

Marine Diesel Engine NOx Certification Procedure

Version 2016A

Contents

1. File revision history	1
2. Introduction	2
3. NOx certification to a marine diesel engine	3
4. Approval to an engine family/engine group or Individual engine	4
5. Approval to a member Engine of an engine family/engine group	6
6. Pre-certification to an engine system fitted with SCR	7
6.1 General	7
6.2 Pre-certification under Scheme A	7
6.3 Pre-certification under scheme B	8
7. NOx certification to an engine with Exhaust Gas Recirculation (EGR) technology	9
8. NOx certification to a Dual Fuel and Gas-Fuelled Engine	10
9. Approved method (pre-2000 engines under MARPOL Regulation 13.7.1)	11
10. Amendment to the Technical File of the existing engine on board	12
11. Major conversion (under MARPOL Regulation 13.2.1, 13.2.2)	13
Appendix I	14
NOx Technical File contents	14
Appendix II	19
Guidance for NOx “Conformity of Production” approval	19
Appendix III	23
Files list submitted for Marine Diesel Engine NOx certification	23
Appendix IV	30
Marine Diesel Engine Pre-Certification NOx Emission Test Report	30
Appendix V	38
Marine Diesel Engine Pre-certification NOx Verification of Conformity (VoC) Report	38
Appendix VI	39
LR Marine Design Appraisal Document (DAD) for Marine Diesel Engine NOx certification	39
Appendix VII	47
LR NOx emission calculation software (LR only)	47

1. File revision history

Version	Date	Status/Changes
2016A	20/12/2016	Initial

2. Introduction

- .1 This procedure outlines LR provisions for verifying and issue of certification for the Emissions of Nitrogen Oxides (NOx) from Marine Diesel Engine for compliance with the requirements as specified in MARPOL 73/78, Annex VI Regulation 13 for the Prevention of Air Pollution from ships.
- .2 This procedure will not intend to duplicate related statutory descriptions while it wants to deliver clear and practical requirements and guidance which should be followed during the NOx certification process.
- .3 This procedure covers the marine diesel engines above 130kW which are intended to be installed on-board the ship subject to Annex VI of MARPOL 73/78.
- .4 This procedure covers both the initial certification process at the time of engine manufacture and also a number of possible subsequent issues for existing engines on board. A scenario which is not covered by this procedure, please contact with engineering@lr.org for guidance.
- .5 NOx certification in accordance with these procedures, and any related Plan Approval Circulars, MTN, is undertaken on the basis as followed.
MARPOL Annex VI – as amended
NOx Technical Code – as amended
Relevant MEPC Guidelines – as revised
Relevant MEPC Unified Interpretations – as revised
Relevant IACS Unified Interpretations as given in the MPC series – as revised.
- .6 This procedure is mainly used for LR internal guidance of the NOx certification activities, it could be shared with applicants of NOx certification in order to make the NOx certification activities more transparent and get cooperation from applicants at the same time.
- .7 LR MSPM should be referred by attending Surveyor accordingly for more guidance of field survey activities.
- .8 This procedure supersedes previous versions. This procedure is subject to on-going review, the latest version can be found in LR Class Direct-www.cdlive.lr.org (Information>Approvals>NOx emissions).
- .9 Any question to this procedure, please get contact with LR through email of engineering@lr.org.

3. NOx certification to a marine diesel engine

- .1 Marine diesel engine as defined in IMO Resolution MEPC. 258 (67) means any reciprocating internal combustion engine operating on liquid or dual fuel, to which regulation 13 of MARPOL Annex VI, including booster/compound systems if applied. In addition, a gas fuelled engine installed on a ship constructed on or after 1 March 2016 or a gas fuelled additional or non-identical replacement engine installed on or after that date is also considered as a marine diesel engine.
 - .2 The approval process can be divided into two types of approval including approval to the engine family/engine group or individual engine and member engine of an engine family/engine group.
 - .3 The engine NOx Technical File approval should be conducted by authorised Specialist who holding relevant Code of Authorisation (CoA) in accordance with LR requirements. There are two types of Code of Authorisation (CoA) in LR designed for NOx certification including MC0357 (member engine approval) and MC0358 (Parent engine approval) in the CoA system.
 - .4 In general, the flow charts in the NTC 2008, Appendix 2 can be followed within LR for the normal survey and certification of marine diesel engines.
 - .5 The latest Country File of the vessel's flag state in Class Direct should refer at the first instant to make sure correct certificate form is used and any instruction from flag administration is to be considered during the certification.
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4. Approval to an engine family/engine group or Individual engine

LR Client Facing Office (CFO):

- .1 To receive application from applicant and to contact with relevant TSO for fee quotation.
- .2 To prepare for the marine service contract with client to cover design appraisal service and field survey service.
- .3 Arrange field Surveyor to attend the emission test.
- .4 Field Surveyor:
 - 1) Review the emission test plan as requested before emission test (the relevant TSO can be consulted if needed);
 - 2) Attend the emission test and monitor the test conducted properly in accordance with NOx Technical Code and relevant IMO Guidelines;
 - 3) Complete the test report indicated in Appendix IV- "Marine Diesel Engine Pre-Certification NOx Emission Test Report" and send it to LR CFO for record and be ready to send to relevant TSO as a supportive document.
- .5 To collect the files submitted by applicant and field Surveyor, then send them to relevant TSO for design appraisal. The suggested files to be submitted can refer to the Appendix III accordingly.
- .6 Distribute the approved documents (e.g. NOx certificate, NOx Technical File) received from LR TSO to applicant.
- .7 Filing relevant documents and correspondences properly for future refer.

LR Technical Support Office (TSO):

- .1 To supply a fee quotation made by an Authorised Specialist to LR CFO.
- .2 Authorised Specialist:
 - 1) Make the fee quotation as requested.
 - 2) Review the emission test plan as requested before pre-certification emission test.
 - 3) Make sure necessary files to be supplied from LR CFO after emission test. The files list can refer to Appendix III accordingly.
 - 4) Conduct the design appraisal, approval the Technical File and issue NOx certificate (EIAPP or EAPP) accordingly.
 - a) Make sure the minimum information should be included in the NOx Technical File.
 - b) NOx value(s) in the Technical File from client should be verified by calculation review or calculation by LR, the LR NOx emission calculation software can refer to Appendix VII which can be downloaded from LR Class Direct.

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- c) A LR Marine Design Appraisal Document (DAD) (examples of DAD can refer to Appendix VI) should be issued together with the issued NOx certificate and the approved NOx Technical File.
 - d) The approved NOx Technical File should be digitally stamped by using dedicated stamp no. LR515. LR IT Helpdesk can help to install the stamp if needed.
 - 5) The related requirements in Plan Approval Circulars (PAC-General-1A, February 2016) apply to issue a Marine Design Appraisal Document (DAD) for NOx certification.
 - 6) The LR MTN 2014/32 relevant requirement to the statutory certificate issued on behalf of a flag administration should be followed accordingly. An original hard copy of NOx certificate should be instructed to be retained on board the ship.
 - 7) To approve the conformity of production (CoP) procedure in accordance with NTC 2008 relevant requirement for serially produced engines within an engine group/family. The Guidance for the CoP approval can refer to Appendix II.
- .3 Prepare a working order number for authorised Specialist to start the work.
 - .4 Distribute the deliverables completed by authorised Specialist to LR CFO.
 - .5 Filing the deliverables in order for future refer.
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5. Approval to a member Engine of an engine family/engine group

LR CFO:

- .1 To receive client's application and contact with relevant TSO for fee quotation.
- .2 Prepare for the marine service contract with client to cover design appraisal service and field survey service if applicable.
- .3 Collect the files submitted by applicant and field Surveyor, then send to relevant TSO for design appraisal. The suggested files list can refer to Appendix III accordingly.
- .4 Field Surveyor:
 - 1) For engine subject to direct survey, complete the survey report as Appendix V- Marine Diesel Engine Pre-certification NOx Verification of Conformity (VoC) Report after verification survey and send it to LR CFO for record.
 - 2) For the Engine produced under LR Quality Scheme for Machinery, the LR form QA027 is to be completed and send it to LR CFO for record.
- .5 Distribute the approved documents received from LR TSO to applicant.

LR TSO:

- .1 To supply a fee quotation made by an Authorised Specialist to LR CFO.
- .2 Authorised Specialist:
 - 1) Make the fee quotation as requested.
 - 2) Make sure necessary files to be supplied from LR CFO. The file lists can refer to Appendix III accordingly.
 - 3) Before conducting the design appraisal, to make sure an approved CoP in place for the manufacturer. The Guidance for NOx conformity of production approval can refer to Appendix II.
 - 4) Conduct the design appraisal, approval the Technical File and issue NOx certificate (EIAPP or EAPP) accordingly by considering the Country File accordingly.
 - a) Make sure the minimum required information to be included in the Technical File against the approved parent engine. The Technical File should be designed to the dedicated member engine and each member engine should have its own Technical File.
 - b) A LR Marine Design Appraisal Document (DAD) (examples of DAD can refer to Appendix VI) should be issued together with the issued NOx certificate.
 - c) The approved NOx Technical File should be stamped by using dedicated stamp no. LR515. LR IT Helpdesk can help to install the stamp if needed.
 - d) The related requirements in Plan Approval Circulars (PAC-General-1A, February 2016) apply to the issue of Marine DAD during NOx certification.

- e) The LR MTN 2014/32 relevant requirement to the certificate issued on behalf of a flag administration should be followed accordingly. An original hard copy of NOx certificate should be instructed to be retained on board the ship
- .3 Supply a working order number for authorised specialist to start the design appraisal work.
- .4 Distribute the deliverables completed by authorised specialist to LR CFO.
- .5 Filing the deliverables in order for future refer.

6. Pre-certification to an engine system fitted with SCR

6.1 General

- .1 A selective catalytic reduction (SCR) system is one kind of NOx-reducing devices which is envisaged in the NOx Technical Code 2008 (NTC 2008) as given in section 2.2.5.
- .2 The approval to an engine system fitted with SCR is to be considered with IMO Resolution MEPC.198 (62)-2011 Guidelines for engine fitted with SCR. There are two schemes including Scheme A and Scheme B are mentioned in this Resolution.
- .3 IACS related UIs should refer during design appraisal, such as MPC108 to MPC126. The IACS UIs can be downloaded from the website of www.iacs.org.uk.
- .4 The LR procedure for approval of engine system fitted with SCR can refer to Chapter 4 and Chapter 5 respectively in this file.
- .5 The latest Country File of the vessel's flag state in LR Class Direct should refer at the first instant for requirements and instruction from flag administration.
- .6 The applicant for the certification could be engine manufacturer, SCR manufacturer, shipyard or other party accepted by LR, this applicant should lead and be responsible for the whole process for this certification.

6.2 Pre-certification under Scheme A

- .1 The manufacturer shall propose the scope of Engine family/Engine group of engine(s) system fitted with SCR.
- .2 The selected engine system fitted with SCR for certification emissions testing should have the highest NOx emission level in general among the engine group/family. It should be agreed in advance before the emissions testing.
- .3 A test for a combined system of an engine fitted with a full size SCR in Scheme A is to ensure compliance with the applicable NOx emission limits of MARPOL Annex VI, Regulation 13, as required. The test bed measurement procedures of Chapter 5 of the NTC2008 should apply. The parameters mentioned in the MEPC. 198(62), paragraph 5.2.2 should be measured and recorded in the engine test report in accordance with section 5.10 of the NTC 2008.
- .4 The contents of Technical File to the engine fitted with SCR can refer to Appendix I.

- .5 Please be aware the NO_x correction factor for humidity and temperature could not be applied, so the updated LR NO_x emission calculation software mentioned in the Appendix VII are to be used for verification to NO_x value.

6.3 Pre-certification under scheme B

- .1 In cases where combined engine system fitted with SCR can neither be tested on a test bed due to technical or practical reasons nor an on board test can be performed fully complying with the requirements of chapter 5 of the NTC 2008, the scheme B is applied for NO_x certification. The applicant makes the application for the NO_x certification under Scheme A or Scheme B and agreed by LR in advance.
- .2 The emission test to the selected parent engine will be conducted in accordance with Chapter 5 of NTC 2008. The purpose of this test is to establish the emission value(s) for the NO_x emission value calculation of the engine system fitted with SCR.
- .3 The SCR NO_x reduction rate could be calculated by modelling tool(s). The modelling tool(s) should be approved and agreed in advance. An "Approval in Principle" to the modelling tool(s) could be issued to the applicant as requested.
- .4 The SCR chamber for validation testing could be a full scale SCR chamber or a scaled version. Where a scaled version of the SCR chamber is used, the scaling process should be validated and agreed in advance by LR.
- .5 The on board initial confirmation test to the engine fitted with SCR should be witnessed by LR or other arrangement agreed by LR in advance. The confirmation testing results should be verified and reviewed against the approved engine's NO_x Technical File by attending Surveyor or the initial NO_x Technical File approval office if needed.

7. NOx certification to an engine with Exhaust Gas Recirculation (EGR) technology

- .1 EGR system works by recirculating a portion of engine exhaust gas back to the engine cylinders, the recirculated exhaust gas with or without treatment into the engine cylinders dilutes the O₂ in the inlet air and provides gases inert to combustion to act as absorbents of combustion heat to reduce peak combustion temperature. The engine with EGR technology can be certified in accordance with NTC 2008.
 - .2 The certification to the engine with EGR technology, LR procedure mentioned in the Chapter 4 and Chapter 5 as above is to be followed.
 - .3 LR Southampton Technical Support Office could be contacted through engineering@lr.org for further advice to handle the certification of engine with EGR technology cases.
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8. NOx certification to a Dual Fuel and Gas-Fuelled Engine

- .1 The certification to a Dual Fuel and Gas-Fuelled Engine, LR procedure mentioned in the Chapter 4 and Chapter 5 as above are to be followed.
- .2 To be aware the gaseous emissions calculation formulas in NTC 2008 have been amended by considering the dual fuel and gas fuel, the updated LR NOx emission calculation tools mentioned in the Appendix VII are to be used accordingly.
- .3 LR Southampton Technical Support Office could be contacted through engineering@lr.org for further advice to handle the certification of a Dual Fuel and Gas-Fuelled Engine cases.
- .4 The following documents could refer when carrying out the NOx certification:
 - .1 IMO circular MEPC.1/Circ.854 - Guidance on the Application of Regulation 13 of MARPOL Annex VI Tier III Requirements to Dual Fuel and Gas-Fuelled Engines – (1 July 2015);
 - .2 IMO Resolution MEPC 251(66) -Amendments to MARPOL Annex VI and the NOx Technical Code 2008.

9. **Approved method** (pre-2000 engines under MARPOL Regulation 13.7.1)

- .1 LR Marine Technical Notice 2010/43A should refer at the first instance.
 - .2 The list of approval methods certified by IMO can be found in the IMO website.
<https://gisis.imo.org/>.
 - .3 In addition, the following IMO Resolutions can refer.
 - .1 Resolution MEPC.242 (66) – 2014 Guidelines in Respect of the Information to be submitted by an Administration to the Organization Covering the Certification of an Approved Method as Required under Regulation 13.7.1 of MARPOL Annex VI.
 - .2 Resolution MEPC.243 (66) – 2014 Guidelines on the Approved Method Process.
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10. Amendment to the Technical File of the existing engine on board

- .1 The existing Technical File and/or NOx certificate of the existing engine on board may be amended as requested by applicant. This approval should be carried out by the authorised Specialist who has CoA of MC0358 for the unsupervised authorisation of parent engine approval level.
- .2 The following approval working procedure can be followed.
 - 1) Applicant submits application and relevant documents to their LR Client Facing Office (CFO);
 - 2) The CFO requests fee quotation from LR Technical Support Office (TSO);
 - 3) A service contract is prepared by CFO and it returns to CFO signed by applicant;
 - 4) Following signing of the service contract, a Work Package (WP) is created by administrative team for authorised Specialist to work on it;
 - 5) The TSO authorised Specialist conducts the approval and returns approved files with an issued Marine DAD to CFO;
 - 6) LR CFO delivers the approved files and DAD to Applicant.
- .3 The suggested documents are to be supplied from applicant through CFO as followed:
 - 1) Amendment to Technical File (May include the information of engine manufacturer, engine serial number, NOx critical component/parameter name & its identification marking or setting);
 - 2) Drawings or specification of Existing & Replacement/alternative for NOx critical components;
 - 3) Demonstration test report and analysis result to NOx emission effect or the explanation of the differences/changes if demonstration test is not needed;
 - 4) The permission to the exiting Technical File amendment;
 - 5) Other supportive information, e.g. ship name, IMO number, engine approval documents including EIAPP/EAPP certificate, DAD and Technical File on board.
- .4 LR Southampton Technical Support Office could be contacted through engineering@lr.org for further advice to handle the existing NOx Technical File amendment cases.

11. Major conversion (under MARPOL Regulation 13.2.1, 13.2.2)

- .1 The major conversion of the engine can be happened as follows:
 - 1) Engine on-board is replaced or an additional marine diesel engine is installed.
 - 2) Any substantial modification is made to the engine.
 - 3) The maximum continuous rating of the engine is increased by more than 10% compared to the maximum continuous rating of the original certification of the engine.
- .2 The IMO document of MEPC.1/Circular 849 – Guidance on the Supplement to the IAPP Certificate can refer for the different engine certification scenarios and its applicable regulation of MARPOL Annex VI.
- .3 The Unified Interpretation to “Time of replacement of an engine” can refer to the Section 7 of MEPC.1/Circular.795 Rev.2 – Unified Interpretations to MARPOL Annex VI – (1 December 2014) and IACS Unified Interpretation MPC98 respectively.
- .4 For the replacement with non-identical replacement engine, if it is not possible for such a replacement engine to meet the Tier III requirement, then that replacement engine shall meet Tier II requirement by taking into account the Guidelines mentioned in IMO MEPC. 230 (65)-2013 Guidelines as Required by Regulation 13.2.2 of MARPOL Annex VI in Respect of Non-Identical Replacement Engines Not Required to meet the Tier III Limit – (Adopted on 17 May 2013).
- .5 The Unified Interpretation to “Identical replacement engine” can refer to the Section 6 of MEPC.1/Circular.795 Rev.2 – Unified Interpretations to MARPOL Annex VI – (1 December 2014) and IACS Unified Interpretation MPC103 respectively.
- .6 The term of “substantial modification” can refer to NOx Technical Code 2008, section 1.3.2.

LR Southampton Technical Support Office could be contacted through engineering@lr.org for further advice to handle the major conversion cases.

Appendix I

NOx Technical File contents

CONTENTS

Chapter	Topic	
1	General	
2	Marine Diesel Engine	
3	Engine system fitted with SCR	

1. General

- .1 Every marine diesel engine installed on board a ship shall be provided with a Technical File. The Technical File shall be prepared by the applicant for engine and approved by the Administration.
 - .2 The Technical File is required to accompany an engine throughout its life on board ship.
 - .3 The contents of technical file will be verified against the Regulation requirements during the Technical File approval to make sure the minimum information to be included.
 - .4 LR may require additional information to be put into the Technical File or supportive documents to the Technical File.
 - .5 Any question, please send email to engineering@lr.org for advice.
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2. Marine diesel engine

Regulation	Information
	Name and address of manufacturer
	Place of engine build
	Date of engine build
	Place of pre-certification survey
	Date of pre-certification survey
	Engine type and model number
	Engine serial number
	Rated power and rated speed values or ranges
	Test cycle(s)
	Parent engine test fuel(s) specification(s)
	Parent engine emission value(s)
	Applicable NOx emission limit(s)
	Engine group/family scope
	Parent or member engine of engine group/family
NTC 2008, section 2.4.1.1	Identification of those components, settings and operating values of the engine that influence its NOx emissions including any NOx –reducing device or system
NTC 2008, section 2.4.1.2	Identification of the full range of allowable adjustments or alternatives for the components of the engine
NTC 2008, section 2.4.1.3	Full record of the relevant engine’s performance, including the engine’s rated speed and rated power (i.e. shop test record or equivalent).
NTC 2008, section 2.4.1.4	A system of on board NOx verification procedures to verify compliance with the NOx emission limits during on board verification survey in accordance with chapter 6 of NTC 2008
NTC 2008, section 2.4.1.5	A copy of the relevant parent engine test data, as given in section 2 of appendix V of NTC 2008
NTC 2008, section 2.4.1.6	The designation and restrictions for an engine that is an engine within an engine family or engine group, if applicable
NTC 2008, section 2.4.1.7	Specifications of those spare parts/components that, when used in the engine, according to those specifications, will result in continued compliance of the engine with the applicable NOx emission limit
NTC 2008, section 2.4.1.8	The EIAPP certificate, as applicable
MEPC.1/Circ. 854, Paragraph 6	Written procedure showing how the Tiers change-over if applicable
MEPC.1/Circ. 854, Paragraph 9	Auxiliary control devices (ACD) if applicable
NTC 2008 Section 2.4.3	On board NOx verification procedure(s)

3. Engine system fitted with SCR

Regulation	Information
	Name and address of applicant
	Name and address of engine manufacturer
	Place of engine build
	Date of engine build
	Place of pre-certification survey
	Date of pre-certification survey
	Engine type/model number
	Engine serial number
	Rated power and rated speed values or ranges
	Test cycle(s)
	Parent engine test fuels specification
	Parent engine emission value(s)
	Applicable NOx emission limit(s)
	Engine group/family scope
	Engine fitted with SCR group/family scope
	Parent or member engine fitted with SCR
	Name and address of SCR system manufacturer
	Place of SCR build
	SCR type/model number
	SCR serial number
NTC 2008, section 2.4.1.1	Identification of those components, settings and operating values of the engine that influence its NOx emissions including any NOx –reducing device or system
NTC 2008, section 2.4.1.2	Identification of the full range of allowable adjustments or alternatives for the components of the engine
NTC 2008, section 2.4.1.3	Full record of the relevant engine’s performance, including the engine’s rated speed and rated power (i.e. shop test record or equivalent).
NTC 2008, section 2.4.1.4	A system of on board NOx verification procedures to verify compliance with the NOx emission limits during on board verification survey in accordance with chapter 6 of NTC 2008
NTC 2008, section 2.4.1.5	A copy of the relevant parent engine test data, as given in section 2 of appendix V of NTC 2008
NTC 2008, section 2.4.1.6	The designation and restrictions for an engine that is an engine within an engine family or engine group, if applicable
NTC 2008, section 2.4.1.7	Specifications of those spare parts/components that, when used in the engine, according to those specifications, will result in continued compliance of the engine with the applicable NOx emission limit
NTC 2008, section 2.4.1.8	The EIAPP certificate, as applicable

MEPC. 198 (62), section 3.2.1.1	reductant: component/type and concentration
MEPC. 198 (62), section 3.2.1.2	reductant injection system including critical dimensions and supply volume
MEPC. 198 (62), section 3.2.1.3	design features of SCR specific components in the exhaust duct from the engine exhaust manifold to the SCR chamber
MEPC. 198 (62), section 3.2.1.4	catalyst block specification and arrangement in the SCR chamber
MEPC. 198 (62), section 3.2.1.5	inlet parameters including allowable exhaust gas temperature (maximum and minimum) at the inlet of the SCR chamber
MEPC. 198 (62), section 3.2.1.6	cross-unit parameters: allowable pressure loss (Δp) between inlet and outlet of SCR chamber and in the exhaust duct caused by SCR components
MEPC. 198 (62), section 3.2.1.7	aspects related to the fuel oil quality resulting in continued compliance of the engine with the applicable NO _x emission limit
MEPC. 198 (62), section 3.2.1.8	factors related to the deterioration rate of SCR performance, e.g., exchange condition for SCR catalyst blocks and recommended exchange time of SCR catalyst blocks
MEPC. 198 (62), section 3.2.1.9	controlling arrangements and settings of the SCR, e.g., model, specification of control device
MEPC. 198 (62), section 3.2.1.10	measures to minimize reductant slip
MEPC. 198 (62), section 3.2.1.11	parameter check method as the verification procedure: with regard to the application of the parameter check method, requirements given in paragraph 2.3.6 of the NTC 2008 and guidance given in appendix VII, paragraph 2 of the NTC 2008 should be taken into account in assessing the adequacy of a proposed procedure with analysers meeting or exceeding the requirements of appendix III of the NTC 2008
MEPC. 198 (62), section 3.2.1.12	any other parameter(s) specified by the applicant
MEPC.1/Circ. 854, Paragraph 6	Written procedure showing how the Tiers change-over if applicable
MEPC.1/Circ. 854, Paragraph 9	Auxiliary control devices (ACD) if applicable
NTC 2008 Section 2.4.3	On board NO _x verification procedure(s)

Appendix II

Guidance for NOx “Conformity of Production” approval

CONTENTS

Chapter	Topic	
1	General	
1.1	Foreword	
1.2	NOx Conformity of Production (CoP)	
2	NOx Conformity of Production (CoP) approval	
2.1	LR Technical Support Office (TSO)	
2.2	LR Client Facing Office (CFO)	
2.3	Client	
3	NOx CoP approval under LR Quality Scheme for Machinery	
3.1	NOx CoP approval	
3.2	NOx verification of conformity report and EIAPP certification	
3.3	Maintenance and Audit	

1. General

1.1 Foreword

In order to meet the requirements for the NOx Conformity of Production (CoP) procedure in accordance with the requirement of Section 4.3.7 or 4.4.5 of the NOx Technical Code 2008, this document gives the instructions for this item.

In addition, the IACS UI MPC55 can refer for the unified interpretations to this item.

1.2 NOx Conformity of Production (CoP)

- .1 The CoP procedure should address the design process implemented to maintain the control of the issue of related drawings, uniformity of the product's materials and dimensions, inspection and testing, the identification markings, product assembly using compliant components, the implemented procedures that ensure any NOx critical component spare parts supplied to a certified engine.
- .2 The NOx CoP procedure should cover all the engines manufactured at the works in general. All the elements, requirements and provisions adopted by the manufacturer to ensure conformity of production shall be documented in a systemic and orderly manner in the form of written procedures and instructions.
- .3 For the engine groups established for the purpose of engine modification on board after an EIAPP certificate issued may not be necessary to have the requirement for NOx CoP. NTC2008, section 4.4.5 refers.
- .4 The IACS UI MPC106 should be considered when approval the NOx CoP submitted by licensor.
- .5 For the engine system fitted with SCR, the SCR system should be considered during the CoP procedure approval.

2. NOx Conformity of Production (CoP) approval

2.1 LR Technical Support Office (TSO)

- .1 LR TSO will be responsible for the approval NOx CoP against the requirements of section 4.3.7 and 4.4.5, NOx Technical Code 2008.
- .2 After approval, the NOx CoP file should be stamped and a Marine Design Appraisal Document (DAD) can be issued to client through LR CFO.
- .3 The approved CoP should be filed in order for future reference.

2.2 LR Client Facing Office (CFO)

- .1 LR CFO will be responsible for the service contract with client and arrange field Surveyor to conduct initial audit against the approved NOx CoP file by LR TSO.
- .2 The field Surveyor should conduct the audit against the approved NOx CoP and make sure the written procedure matched with real situations in the works. Any findings should be feedback to LR initial approval TSO for further action.

2.3 Applicant/Manufacturer

- .1 Applicant/Manufacturer should make sure the CoP has been approved before any member engine certification application;
 - .2 Applicant/Manufacturer is requested to keep the approved NOx CoP file updated and any amendment to this file, the LR CFO should be contacted in the first instance.
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3 NOx CoP approval under LR Quality Scheme for Machinery

3.1 NOx CoP approval

- .1 When the engines produced under the LR Quality Scheme for Machinery, the NOx CoP should be approved as mentioned in Chapter 2.
- .2 The NOx CoP in accordance with NOx Technical Code may be either incorporated into the LR Quality Scheme for Machinery procedures or remain as an separate document.

3.2 NOx verification of conformity report and EIAPP certification

- .1 The manufacturer is authorised to issue the LR form QA027 "Marine Diesel Engine Pre-certification NOx verification of conformity report".
- .2 When an EIAPP certificate is required for engine released under this scheme, an application is to be made to LR with the relevant documents (e.g. member engine's Technical File, Factory test report, LR form QA027) and ship's flag state, IMO number (in case ship's flag state and IMO number is not known at the application, an EAPP certificate will be issued accordingly).

3.3 Maintenance and Audit

- .1 LR will confirm the manufacturer's system satisfactorily operated and it remains acceptable through conducting annual surveillance audit successfully by LR.
- .2 A record of the NOx compliant engines produced under the LR Quality Scheme is to be submitted to relevant LR CFO on a monthly basis.
- .3 The authorisation to issue the form QA027 by client will be cancelled automatically if LR Quality Scheme for Machinery gets void.
- .4 Where the NOx compliance is affected, the relevant LR CFO should be informed in the first instance. Agreed corrective actions are to be implemented immediately and verified to the satisfaction of LR. This may include reverting to direct survey until the corrective is implemented.
- .5 To maintain the approval, the arrangements authorised at each works are to be kept under review by the LR relevant office in order to ensure that the approved procedures for manufacture and quality control are being maintained in a satisfactory manner.

Appendix III

Files list submitted for Marine Diesel Engine NOx certification

Content

Chapter	Topic	
1	General	
2	Parent engine of an engine group/family or individual engine	
3	Member engine to an engine group/family	
4	Parent Engine system fitted with SCR under Scheme A	
5	Parent Engine system fitted with SCR under Scheme B	
6	Member engine system fitted with SCR	

1. General

- .1 The files list is for guidance during the NOx certification and this Appendix can be shared with external clients;
- .2 The contents of NOx Technical File mentioned in this file can refer to [Appendix I](#) of NOx certification procedure.
- .3 For other cases which are not listed in this file, please contact with Southampton Technical Support Office by sending email to engineering@lr.org for further advice.

2. Parent engine of an engine group/family or individual engine

Stages	Files	Submitted by
Before pre-certification NOx emission test	Test plan	Engine maker
	Parent engine selection and the scope of engine group/family	Engine maker
	Preliminary NOx Technical File	Engine maker
	Manufacturer's Conformity of Production (CoP) procedure Or Manufacturer's LR Quality Scheme for Machinery	Engine maker
After pre-certification NOx emission test	NOx Technical File	Engine maker
	Parent engine emission test report (Countersigned by attending Surveyor)	Engine maker
	NOx value calculation process and result as requested in case LR chooses to review the calculation process	Engine maker
	Drawings and detailed specifications for NOx sensitive components	Engine maker
	NOx sensitive components and parameters setting inspection record (Countersigned by attending Surveyor)	Engine maker
	Ship's flag state and IMO number if known	Engine maker
	Other emission test supportive documents	Engine maker
	Pre-Certification NOx Emission Test Report	LR CFO/Surveyor

3. Member engine to an engine group/family

Survey type	Files	Submitted by
Direct survey	NOx Technical File	Engine maker
	NOx sensitive components and parameters setting inspection record (Countersigned by attending Surveyor)	Engine maker
	Ship's flag state and IMO number if known	Engine maker
	Engine FAT report	Engine maker
	Pre-certification NOx Verification of Conformity (VoC) Report	LR CFO/Surveyor
	Survey under LR Quality Scheme for Machinery	NOx Technical File
Survey under LR Quality Scheme for Machinery	NOx sensitive components and setting inspection record	Engine maker
	Ship's flag state and IMO number	Engine maker
	Engine FAT report	Engine maker
	LR QA027 report	LR CFO/Surveyor

4. Parent Engine system fitted with SCR under Scheme A

Stages	Files	Submitted by
Before pre-certification NOx emission test	Test plan	applicant
	Parent engine system fitted with SCR selection and scope of engine group/family	applicant
	Preliminary NOx Technical File	applicant
After pre-certification NOx emission test	NOx Technical File	applicant
	Emission test report (Countersigned by attending Surveyor)	applicant
	NOx value calculation process and result as requested in case LR chooses to review the calculation process	applicant
	Drawings and detailed specifications for NOx sensitive components	applicant
	NOx sensitive components and parameters setting inspection record (Countersigned by attending Surveyor)	applicant
	Other emission tests supportive documents	applicant
	Manufacturer's Conformity of Production (CoP) procedure	applicant
	Pre-Certification NOx Emission Test Report	LR CFO/Surveyor

5. Parent Engine system fitted with SCR under Scheme B

Stages	Files	Submitted by
Before On-board Confirmation test: Parent Engine system fitted with SCR_SCR approval	Documents for Scaling process validation approval in case of scale version of SCR chamber used	applicant
	Documents for SCR chamber validation testing (Full scale / Scale version) 1) Test plan before testing 2) Test reports after testing	applicant
	Documents for Modelling tools approval 1) Modelling tools detailed information 2) SCR chamber validation testing reports and relevant Design Appraisal document if applicable	applicant
Before On-board Confirmation test: Parent Engine system fitted with SCR_Engine only NOx emission test	Parent engine Emission Test plan	applicant
	Pre-certification NOx Emission Test Report	LR CFO/Surveyor
Before On-board Confirmation test: Parent Engine system fitted with SCR	NOx Technical File	applicant
	Parent Engine only NOx emission test report (Countersigned by attending Surveyor)	applicant
	NOx value calculation process and result as requested in case LR chooses to review the calculation process	applicant
	Drawings for NOx sensitive components	applicant
	NOx sensitive components and parameters setting check record (Countersigned by attending Surveyor)	applicant
	On-board confirmation test plan	applicant
	Manufacturers' Conformity of Production (CoP) procedure	applicant
After On-board Confirmation test: Parent Engine system fitted with SCR	On-board confirmation test report (Countersigned by attending Surveyor)	applicant
	Updated Technical File if applicable	applicant

6. Member Engine system fitted with SCR

Files	Submitted by
NOx Technical File	Applicant
NOx sensitive components and parameters setting inspection record (Countersigned by attending Surveyor)	Applicant
Ship's flag state and IMO number if known	Applicant
Engine FAT report	Applicant
Pre-certification NOx Verification of Conformity (VoC) Report	LR CFO/Surveyor

Appendix IV

Marine Diesel Engine Pre-Certification NOx Emission Test Report

**Marine Diesel Engine
Pre-Certification NOx Emission Test Report**
(Regulation 13 of MARPOL 73/78 Annex VI & NOx Technical Code 2008)

ENGINE INFORMATION	
Manufacturer Name & Address	
Type / Model Number	
Serial Number	
Rated Power (kW) @ Rated Speed (rpm)	
Engine Fuel oil types: Oil fuel, Dual fuel or Gas fuel	
Test Cycle(s): E2, E3, D2, C1	
Stage(s): Tier II and/or Tier III	
Remarks	

Report number	
Date of Engine Test	
Place of Engine Test	
Authorised Surveyor name, signature & stamp	

Notes:

1. This file should be filled properly by attending Surveyor and sent it to relevant TSO which conducts the engine NOx certification through LR CFO.
2. The updated version for this file can be found in LR Class Direct.
3. The on-board confirmation test under Scheme B required in Chapter 7 of MEPC. 198 (62) is not applicable to this file.

CONTENTS		Pages
Section 1: Pre-Emission test		
1.1	General	3
1.2	Sampling for raw exhaust gases	3
1.3	Analysers	4
1.4	Calibration of Analytical & Measuring Instruments	5
1.5	Pre-measurement	5
1.6	Exhaust gas flow determination	5
Section 2: Emission test		
2.1	Spot check data record during the Emission Test	6-7
2.2	NOx-reducing device or Technologies	8
Section 3: Post-Emission test		
3.1	Analysers & sampling line re-check	8
3.2	Fuel(s) used for emission test	8
3.3	Engine Component & Setting Verification	8

Section 1: Pre-Emission test

1.1. General

Item	Checked/Recorded
Test plan is reviewed and agreed by LR?	
NOx-reducing device (e.g. SCR) or Technology (e.g. EGR) applied? (if yes, please fill in Section 2.2)	

1.2. Sampling for raw exhaust gases (NTC 2008, section 5.9.3 and Appendix 3)

Item	Checked/Recorded
1. Sampling Probe design and construction	
1) Material:	
2) Straight, multi-hole with closed-end:	
3) Inner diameter and wall thickness (mm)	
4) Length (mm)	
2. Exhaust Pipe Diameter at sampling point (mm)	
3. Sampling point relative position to T/C or After-treatment device outlet (m)	
4. Sampling point relative position to the upstream of the exit of the exhaust gas system (m)	
5. Heated sampling line design and construction	
1) Material:	
2) Inner diameter:	
3) Temperature maintained:	
6. Cooling unit Temperature maintained	
7. Gas drying device if used	
8. Multi probes and sampling lines used?	

1.3 Analysers

Specifications & Calibration (NTC 2008, Appendix 3 & 4)			
Carbon Monoxide (CO) Analyser		Carbon Dioxide (CO ₂) Analyser	
Make		Make	
Type/Model		Type/Model	
Serial number		Serial number	
Calibration date		Calibration date	
Calibration curve reviewed		Calibration curve reviewed	
Calibration gases expiry date		Calibration gases expiry date	
Oxides of Nitrogen (NO _x) Analyser		NO _x converter efficiency (NO ₂ ⇌ NO)	
Make		Efficiency (≥90%)	
Type/Model			
Serial number			
Calibration date			
Calibration curve reviewed			
Calibration gases expiry date			
Hydrocarbon (HC) Analyser		Oxygen (O ₂) Analyser	
Make		Make	
Type/Model		Type/Model	
Serial number		Serial number	
Calibration date		Calibration date	
Calibration curve reviewed		Calibration curve reviewed	
Calibration gases expiry date		Calibration gases expiry date	

1.4 Calibration of Analytical & Measuring Instruments (NTC 2008, Appendix 4)

Item	Checked/Recorded	Notes
Measuring Instruments calibration certificates/records		Detailed information to be attached to this report
Zero and span gases specifications and expiry dates		Detailed information to be attached to this report

1.5 Pre-measurement

Item	Checked/Recorded	Notes
Analysers warm-up at least 2 hours or as specified		
Sample line heated to specified temperatures (°C)		
Gas sample temperature after dryer (°C) if applicable		
Sample line leakage test before measurement		
Gas analysers zero and span response check		Recording period not less than 3 minutes. Refer to section 5.9.7 of NTC2008
Engine conditions (e.g. speed, load etc.)		Refer to section 5.9.8 of NTC2008

1.6 Exhaust gas flow determination (NTC 2008, Section 5.5)

Exhaust gas flow determination	Tick below
Fuel flow and Carbon balance methods (NTC2008, sec. 5.5.4) <i>*_if not, please contact relevant authorised TSO for advice</i>	
Air and Fuel Measurement method (NTC2008, sec. 5.5.3)	
Direct Measurement method (NTC2008, sec. 5.5.2)	

Section 2: Emission test (NTC 2008, Appendix 5)

2.1 Spot check data record during the Emission Test

Test points						
		1	2	3	4	5
Date	dd/mm/yyyy					
Time at record	hh:mm					
Rated Power	%					
Power	kW					
Rated Speed	%					
Speed	rpm					

Ambient Conditions						
Atmospheric Pressure	kPa					
Intake Air Temperature	°C					
Intake Air Relative Humidity	%					
Notes: the measurement devices should be close to the position of air inlet of engine						

Generator Data [#] to be filled in when electric generator/motor is used for the test.						
Electrical Power	kWe					
Current	A					
Voltage	V					
Power factor	Φ					
Generator Efficiency	η					

Records for Exhaust gas flow & Intake air flow [#]						
Exhaust gas flow* (*-Direct Measurement method only)	kg/h					
Intake air flow * (wet/dry) (*-Air and Fuel Measurement method only)	kg/h					
# -no need to fill if using Fuel flow and carbon balance method to determine exhaust gas flow (refer to NTC2008, Section 5.5.4)						

Test points									
Gaseous emissions data (Concentration)		1	2	3	4	5			
NO _x (Dry or Wet ^{HCLD type analyser})	ppm								
CO (Dry)	ppm								
CO ₂ (Dry)	%								
O ₂ (Dry or Wet ^{ZRDO type analyser})	%								
HC (Wet)	ppm C1								
Charge air temperature	°C								
Charge air pressure	kPa								
Charge air Temperature Reference temperature (T _{CSRef}) (data supplied by client)	°C								
Coolant Inlet & Outlet of Charge air cooler	°C								
Liquid fuel mass flow (net consumption)	kg/h								
Liquid fuel Temperature before the engine	°C								
Gas fuel mass flow (net consumption) (Dual fuel or Gas fuelled engine)	kg/h								
Gas fuel Temperature before the engine (Dual fuel or Gas fuelled engine)	°C								
Exhaust Back Pressure	kPa								
Exhaust Temperature	°C								
Selective Catalytic Reduction (SCR)* (*-for Scheme B under MEPC. 198(62), the approved on-board confirmation test procedure refers)									
Reductant specification	-								
Reductant Injection rate	kg/h								
Exhaust gas temperature at Inlet of SCR chamber	°C								
Exhaust gas temperature at Outlet of SCR chamber	°C								
Pressure loss across SCR chamber	kPa								

Note:

1. When engine stabilized, the output of the analysers shall be recorded both during the test (recording period not less than 10 minutes) and during all zero and span response checks (recording period not less than 3 minutes).
2. The attending Surveyor should confirm the test report containing the necessary data to fully define the engine performance and enable calculation of the gaseous emissions including the data as set out in section 1 of Appendix V of NTC 2008, and Final test report should be countersigned by attending Surveyor.
3. The above record sheet is designed for D2, E2 or E3 test cycle type. For type C1, please put more columns by attending Surveyor.

2.2 NO_x-reducing device or Technologies (If applicable)

NO _x -reducing device or Technologies provided to reduce NO _x emission					
Selective Catalytic Reduction (SCR)		Exhaust Gas Re-circulation (EGR)		Humidification of Inlet Air	
Oil Fuel Emulsification		Direct water injection			
Others (to specify)					
Specifications of the NO _x -reducing device					
Manufacturer Name & Address					
Type /Model					
Serial number					

Section 3: Post-Emission test

3.1. Analysers & sampling line re-check

Item	Checked/Recorded
Gas analysers zero and span response check	
Sampling line leakage test after the test	

3.2 Fuel(s) used for emission test (including Gas fuel if applicable)

Fuel(s) samples taken during emission test and sealed for analysis	
--	--

3.3 NO_x sensitive Components & Settings Verification

Item	Verified/Inspection
NO _x sensitive components & settings verified against the drawings or specification	
Auxiliary control devices (ACD) if applicable	

-END-

Appendix V

Marine Diesel Engine Pre-certification NOx Verification of Conformity (VoC) Report

This report is to certify that the following Marine Diesel Engine(s)' NOx critical components and identification numbers, settings were verified as complying with those detailed in the approved Parent Engine Technical File during manufacture, assembly and factory acceptance testing.

Engine Manufacturer	Name		
	Address		
Engine Type/Model			
Serial No(s)			
Date(s) of testing			
Parent Engine NOx Technical File	Approval Number		
	Approval Date		
Conformity of Production (CoP)	Approval number		
	Approval Date		
Remarks			
Ship information			
Shipyard Name		Hull No.	
Flag State		IMO No.	
Remarks			

*The above supplied information in this report has been verified by the undersigned surveyor.
The inspection record to the above engine(s) NOx critical components and identification numbers, parameter settings were stamped.*

Report number	
Report date	
Surveyor name, signature & stamp	

Appendix VI

LR Marine Design Appraisal Document (DAD) for Marine Diesel Engine NOx certification

CONTENTS

Chapter	Topic	
1	General	
2	Parent engine of an engine group/family or individual engine	
3	Member engine to an approved engine group/family	
4	Examples of DAD for engine NOx Technical File approval	

1. General

- .1 The relevant Marine Design Appraisal Document (DAD) (LR form 6438) should be issued together with the NOx certificate.
- .2 The purpose of the DAD is to indicate what the design appraisal work done and any issues which should be paid attention by the attending Surveyor in the following steps.
- .3 The related requirements in LR Plan Approval Circulars (PAC2016-General-1A and PAC2016-General-1B) apply to the DAD for the NOx certification accordingly.

2. Parent engine of an engine group/family or individual engine

2.1 The following items should be included in the issued DAD.

- 1) The basic information of the engine group/family;
- 2) The information for the testing parent engine of the engine group/family, such as engine manufacturer, engine type/model, serial number, test cycle(s), rated power and rated speed, approval number etc.;
- 3) The scopes of Engine group/family under this approval, the detailed information should be listed clearly in this DAD or refer to the relevant approved NOx Technical File in order to give clear instruction for member engines approval;
- 4) The engine manufacturer's name and detailed address. Depending on the Conformity of Production (CoP) arrangement, all the manufacturers and their detailed addresses should be listed in this DAD;
- 5) For the engine fitted with SCR, the detailed information of SCR should be addressed in the DAD, such as manufacturer name, address, type/model, serial number etc.
- 6) For the engine fitted with other technologies to reduce NOx emissions, the technology should be specified, e.g. EGR.
- 7) Other further outstanding issues should raise the attention of LR attending Surveyor and/or applicant after this design appraisal.

3. Member engine to an approved engine group/family

3.1 The following items should be included in the issued DAD.

- 1) The basic information of the engine group/family which the member engine belonging to;
 - 2) The basic information of member engine within the approved engine group/family, such as engine manufacturer name, engine type, serial number, applicable test cycle, rated power and rated speed, approval number etc.;
 - 3) The engine manufacturer's name and detailed address;
 - 4) For the engine fitted with SCR, the SCR manufacturer's name, address, type/model, serial number etc.;
 - 5) For the engine fitted with other technologies to reduce NOx emissions, the technology should be specified, e.g. EGR.
 - 6) Other outstanding issues should raise the attention of attending Surveyor and/or applicant after this design appraisal.
-

Design Appraisal Document

Lloyd's Register EMEA
Southampton Technical Support Office
Lloyd's Register Global Technology Centre
Southampton
SO16 7QF
UK

Date
08 February 2017

Please quote this reference number on all future communications
SOUTSO/ENG/MWZ/W04666046/WP28149385

LLOYD'S REGISTER MARINE ENGINE NOx EMISSION APPROVAL
RECIPROCATING INTERNAL COMBUSTION ENGINE
MANUFACTURER: ABC DIESEL CO., LTD.
ENGINE TYPE: ABC 6H80ME-C9.0
ENGINE GROUP: ABC-H80EC-16-11

1. The Document(s) listed in paragraph 1 of the appendix have been examined for compliance with NOx Technical Code 2008 and the NOx limits specified in MARPOL 73/78, Annex VI, Regulation 13 and was found to comply in accordance with the following conditions:-

1.1 The testing parent engine of the engine group is as followed.

Engine Manufacturer	Model Number	Serial Number	Test Cycle(s)	Rated Power & Speed	Technical File Approval Number
ABC Diesel Co., Ltd	6H80ME-C9.0	CE0123A	E3	18240 kW @ 58 rpm	ABC-H80EC-16-11/CE0123A

1.2 This approval is only limited to the following manufacturer:

ABC Diesel Co., Ltd.
 6 Zhonghua Road, Shanghai 201300
 People's Republic of China

1.3 The scope of engine group ABC-H80EC-16-11:

Engine Type: 6H80ME-C9.0, Rated power and speed: 18000kW @60rpm

1.4 Any amendment to this approval is to be submitted for reconsideration. -

2. After installation of the pre-certification engine on board a ship, an on-board verification survey should be conducted to verify the engine continues to comply with the applicable NOx emission limit. A hard copy of EIAPP certificate can be issued by attending Surveyor based on the digital signed certificate. -

Firstname Surname
 Senior Specialist, Engineering Systems
 Southampton Technical Support Office, Marine & Offshore
 Email: firstname.surname@lr.org

1. The documents listed below have been examined

Document No.	Rev.	Title	Status	Date
ABC-H80EC-16-11	-	Technical File For engine no. CE0123A	A	08-Feb-2017
-	-	Supportive Documentation to engine no. CE0123A	SI	08-Feb-2017

2. The documents listed below have been considered together with the submitted documents in the appraisal

Document No.	Rev.	Title
SHI1621367	-	LR NOx emission pre-certification test report
-	-	Drawings for NOx sensitive components
SHI1621367/YCH	-	Memo from Shanghai port office

Appraisal Status Key

A Approved - provided the arrangements are to the surveyor's satisfaction

SI Retained as supporting documentation for information only

Design Appraisal Document

Lloyd's Register EMEA
Engineering Systems
Southampton Technical Support Office
Lloyd's Register Global Technology Centre
Southampton
UK SO16 7QF

Date
04 April 2017

Please quote this reference number on all future communications
SOUTSO/ENG/MW/W04773766/WP12345678

LLOYD'S REGISTER MARINE ENGINE NOX EMISSION APPROVAL
RECIPROCATING INTERNAL COMBUSTION ENGINE
MANUFACTURER: ABC FINLAND OY
ENGINE TYPE: D9L20
ENGINE GROUP: ABC 20-ER2 G1_PE01728

1. The Document(s) listed in paragraph 1 of the appendix have been examined against the approved engine group ABC 20-ER2 G1_PE01728 for compliance with NOx Technical Code 2008 and the NOx limits specified in MARPOL 73/78, Annex VI, Regulation 13 and was found to comply in accordance with the following conditions:-

- 1.1 The member engines of the engine groups on board the ship as followed.

Engine Manufacturer	Model Number	Serial Number	Test Cycle(s)	Rated Power & Speed	Technical File Approval Number
ABC Finland Oy	D9L20	PE27788	E2	4640kW @750rpm	ABC 20-ER2 G1_PE01728/PE27788
ABC Finland Oy	D9L20	PE27789	E2	4640kW @750rpm	ABC 20-ER2 G1_PE01728/PE27789

- 1.2 This approval is only limited to the following manufacturer:

ABC Finland Oy
16 Hill Road, Vaze
Finland

- 1.3 Any amendment to this approval is to be submitted for reconsideration.

2. After installation of the pre-certification engine(s) on board the ship, an on-board verification survey should be conducted to verify the engine(s) continue to comply with the applicable NOx emission limit. A hard copy of EIAPP certificate can be issued by attending Surveyor based on the digital signed certificate.

1. The documents listed below have been examined

Document No.	Rev.	Title	Status	Date
DAF965332	-	TECHNICAL FILE For engine no. PE27788	A	04/04/2017
DAF965333	-	TECHNICAL FILE For engine no. PE27789	A	04/04/2017

2. The documents listed below have been considered together with the submitted documents in the appraisal

Document No.	Rev.	Title
HEL 1604019	03/02/2017	Member Engine NOx Verification of Conformity Report
HEL 1604027	03/02/2017	Member Engine NOx Verification of Conformity Report
-	-	Test Protocol for member engines
-	-	IMO ID numbers inspection records

Appraisal Status Key

A Approved - provided the arrangements are to the surveyor's satisfaction

Appendix VII

LR NOx emission calculation software (LR only)

CONTENTS

1	General	
2	Where to find the software	
1)	NOx calculation for liquid fuel engine (D2)	
2)	NOx calculation for liquid fuel engine (E2)	
3)	NOx calculation for liquid fuel engine (E3)	
4)	NOx calculation for Dual fuel/Gas fuel engine (D2)	
5)	NOx calculation for Dual fuel/Gas fuel engine (E2)	
6)	NOx calculation for Dual fuel/Gas fuel engine (E3)	
7)	NOx calculation for liquid fuel engine fitted with SCR (D2)	
8)	NOx calculation for liquid fuel engine fitted with SCR (E2)	
9)	NOx calculation for liquid fuel engine fitted with SCR (E3)	

1. General

- 1) The relevant software for NOx calculations are designed by using Mathcad software. The IT helpdesk can be consulted for the installation of the software.
- 2) The software for NOx calculations are used for LR verification of NOx calculation results which are submitted by applicant.
- 3) To review the applicant's calculation process and software can be accepted as an alternative method for NOx calculation verification.

2. Where to find the software

LR calculation software can be found in Class Direct which is same routine to find other NOx files.

(Information>Approvals>NOx emissions)