for the archiving of process data; and
- HMI built to be fault tolerant.

Remote Analytics

When specific faults are detected (configurable), a block of data from the time period surrounding the fault will be saved on the disk and optionally emailed to a select group of individuals.

Qualifications

Improved Reliability:
AKA has the qualifications and experience to engineer, manufacture, commission and maintain your high reliability power plant systems.

System Testing

AKA's equipment is tested on our factory floor as a system to determine that there are no deficiencies and the installation is in good order prior to shipping. These efforts reduce time consuming troubleshooting efforts and decrease installation timelines on site.

Quality Registrations

- AKA Maintains ISO9001:2015

Service and Installer Qualifications

- Red Seal Electricians
- PLC Programmers
- BST Survival Systems Training
- HUET Survival Systems Training
- US Coast Guard Qualification
- SEMS Training Certification
- BP6N1 Gulf Rig Pass

Documentation Deliverables

All systems designed, manufactured and commissioned by AKA are developed on a solid documentation foundation. This Integrated Documentation System (IDS™) serves the design and development of the system, but also the end user. Documentation is developed throughout the engineering process and is culminated at the end of projects by the submission of final project documents, including:

- Project Documents
- Installation Manuals
- Operation and Maintenance Manuals
- Design Schematics and Mechanical Drawings

Technical Functional Drawings

AKA's unique functional schematics are a fundamental concept of our business practices. They provide device and function attributes for clear instructive information to our processes from system engineering, through manufacturing, commissioning and documentation. The same informative material is also well suited for continued life cycle support of the installed system.

deviceTRAK

All systems designed, manufactured and commissioned by AKA include deviceTRAK. deviceTRAK is a unique configuration management tool that captures, controls and protects system specific configuration settings and support software for programmable devices. deviceTRAK provides a single controlled source for all programmable device data, alleviating the need to search for configuration files and the uncertainty caused by their unknown programming accuracy.

Agency Listings Approvals

AKA can deliver to any class requirements. Agency approvals include:

- Lloyd's Register
- DNV
- ABS
- UL
- CSA

High Reliability Power Plant

Performance Oriented: Improved reliability, increased availability, reduced operating costs and predictable performance.

By using a disciplined design process AKA has improved the reliability and increased the availability of conventional offshore drilling power plants. As a result, AKA has also shifted the paradigm for fuel efficiency in the offshore drilling industry.

AKA's High Reliability Power Plant includes:

- Advanced Generator Protection (AGP) with DP3 Closed Bus Operation
- High Availability Distribution Bus
- Advanced Thruster Control and Protection System (ATCAP)
- Pre-Magnetization System
- Autonomous Tie Breaker
- Hybrid Drillfloor
- Uninterruptible Power Supply System (UPS)
- Emergency Generator and E-Bus Control

FEATURES

Improved Reliability
AKA's systems improve fault detection capabilities, eliminate potential faults and reduce the consequences of a fault.

Increased Availability
AKA's systems minimize the post fault recovery time, reducing the time a system is offline.

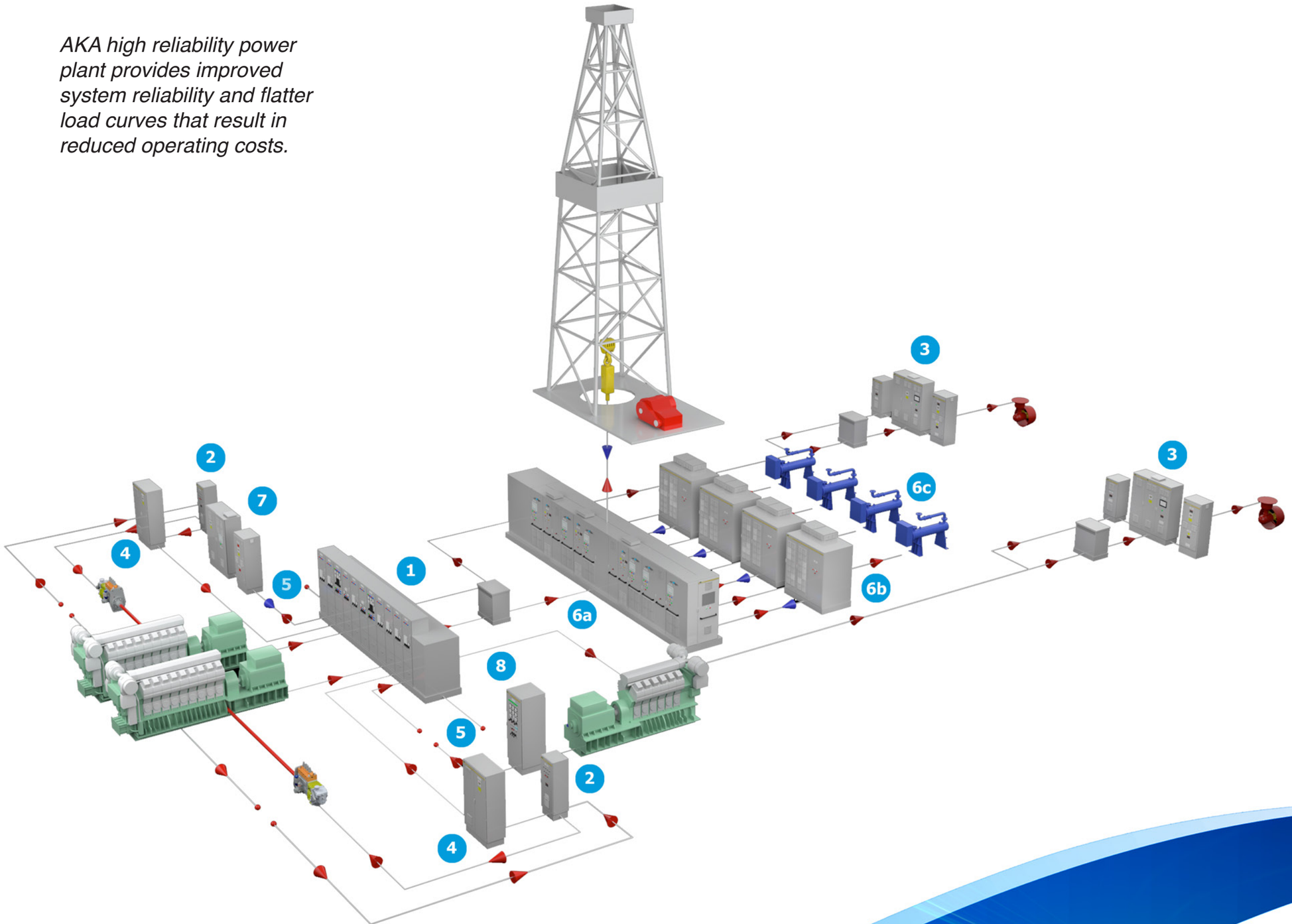
Reduced Operating Costs
AKA's systems incorporate hybrid energy storage systems (HESS) and revolutionary distribution arrangements and technologies to ensure power plants are performing efficiently.

Predictable Performance
AKA's systems perform with expected responses to both normal and non-normal conditions.

Collaborative Development
AKA works with our clients to provide solutions to satisfy their unique power and automation needs.

Life Cycle Support
Our clients select AKA for obsolescent proof life cycle support.

AKA high reliability power plant provides improved system reliability and flatter load curves that result in reduced operating costs.



AKA High Reliability Power Plant Legend

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Advanced Generator Protection (AGP) with DP3 Closed Bus Operation

Improved Reliability:
AKA's systems improve fault detection capabilities, eliminate potential faults and reduce the consequences of a fault.

FEATURES

Fault Tolerant Design
Key elements of the AGP system's fault tolerant design are:

- Eliminates potential faults;
- Improves fault detection capability;
- Reduces fault consequences; and
- Minimizes recovery time following a fault.

System Monitoring
The AGP system includes a comprehensive human machine interface (HMI) that allows for supervisory level operation of critical elements of the power distribution scheme. Historical alarms and trending data are also made available on the HMI system, allowing for multiple layers of record keeping to exist should a vessel event occur.

DP3 Closed Bus Operation
AKA was the first company to successfully carry out live short circuit testing on their system with a successful and predictable outcome.

More Reliable System
AKA's AGP with DP3 closed bus operation reduces the impact on propulsion capability during worst-case failure modes compared to a system designed with open bus architecture.

Reduced Fuel Costs
Installation uses less fuel than the same operation in an open bus configuration.

Reduced Environmental Impact
Installation produces less harmful emissions.

Reduced Maintenance Costs
Number of diesels operating is based on load, resulting in fewer diesels running.

OVERVIEW

Conventional drillship vessel power plants rely on power distribution systems that operate on an open bus system. This essentially creates multiple power plants that are all operating independently to supply vessel loads with their required power.

The AGP system coordinates multiple sub-systems in a unique architecture that is founded on fault tolerance. By monitoring the various generator incomers, tie breakers, and overall power distribution, the AGP is able to predict vessel events to prevent or minimize their effects.

AGP systems, coupled with AKA's medium voltage distribution designs, allow for the multiple buses to operate in a closed ring configuration that is conducive to:

- DP3 operations;
- Generator load sharing for high efficiency operation; and
- High fault tolerance that prevents or reduces major vessel events resulting in significant downtime.

By combining elements such as AGP, generator incomers, tie breakers, and transformer feeder controls backed by pre-magnetization distribution, AKA allows for secure and confident vessel operations in a closed bus DP3 environment.

AGP System installed on the Deepwater Nautilus.

1 GENERAL ARRANGEMENT

Not to be used for installation purposes.

High Availability Distribution Bus

Increased Availability:
AKA's systems minimize post-fault recovery time, reducing the time a system is offline.

FEATURES

Redundant Power Sources
The high availability distribution bus provides multi-sourced power for the critical AC loads required to support the operation of diesel engines. It is a device that selects power from several sources.

High Availability
During a power disturbance, the possibility may exist that one of the sources has been damaged, and the high availability bus will engage an alternate source if the one in use is disabled.

Engages Pneumatic Fuel Pump
The high availability distribution bus will engage an air-powered (pneumatic) fuel pump if none of the AC power sources are available.

OVERVIEW

Typical drillship power plants rely on conventional distribution systems for sustaining power to critical AC loads such as generator auxiliaries and fuel systems.

AKA's high availability distribution bus uses a designed redundancy system to allow for multiple power sources to feed these types of critical systems. The high availability distribution system is also capable of creating a selection and redundancy scheme between various available auxiliaries. This allows for a redundant architecture involving supplies and loads. In the event that one distribution scheme is lost or unavailable, AKA's high availability distribution bus will immediately select another based on configurable selection logic.

This includes the use of air driven pumps and other energy sources.

High Availability Distribution Bus installed on the Deepwater Proteus.

2 GENERAL ARRANGEMENT

Not to be used for installation purposes.

Advanced Thruster Control and Protection System (ATCAP)

Predictable Performance:
AKA's systems perform with expected responses to both normal and non-normal conditions.

FEATURES

Frequency Based Phase Back
At 100% plant load, the AKA ATCAP system will reduce the thruster variable frequency drive power consumption to prevent an overload. If an overload condition occurs, the AKA ATCAP system will shed thruster load and allow the plant to recover and operate under 100% load.

Autonomous Stand-Alone Control
The AKA ATCAP system allows full control of the thruster, as well as full autonomous control. The thruster does not rely on any external source or resource to be operational and available.

Main Bus Disturbance Response
The AKA ATCAP system detects the status of thruster auxiliaries and engages them as necessary. Should a main power disturbance momentarily disable auxiliaries, the AKA ATCAP system will respond with logic to allow thruster ride-through and recover auxiliaries when the main bus is again within specification.

OVERVIEW

The AKA Advanced Thruster Control and Protection (ATCAP) system provides both predictable and favourable thruster behaviour under normal and non-normal conditions.

The ATCAP approach to thruster stability takes advantage of combining the UPS, feeder, and thruster infrastructure control system to provide all-encompassing thruster operations in DP systems.

The UPS provides the required supply with heightened redundancies and tolerance. The feeder system offers protection logic for supply from the medium voltage switchboard. The thruster infrastructure controller engages these systems to help provide a seamless connection via health monitoring, pre-magnetization, and bus pre-charge. Together they form the ATCAP system, which stands out against all other typical vessel thruster systems.

The ATCAP system contributes to thruster autonomy, reliability, and predictability. The predictable behaviour is such that when a thruster is exposed to any event, it will perform as expected.

ATCAP installed on the Discoverer Deep Seas.

3 GENERAL ARRANGEMENT

Not to be used for installation purposes.

Pre-Magnetization System

Increased Availability:
AKA's systems minimize post-fault recovery time, reducing the time a system is offline.

FEATURES

- Virtually eliminates inrush current.
- Has been successfully implemented on similar installations.
- Is simple and robust, relying on a relatively small pre-magnetization transformer and standard switchgear components.
- Eliminates DC current injection on the medium voltage bus.
- Verifies that the main transformer is healthy before closing the feeder breaker.
- The use of pre-magnetization on large transformers allows them to be connected to the medium voltage bus with just one generator.
- Removes mechanical shock load on transformer.
- Removes voltage dip and shock load on main bus.

OVERVIEW

AKA's pre-magnetization system reduces the effects of high inrush currents when power is first applied to the transformer primary. These high inrush current conditions can cause major stress on the power generation systems, even leading to the danger of tripping a generator. Removal of inrush allows the control system to better discriminate between normal and abnormal current.

In order to limit these current peaks, AKA's pre-magnetizing system magnetizes the iron core in synchronization with the medium voltage bus prior to connection on all major transformers. Once the medium voltage connection has been made, the pre-magnetization source to the secondary is immediately removed.

With the use of AKA's pre-magnetizing system, it is possible to connect large transformers to the bus when only one generator is running. The time taken to reinstate operation after a problem has led to the loss of a bus will be greatly reduced, as it will not be necessary to wait for multiple generators to be sequentially started. It also means that, during normal operations, transformers can be easily connected to the bus without the need to start multiple additional generators.

The pre-magnetization sequence is supervised and also provides an opportunity to assess and determine the health of the transformer and the associated network prior to connection of the primary to the medium voltage bus.

Pre-Magnetization System installed on the Deepwater Pontus.

4 GENERAL ARRANGEMENT

Not to be used for installation purposes.

Autonomous Tie Breaker

Increased Availability:
AKA's tie breakers provide unparalleled confidence and obsolescent proof operation.

FEATURES

Improved Autonomy:

- Eliminates the need for data communication between tie breaker cells in separate compartments.
- Allows each tie breaker to determine when it is safe to close.

OVERVIEW

Each of AKA's tie breaker systems operates autonomously superseding conventional failure prone master slave configurations. The tie breaker system is equipped with a controller, inputs that sense bus tie voltage, and contactor status. The only connection between two bus tie systems is the medium voltage power connections.

The tie breaker controller will determine the health of the link before allowing the tie breaker to close. During the health check of the link, the system applies a collision detection strategy to prevent a crash closure event.

The tie breaker has three modes of operation that are selectable via the door mounted selection switch; local mode, local auto mode, and remote auto mode.

In the local mode the tie breaker can be closed as a manual operation using the controls provided on the door. Both the local auto mode and the remote auto mode use a bus impedance sensing process to check health before using the synchronizer to automatically sync and close the tie breaker. The difference between these two modes of operation lies in how the process is initiated.

In local auto mode the 'Start Sync' and 'Stop Sync' pushbuttons will respectively initiate and abort the sync and close process.

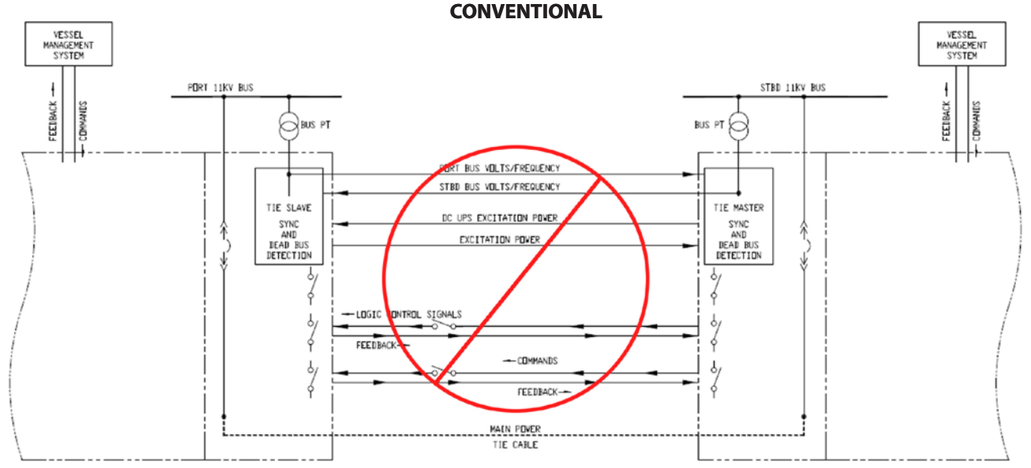
In remote auto mode the vessel management system (VMS) is able to remotely initiate the sync and close sequence or open the breaker.

Autonomous Tie Breaker installed on the Deepwater Thalassa.

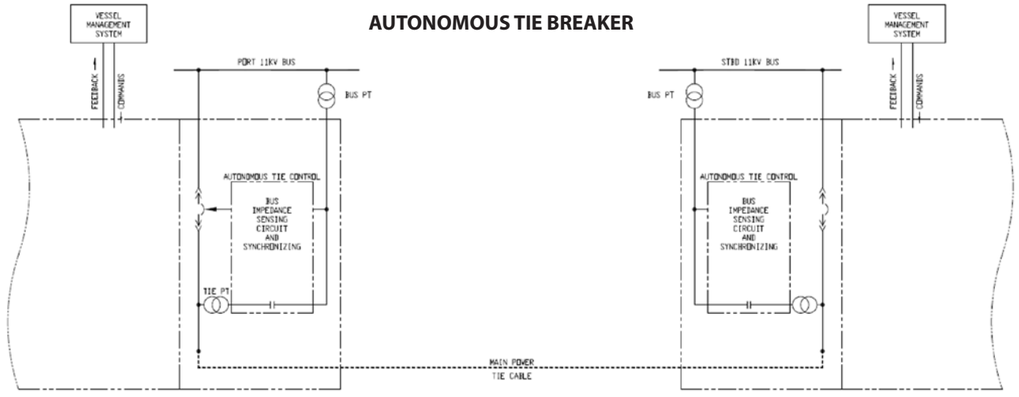
GENERAL ARRANGEMENT

Not to be used for installation purposes.

CONVENTIONAL



AUTONOMOUS TIE BREAKER



AKA Hybrid Drillfloor

Reduced Operating Costs:
AKA's systems incorporate hybrid energy storage systems (HESS) and revolutionary distribution arrangements and technologies to ensure power plants are performing efficiently.

FEATURES

Ride-Through Capability
The brake choppers and energy storage system work together to create ride-through capability for the drilling DC bus.

Flat Power Curve
AKA's hybrid drillfloor has the ability to respond to load demand changes safely and instantaneously. The system changes between charging and discharging states in milliseconds and can quickly charge and discharge energy with minimal heat generation.

Improved Reliability
System redundancy with improved fault identification and fault propagation prevention.

Reserve Capacity
The hybrid drillfloor provides reserve capacity to supply power for transient loads that exceed the capacity of the diesel generators currently online.

Environmentally Responsible and Economical
Fewer diesel generators required online during operations.

OVERVIEW

AKA's hybrid drillfloor uses a combination of DC bus control, energy storage, and controller infrastructure to dramatically reduce the impact on the drilling process drives due to vessel disturbances. This is accomplished by using advanced ride-through technology and also works with the rest of AKA's systems to create a more stable and predictable vessel power plant.

The hybrid drillfloor has been designed to operate completely autonomously and to be highly reliable through the use of redundancy. Drillships require numerous Variable Frequency Drives (VFD) used for different functions encountered in the drilling process. Drilling process drives can be:

- Top drive motors;
- Drawwork motors,
- Mud pumps motors; and
- Cement pumps.

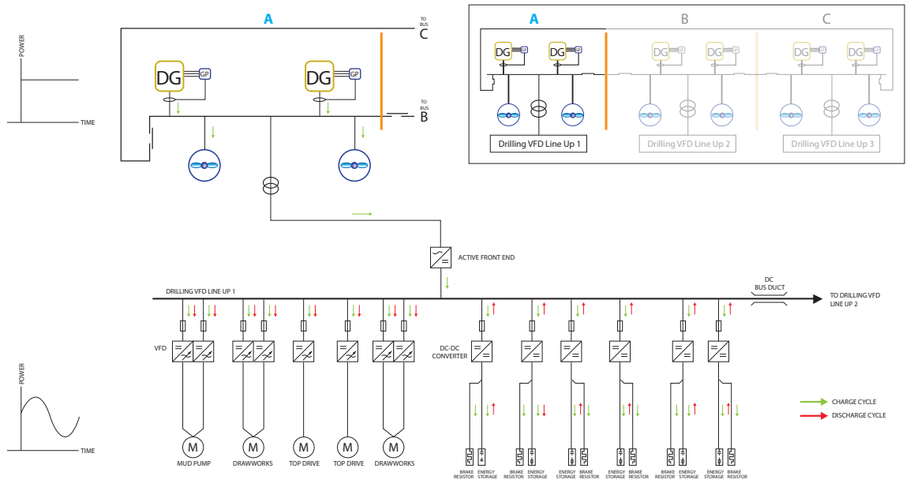
With AKA's hybrid drillfloor, the drilling process drives are able to be decoupled and driven completely independently of their controllers. Redundant systems are also connected to a single interface and control module for the various drilling motor VFDs.

The hybrid drillfloor is one of the most critical elements to AKA's combined vessel power plant stability architecture. This system, coupled together with AKA's AGP system, provides a level of vessel power plant stability that is unmatched in conventional drillships.

Hybrid Drillfloor installed on the Deepwater Conqueror.

5a GENERAL ARRANGEMENT

Not to be used for installation purposes.



Uninterruptible Power Supply System (UPS)

Improved Reliability:
AKA's systems improve fault detection capabilities, eliminate potential faults and reduce the consequences of a fault.

FEATURES

Customizable Redundant Power Sources
Customizable redundancy gives AKA's UPS systems a significant advantage for those looking to outfit vessels with complex power distribution arrangements.

Redundant Power Supplies
Each system is designed with N + 1 redundancy. The failure of any single power supply unit will not affect the rated output capability of the UPS.

Hot-Swappable Power Supply Units
Each power supply unit is hot-swappable, and each power supply unit is individually monitored. A failed rectifier unit can be replaced without interruption of the UPS output.

Undisturbed Ride-Through Technology
The AKA UPS includes a distribution that provides undisturbed ride-through capability to all loads.

Hardware-In-The-Loop Testing
Hardware-in-the-loop testing ensures that critical components are capable of functioning properly when they are called upon.

OVERVIEW

The offshore drilling environment is routinely exposed to operations that cause power disturbances, such as the following:

- Connecting high current loads;
- Disconnecting a loaded generator;
- High harmonic currents on the main bus;
- Faults on power control devices; and
- Rapid load changes by aggressive loads, such as the drawworks.

AKA's uninterruptible power supply (UPS) system is able to limit the effect of these disturbances, so that output power remains stable and available for any equipment powered from the UPS system.

Typical vessel UPS systems suffer from two critical weaknesses in the design:

- Hidden failures that occur well before the UPS is needed; or,
- Unusual power plant failures or disturbances that expose the UPS to unusual supply or load conditions.

The failure of a UPS usually escalates to a serious loss of process control. AKA's current UPS design helps achieve the stability required to overcome these weaknesses and provide a reliable UPS.

UPS installed on the Deepwater Asgard.

6 GENERAL ARRANGEMENT

Not to be used for installation purposes.

Emergency Generator & E-Bus Control System

Increased Availability:
AKA's systems minimize post-fault recovery time, reducing the time a system is offline.

FEATURES

- Both real and reactive power load sharing carried out autonomously.
- Local automatic and manual synchronization.
- Real-time power calculations and harmonic analysis.
- Emergency bus power management functions carried out autonomously, including automatic start when bus performance is outside of specification.
- Above standard blackout detection and recovery times; greater than 33% improvement over industry standard.
- Built-in high speed oscilloscope, capable of real-time data streaming, trending and monitoring.
- Included HMI for alarm management and synchronization.
- Emergency shutdown monitoring.
- Includes all class required protection such as:
  - Under/over voltage:
  - Under/over frequency;
  - Reverse power; and
  - Differential current.
- Generator temperature monitoring and protection.
- Full local instrumentation.
- No external control power required for operating generator.
- Can run indefinitely in parallel with main generators.
- Full load shedding performance.

OVERVIEW

AKA provides the optimum in predictable and reliable emergency generator incomer and controls. The emergency generator incomer and control system is built to comply with DNV regulations. It provides fast, industry-leading blackout detection and recovery, reducing the time that critical loads are unavailable. The design creates autonomous, resilient, and predictable system operations.

The emergency switchboard manages the emergency power and its distribution through the emergency generator incomer. AKA's emergency generator incomer and control provides fast sampling and trending for monitoring current and historic system operation.

AKA's emergency generator controller is the only system that will permit the generator to operate either independently or in parallel using proportional load sharing with AKA's 6th generation power plant.

This synchronized parallel operation with the 6th generation power plant allows for easier monthly emergency generator preventative maintenance, as there is no need to temporarily de-energize the emergency switchboard. Normal supply transfer is seamless, having no need for "bang bang" supply switching. The AKA emergency generator incomer can keep the bus up and synchronized when swapping the normal E-Bus supply source, allowing for a predictable and smooth transfer.

Emergency Generator and E-Bus Control System installed on the Deepwater Thalassa.

7 GENERAL ARRANGEMENT

Not to be used for installation purposes.

Functional Drawings

Life Cycle Support:
AKA's unique functional schematics concept supports a better understanding by the reader for system operation, maintenance and troubleshooting.

FEATURES

- Accessible, complete functional drawings are the true basis of worldwide real time support and participation of experts.
- Simplifies the traceability of hardware implementation to system functions on a single drawing.
- Determines predictable results to inputs through a better understanding of system elements defined by functional boundaries within a single drawing.
- Reduces commissioning time and facilitates in-service troubleshooting.
- Extensive device identification (device name/function/ location) and cross-referencing binds all components of the system installation and documentation together.
- Available data extracts ensure higher system quality and reliability through the engineering development process to life cycle support efforts.

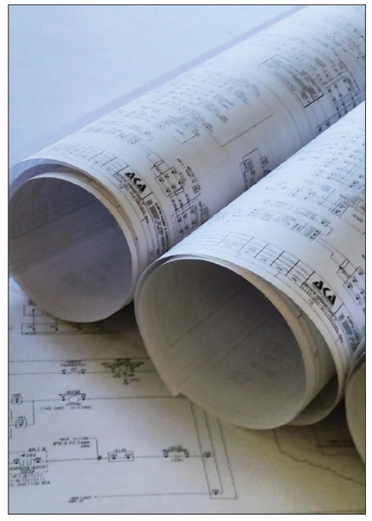
OVERVIEW

Aspin Kemp & Associates' (AKA) unique functional schematics are a fundamental concept of our business practices. They provide clear instructive information to our processes from system engineering, through manufacturing, commissioning and documentation. The same informative material is also well suited for continued life cycle support of the installed system.

Conventional schematics, from other suppliers, require multiple drawings for a single system and only show how the electrical components are connected. AKA's functional drawings delineate the functions of the system on a single schematic.

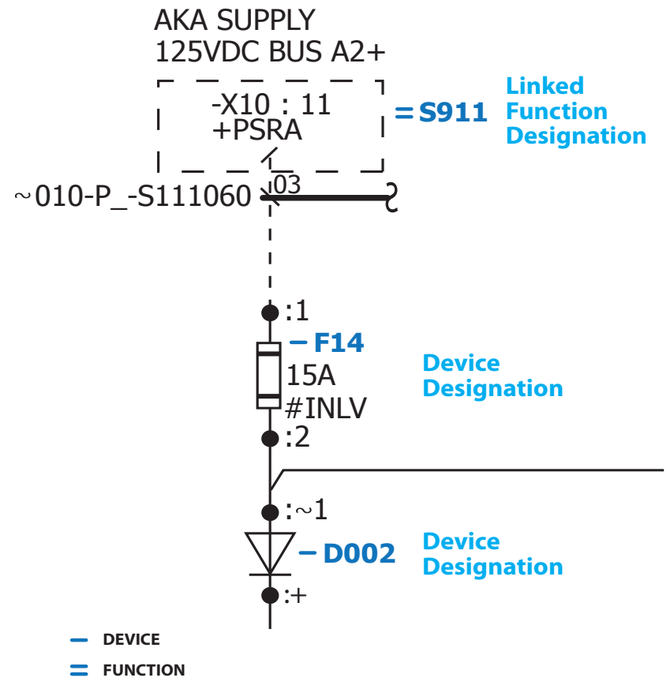
Each device on AKA's functional schematics is shown having a distinct device ID that incorporates the device type and a unique number designation. The device ID is a common indicator that can be used for field referencing or other information formats for the system. Each system device is identified by its associated function and location, supplementing the device ID. These attributes, along with drawing styles, provide an extractable normalized database within the functional schematic that can be used for developing multiple system related information tools. This provides extensive cross-referencing, binding all components of the system installation and documentation together.

AKA's functional approach to schematics supports a better understanding by the reader for system operation, maintenance and troubleshooting.



GENERAL ARRANGEMENT

Excerpt from AKA's =S111 Functional Drawing



Integrated Documentation System (IDS™)

Collaborative Development:
AKA works with our clients to provide solutions to satisfy their unique power and automation needs

FEATURES

- AKA IDS™ documentation reduces the time it takes operators and maintainers to familiarize with new systems. IDS™ speeds access to the right information needed for troubleshooting.
- Personnel can identify any physical device they wish to find more information on or troubleshoot and, using the component's device number, access the appropriate area of the IDS™ quickly.
- IDS™ documents in an E-DOCS format give access within seconds to any system document from any PC or laptop equipped with a CD drive. In addition to supporting end users, this provides critical on-site support for project personnel during installation and commissioning activities.
- AKA relieves the client's design team of the arduous task of translating and formatting technical information into user-friendly documents.
- Documents are produced and presented as though they were original client documents.
- Mission critical data, such as PLC programs and programmable device configuration files, can be archived as part of the E-DOCS collections. Source documents in their native formats, such as AutoCAD drawing files, can also be included.
- IDS™ documents are reproducible; all documents are digitized and electronically stored and can be reproduced in the original quality as required.

OVERVIEW

The Integrated Documentation System (IDS™) provides a complete documentation package that fully details the engineering scope of supply and details the integration of all vendor equipment.

The IDS™ is an integral component of AKA's engineering process. This system has proven its operability in a number of marine and industrial applications.

The final system documentation package references all supplied equipment. It provides system operational philosophies, operation/ maintenance manuals, technical specifications, parts lists, drawings and schematics, and system software.

DEVELOPMENT

AKA's documentation team works collaboratively with the client to produce the required documentation. AKA's documentation development process ensures the highest quality of project deliverables.

The IDS™ development process includes the following tasks:

- Project documentation familiarization;
- Assess client needs and source document gap analysis;
- Resource acquisition;
- Overall design of deliverables;
- Storyboarding;
- Overall graphic design;
- Database population;
- Revision tracking;
- In-depth project technical familiarization;
- Issue tracking;
- Technical writing;
- Technical Illustration; and
- Creating IDS™ E-DOCS.

MASTER REFERENCE

The Master Reference has been designed as the master access book to the technical documentation, instruction manuals, specifications, parts list, cable list, tests and trials documentation, systems software archive and the drawings and schematics. The referenced documentation is contained within accompanying book sets.

The purpose of the Master Reference is to facilitate the operators' access to information by providing a range of access devices and cross-referencing to all IDS™ components. In this way, operational staff would use the Master Reference as the main reference point in their search for any installation-specific information.

Beyond its role as a reference book, the Master Reference provides the operational philosophies of the PCS and AMS together with component descriptions, line diagrams, photographs, operational and procedural information; as well as maintenance and troubleshooting techniques. This information, which is presented in logical modules, is provided in a simple and concise manner, ensuring that the Master Reference also serves as an effective training/reference tool throughout the life of the installation.

The Master Reference is fully indexed and cross-referenced to all other IDS™ and field components. A glossary of terms is also included to facilitate understanding.

IDS DOCUMENTATION SET INCLUDES

Master Reference

The Master Reference includes the following topics:

- Introduction to the Use of the Master Reference;
- Systems Overview;
- System Descriptions;
- Major Devices;
- Operating Procedures;
- Periodic Safety and Maintenance; and
- Glossary and Index.

Parts List and Spare Parts List

The parts list is developed in conjunction with the development of the system drawings. The parts list is presented in electronic and hard copy format by location, by device, by manufacturer and by part number, thereby expediting user access.

The parts database contains the following fields:

- Device number;
- Part number;
- Model number;
- Manufacturer;
- Supplier;
- Part description;
- Quantity fitted;
- Associated drawings; and
- Sheet number.

Cable List

An extraction of cable information from the drawings enables the provision of detailed cable lists for the refitted systems on each installation. This is provided in both electronic and paper format.

OEM Documentation

The OEM documentation contains operation and maintenance manuals, as well as the technical sheets and narratives for each installed piece of equipment as supplied by the appropriate manufacturer.

Manuals and other technical documentation is catalogued according to the manufacturer and are arranged in this book with tables of contents to facilitate the accessibility of information. OEM documentation is referenced in the Master Reference according to book number and section number.

Drawings & Schematics

All drawings and schematics, after being validated and determined FINAL AS BUILT, are presented in 11" x 17" format. All drawings are grouped into discrete binders containing a contents page and drawing index, providing location in document set, drawing number, sheet number, drawing title, and all other data available through the title block. AKA will use its Project Tools to automatically extract and compile the relevant title block information.

QuickFind Documentation Map

The purpose of the QuickFind documentation map is to provide the user with a single page content reference to the IDS™. The QuickFind is a laminated card detailing the location of each documentation component as an additional information access device for the end-user.

deviceTRAK

Increased Availability:
AKA's systems minimize post-fault recovery time, reducing the time a system is offline.

FEATURES

Captures Configuration Data
Captures system-specific configuration data, including common configurations, plus the interfaces (auxiliary tools and software) for every programmable device.

Version Control
Controls and maintains current and historical configuration files in a single location.

Protection
The "Check-In/Check-Out" vault feature protects the files using multiple levels of security.

Additional Relevant Information
deviceTRAK provides device-specific operational documentation, verification images and step-by-step procedures for connection and interaction.

Software Registry
The software registry lists every captured programmable configuration of the systems in the plant. The software registry provides auditable evidence of the stored device information.

Searchable Database
Searches can be done based on system, sub-system or device name to quickly locate the material required.

SQL Database
deviceTRAK is built on an industry recognized platform that delivers predictable, secure and scalable performance.

Network Ready
Network ready design provides connectivity, permitting safe sharing of data by multiple users.

OVERVIEW

deviceTRAK is a unique configuration management regimen that captures, controls, and protects system-specific configuration settings and support software for programmable devices.

In the event of a component failure, spare parts are a necessity. With the proliferation of automation and electronics used in modern plants, addressing system failures is not as easy as simply replacing that component.

Replacing PLCs, motor drives, adjustable circuit breakers and timers are possible, but if the configuration files or programmable settings of that device are unknown, the device and potentially the entire system can remain inoperable.

deviceTRAK stores identified connection hardware and software for use with specific devices, and the onsite location of these items for easy reference. Step-by-step procedures are provided for connection to, and interaction with, these devices, including:

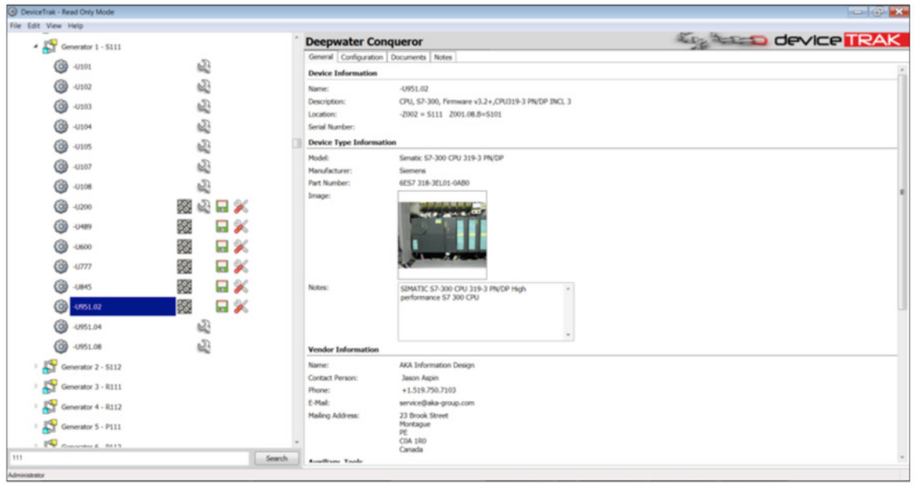
- Load to Device;
- Save to Flash;
- Restore Configuration File; and
- Compare Configuration Files.

Original equipment manufacturers' (OEM) documents are stored for reference as required, and device images are displayed for additional verification of the programmable device.

deviceTRAK installed on the Discoverer Clear Leader.

SYSTEM HIERARCHY

INSTALLATION → SYSTEM → SUB-SYSTEM → DEVICE



Technical Services

Life Cycle Support:
From engineering design and consulting to commissioning and field service, AKA stands with you. We are here to support the continued success of your installations.

AKA has over 20 years of experience with all types of power and control systems from every major vendor.

AKA mobilizes our field service resources to the location of the installation. All service activities performed are documented in a written report when complete, including any assigned tasks, resulting activities and recommendations.

System Integration

AKA is a systems integrator that delivers innovative products, technically advanced services, quality documentation and world-class training. AKA has the skill to incorporate systems into your installation and educate personnel for a seamless transition and knowledgeable life cycle support.

Project Engineering and Management

AKA is your solution for qualified project engineers. Our experienced engineers can provide support to all phases of your project, including design reviews, installation supervision, integration and project management.

AKA has provided project management services for its own systems, as well as for other leading manufacturer's products. AKA has experience working in all phases of the formal design process for electrical equipment; from requirement definition, through detailed design, production and installation. AKA understands the importance of reducing risk and cost through upstream innovation to resolve issues early in order to deliver project requirements on time and within budget.

Regulatory Agency Consulting

Navigating and interpreting the world of Marine Classification Society regulations can be complex, costly, and adds significant risk to your project. AKA has extensive experience achieving approvals from all major marine classification society. Whether it be design review and recommendations or full service class management, AKA is your partner in achieving marine and other regulatory approvals.

Electrical Systems Upgrade

AKA's expertise with the integration of power and control systems from every major vendor allows us to knowledgeably upgrade your electrical systems, eliminating potentially costly interaction across multiple vendors.

Electrical System Troubleshooting

From complex to basic, unique or obsolete, your electrical system issues can be solved by an experienced AKA service team member. With experience in troubleshooting all types of power and control systems, AKA can analyze and solve issues on a system level.

Testing, Auditing and Witnessing

AKA offers multi-discipline expertise for customer acceptance test inspections and witnessing. We can provide licensed electricians and technicians, or electrical/mechanical engineers, depending on equipment complexity and customer needs.

AKA's product knowledge includes:

- Switchboards;
- Transformers;
- Drives;
- Motors;
- Generators;
- Engines; and
- Control Systems.

Our experienced staff will attend the vendor's customer acceptance tests on your behalf and provide a high level of reporting, communication, and confidence.

Measurement and Instrumentation

AKA offers qualified instrumentation technicians for your process and measurement needs. Services are available for system design or upgrade, installation and commissioning, or maintenance.

Automation

AKA has provided control and automation solutions for the offshore oil and gas industry, marine, coast guard, industrial processes and municipal water companies. Our efforts ranged from assessment, maintenance and service for existing systems to the engineering and installation of new control and automation systems.

AKA's control and automation systems include:

- Supervisory Control and Data Acquisition (SCADA);
- PLC Systems;
- Human Machine Interface SIMATIC WinCC;
- Large Drives;
- Process Control Systems;
- Electrical Control Systems;
- Industrial PC Control Systems;
- Condition Monitoring Technology; and
- Add-on Components for Enhancement of Pre-delivered Systems.

Secondary Injection Testing

Testing of trip units on protection devices ensures a high level of confidence and predictability should your electrical system ever experience a disturbance. When you have confidence in your protection, you have significantly reduced your risk.

Secondary injection testing injects simulated waveforms into the protection device and analyzes the response, then compares it to the expected response to validate the protection device. It should be carried out periodically according to the manufacturer's recommendation, local or applicable regulations, or after any service to a circuit breaker.

Protection and Coordination Studies

Contact AKA before you implement a new electrical distribution system design to ensure safe, efficient and economical operation. AKA has an extensive engineering toolset to carry out system analysis such as short circuit and coordination studies.

Programmable Device Management

deviceTRAK is a unique configuration management regimen that captures, controls and protects system specific configuration settings and support software for programmable devices.

AKA provides the deviceTRAK software ready for database population and the professional installers for initial software installation and database population. This assures that all information is current and accurate.

Hazardous Area Inspection

AKA is an industry leader in rig-specific hazardous area electrical installation and protection practices. AKA has the qualified personnel to perform the inspection and the software developed to provide a more efficient way to track and maintain your hazardous area equipment.

Rig Vessel Profile - Closed Ring System & Short Circuit Test

ASPIN KEMP & ASSOCIATES

Since 2006, AKA has retrofitted over 30 drillships/rigs to the closed bus operation system. In 2011, AKA demonstrated the DP3 short circuit test on a real vessel - an ultra deepwater drillship, and became the first and the only company that has the ability to deliver DNV DP3 closed bus operation systems.

	DEEPWATER PATHFINDER	DEEPWATER FRONTIER	DEEPWATER MILLENNIUM	DISCOVERER SPIRIT	DISCOVERER DEEP SEAS	DISCOVERER INSPIRATION
						
SHIP TYPE	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship
SHIP OWNER	Transocean	Transocean	Transocean	Transocean	Transocean	Transocean
YEAR: BUILT	1998	1999	1999	2000	2001	2008
YEAR: RETROFIT	2007	2011	2007/2013	2009		
CLASSIFICATION	ABS	ABS	ABS	DNV	DNV	DNV
DIMENSIONS	727 ft. long x 138 ft. wide x 66 ft. deep	726 ft long x 138 ft wide x 66 ft deep	726 ft long x 138 ft wide x 66 ft deep	835 ft. long x 125 ft. wide x 62 ft. deep	835 ft. long x 125 ft. wide x 64 ft. deep	835 ft. long x 125 ft. wide x 62 ft. deep
MAIN POWER (kW)	6 x 7,290 kW, 720 rpm diesel, 6 x 8,750 kVA generator (ABB)	3 x 4,700 kW (ABB)	3 x 9,333 hp diesel, 3 x 6,266 hp diesel each (ABB)	4 x 9,772 hp diesel, 2 x 6,515 hp diesel, 6 x 1,000 kW generator (ABB)	4 x 9,772 hp diesel, 2 x 6,515 hp diesel (ABB)	6 x 7,000 kW diesel (SIEMENS)
EMERGENCY POWER (kW)	1 x 470kW (AVK)	1 X 400kW (AVK)	1 X 608 hp diesel (ABB)	1 X 2635kVA (ABB)	1 x 3257 hp diesel (ABB)	1 x 2100kW (HYUNDAI)
POWER DISTRIBUTION	Hammond + AKA	ABB + AKA	ABB + AKA	Baylor + AKA	Baylor + AKA	SIEMENS + AKA
THRUSTERS	6 x FPP Azimuth	6 x FPP Azimuth	6 x Azimuth (KAMEWA)	6 x Azimuth	6 x Azimuth (RR)	6 x Azimuth (RR)
DP SYSTEM	DP3	DP3	DP3	DP3	DP3	DP3
CLOSE RING SYSTEM	Retrofitted	Retrofitted	Retrofitted	Retrofitted	Retrofitted	Built In
SHORT CIRCUIT TEST	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required
AKA SUPPLIED EQUIPMENT						
AGP	•	•	•	•	•	•
ATCAP				•	•	
IPD						
UPS	•	•	•	•	•	•
HDF						
ESS						
DOCUMENTATION	•	•	•	•	•	•

	DEEPWATER CHAMPION	DEEPWATER NAUTILUS	DEEPWATER ASGARD	DEEPWATER INVICTUS	DISCOVERER CLEAR LEADER	DEEPWATER THALASSA	DEEPWATER PROTEUS	DEEPWATER PONTUS
								
SHIP TYPE	Ultra Deepwater Drillship	Semi-Rig	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship	Ultra Deepwater Drillship
SHIP OWNER	Transocean	Transocean	Transocean	Transocean	Transocean	Transocean	Transocean	Transocean
YEAR: BUILT	2010	2000	2014	2014	2008	2015	2015	2015
YEAR: RETROFIT	2011	2007/2014			2014			
CLASSIFICATION	DNV DYNPOS-AUTRO	ABS	DNV	DNV	DNV	DNV	DNV	DNV
DIMENSIONS	752 ft. long x 118 ft. wide x 59 ft. deep	374 ft. long x 308 ft. wide x 136 ft. deep	781 ft long x 138 ft wide x 62 ft deep	781 ft long x 138 ft wide x 62 ft deep	835 ft. long x 125 ft. wide x 62 ft. deep	781 ft. long x 138 ft. wide x 62 ft. depth	781 ft. long x 138 ft. wide x 62 ft. depth	781 ft. long x 138 ft. wide x 62 ft. depth
MAIN POWER (kW)	6 x 6,035 hp diesel, 6 x 4.3 MW generator, 2 x 12,069 hp diesel, 2 x 8.7MW generator (ABB)	4 x 6,300 hp diesel, 4 x 4,700 kW generator (ABS)	6 x 7,000 kW, 720 rpm diesel, 6 x 8,125 kVA generator	6 x 7,000 kW, 720 rpm diesel, 6 x 8,125 kVA generator	6 x 7,000 kW diesel (SIEMENS)	6 x 720 rpm diesel, 6 x 6,750 kW x 11kV generator (HHI)	6 x 720 rpm diesel, 6 x 6,750 kW x 11kV generator (HHI)	6 x 720 rpm diesel, 6 x 6,750 kW x 11kV generator (HHI)
EMERGENCY POWER (kW)	1 x 1500kW	1 x 500kW (CAT)	1 x 1780kW	1 x 1785kW	1 x 2100kW	1 x 2000kW	1 x 2000kW	1 x 2000kW
POWER DISTRIBUTION	ABB + AKA	Hammond	SIEMENS + AKA	SIEMENS + AKA	SIEMENS + AKA	AKA	AKA	AKA
THRUSTERS	6 x FPP Azimuth (RR)		6 x FPP Azimuth (RR)	6 x FPP Azimuth (RR)	6 x Azimuth (RR)	6 x FPP Azimuth (GE)	6 x FPP Azimuth (GE)	6 x FPP Azimuth (GE)
DP SYSTEM	DP2		DP3	DP3	DP3	DP3	DP3	DP3
CLOSE RING SYSTEM	Retrofitted		Built In	Built In	Built In	Built In	Built In	Built In
SHORT CIRCUIT TEST	Done By AKA		Done By AKA	Done By AKA	Done By AKA	Done By AKA	Done By AKA	To Be Done By AKA
AKA SUPPLIED EQUIPMENT								
AGP	•		•	•	•	•	•	•
ATCAP						•	•	•
IPD						•	•	•
UPS	•	•	•	•	•	•	•	•
HDF		(Partial)				•	•	•
ESS						•	•	•
DOCUMENTATION	•	•	•	•	•	•	•	•

AGP: Advanced Generator Protection System • ATCAP: Advanced Thruster Control and Protection System

IPD: Intelligent Power Distribution System • UPS: Uninterruptible Power Supply • HDF: Hybrid Drill Floor • ESS: Energy Storage System

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