Project:

Østfold Avfallssortering IKS - MRF

Title:

APPENDIX D5

PLANT CODING SYSTEM

C1		For Contract			
B1	16.09.22	For Tender	LIF	PT	ASE
A1	24.06.22	For Internal control	LIF	PT	PT
Revision	**Date**	**Text**	**Author**	**Checked**	**Approved**

Developer's logo: mepex EUG GmbH	Contract number: **2022_01**	Version : **B1**	Number of pages: **Page: 1 of 19**

TABLE OF CONTENT

1 General

This “Anlagen Kennzeichnungs System AKS” is based on the “Kraftwerk Kennzeichnungs System KKS”, which is used for power generation plants and the energy supply industry, a simplified but logically consistent system for waste sorting - and recycling plants.

The plant coding system (AKS) for the Østfold Avfallssortering IKS - MRF must be used for unambiguous identification of the plants, plant parts, equipment, machinery, test points, flow charts, schematics, documentation etc., e.g., in the following areas:

- Planning (basic, process, P & I diagrams, equipment layout plans, summary, circuit diagrams, function diagrams, etc.)
- Inventory plans (operational, deposition, maps, etc.)
- Maintenance, preventive maintenance
- Spare parts - and Materials Management
- Process monitoring and optimization
- Message and alarm archiving
- Handling of accidents and malfunctions
- Data collection, documentation and evaluation

2 Explanatory notes on AKS

The AKS is based on a 5-digit function key and a 3-digit equipment key.

Function Key

Plant Suffix	
A	**A**
1	2

Group	Equipment Number	
N	**N**	**N**
3	4	5

Equipment key

Equipment Type		Equip. No.
A	**A**	**N**
1	2	3

A = Alpha key

N = Numeric key

A = Alpha key + number

2.1 Function Key

The first two digits A1 and A2 are to distinguish future plants at the Norwegian PRF.

The plant group is characterized by the numerical point N3 and is dependent on the classification of the plant in procedural groups (subsystems). The numbers N4 and N5 are assigned to the two-digit sequential number of the unit within the plant group or process subsystem.

2.2 Equipment Key

The equipment key indicates the numbering of equipment, machinery and measuring points used in the plant. It consists of a combination of letters A1 and A2 for the digits 1 and 2 (alpha characters) and a digit N3 as a sequential number.

The letters A1 and A2 in the equipment key designate the type of equipment and its function. The number N3 is a counting number.

The same applies to measuring devices and sensors for the measuring point number.

2.3 Integration of AKS in the Design Process and Plant Erection

Design

During the design process of the plant the AKS is consistently applied in all documents to be created. These include in particular:

- Specifications
- Drawings
- Flow charts
- Installation plans
- P & I diagrams
- Mechanical and electrotechnical documentation

The Engineer will pay attention to the consistent application of the AKS by the Contractor.

Plant Erection

The coding and marking of the equipment used in the plant is based on the AKS. All components have to be labelled with the AKS-coding clear, durable and easy to read, identical to the unit, installation and documentation. Cables have to be marked on both ends.

More details related to the Norwegian PRF project are written down in the tender and contract documents.

3 Expansion of the AKS for Electrical Equipment

The AKS is intended for identification of all equipment used within the plant. In this respect, the electrical equipment has to be integrated into in the AKS. That means:

a) A system is needed, not only to describe the location and the medium of a measurement, but also the type, function and processing of the measurement is characterized.

b) In order for a process element, that can be adequately described with the equipment key, additional components are added (e.g. motor protection, circuit breakers, etc.), a suffix is needed to apply the AKS in the circuit diagram consistently.

3.1 Measuring Point Function Identifier (MPFI)

Application for P & I diagrams

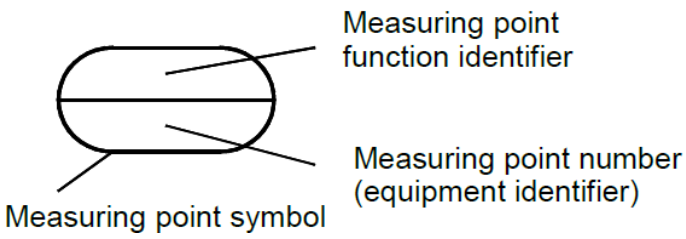
To represent type, function and processing of a measurement at a certain point, it must be given a functional classification of a measuring point. The measuring points function identifier shows what should be measured and displayed. The MPFI must not be confused with the corresponding measuring point number, which is only the equipment identifier of the measuring point.

All measurements should be represented with an oval measuring point symbol in the P & I diagram. By way of illustration, the arrangement and AKS-numbering of the measuring points can be seen:

- whether it is purely a local display of a measurement
- whether the measured value is displayed both, locally and in the control room
- whether the measured value is to be displayed on an additional place
- how many sensors are physically available for one measurement?
- whether switch points were created from a discrete measurement, by an evaluation device of a continuous measurement or a calculation, that can be carried out in a controller (software)

The **measuring point function identifier** according to Attachment 3 must be used above in the measuring point symbols. This is the description of **what** is being measured **(qualification).** The following letters to build the MPFI should be used in the order Q-O-I-R-C-S-Z-A.

The measuring point number, that is used to **identify** the measuring point, has to be placed in the lower part of the measuring point symbols.



The measuring point function identifier has to be formed with the code letters in accordance with the table in Attachment 3.

The following arrangements are mandatory for the choice of the code letters, to allow a uniform application:

1. Continuous measurements are characterized by the use of the letter **I** as the first following letter to display the value and to show clearly, that this is an analogue (⇒ continuous measured) value.

2. For binary signals, which has to be displayed, the letter **O** has to be used as the first following letter.

3. Alarms, characterized by the next letter **A**, are brought automatically for display. When using a control and monitoring system, alarms are always archived. Since alarms are always displayed, the preceded code letter **O** can be omitted in this case.

4. Safety interventions, such as emergency stop switches, ripcord switches, door switches, light curtains, etc. are described by the next letter **Z**.

5. The use of **++, +, -, --** is allowed also to provide additional clarification (e.g. limit switches and other physical limit switches). Limit values, which are generated in an evaluation device of a continuous measurement or formed in the control system, has to be labelled in the same way.

6. Measurements which generate switching points directly or by means of an evaluation device, will be labelled with the next letter **S** to mark the switching point. In case of generating more than one switching point from a continuous measurement by the control system, these switching points has to be labelled also with the next letter **S**.

7. Local operation panels (LOP) are generally characterized as **HOS**. **H** stands for manual operation, **O** for the local optical signal or on the monitoring system and **S** for the switching operations that can be executed there. For the sake of clarity in the P & I diagram only one measurement symbol with an AKS-number for the manual operation signals should be illustrated. All individual signals from the local operation panels are shown in the corresponding measuring point list.

   If an emergency stop is provided at the LOP, the identifier **Z** is added to the next letter for the identification of an emergency operation. The complete labelling is then **HOSZ**.

   Separately installed emergency stop switches, ripcord switches, etc. are labelled **HOZ**. In this case the letter **S** for the switching action is not required. The alarm contact, used for the localization of the activated switch in the monitoring system, has to be marked also with **HOZ** in the measuring point list.

8. If a monitoring system is used, all continuous measurements have to be represented always as a trend curve on the control and monitoring system.

9. If a shut-off valve has the function identifier **GOS**, the open and closed position has to be captured and displayed by the use of two limit switches.

10. If more than one switch point is created with a single probe (physical measurement unit), this can also be written as an exception in one measuring point symbol, if it is just for clarity. In this case, different switch points should be separated with a slash (*/*). If, for example, an upper and lower alarm is generated from one physical measurement, it is allowed to mark them as **... A+ / A-**.

The same applies to switch points (... **S + / S**) and a combination of both (**S + / S / A + / A-/ A + / A -**).

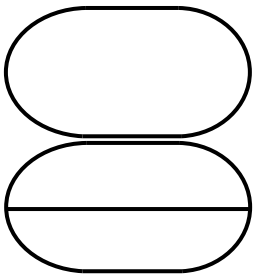
In the measuring point list, all the signals are listed with their corresponding ID in a new line as a separate signal.

11. If there is a unit which consists of several subcomponents, the subcomponents are allocated to the unit and differed in the P & I diagram by a suffix, if the presentation of the sub-components is necessary for an understanding of the drawing.

Example: The conveyor **251AF1** has 2 drives,
thus, these drives are called to full identification
251AF1-M1 and **251AF1-M2.**

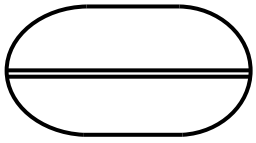
Since these subcomponents are dealing with electrical equipment, the described labelling applies only to P & I diagrams and related documents. The use of the suffix in the electrotechnical documentation is described in Chapter 3.2 “Use of AKS in Electrical Documentation”.

For the measuring points the following symbols are used:



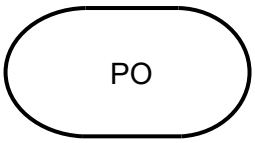
Display locally; also non-electrical devices

Display in central control room

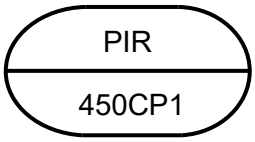


Display only at a local control panel within the plant

Measurements which are displayed at different locations are generated by a combination of these symbols. An example of a pressure measurement is:

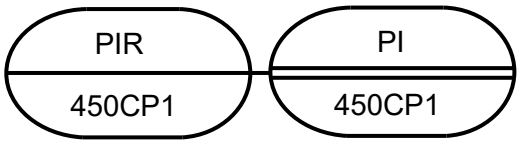


Pressure measurement; single manometer to display the value locally



Pressure measurement; continuous; with registration; **showing only in the control room** with the appropriate measuring point number

For each physically existing measurement a measuring point is assigned, according to the AKS. Is the local display a part of the measurement itself (e.g. installed in the transmitter or the local evaluation device), it will not get its own measuring point number:



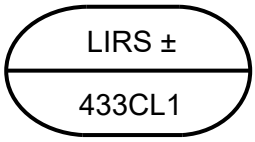
Pressure measurement; continuous; **display and registration in the control room and display only on a local control panel**. The measuring point number remains the same, since it is only one physical measurement.

If physically only one probe is installed, from which a continuous value will be also, measured and displayed and also several switch points will be generated by the evaluation device, the continuous measurement and the switching thresholds will both get a measuring point number.

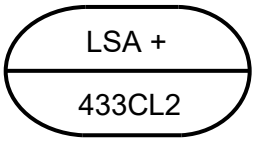
Example of a level measurement in a bunker:

The level in the bunker with the function key 433 is measured continuously and registered in the control and management system. Furthermore, a minimum and a maximum alarm is generated by an evaluation device. The value and the alarms will be displayed only in the control room.

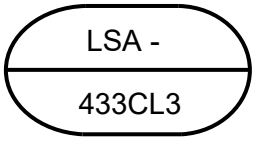
The proposed alarm points LSA+ and LSA- are provided with separate measuring point symbols and measuring point numbers in the P & I diagram.



example.: 433CL1-A1
(analogue value level silo 433BB1)



example: 433CL2-A1
(binary alarm-threshold maximum level)



example: 433CL3-A1
(binary alarm-threshold minimum level)

The evaluation device of the analogue level measurement has for example the equipment identification -A1. This equipment identification will be used both in the measuring point list and in the electrotechnical documentation. It is clearly shown that the analogue level signal and the binary switching points are generated from the same device.

When programming the control system the variable for the analogue level should be named like the measuring point number 433CL1. The binary variables for the alarm switching points should be named like the measuring point numbers 433CL2 and 433CL3.

This system is similar for all types of sensors, probes, transducers, etc.
As a rule of thumb:

- Any existing physical measurement will be given exactly one measuring point number.

All switching points, whether existing as hardware or made available by software, will get their own measuring point symbol. The assignment to the physical measurement is done by the associated equipment ID as explained below.

3.2 Use of AKS in Electrical Documentation

The AKS has to be adapted as a continuous extension in the electrotechnical documentation for sensors, probes, transducers and other equipment, representing a measuring point.

The combination of function key and equipment key has to be interpreted as follows:

Function Key

A1	A2
K	K

N3	N4	N5
G	G	G

Equipment Key

A1	A2	N3
M	M	X

EMC suffix

S1	S2	S3
Y	Y	Y

Since there are a lot of electrical components in the plant that are not listed in the process flow diagram an opportunity must be provided to identify those components. This opportunity is given by the EMC suffix (EMC is the abbreviation for Electrical Measurement and **C**ontrol). By means of this suffix, all electrical equipment can be identified.

Function key, equipment key and the EMC suffix together form the complete designation.

KK GGG MM X YYY

in which

KK = Alpha key for plant type, Plant suffix

GGG = Numerical group number and equipment number

MM = Alpha key as equipment identifier (mechanical or electrical measurement)

X = Sequential number

YYY = EMC suffix (only in electrotechnical documentation)

Plant Suffix (KK):

The first two digits A1 and A2 are to distinguish the different future plants at the Norwegian PRF.

Group and equipment number (GGG):

Each plant can contain up to 999 units, divided into groups. These are usually divided into process engineering and plant engineering sections. (see Attachment 1, Plant Groups)
Areas of group numbers, which are not occupied by the plant itself, can be used for other technical equipment, such as HVAC, general electrical engineering and power supply, infrastructure, buildings, etc.

Equipment ID (MM):

The letter combinations for equipment and measuring point numbers are listed in Attachment 2. For the process control should be noted, that signals, used or generated only in a PLC or in the SCADA system, are always get the measuring point characteristics .....FU... (see also Attachment 2).

Sequential number (X):

The sequential number is usually a continuous numbering according to the number of groups in Attachment 2. Some number groups are thereby specifically attributed to properties to enable a more accurate specification of the characterizing element.

EMC Suffix (YYY):

Especially for the electrical, hydraulic or pneumatic, it is necessary to use a suffix. It is always necessary, if for a procedural element, such as the exhaust fan (e.g. AKS-mark 521AN1), additional components such as, for example, circuit breaker, motor contactors, drives, etc. must be assigned. These components then will be referred to the following example:

Exhaust fan: 521AN1

Electrical Equipment (part of main current circuit)

521AN1-M1 drive motor of the fan

521AN1-Q1 circuit breaker

521AN1-K1M contactor to motor

521AN1-A1 frequency converter

521AN1-X1:1 terminal block 1, terminal 1

Devices represented by measuring point numbers

521CS1-B1 Analogue speed measurement of the fan

521CT1-B2 Analogue measurement of bearing temperature

521CH1-Q1 Response signal from maintenance switch

General Notes on adaption of the AKS in CAD software applications for the electrotechnical documentation:

In circuit diagrams the site/plant key (KK) is marked by the identifier '**=**'. Similarly, the systems group and the assignment to a mechanical unit is marked by the identifier '**+**' in the circuit diagrams. All electrical components are added, according to AKS, in the circuit diagram with '**+ equipment number**' and '**- EMC suffix**' as a complete equipment ID.

This applies to the entire electrotechnical documentation.

4 Practical Application of the Plant Coding System AKS

The AKS will also support the operator in his daily work, e.g.:

- Inspection, maintenance / preventive maintenance
- Process monitoring and optimization
- Spare parts inventory and materials management
- Detection of faults and repair

5 Attachments to AKS

Attachment 5.1: Function key
Attachment 5.2: Letter Code for Function Key and Equipment Key
Attachment 5.3: Letter Code for Measuring Point Function Identifier (MPFI)

5.1 Attachment 1 – Function Key

To avoid any confusion, the first two digits of the Function Key, which marks the different potential future plants in the Østfold Avfallssortering IKS - MRF Project, must be added as a leading prefix to the standard AKS code as a plant identifier.

Plant key:

SA Sorting Plant (MRF)

Group and equipment number (GGG)

These group number areas divide the whole plant into process engineering and plant engineering sections.

Plant grouping for the Sorting Plant:

Plant Key	Plant Group (Proposal)	Description
SA	**100-199**	**Infeed, Screening, Metal Separation**
SA	**200-299**	**Polymer Sorting, Paper Sorting**
SA	**300-399**	**Fines Sorting**
SA	**400-499**	**Bunkers, Balers**
SA	**500-549**	**Compressor Plant**
SA	**550-599**	**Dedusting System**
SA	**600-949**	**Spare number groups**
SA	**950-999**	**CMS Sorting Plant**

5.2 Attachment 2 – Letter Code for Function Key and Equipment Key

Machines and units (active components):

Letter code	Description
AA	Armatures and fittings
AB	Locks, star feeder locks, rotary air locks
AC	Heat exchanger (liquid - liquid)
AD	Brakes, brakes systems
AE	Slewing, moving, lifting and swivelling gears (also manipulators)
AF	Conveyors, allocators
AG	Generators
AH	Heaters and cooling units (only for process technology)
AJ	Shredders, mills, granulators, perforators
AK	Compactors, balers, pelletisation
AM	Mixer, blender, agitators
AN	Compressors, fans
AP	Pumps
AS	Adjustment and tensioning drives
AT	Sorter, separators, filters, dryer, dedusting systems
AU	Converter (mechanical), force transmission
AV	Incineration units
AW	Stationary treatment units
AX	Testing devices, surveillance units (e.g. weighing devices, belt weigher)
AY	Lubrication units, oiler
AZ	Special machines and units (currently not listed above)

Other devices (static components):

Letter code	Description
BB	Containers, silos
BE	Shafts (only for assembly, maintenance, etc.)
BF	Foundations
BG	Boilers, heating surfaces
BH	Hydraulic shunts
BN	Emitters, injectors, ejectors
BM	Feeder, after feed units
BP	Restrictors, orifices, (not for measurement), rupture discs
BQ	Mountings, framework, pipe grommets
BR	Pipes, ducts, drains
BS	Sound absorbers
BU	Insulations, circumvallation, housings
BY	Mechanical operated controllers, regulators
BZ	Special devices (currently not listed above)

Direct measuring points (directly measured):

Letter code	Description
CD	Density
CE	Electrical values (current, voltage, capacity, etc.)
CF	Flow, flow-rate
CG	Distance, length, position
CH	Local operation, manual local intervention
CK	Time
CL	Level, leakage detection
CM	Moisture

CP	Pressure
CQ	Quality (analysis, substance properties)
CR	Radiation
CS	Speed, number of revolutions, frequency
CT	Temperature
CU	Combined values
CV	Viscosity
CW	Weight force, mass
CY	Oscillation, elongation, rotation, torsion
CZ	Emergency-stop equipment

Control loops:

Letter code	**Description**
DD	Density
DE	Electrical values (current, voltage, capacity, etc.)
DF	Flow, flow-rate
DG	Distance, length, position
DH	Local controllers
DK	Time
DL	Level
DM	Moisture
DP	Pressure
DQ	Quality (analysis, substance properties)
DR	Radiation
DS	Speed, number of revolutions, frequency
DT	Temperature
DU	Combined values

DV	Viscosity
DW	Weight force, mass
DY	Oscillation, elongation, rotation, torsion

Indirect measuring points (indirectly measured):

Letter code	Description
FD	Density
FE	Electrical values (current, voltage, capacity, etc.)
FF	Flow, flow-rate
FG	Distance, length, position
FK	Time
FL	Level
FM	Moisture
FP	Pressure
FQ	Quality (analysis, substance properties)
FR	Radiation
FS	Speed, number of revolutions, frequency
FT	Temperature
FU	Combined values (also for internal PLC flags, set values, etc.)
FV	Viscosity
FW	Weight force, mass
FY	Oscillation, elongation, rotation, torsion

Cables:

Letter code	Description
WA	Medium voltage cables up to 25 kV
WB	Low voltage cables up to 550 V; max. cross section 240mm²
WC	Installation cable (for lighting, plugs, etc.) up to 250 VAC)

WD	Control cable, non-shielded, multi-wired
WE	Control wire, non-shielded, single wire
WF	Signal cable, shielded, multi-wired
WG	Coaxial cable
WH	Triaxial cable
WI	Fibre-optic cable
WK	Special cables (currently not listed above)
WL	Band iron, earthing strip

Signal devices / auxiliary devices:

Letter code	Description
HA	Acoustical signal devices (e.g. hooters, sirens, etc.)
HO	Optical signal devices (e.g. rotating lights, strobe lights, optical displays, etc.)
HX	Lighting as a part of a machine or unit (e.g. inside a drum screen, etc.)

5.3 Attachment 3 – Letter Code for Measuring Point Function Identifier (MPFI)

Group 1: Measuring value				**Group 2:** Processing					
Code letter (first.digit)				Auxiliary (optional)				Next letter(s) (following digits)		
		A						Alarm	Alarm	**A**
		B								**B**
Leitfähigkeit	conductivity	**C**						Regelung	control	**C**
Dichte	density	**D**		Differenz	difference	**d**		Differenz	difference	**D**
Elektr. Größe	electrical	**E**								**E**
Durchfluss, Menge	flow, quantity	**F**								**F**
Stellung	position	**G**								**G**
Handeingabe	manual operation	**H**								**H**
		I		Anzeige lokal	local indicator	**i**		Anzeige	indication	**I**
		J								**J**
Zeit	time	**K**								**K**
Niveau, Stand	level	**L**								**L**
Feuchte	moisture	**M**								**M**
		N								**N**
		O						Meldung	optical	**O**
Druck	pressure	**P**								**P**
Qualität	quality	**Q**		Zählung	integration	**q**		Zählung	integration	**Q**
		R						Registrierung	registration	**R**
Geschwindigkeit	speed	**S**		Schalter	switch	**s**		Schalter	switch	**S**
Temperatur	temperature	**T**		Übertrager	transmitter	**t**				**T**
		U								**U**
Viskosität	viscosity	**V**								**V**
Gewicht, Masse	weight	**W**								**W**
		X								**X**
		Y								**Y**
		Z						Noteingriff	emergency	**Z**
								MAX-MAX Grenzwert	high-high contact	**++**
								MAX Grenzwert	high contact	**+**
								Zwischenwert	intermediate contact	**+/-**
								MIN Grenzwert	low contact	**-**
								MIN-MIN Grenzwert	low-low contact	**- -**