



SCOPE OF WORK

T71 FLYTOGET, T73A AND T73B
LED INTERIOR LIGHTING UPGRADE

ENGINEERING, PROTOTYPE AND EQUIPMENT
PROCUREMENT

Content

1. General Information.....	3
1.1 Purpose	3
1.2 Background	3
1.3 System overview	7
1.3.1 Differences between the vehicle types T71 Flytoget, T73A, T73B	11
2. Proposed LED-based lighting solution.....	16
3. Scope of work in this contract.....	16
3.1 General.....	17
3.2 Included services by Supplier	17
3.3 Excluded services	17
3.4 Cleaning and repair of metal light covers/ light diffusers	18
3.5 Prototype completion.....	18
4. Requirements / Evaluation.....	18
4.1 RAMS and LCC requirements.....	18
4.2 Documentation	19
4.2.1 Spare parts analysis	19
4.2.2 Document identification	20
4.2.3 Document handover method	20
4.3 Verification, test and quality requirements	20
4.4 Environmental requirements	21
4.4.1 Recycling	21
4.4.2 Environmental data	21
5. Project schedule	22
5.1 Project schedule	22
5.2 Project team	22
5.3 Inventory management and storage of components.....	22
6. List of Appendices.....	23

1. General Information

1.1 Purpose

This Scope of Work (SoW) defines engineering, prototype implementation and optional prototypes and equipment procurements for an LED-based interior lighting solution for Class 71 Flytoget, Class 73A and Class 73B railway vehicles.

Base scope in this agreement:

The base scope includes complete engineering for all three vehicle types and one prototype installation including all components/ equipment for one vehicle type selected by Norske tog.

Options in this agreement:

Additional prototype and serial equipment deliveries are included as options in this agreement. Based on the needs Norske tog can decide the number of vehicles in each option. The Options shall be valid until 5 years after signing of contract. Option order will be formalized in writing by Norske tog, where Norske tog specifies the number of trainsets the Supplier shall provide with components for which option (see chapter 5.3).

The Supplier shall deliver a complete, verified and implementation-ready engineering solution and component/ equipment package that forms the technical basis for subsequent and separate competitions for serial installation work on the vehicles:

Separate competition(s):

- installation works for serial installation on vehicle type 1
- installation works for serial installation on vehicle type 2
- installation works for serial installation on vehicle type 3

The remaining service life of the vehicle types is limited.

The engineering effort shall therefore prioritize a cost-effective, maintainable, and robust solution for equipment and installation works, rather than the latest lighting trends.

1.2 Background

Norske tog (hereinafter referred to as “NT”) shall phase out fluorescent lighting across most of its train fleet to ensure the vehicles’ intended service life. This need arises from governmental regulations mandating the phase-out of fluorescent lighting in Norway, in accordance with the EU Restriction of Hazardous Substances (RoHS) Directive.

As OEM manufacturers have ceased production of fluorescent tubes, NT must implement an LED-based lighting solution to ensure continued regulatory compliance and to fulfil the operational lighting requirements applicable to rolling stock.

Furthermore, halogen pin-type downlights of types G4, GY6.35, and G9 have been discontinued and have not been manufactured since September 2023. Consequently, such light sources shall not be considered viable for replacement or continued use within the scope of this project.

This document constitutes the Scope of Work (SoW) for the replacement of interior lighting on trainsets Class 71 Flytoget (15 vehicles), Class 73A (14 vehicles), and Class 73B (6 vehicles), hereinafter referred to as T71, T73A, and T73B, respectively. Each trainset has 4 coaches.

26-32 INTERNAL LED LIGHTING T71
T73A T73B

The design of these trainset classes is based on a common platform and was developed sequentially in the following order: T71, T73A, T73B, and T71BMX (intermediate coach on T71 Flytoget). For more information on naming of the coach/ car, see table below.

The trainsets are owned by Norske tog and are leased to train operators under lease agreements with a duration of ca ten (10) years. An overview of the vehicle fleet is provided in the table below.

Note that the Norwegian Railway Directorate through a direct procurement for traffic package 1 south has chosen a new train operator from 2027. Go Ahead will in 2027 be replaced by train operator Vy and the maintenance company of Vy for package 1 south will be Mantena. This applies to 8 vehicles T73A.

**26-32 INTERNAL LED LIGHTING T71
T73A T73B**

Table 1: Overview T71, T73A, T73B, and the leasees (train operators). See note about Go Ahead Nordic in the general text.

Trainset class	Number of trainsets	Trainset operator	Maintenance company of train operator	Maintenance location
T71	15	Flytoget	Mantena	Lodalen
T73A	8	Go Ahead Nordic (*)	Go Ahead Maintenance	Lodalen / Kvalaberg
T73A	6	SJ Norge	Mantena	Lodalen / Marienborg
T73B	6	VY	Stadler (SRS)	Lodalen

Table 2: Overview T71, T73A, T73B – coach designations

Trainset class	Coach 1	Coach 2	Coach 3	Coach 4
T71	BM71	BMX71	BMU71	BFM71
T73A	BM73A	BFR73A (bistro)	BMU73A	BFM73A
T73B	BM73B	B73B	BMU73B	BFM73B

Note that for T71 Flytoget, the BMX71 coach was produced new and added ca 2008. The first three coaches were produced in the period 1997-1998.

Technical information:

Information is also found on webpages of Norske tog.

T71 Flytoget:

Parameter	Value
Total number of trainsets	15
Length	108.5 metres
Weight	246 tons
Width	3.05 metres
Height	4.48 metres
Passenger doors	16 (8 on each side)
Year built	1997-1998
Top speed	210 km/h
Manufacturer	ADtranz/ Bombardier
Seats	247
Battery voltage	110V
External power supply	15 kV AC, 16 2/3 Hz, 1000V 16 2/3 Hz or 50 Hz

T73A and T73B:

Parameter	Value
Total number of trainsets	20
Length	108.5 metres
Weight	246 tons
Width	3.05 metres
Height	4.48 metres
Passenger doors	16 (8 on each side)
Year built	1997-1998
Top speed	210 km/h
Manufacturer	ADtranz/ Bombardier
Seats	204/249
Battery voltage	110V
External power supply	15 kV AC, 16 2/3 Hz, 1000V 16 2/3 Hz or 50 Hz

1.3 System overview

The T71 and T73A and T73B vehicle classes are equipped with several types of interior lighting, each serving distinct functional purposes within the vehicles.

Primary lighting (lighting tubes)

The primary lighting system consists of **fluorescent tubes** providing general illumination in passenger compartments, luggage areas, toilet facilities, and the conductor's cabin. For Class 73A vehicles, the primary lighting system also covers the bistro/cafeteria area.

Supplementary lighting (spotlights/ downlights)

Supplementary lighting is provided by halogen spotlights installed in the above-mentioned areas (passenger compartments, luggage areas, toilet facilities, and the conductor's cabin), as well as in doorways and the driver's cab.

Technical cabinet lighting

In addition to passenger-area lighting, fluorescent lighting is installed in technical cabinets, while halogen light sources are used for the occupied/vacant indicators in toilet facilities.

Emergency lighting (spotlights/ downlights)

Emergency lighting comprises downlights installed in aisle compartments, vestibules, and panorama areas, as well as fluorescent lighting in toilet facilities and luggage areas.

Reading lights in overhead luggage racks

On T71 Flytoget the halogen reading lights have to be replaced with LED, however not in the newest coach BMX which already has LED reading lights.

Power supply to the lighting systems – 110 V

The interior lighting systems are predominantly supplied by a 110 V power supply.

Lighting is fed via both normal circuits and emergency circuits. For details on circuit distribution, references are made to technical documentation available in EU Supply, which contains the relevant technical documentation and circuit diagrams (EU Supply / CTM).

The existing fluorescent lighting primarily consists of **T8 tubes** with **58 W tubes** used as standard. Where spatial constraints prevent the installation of 58 W tubes, such as carriage ends, in toilet facilities, and in the conductor's cabin, **36 W and 18 W** tubes are installed.

In the T73A vehicle class, the Bistro/cafeteria compartment additionally utilizes **7 W** fluorescent tubes for illumination of the arched desk and service counter.

26-32 INTERNAL LED LIGHTING T71
T73A T73B

Technical cabinets are equipped with **PL-S 4-pin fluorescent tubes**.

All fluorescent light sources are associated with dedicated ballast units, which convert the 110 V DC supply to the appropriate AC voltage and current required by the respective tube types and control/dimming systems, as illustrated in Figure 1.

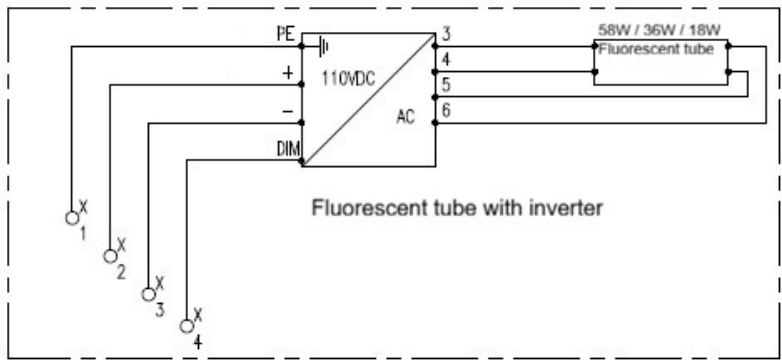


Figure 1: 58W / 36W / 18W fluorescent tube with inverter/ballast

**26-32 INTERNAL LED LIGHTING T71
T73A T73B**

The halogen light sources are also equipped with **dedicated ballast units**, which convert the 110 V DC supply to 11.2 V AC, as illustrated in Figure 2.

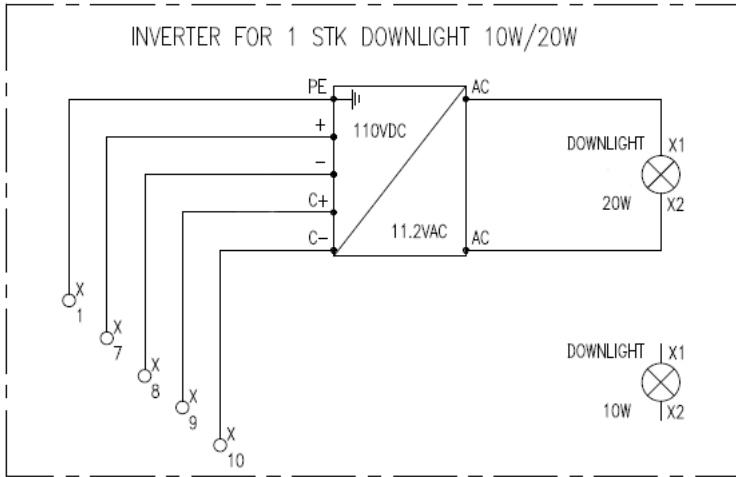


Figure 2: 20W / 10W downlight/halogen bulb with inverter/ballast

Figures 3 and 4 illustrate the interior lighting in a carriage of the T73A vehicle class, where halogen spotlights are installed between the fluorescent tubes in the interior roof. The fluorescent tubes are arranged in two longitudinal “Channels”, one on each side of the central ceiling panel above the aisle. These “Channels” run continuously throughout each compartment. Fastened in extruded aluminium profiles.

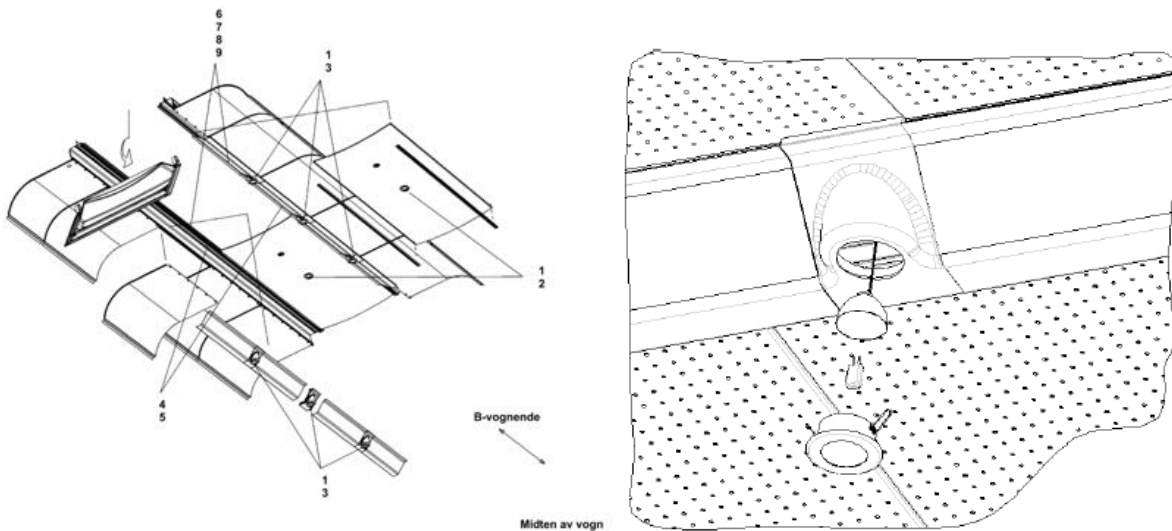


Figure 3: Mechanical drawing of a T73A passenger compartment's main lighting arrangement

26-32 INTERNAL LED LIGHTING T71
T73A T73B



Figure 4: Passenger compartment of Type 73A. The interior roof consists of a repetitive pattern/standard modules.

Control panels

The Passenger area lighting can be controlled via control panels located in technical cabinets **S4 or S14** in each car/ coach. For the T73A vehicle class, an additional lighting control panel is installed in the bistro car.

Figures 5 and 6 illustrate the lighting control panels located in technical cabinets S4/S14 and in the bistro car of the T73A, respectively.

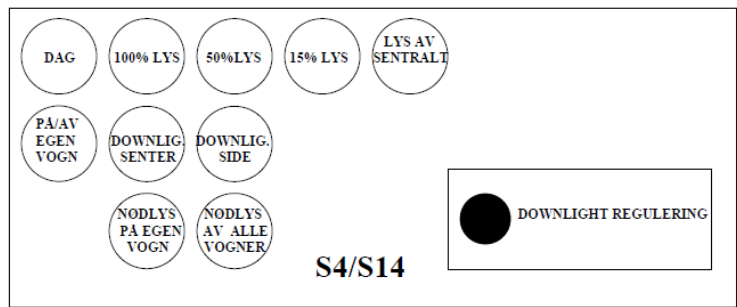


Figure 5: Lighting control panes located in technical cabinets S4/S14 at each car.

26-32 INTERNAL LED LIGHTING T71 T73A T73B

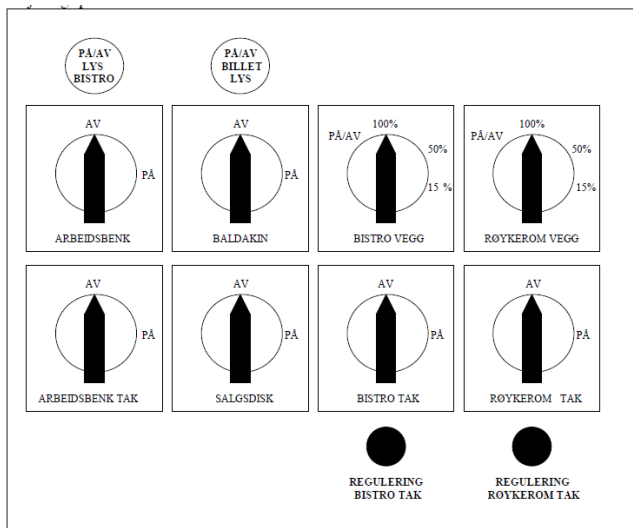


Figure 6: Lighting control panels located in Bistro car of the T73A.

The primary lighting (lighting tubes) is protected by metal covers (which also function as “diffusers”) attached with a snap-fit mechanism. These mechanisms have become looser over time, and can be a hazard to passengers, as these covers can unsnap when passengers remove overhead luggage. Therefore, these mechanisms have to be repaired, see separate chapters.

1.3.1 Differences between the vehicle types T71 Flytoget, T73A, T73B

The primary difference between the T73A vehicle class and the T71 Flytoget and T73B vehicle classes is the presence of a bistro car. There are also variations in the detail solutions used.

This distinction also applies to the interior lighting configuration. The bistro car features dedicated lighting arrangements, including specific placements of fluorescent tubes, the use of shorter tube lengths, and additional spotlights in the cafeteria area, as previously described.

The T71 Flytoget and T73A and T73B vehicle classes are, as noted, based on a largely common design platform; however, certain differences remain.

The toilet occupied/vacant indicators in the T71 Flytoget vehicles are already equipped with an LED-based solution. Consequently, replacement of these indicators is only applicable to the T73A and T73B vehicle classes.

The reading lights installed in the T71 vehicles are of a non-LED type and therefore require replacement with LED-based alternatives (Not the BMX coach which is produced later and has LED reading lights).

T71 Flytoget Documentation

Please note that documentation of T71 is structured in somewhat different way than T73A and T73B,

The following documents of the existing solution will help tenderer to get a more detailed overview:

26-32 INTERNAL LED LIGHTING T71
T73A T73B

150276_1 oversiktstegning målsatt_Type 71

3EST000228-1352_Forerhandbok_Innvendig belysning

3EST000228-1574_Instruks for vedlikeholdsreparasjoner

3EST000228-1575_Instruks for forebyggende vedlikehold

T73A and T73B Documentation

See the technical documentation made available in CTM/ EU Supply. See maintenance documentation as well as wiring diagrams. The figures below are screenshots from the maintenance documentation.

Table 3 shows an overview of fluorescent tubes and downlights per trainset/ vehicle type T71, T73A, T73B

Note T71: Has LED indicators for "Non-LED vacant/ occupied toilet lights. In BMX coach LED reading lights.

Note T73: Already has LED reading lights (in double units per double seat), thus the need is 0 as in table 3.

Table 3: Fluorescent tubes (marked in W) and downlights/non-LED reading lights per trainset

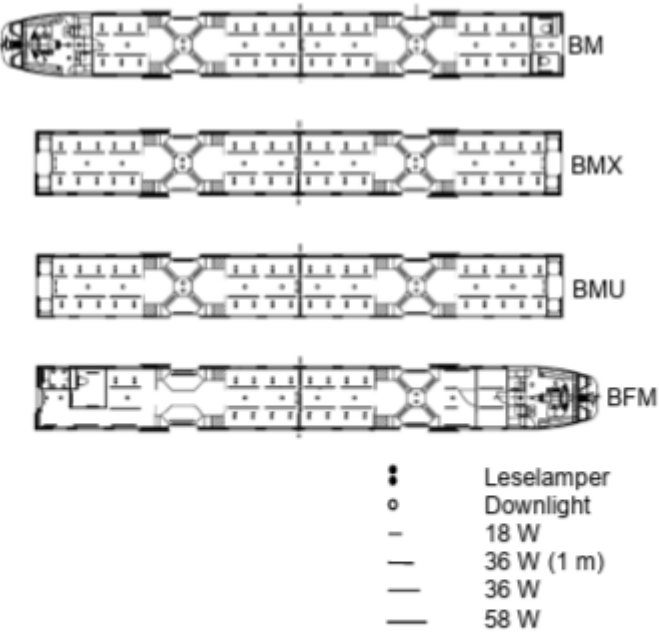
Train-set type	Fluorescent light tubes 58W 1500mm (ceiling and wall)	Fluorescent light tubes 36W 970mm (ceiling, vestibule, panorama and luggage compartment)	Fluorescent light tubes 18W 590mm (ceiling, wall, workbench area, and toilet)	Fluorescent light tubes 9W (technical cabinets)	Fluorescent light tubes 7W (bistro)	Downlights	Non-LED reading lights (double units)	Non-LED vacant/ occupied toilet lights
T71	56	24	48	22	0	49	84	0
T73A	52	31	23	23	3	195	0	18
T73B	52	31	16	25	0	196	0	18

TYPE 71		Instruks for vedlikeholdsreparasjoner		
Kontrakt nr 1301		Innvendig belysning		
Dok. nr.:	3EST000228-1574	Rev.:	A	Rev. Dato: 2009-03-11
		Side:	4	av 52

1 Innledning

Denne instruks for vedlikeholdsreparasjoner gjelder for utskifting av elektrisk utstyr til belysning:

- 7.7.110 Lysrørarmatur i kupé og godsrom
- 7.7.120 Setebelysning
- 7.7.130 Belysning i midtgang
- 7.7.140 Nødbelysning
- 7.7.150 Dør belysning
- 7.7.160 Trappebelysning / lys i servicesøyle
- 7.7.170 Belysning i førerrom
- 7.7.220 Belysning i konduktorkupé
- 7.7.230 Belysning på toaletter



Figur 1 Oversikt belysning

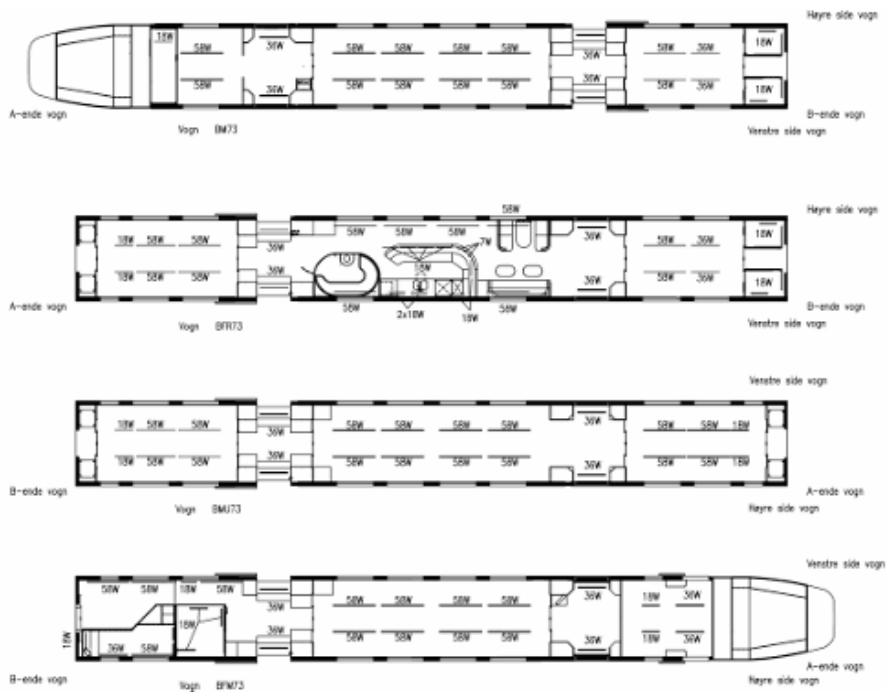
Figure 7 T71 Flytoget lighting layout in coaches BM, BMX, BMU, BFM, from document 3EST000228-1574

EKSXPRESSTOG Motorvognsett type 73 Kontrakt nr. 9043 00 / EO 001-050		Instruksjon for forebyggende vedlikehold	
INTERIØR / INNVENDIG BELYSNING			
Dok. Nr: 3ENS 13-182	Rev.: 5	Rev. Dato:01.02.02	Side: 3 av 13

1 Innledning

Denne instruks gjelder forebyggende vedlikehold for:
7.7AKT01, 7.7AKT02 og 7.1AKT04.

Skifting av lysrør samt støvsuging av vekselretter for 220V avbruddsfri strømforsyning.



Figur1 Plassering av lysrør XTBELYS_1.DWG

Figure 8 T73A Lighting, from technical document 3ENS 13-182

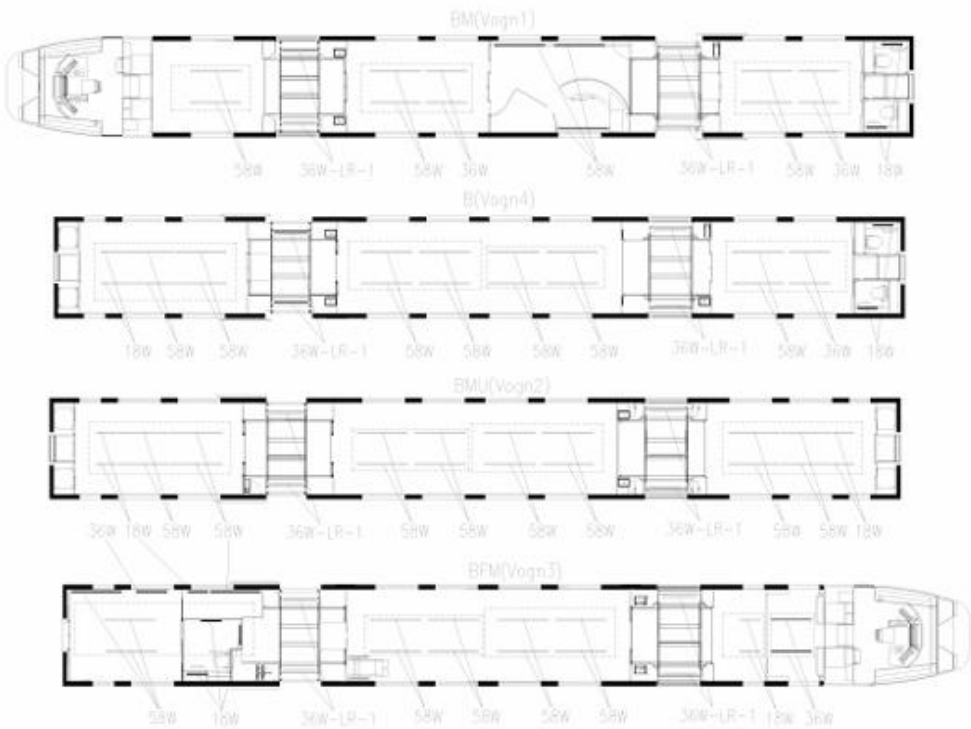
Motorvognsett type IC 73B Kontrakt nr. 9043 00 / IC-OPSJON		Instruks for forebyggende vedlikehold	
INTERIØR / INNSENDIG BELYSNING			
Dok. Nr: 3ENS 14-182	Rev.: 3	Rev. Dato:28.02.03	Side: 3 av 13

1 Innledning

Denne instruks gjelder forebyggende vedlikehold for:

7.7AKT01, 7.7AKT02 og 7.1AKT04.

Skifting av lysrør i kupé, godsrom, over panoramavindu og over dør samt støvsuging av vekselretter for 220V avbruddsfri strømforsyning.



Figur1 Plassering av lysrør

Figure 9 T73B lighting, from technical document 3ENS 14-182

2. Proposed LED-based lighting solution

NT requires that all interior lighting systems that do not currently use LED technology shall be replaced with LED-based solutions.

- All existing fluorescent tubes shall be replaced with LED tubes.
- The new lighting solutions shall be **dimnable**.
- Existing metal lighting covers shall be inspected, repaired, and reused. The engineering documentation shall include this.
- Fluorescent luminaires and aged plastic components, including lamp holders, shall be replaced to support reliability and full warranty of the complete lighting system.
- Where applicable, existing ballast/inverter units shall either be replaced with units compatible with LED lighting or removed where the selected LED solution permits direct connection.
- For halogen pin-type downlights, complete luminaire replacement is the preferred solution because existing ballasts/inverters and lamp holders may be obsolete or non-standardized and maintaining dimming functionality may be difficult.
- Non-LED reading lights shall be replaced where applicable as defined in the vehicle-specific requirements.
- Existing lighting control and dimming functionality shall not be modified unless technically necessary. The Supplier shall prioritize solutions compatible with the existing analogue control and dimming ranges.
- The lighting covers/diffusers shall be assessed for an improved and strengthened locking mechanism that prevents unintentional release while remaining easy serviceable for maintenance personnel.

An engineering direction to be explored is maximum reuse of existing mechanical components, including metal lighting covers, combined where technically feasible with a 1:1 replacement of existing tube types by suitable LED tube types.

The serial installation company must be able to provide a full warranty for the complete lighting system. The engineering shall therefore identify and replace aged or worn electrical components where necessary, including sockets and other components whose condition could compromise the warranty or system reliability.

The engineering solution shall use standardized, well-defined and fully documented electrical, mechanical and functional interfaces. Components shall be specified using functional and performance-based requirements rather than manufacturer-specific solutions unless otherwise approved by NT.

The Supplier shall deliver a complete engineering package, including all drawings, specifications, interface definitions, bills of materials, datasheets, software documentation where applicable, installation instructions and test documentation, sufficient to enable subsequent procurement, installation, testing and commissioning by third parties without redesign or further engineering support from the Supplier.

3. Scope of work in this contract

The base scope comprises **complete engineering for T71, T73A and T73B**, one prototype installation package for **one selected vehicle type**, prototype validation, and delivery of the complete engineering and component package necessary for subsequent procurements.

The scope includes, but is not limited to:

- system engineering and detailed design;
- electrical and mechanical integration;

- definition and verification of electrical, mechanical and functional interfaces;
- technical specifications, drawings, bills of materials and procurement-ready engineering documentation;
- maintenance documentation;
- installation descriptions for each vehicle type;
- reengineering where necessary based on verification or prototype results;
- one prototype on a vehicle type selected by NT;
- prototype testing, verification and validation;
- component deliveries were included or called off as an option; and
- cleaning, repair and engineering of metal light covers/diffusers.

Norske tog will facilitate access to trains when required. Workshop access shall be requested with sufficient notice, normally at least 14 days in advance.

3.1 General

The Supplier shall perform complete engineering for all three vehicle types and define all components needed for the LED lighting solution (electrical and mechanical) in accordance with the technical requirements specified in Appendix A and Appendix C.

The engineering shall result in a verified, complete and implementation-ready solution that can be installed by third parties without redesign.

A design review shall be agreed between NT and the Supplier and conducted prior to commencement of the prototype installation. If the design review identifies incomplete information, unresolved issues, or missing documentation, a follow-up design review may be required before the prototype installation commences.

Factory Acceptance Tests (FAT) may also be requested for relevant components or equipment where considered necessary by NT.

3.2 Included services by Supplier

- System engineering and detailed design.
- Electrical and mechanical integration.
- Definition and verification of all electrical, mechanical and functional interfaces.
- Development of technical specifications, drawings, bills of materials and other engineering documentation.
- Preparation of maintenance documentation.
- Delivery of a complete engineering package suitable as the technical basis for subsequent procurements.
- Delivery of installation descriptions for each vehicle type.
- Reengineering if necessary.
- Prototype implementation on one vehicle type, to be selected by NT.
- Prototype test planning, execution, reporting and validation.
- Procurement and delivery of prototype equipment/components.
- Production planning for optional component deliveries.

3.3 Excluded services

- Serial installation, testing and commissioning on trainsets.
- Fleet-wide installation and rollout of the LED interior lighting solution.
- Installation works associated with subsequent vehicle types unless separately procured.

The delivered engineering package and component package shall form the basis for subsequent and separate procurements for serial installation on all three vehicle types.

3.4 Cleaning and repair of metal light covers/ light diffusers

Cleaning, repair and technical treatment of the existing metal light covers/diffusers shall form part of the engineering and prototype scope. The cleaning, repair and technical treatment are to be part of the prototype, and the engineering shall include work instructions to serial installation. The Supplier shall develop vehicle-specific repair and handling instructions.

- Cleaning of light diffusers.
- Repair of light diffusers.
- Replacement of damaged or missing mounting materials, including screws and click mechanisms.
- Repair of metal covers to their original shape where practicable.
- Replacement of covers that cannot be repaired.
- Repair or replacement of damaged reflectors on T73A and T73B.
- Verification of correct tolerances and achievement of a straight, clean and consistent appearance after remounting.
- Development of an improved/strengthened locking mechanism where required, while retaining maintainability.
- Finding a supplier for repair spare parts.

For T71 Flytoget, reference shall be made to *3EST000228-1574_Instruks for vedlikeholdsreparasjoner*. This document does not define all required repair methods; the Supplier shall develop the necessary methods.

For T73A and T73B, relevant technical documentation is available in EU Supply / CTM.

3.5 Prototype completion

Upon completion of the prototype, the Supplier shall document that the lighting solution is complete, compliant and ready for operation.

All required updates to drawings, specifications, bills of materials, installation descriptions, maintenance documentation and test documentation shall be completed.

4. Requirements / Evaluation

All detailed requirements applicable to this SoW are specified in Appendix C Requirements. Where applicable, requirements and documentation requirements may be provided in Excel format.

Key requirements are minimum mandatory requirements and shall be fulfilled. **Evaluation requirements** are not mandatory unless explicitly stated otherwise, but compliance may be considered during tender evaluation.

The Tenderer shall provide a detailed description of how each requirement is fulfilled. Where the available space is insufficient, supplementary appendices may be submitted with clear references to the relevant requirement.

4.1 RAMS and LCC requirements

The Supplier shall implement a RAMS management process in accordance with EN 50126. The process shall address system definition, risk assessment, requirements allocation, verification, validation and documentation to ensure reliability, availability, maintainability and safety of the lighting system throughout its service life.

The RAMS process shall consider interactions between the existing system and the renewed lighting system, including assumptions concerning the safety performance of the existing system. Changes to the maintenance programme shall be identified and documented.

For modifications to already accepted systems, impacts on interfacing or neighbouring systems and, where relevant, the overall railway system shall be assessed proportionately to the change. Where no new risks are introduced, this shall be explicitly documented.

4.2 Documentation

All documentation requirements applicable to this Scope of Work are specified in Appendix A and Appendix C Specifications under the tab Documentation Requirements. The Supplier shall provide documentation in accordance with the Document Delivery Plan (Appendix D).

The Supplier shall deliver all documentation necessary to update existing documentation related to maintenance, repair, overhaul, and onboard operation of the lighting system. The Supplier is responsible to update all documentation necessary.

The Customer shall provide relevant existing documentation to support understanding of the current lighting system.

Appendix E contains overview of technical documentation, as general system descriptions and apparatus lists intended to define the system scope and to provide an overview of the current installation, including the quantity and types of fluorescent tubes presently in use.

NT's document analysis template is provided in Appendix E.

Additional documentation may be made available to the Supplier following contract award.

Documentation Requirement (cf. Appendix A, Appendix C Specifications)

The maintenance documentation shall include, but not be limited to, the following information:

- a list of maintenance tasks to be performed
- detailed descriptions of maintenance activities
- limit values for components that shall not be exceeded during operation
- required tools, facilities, and service software
- materials and consumables required to perform the tasks
- necessary calibration, adjustments, tests, and procedures to be carried out following each maintenance activity
- drawings required for correct assembly and disassembly of replaceable parts
- personal protective equipment (PPE) and safety provisions
- general requirements related to mechanical, electrical, fabrication, and other relevant engineering competencies

4.2.1 Spare parts analysis

Documentation Requirement (cf. Appendix A, Appendix C Specifications)

The Spare Parts Analysis shall include a spare parts list containing, but not limited to, the following information for each item:

- special tools and equipment required for operation and maintenance
- unit price
- Supplier's article number
- manufacturer's article number

- original (true) manufacturer
- quantity per vehicle
- failure rate
- failure rate unit (e.g. FPMK, FPMH)
- delivery lead time (calendar days)
- recommended quantity to be held in stock

4.2.2 Document identification

Documentation Requirement (cf. Appendix A, Appendix C Specifications)

The Supplier shall, as a minimum, include the following information in the document structure:

Front page:

- Doc. no. (document number).
- Doc. title (document title).
- Rev. no. (revision number).
- Rev. date (revision date). format - dd.mm.yyyy

Following pages:

- Doc. no.
- Page no.

4.2.3 Document handover method

Documentation Requirement (cf. Appendix A, Appendix C Specifications)

As part of the document production and acceptance process, the Customer shall assign a status code to each submitted document in accordance with the classifications defined below:

Code 1 – Accepted

The document is approved for its intended purpose and may be used accordingly. Revision of the document shall only be required where reasonable changes are necessary or where the document is to be issued for an alternative purpose.

Code 2 – Accepted with Comments (to be incorporated at next revision)

The document may be used for the purpose for which it is issued; however, the Customer's comments shall be considered during subsequent use. All comments shall be incorporated in the next revision of the document.

Code 3 – Rejected (revision and resubmission required)

The document is not approved for its intended purpose. The Supplier shall revise and resubmit the document for Customer review within fourteen (14) calendar days of receipt of the review comments.

Note: Assignment of status code Accepted or Accepted with Comments confirms that the Customer considers the document fit for purpose for the continuation of the Work.

4.3 Verification, test and quality requirements

The Supplier shall be fully responsible for the correctness, completeness, feasibility and technical integrity of the engineering solution and for compliance with this SoW.

The Supplier shall perform all analyses, calculations, engineering assessments, inspections and other verification activities necessary to demonstrate compliance with the specified technical and functional requirements.

The Supplier shall document verification and validation activities and provide the corresponding reports as part of the engineering package.

A design review shall be agreed between NT and the Supplier and completed **before prototype installation**. If information is incomplete, a follow-up design review may be required before prototype installation. For selected components, NT may request a Factory Acceptance Test (FAT).

Prototype testing shall demonstrate and document compliance with applicable technical, functional and safety requirements.

Any deviations, deficiencies or required design changes identified during prototype testing shall be documented and incorporated before the solution is released for subsequent procurement/serial implementation.

4.4 Environmental requirements

All work shall be conducted in line with applicable sustainability standards, rules and regulations. Work shall be conducted to the benefit of Norske tog's sustainability strategy and the Norwegian Government ambitions for the sector as a clean, green alternative to road- and air transport.

Contractor shall strive to choose environmentally friendly transport- and logistics solutions.

Contractor shall endeavour to document waste and emission generation and share this with Norske tog for compliance and reporting purposes. See below details.

4.4.1 Recycling

Contractor shall describe and document their waste management system. As a part of this, the Contractor shall prepare and deliver a waste and recycling plan document covering material removed from the prototype. The plan must at least contain requirements listed in Appendix C.

Contractor should strive to treat materials removed from the train in accordance with the EU Waste Framework Directive and applicable Norwegian and European law, guidance and standards for waste management.

4.4.2 Environmental data

Contractor shall provide Norske tog with a description of the new materials (components) comprising the LED lighting and associated components, with an assessment of their environmental impact and recyclability. This includes weight, expected energy efficiency and other data necessary to conduct a Life Cycle Assessment (LCA) on the installation.

Further, the Contractor shall inform Norske tog in writing about compliance with all relevant environmental regulations, as listed in Appendix C.

5. Project schedule

5.1 Project schedule

Norske tog will evaluate the time from contract signing to ready for installation first prototype, The tender shall contain a detailed project schedule which describes the main activities of the project. This schedule shall be delivered as part of **Appendix H**.

The schedule should cover all elements listed this SoW, so that all phases from engineering, prototype installation and lead time for component delivery are presented.

The schedule must include milestones and deadlines for each phase.

The schedule must also include information regarding the listed activities, the time will be evaluated:

- Equipment kit for prototype
- Delivery of prototype (Verified and tested)
- Delivery time engineering vehicle type #2
- Delivery time engineering vehicle type #3
- Delivery lead-time on components/ vehicle kit packages (time from signing of option)

The ease of installation/completion in terms of efficiency will also be evaluated according to Appendix C.

For the prototype installation, Norske tog will secure a train and a track to do the work. Due to the difficulty with availability, both in regard to trainsets and tracks, this needs to be planned as early as possible after contract signing, but after the supplier can estimate how long time is needed for this installation. The prototype work can be in Oslo area or Stavanger, depending on train and track availability.

5.2 Project team

Please provide descriptions of the Tenderer's organization for this Contract, including communication lines between the Contractor's project organization and internal top management. Describe the engineering team/ teams, and how engineering and documentation cooperate. Please provide a description of the roles and responsibilities for the personnel doing the engineering work and the prototype installation

Please provide 3-5 CV for the critical members dedicated to the project (I.e. Project Manager, Engineer, Documentation, Installation prototype) and include their planned allocation to the project, expressed as a percentage of their working time. The evaluation will be based on experience and competence relevant for the Scope of work and how they are dedicated to the project.

5.3 Inventory management and storage of components

It is essential that delivery times for the required products are carefully planned and coordinated by the Supplier with Norske tog.

The Supplier must ensure that adequate installation kits/ equipment are available so that installation can proceed promptly when prototype(-s) are available.

For the options, the installation kits can be sent to Norske togs storage in Skoppum/Horten. Address will be shared if/when needed.

All parts need to be marked with NT article number, provided by NT by request, if this Storage is to be used.

**26-32 INTERNAL LED LIGHTING T71
T73A T73B**

Options for prototypes and delivery of components in this contract/ SOW.

Note: Norske tog does not have to order for all the vehicles for one vehicle type for Option 3, Option 4 and Option 5. The number can be reduced on the actual need at the time of ordering/ call off, prototypes etc. For example in Option 4 Norske tog can choose to only order for 6 vehicles T73A.

Option 1 – Prototype vehicle type #2 – 1 vehicle

Option 2 – Prototype vehicle type #3 - 1 vehicle

Option 3 – Delivery of components for T71 Flytoget – 15 vehicles

Option 4 – Delivery of components for T73A – 14 vehicles

Option 5 – Delivery of components for T73B – 6 vehicles

Option 6 – Engineering support to the company that will carry out the serial installations

6. List of Appendices

See the list in General Contract Terms and Conditions.

Also see the excel document overview for technical documentation available in CTM/ EU Supply, together with all the technical documentation.