

SCOPE OF WORK

New Internal Lighting Class 5

Content

1. General information	3
1.1 Purpose	3
1.2 Background	3
1.3 Overview	3
1.3.1 Class 5	3
1.4 System overview	3
1.4.1 Electrical system	3
1.4.2 Internal lighting	4
2. New system	4
3. Scope of Work contents	5
3.1 Engineering	6
3.2 Prototype development and test	6
3.3 Production planning and procurement	6
3.4 Installation	6
3.5 Completion	6
4. Requirements	6
4.1 RAMS and LCC requirements	6
4.2 Documentation	7
4.2.1 Maintenance documentation	7
4.2.2 Spare part analysis	7
4.2.3 Document identification	7
4.2.4 Document handover method	8
4.3 Test and quality requirements	8
4.4 Environmental requirements	8
4.4.1 Recycling	9

4.4.2 Environmental data	9
5. Implementation	10
5.1 General information	10
5.2 Project schedule	10
5.3 Inventory management.....	10
6. List of Appendices	10
7. Pictures from carriage inspection.....	11
T5 Fluorescent tubes and pre coupling units	12

1. General information

1.1 Purpose

The purpose of this document is to provide suppliers with comprehensive background information and a clear understanding of Norske tog's objectives for the LED lighting upgrade project. By sharing requirements and context, we aim to enable suppliers to develop solutions that fully meet our operational and technical needs. This scope is intended to ensure transparency and facilitate effective planning and execution. Our goal is to make all relevant information available, supporting suppliers in preparing high-quality and competitive proposals.

1.2 Background

Norske tog (referred to as NT) is required to phase out fluorescent lighting on most of its train fleet to maintain their intended service lifetime. This change is driven by government regulations mandating the phase-out of fluorescent lighting in Norway, in accordance with the EU's RoHS Directive. Since both national and European manufacturers have ceased production of fluorescent tubes, an LED solution must be adopted to meet lighting requirements for rolling stock.

This document tackles replacing the lighting for NT's Class 5, a class of passenger coaches serving long distance trains in Norway.

1.3 Overview

1.3.1 Class 5

Parameter	Value
Total number of coaches	54(2 A5-1, 4 A5-7, 18 B5-3, 8 B5-5, 6 B5-7, 7 BC5-3, 9 FR5-1)
Length	25,3m
Weight	40-44t
Width	3,1m
Height	4,1m
Passenger doors	4 (2 on each side), 0 for FR5
Year built	1977-81, upgraded in 2011-13
Top trailing speed	160 km/t
Manufacturer	Strømmen
Seats	Various
Battery voltage	36 V
External power supply	1000V, 16 2/3 Hz

1.4 System overview

1.4.1 Electrical system

The principle of the electrical system on NT's coaches is largely the same across all classes. The coaches are powered by an external power supply of 1000V, 16 2/3 Hz, fed through one end of the coach. From there, the voltage is transformed to be applied in one of two ways, either through 400/230 V AC power or DC power to charge the 36V battery. As such, most of the electric loads in the coaches either use a 400/230V AC supply or a 36V DC supply. If the 36V DC battery is supplying the power, the appliance is likely to be a safety critical component should there be a power outage in the coach.

1.4.2 Internal lighting

The internal lighting in NT's coach class 5 draws power from the 36V DC source coming from the batteries. As such, the lighting will remain on when there is a power outage. Today's lighting system mostly consists of fluorescent tubes, which are installed in continuous light channels covered by diffusers.

Before powering the tubes, power from the DC battery is converted to AC. In class 5, this is done locally with a pre-coupling unit that sits next to the fluorescent tube. The unit usually powers a single or a couple of tubes, depending on the tube's power consumption. The pre-coupling unit also receives a control signal from a control panel which allows dimming of the light tubes.

In addition to fluorescent lighting, there are many other lighting systems on NT's class 5. However, most of them already use LED lighting. As such, they remain outside this Scope of Work.

Table 1 shows the tally of fluorescent tubes that need to be replaced on class 5.

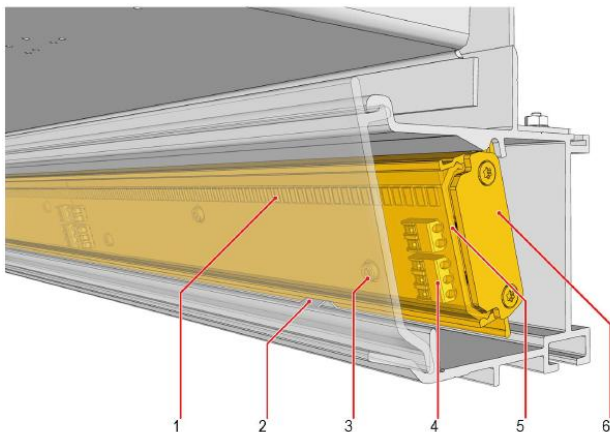
Table 1: Class 5 Tally

B5	A5	BC5	FR5	Name
6	2	7	2	21W fluorescent tube T5
24	26	19	10	35W fluorescent tube T5
3	3	3	0	18W fluorescent tube T8
1	1	1	3	Lamp 9W 2-pin

2. New system

NT wishes to replace all internal lighting systems that currently does not use LED with an LED solution. NT is open to all solutions that replace the current system with LED.

An example of a solution for lighting that uses fluorescent tubes would be to replace them with LED tubes. Another solution would be LED strips, such as those installed on the newest options of the FLIRT trains, see figure 4 and figure 5.



1.3 - F3 Lysbånd med lysmodul

1	LED Print	4	Kabling LED Print
2	Fjær	5	Deksel
3	Festeskrue LED Print	6	Lysmodul

Figure 1 LED-solution for FLIRT option 4 and 5. Excerpt from FLIRT's maintenance documentation.

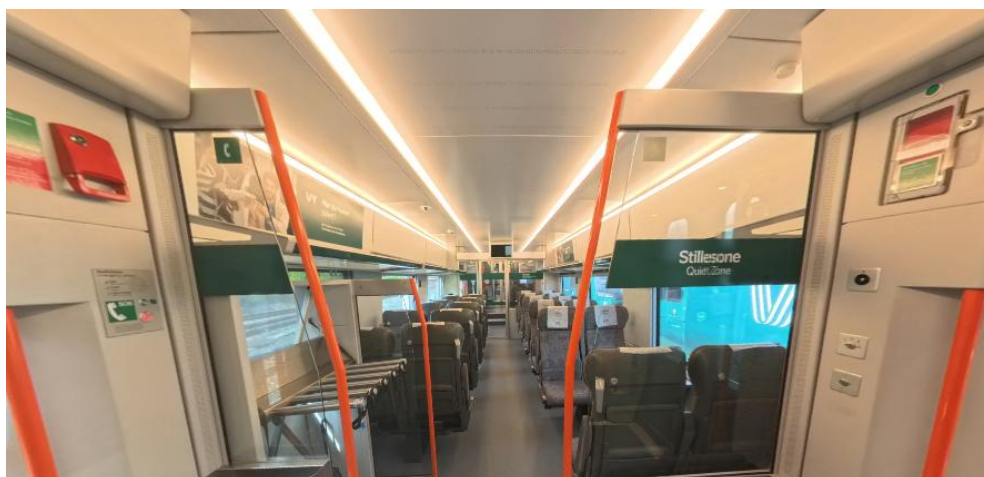


Figure 2 Picture of passenger compartment LED lighting from a FLIRT train, option 5 (74-54).

If needed, the pre-coupling unit should be replaced with a unit suitable for LED lighting, as pre-coupling units for fluorescent lighting and LED lighting are usually not compatible. Regarding control and dimming, NT does not wish to modify the current control and dimming options, and the Contractor is encouraged to find a solution that combines the current analogue control and dimming options with an LED replacement for the lighting. However, NT is open to remove dimming if it reduces cost and time required to implement the proposed solution.

3. Scope of Work contents

The scope of work for the LED lighting upgrade includes all activities necessary to complete a fully functional lighting solution. This includes engineering, prototyping development and test, production planning and procurement, installation and completion. Preparatory train inspection will be made possible for the Contractor.

3.1 Engineering

A fully functional solution shall be engineered according to technical requirements listed in Appendix C. A single design review will be agreed upon between NT and the Contractor and conducted ahead of prototype construction.

3.2 Prototype development and test

The Contractor shall develop a prototype of the new LED lighting solution for class 5. The prototype must be installed and functionally tested in accordance with the requirements, cf. Appendix C. The testing shall document that the solution meets all technical, functional, and safety requirements. Results from the prototype development and testing shall be included as part of the delivery, and any necessary adjustments must be identified and implemented before serial installation begins.

3.3 Production planning and procurement

Production planning and procurement shall be included in the delivery. The Contractor must clarify access to the train sets with the operator and maintainer, in consultation with Norske tog.

3.4 Installation

A complete and functional solution shall be installed and finalised.

3.5 Completion

Serial installation and final completion must be documented as ready for operation.

4. Requirements

All requirements are listed in Appendix C. There are two tabs which both contains requirements that must be met: Specification of requirements and Documentation requirements.

Key requirements are considered minimum requirements which must be met. A higher level of compliance may result in additional evaluation points. Evaluation requirements are not mandatory but should be met.

The supplier must provide a detailed description of how the requirements are fulfilled. If the space provided in the specification form is insufficient for a detailed description, the supplier may include an additional appendix. In such cases, the supplier must clearly indicate in the specification form the exact reference to the relevant section of the appendix.

The following information gives context to some of the requirements listed in Appendix C.

4.1 RAMS and LCC requirements

The RAMS management process shall be carried out in accordance with EN 50126, ensuring that all relevant phases—system definition, risk assessment, requirements allocation, and documentation—are addressed to secure the reliability, availability, maintainability, and safety of the lighting system throughout its lifecycle. The RAMS management process shall consider the possible effects of interaction between the existing and renewed system, including assumption on safety performances of existing system. Any changes to the existing maintenance program related to the lighting system shall be updated and documented.

NOTE: For changes to already accepted systems, the impact on RAMS for neighbouring systems and the overall railway system must be assessed. The scope and depth of the analysis should be adapted to the specific change. If no new risks are introduced, this should be documented.

4.2 Documentation

All documentation requirements are listed in Appendix C under the tab Documentation Requirements. The Contractor must provide documentation in accordance with the Delivered Document Plan (Appendix D).

The Contractor shall deliver all relevant documentation which is needed in order for NT to update its existing documentation for maintenance, repair, overhaul and onboard operation.

The Customer will provide the Contractor with relevant existing documentation for understanding of the lighting system. Appendix G contains general system descriptions, as well as apparatus lists to understand the scope of the system and tally of fluorescent tubes today. Document analysis can be found in Appendix E to give the Contractor a view of what documents are to be changed by NT, given the input from the Contractor. Additional documentation can be delivered when the Contractor is chosen upon agreement with the Customer and the Contractor.

4.2.1 Maintenance documentation

Documentation requirement D4-7, cf. Appendix C.

The maintenance documentation shall contain the following information, including but not limited to:

- the list of the tasks to be carried out
- the description of the maintenance activities
- information about the limit values for components which shall not be exceeded in service
- specific tools and facilities including service software
- materials and consumables required to undertake the task
- necessary calibration, adjustments, tests, and procedures to be undertaken after each maintenance operation
- drawings necessary for correct assembly/disassembly of replaceable parts
- personal protective safety provision and equipment
- general requirements relative to mechanical, electrical, fabrication, and other engineering competencies

4.2.2 Spare part analysis

Documentation requirement D5-8, cf. Appendix C.

The Spare Parts Analysis shall include a spare part list that provides information on

- Special tools and equipment for operation and maintenance
- Price
- Contractor's article number
- Manufacturer's article number
- True manufacturer
- Quantity in one Vehicle
- Failure rate
- Failure rate unit (FPMK, FPMH, etc.)
- Delivery time (calendar days)
- Recommended quantity in stock

4.2.3 Document identification

Documentation requirement D6-8, cf. Appendix C.

Contractor shall as a minimum include the following information in the document:

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.

4.2.4 Document handover method

Documentation requirement D6-22, cf. Appendix C.

In the process of document production and document acceptance, Customer will give each document status codes as follows:

1: Accepted

The document can be used for its intended purpose. The document shall only be revised if any reasonable changes are necessary, or if the document shall be issued for other purposes.

2: Accepted with comments (to be updated at next revision)

The document may be used for the purpose it is issued for, however the comments shall be taken into account in the further use of the document. The comments shall be incorporated in the next revision of the document.

3: Rejected (to be updated and transmitted on new workflow within 14 calendar days after receipt of the reviewed document)

The document is not accepted for the purpose it is issued for. The document shall be revised and resubmitted within 14 calendar days to Customer for review.

Status code "Accepted" and/or "Accepted with comments" means that Customer agrees that the document fills its function for further Work.

4.3 Test and quality requirements

Quality assurance measures will be implemented throughout the project to ensure that all work is conducted properly. This includes adherence to OEM specifications, industry regulations, and internal quality control procedures. Norske tog keeps the right to inspect the progress of the project.

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 train. 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. Implementation

5.1 General information

Due to operational considerations, the installation of LED-light may need to be carried out during operational downtime. Train downtime is typically 8-12 hours from 19:00 in the evening. As such, it is an advantage that the Contractor can execute the installation during these hours. The main location for the work is Lodalen. The Contractor will be responsible for granting track access.

Trainset availability for installation may be subject to change during the project, particularly in the later stages. The Contractor shall therefore maintain close coordination with the operator and maintainer to accommodate adjustments and ensure efficient project execution. We are therefore interested in understanding how your proposed approach aligns with operational requirements and minimizes disruption to train service.

Tenderers will be given the opportunity to conduct an inspection of a Class 5 coach prior to the tender deadline. Inspections may be arranged in week 35 or 36 2026 by prior appointment with Norske tog. If the Tenderer wishes to conduct an inspection, Norske tog must be notified in CTM of this no later than September 1st. Norske tog will be present at the inspection.

5.2 Project schedule

A detailed project schedule shall describe the progress of the project. The schedule should cover all elements listed in chapter 3 of this SoW, so that all phases from engineering to completion are covered. The schedule must include milestones and deadlines for each phase. The project schedule and implementation plan for each trainset must minimize disruption to regular train operations.

The project schedule should be updated after prototype development and include lessons learned during the project.

5.3 Inventory management

It is essential that delivery times for the required products are carefully planned and coordinated. The Contractor must ensure that adequate inventory is maintained so that installation can proceed promptly when trainsets become available.

6. List of Appendices

Appendix A – Scope of work (this document)

Appendix B – Prices and payment

Appendix C – Specifications of requirements

Appendix D – Delivered document plan

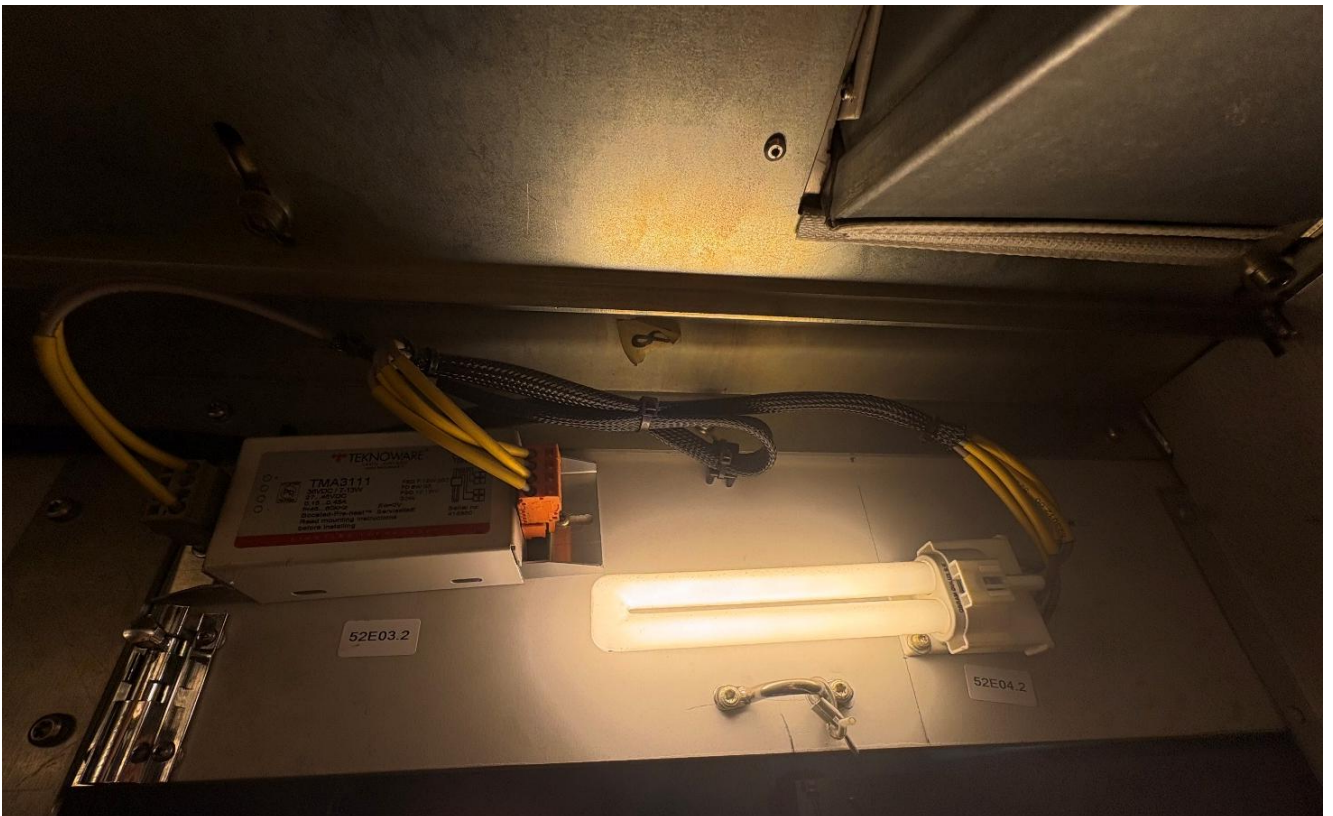
Appendix E – Document analysis

Appendix F – EN15380 – NT structure

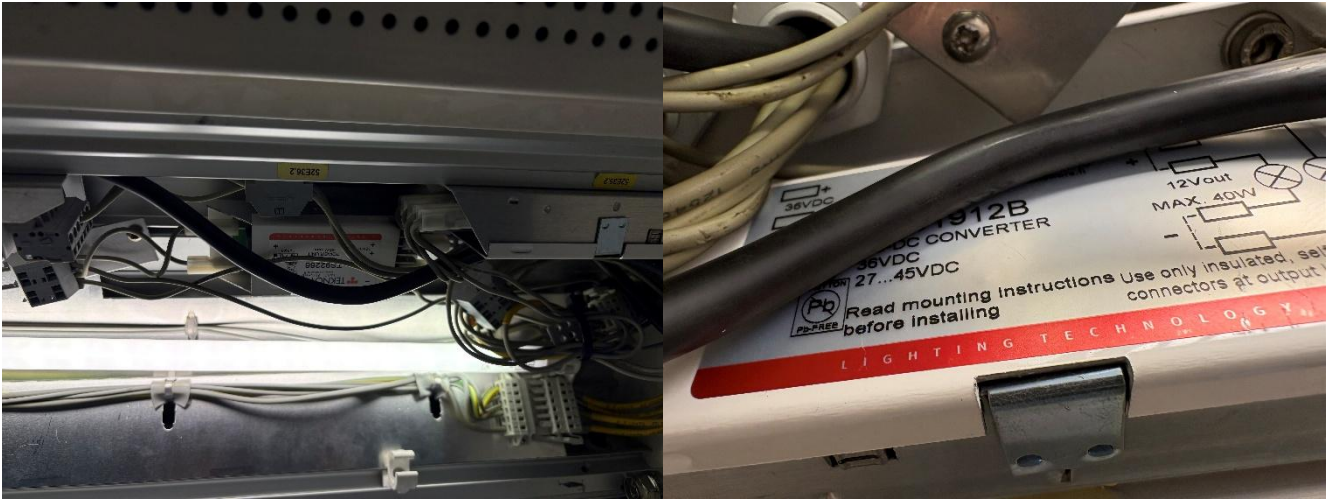
Appendix G – System documentation limited

7. Pictures from carriage inspection

9W 2-pin lamp



T5 Fluorescent tubes and pre coupling units



Control panel



Toilet light

