Sabik NAi System

The NAi (Navigation Aids Interface) product family was developed specifically for the navigation lights of offshore wind farms. The development focuses on the following requirements:

- **Robust, durable design with a high level of availability**
- **Reliable operation**
- **Easy planning of the navigation light systems**
- **Simple installation and commissioning**
- **Simple servicing**

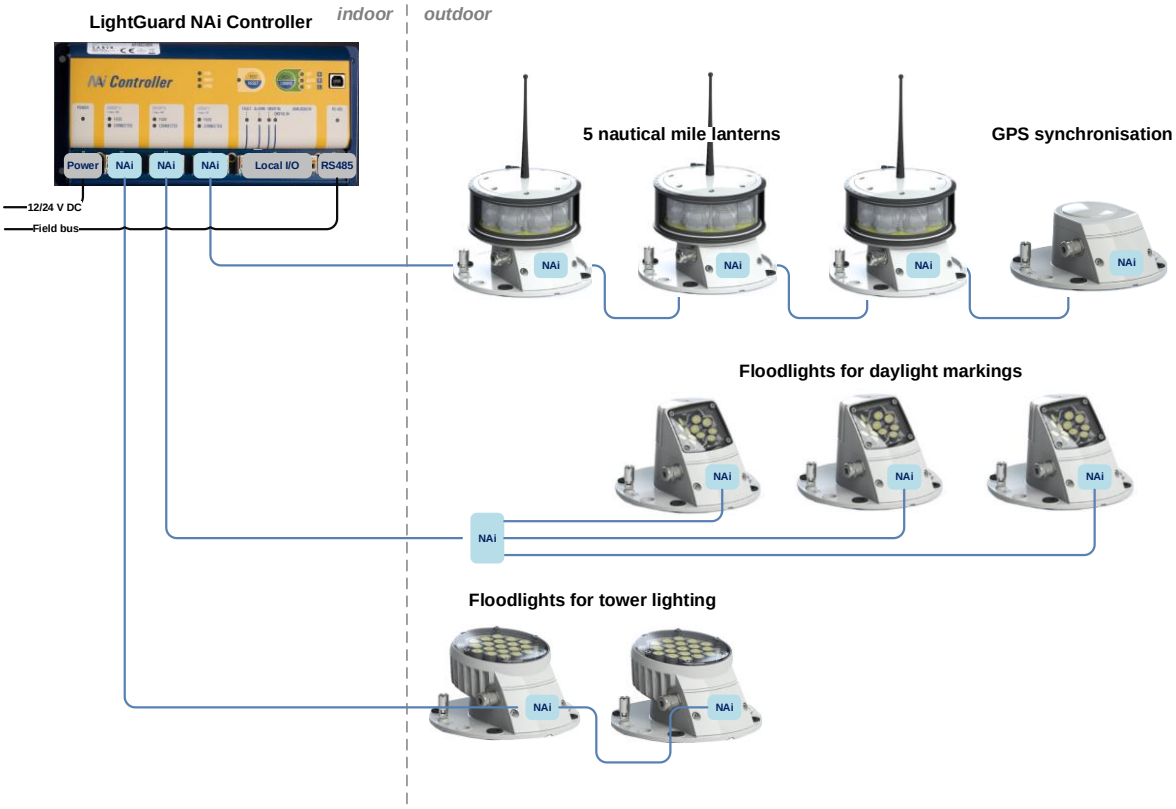

Figure 1: Sabik NAi System, example configuration

The NAi bus is the core of the system. The bus connects all components (NAi Controller, lights, synchronisation unit, ...) using identical connection technology. The bus supplies the components with power, and all components communicate with each other via the bus.

All devices of the NAi product family have an internal system monitoring and cyclically report the present operational status to the NAi Controller, which collects this information and provides it via an RS-485 interface to a higher order control system for evaluation. In return, the controller can configure the NAi devices, and control their function.

Electrical connection

VP	Supply voltage, positive connection
VN	Supply voltage, negative connection
DP	Differential data line, positive polarity
DN	Differential data line, negative polarity
FE	Functional earth, connected to the housing

The terminals in the devices can be duplicated, thereby enabling a direct looping-through wiring. All connections in any combination are protected against reverse polarity among each other.

The connection cable, depending on the current load and required length, is a shielded installation cable (4+1) with a diameter of 0.5 mm² to 2.5 mm² that is suitable for offshore use.

System topology

The central power supply for all components is provided at the feed-in of the NAi Controller ("Power" terminal) located within the tower. The connection is guarded against reverse connection and fused in both phases (L+, L-) with melting fuses. The entire installation of the NAi network is galvanically isolated from all housings/shields (FE).

All NAi devices are connected to one of three cables (terminal blocks "Group A, B, C") of the NAi Controller. The assignment is in principle freely selectable and is based on current consumption and desired selectivity of the devices in the event of a fault (see section on "Selectivity"). The further wiring (outside of the tower) can be, depending on the spatial arrangement of the components, linear (looping-through) and/or a star configuration (via a distributor box). No specific termination of the cable end is required. The maximum cable length per group is 200 m.

The higher order control system can also be connected to the NAi Controller ("RS-485" terminal block). Two potential-free alarm contacts, two potential-free digital inputs and two analogue inputs are available as needed on the NAi Controller at a further terminal block.

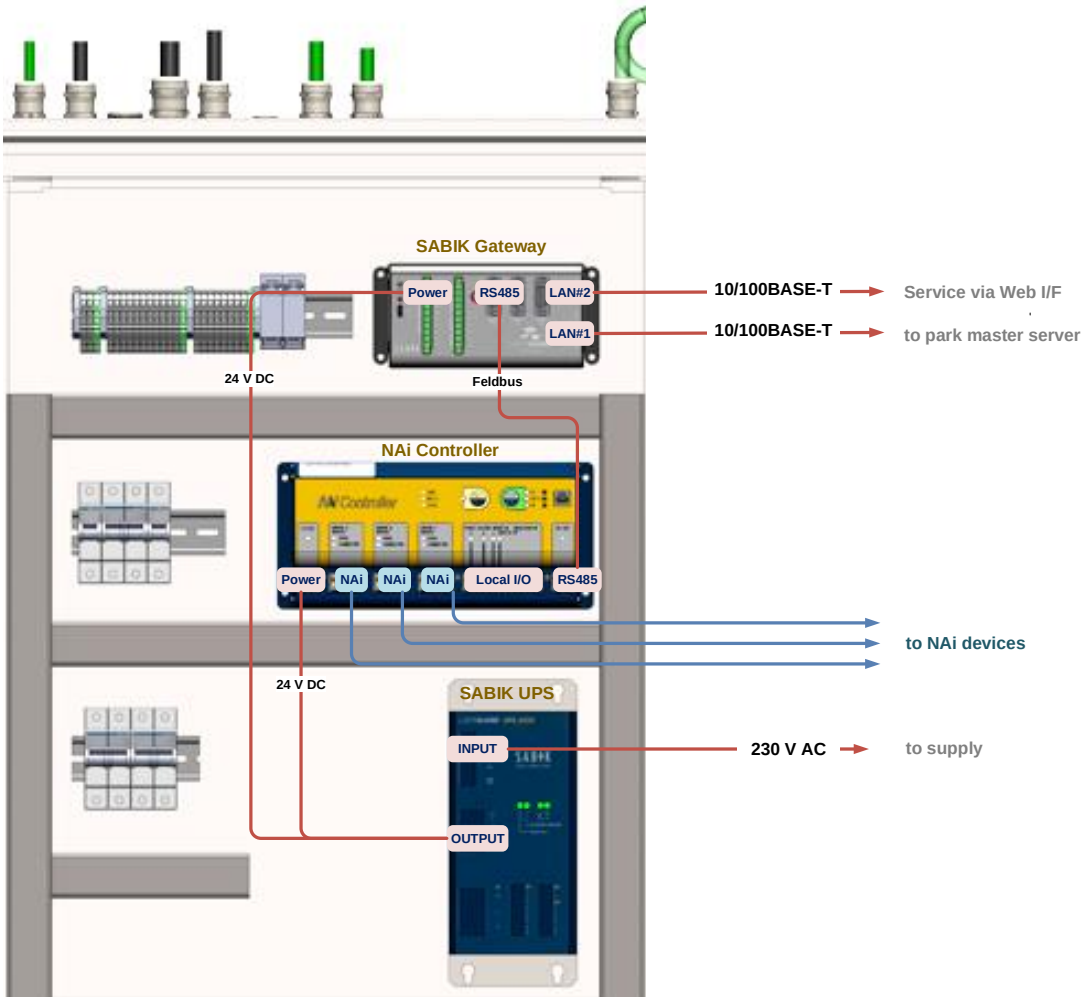

Figure 2: SABIK Gateway and SABIK UPS optionally in the system

Optionally, the system can be expanded with a converter to 10/100 BASE-T-Ethernet (SABIK Gateway) for data forwarding to a central server, and a scalable uninterrupted power supply (SABIK UPS) for an autonomous operation of the navigation lights in the event of a power failure.

Day-Night control, synchronisation

The NAi network generally contains a device which conveys the switching points in time for the day-night-day transition to all components, and guarantees a precise synchronisation in time of the devices with a flashcode generator (e.g., 5 nautical mile lanterns) according to UTC 00:00:00. This occurs transparently to the ongoing communication and does not require any additional wiring. The synchronisation unit (e.g. SABIK GPS NAi or LED 160 GPS NAi) can be present multiple times in the network, for redundancy, and in the event of the failure of the primary unit, is replaced automatically. In the event of a temporary failure of the GPS signal, a sufficient synchronicity to UTC 00:00:00 is maintained for a time period of at least two hours.

The day-night control can be carried out using the synchronisation unit based on the ambient light, based on a fixed stored calendar ("Cuxhaven - calendar") or automatically on the basis of the geographic position and the present date ("astronomical calendar"). Some NAi components additionally have, as a fallback solution, their own ambient light sensor, which in the event of a failure of the network communication autonomously switches the lights on and off depending on the daylight.

Selectivity

All devices connected to the NAi Controller are protected against short circuits and overloads in groups, using a precise electronic fusing. The triggering behaviour of the fuses is adjusted for a reliable protection even in the case of large cable lengths. If the fuse for a group is triggered, the function of the devices in the other groups remains unaffected. In the event of a temporary overload, the triggered fuse can be reset via remote maintenance. All NAi devices are designed so as to make sure that in the event of a communication fault in one device, no blocking of the data exchange over the bus can occur.

Installation

Because all devices have an identical electrical interface, they can easily be cabled together and with the controller using a standardised cable type. The connections are generally made via spring terminal blocks. The cable shielding (outside of the tower) is grounded directly in the cable gland because integrated EMC cable glands are used throughout. The shielding at the NAi Controller can be grounded on a spring terminal block at the controller; however, it is better grounded via EMC cable glands in the switching cabinet. In order to guarantee reliable protection against lightning, all devices outside of the tower must additionally be connected to earth (= the steel construction) via a connection cable that is as short as possible ≥ 16 mm².

Commissioning

The commissioning, after hooking up the supply voltage, is limited to the one-time activation of the network configuration by pressing a button on the NAi Controller. In this phase, the controller detects all devices connected to the bus, and automatically assigns an address to each device for later communication. Then, site-specific settings (intensity, flashcode) are defined using so called PRESETs which are available in the NAi Controller.

With the aid of a tablet PC connected to the NAi Controller it may now be checked whether all devices are present according to the projected plan, and possibly occurring error conditions can be analysed and fixed. Then, by pressing a button, a test mode is activated during which all lights are switched on, and the service technician has the opportunity to check for the proper functioning of all lights, and if needed to perform adjustments.

General technical data

Operating voltage	(9)/19 to 36 V DC	Lower limit (9 V) for some low power devices
Max. current consumption	14 A	All groups under full load (6 A / 6A / 2A)
Bus cycle time	approx. 10 to 30 s	Depending on the number of connected devices
Ambient temperature (operation)	-40 to 55 °C	
Degree of protection	≥ IP66	Outdoor
	IP40	Indoor
Protection class	Class III	
Standards / Specifications applied	IEC 60945	Outdoor, class "Exposed"
	IEC 61000-4	Indoor
	IALA Guideline No. 1069	On Synchronization of Lights
	IALA Guideline No. 1038	Ambient light levels at which aids to navigation lights should switch on and off
	WSV[1)]	Rahmenvorgaben zur Gewährleistung der fachgerechten Umsetzung verkehrstechnischer Auflagen im Umfeld von Offshore-Anlagen. hier: Kennzeichnung[2)] Version 2.0 vom 01.07.2014
	WSV[1)]	Richtlinie „Offshore-Anlagen“ zur Gewährleistung der Sicherheit und Leichtigkeit des Schiffsverkehrs[3)] Version 2.0 vom 01.07.2014 Guidelines to Guarantee the Safety and Efficiency of Vessel Traffic in the surroundings of offshore superstructures

1) WSV (*Wasserstraßen- und Schifffahrtsverwaltung des Bundes)* German Federal Waterways and Shipping Administration
2) Framework conditions for guaranteeing the proper implementation of traffic-related requirements in the surroundings of offshore superstructures. Here: Marking
3) Guidelines to Guarantee the Safety and Efficiency of Vessel Traffic in the surroundings of offshore superstructures