AIS AUTOMATION
SOFTWARE SYSTEMS

VarGBS

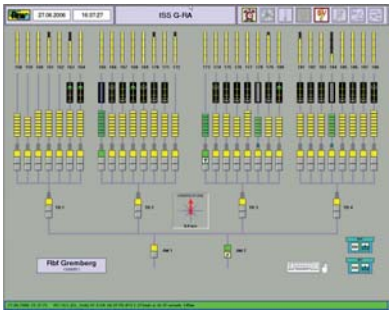
Variable rail brake control in train formation yards

VarGBS - Modular system solutions for control of train formation yards

The automation of process control computers (ASR) in train formation yards (ZBA) requires control engineering solutions for the speed control of gravitation-induced processes, which is both safe and provides reproducible, consistent marshalling quality. A number of functions, parameters and framework conditions need to be taken into account in the development of speed control.
The variable rail brake control VarGBS covers a wide range of applications by using a flexible RTE approach. Marshalling equipment (RTE) is the main focus which is instantiated project-related in form of real-time control components, parameter modules and visualization components for operation, maintenance and archiving.

Scope of service

- Support of different topographies of hump yards and varying levels of equipment
- Combination and control of various types of technological and technical marshalling equipment (RTE), such as axle data measurement (AM), slosh contact (KS), downhill ramp brakes (BB), preliminary brakes (VB), downhill brakes, switching zone (TB), sorting-siding brakes (RB), gradient compensation brakes (GAB), conveyor systems (FA), track occupancy management (FSV), weather measurement facility (WME) of various types and models
- Support of various marshalling procedures, for example, target braking, drag shoe operation (GNHB), target braking and conveying, sequence control (AFO) in the switching zone (AFO-VT) or the sorting siding (AFO-RG) with optional support of gradient compensation braking, customized to the operational requirements and required performance of the train formation facility
- Linking to logistic systems such as, for example, PVG, SiBaCh, HABIS, SAP
- Real-time interface for connection to path control
- Protocol and documentation of the train formation process with a high-performance, data base-supported protocol and archiving system with comprehensive diagnostic capabilities
- Operating and monitoring systems for different user groups, such as operators, maintenance personnel, administrators
- Provision and support of predictive maintenance by providing suitable maintenance-relevant process values, such as wear and tear, operating periods, loading



- Designed as independent brake control, for example, as single TB control or coupled with path controls (LWS) as integral solution of an ASR for high-performance gravity marshaling yards
- Electro-technical design and adaptability to structural conditions
- System design according to national or European regultations, i.e. CENELEC EN50128 or EN61508

Real-time process dynamics

Process-dynamic calculations of the marshalling models which are synchronized and corrected intact with the sensor signals of the outdoor facility provide real-time control data for the speed-governing RTE.
Here it is necessary for all process data measured in the marshalling yard to be recorded continuously, to be displayed in sync with the marshalling process, and processed to give the train formation process, whereby the data includes speeds, timing, axle distances, load conditions, front surfaces with weather information (wind vector, condition of track), process parameters (coupling speeds, speed limits, recommended speeds, target speeds, track occupancy levels), the topography of the facility (derived from the track geometry project or geodetic measurement).

The measured values resulting from gravity marshalling across the topology of the train formation facility (ZBA) are recorded continuously via connected track switching equipment (dual rail switches), radar equipment, light grids, light barriers, wheel load measurement and weather sensors. Time measurement is taken with accuracy greater than 50 µs.

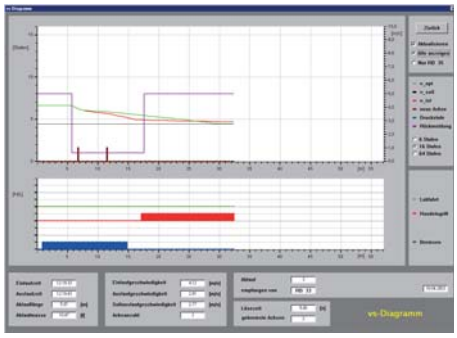
The process data determines marshalling properties, wagon limits and sectioning points. The target locations defined by the dispatching system or the operators are assigned to the processes. After initial determination at the axle measurement unit (AM), the rolling properties of the stock moving in the train formation facility (ZBA) are corrected continuously in real-time. Rolling properties, target locations, prior and subsequent movements and track occupancy levels determine the required running speeds for the braking technology along the tracks. The actual rolling speeds synchronize the internal flow process and arrival predictions to the following RTE for continuous correction of the rolling properties. The predictions are also used to identify the processes and to control the intervals of movement sequences in the switching zone (AFO-VZ) and the sorting siding (AFO-RG).

Precision braking

The functional components of the rail brake control realize the target run-out speeds determined by process data capture (ADE). Different technical types and models, such as hydraulic or electrodynamics retarders are supported.

The speeds, locations and paths of the movements in the areas of the retarders are measured continuously by radar and dual rail switches, and the formation zone monitored.

The optimal braking curve is calculated in real-time from the given values, the process data, and the measured values. In addition to energetic aspects, axle load sequences, axle load intervals and climbing criteria, the optimal braking curve also takes into account the technically ideal barking strategy to provide a high quality braking level with little wear and tear. A non-linear controller calculates the required braking levels for braking along the optimal braking curve. Adaptive changes to the controller parameters at different time levels ensure fast adaptation to the varying braking properties of movement / braking combinations as well as considering the level of wear and tear. This ensures low levels of maintenance requirements for the retarders over a prolonged period at consistent quality.



Operational sequences under control

The operational sequence control (AFO-VZ, AFO-RG) links the calculated target out-speeds and rolling properties of each movement to those of the predecessing movement. This controls the intervals of current movements in the switching zone and the sorting siding within permissible limits. If the operational sequence control identifies potentially critical situations, such as gaining or simultaneous movement on occupied sections, the process dynamic optimal target speeds, path distances or braking behavior are corrected in the upstream retarders to avoid the above-mentioned conflict situation. Control of the operational sequences is not only limited to the switching zones (AFO-VZ). It is also important to avoid dynamic contact due to non-permissible contact speeds between moving processes in the sorting siding. This is the task of the operational sequence control in the sorting siding (AFO-RG).

Order in the sorting siding

Avoiding non-permissible impacts in the sorting siding is a major quality criterion in train formation. The process target braking utilizes the actual dynamic occupancy rate in the sorting siding.
The track occupancy management, if equipped with gradient compensation brakes, can actively influence moving processes in the sorting siding via the gradient compensation brake control (gradient yards) in terms of maintaining distances and relative speeds. It captures the movements of all incoming and outgoing axles in the sorting siding and monitors the movement models in real time.

The movement properties are linked to actual over-rolling at the track switches in the sorting siding, and the movement models are adapted continuously until movement comes to a standstill.

Scalable

The variable rail brake control VarGBS is designed as a distributed control system with scalable functional components. This quite easily allows both functional adaptation, as well as adaptation in terms of performance and size of facility for different applications on a project basis.

The main functional components of the variable rail brake control (VarGBS) include:

- Process data capture (ADE)
- Operational sequence control (AFO)
- Axle data measurement unit (AM)
- Weather station (WMS)
- Downhill ramp brake control (IBB)
- Brake control sorting siding (RB)
- Gradient compensation braking control (GAB)
- Track occupancy management (FSV)
- Conveyor control (FA)
- Incline performance and operating protocol (BLBP)
- Fault register and protocol system (ARCH, WAN)
- Parameterization system for offline and inline parameters
- Process and report archive evaluation (ArchivPC)
- Coupling adapter path control (KOP)
- Bridge disposition system
- Operator workstation (RTE-PC and RZ-PC)
- Maintenance observation station (ISS)
- Remote diagnosis (option)

Conveying and clearing

Conveyor equipment can be installed in train formation facilities (ZBA) to improve performance. Taking load, axle and speed criteria into account, the conveyor control (FA) automatically controls the conveyor equipment such, that time- and movement-optimized incoming stock from the target brake zone comes to a standstill, ready for coupling, at the rear section of the sorting siding.

Any bad running stock stopped in the critical zone behind the sorting siding brake is cleared quickly.

Transparency

As reliability, availability, economic operations and the safety of goods transport by rail depend on the performance and quality of highly automated train formation facilities (ZBA), they need to be checked regularly. A number of requirements relating to compliance with technical, qualitative and safety-relevant parameters need to be monitored and documented. All results, reports, wagon, movement and braking data, braking behaviour, and sectioning lists are recorded in replicated facility data bases. The data bases store the data for a period at least one year (monitored continuous replacement principle). This allows for specific evaluation of performance, quality, operation, precision and fault statistics over longer and shorter periods. High-performance analysis tools support maintenance and management.

Connectivity

High-performance and documented interfaces are prepared for the exchange of dispatch data or for linking the variable rail brake control VarGBS with path control to a process control computer (ASR).

Centralization of train formation facility maintenance necessitates remote access for maintenance personnel to archived data in the fault register and the protocol system to comply with technical safety requirements. In times of personnel reduction this is the only way to provide fast diagnosis and rectification of faults without requiring the permanent presence of maintenance personnel at the facility.

Short overview about of AIS Automation

For more than 20 years AIS Automation Dresden GmbH has been supplying innovative software solutions for factory and production automation, equipment integration and equipment control. We will support you over the entire life cycle - from specification, via installation up to customer service. Our software solutions are deployed in semiconductor, photovoltaics, automotive and other high-tech manufacturing industries.

150 experienced and committed engineers create, develop and install our software solutions for your production needs in close cooperation with you. AIS accompanies you over the entire life cycle and is available as a competent partner from specification, via implementation and installation, through to comprehensive customer service.

AIS Automation Dresden GmbH, support@ais-automation.com, www.ais-automation.com