
ESS Rules for Quality Regulation for Mechanical Equipment RESSQ-Mech

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1. INTRODUCTION

1.1. Background

ESS Rules for Quality Regulations for Mechanical Equipment called “**RESSQ-MECH**” is an interpretative document created by European Spallation Source ERIC (hereinafter referred to as ESS) and this document constitutes a common interpretation in order to fulfill:

- The requirements of the regulations in SSM Document 15-36 “Special conditions for ESS Facility in Lund” chapter 5 – Mechanical Equipment, issued by the Swedish Radiation Safety Authority, [1], [2]
- 2012 Afcen RCC-MRx Code “For design and construction rules for mechanical components of nuclear installations” [3]
- The requirements of the regulations in AFS 2016:1 [4], AFS 2016:2 [5] and AFS 2017:3 [6] on design and manufacturing of pressurised equipment. The Swedish Occupational Safety and Health Board issue these ordinances (www.afs.se).
- Internal ESS requirements
- The level of testing, inspection and reporting considered necessary by ESS in order for an Accredited Inspection Body (hereinafter referred to as AIB) to certify the compliance with the requirements in SSM 15-36.

These regulations can be used as guidance for the preparation of documents for mechanical equipment not formally included in the above regulation.

For requirements on atmospheric storage tanks and piping for flammable liquids, see the regulations in MSBFS 2014:5 [6] BFS 2011:10 [8] and BFS 2013:10 [9].

These rules are subordinated to the ESS process for Quality Management [53].

1.2. Scope and definitions

According to SSM requirements 15-36, chapter 5, sections A1 and A2, the following apply: *A1. These conditions apply to the design and construction, and periodic inspection of mechanical equipment, which form part of a safety function according to SSM 15-36 chapter 4, and whose failure or malfunction can cause radioactive emissions.*

The conditions do not, however apply to:

- *lifting devices and equipment, see SSM's investigation of the requirements for lifting gear in nuclear facilities (SSM 2009/1793). Conditions relating to lifting devices and equipment will be issued later in the incremental licensing process of the facility.*
- *integrated steel components in a concrete structure, such as density plates, tension and slack reinforcement*
- *fully or partially embedded steel components in concrete responsible for receiving loads to be transferred from different anchorages, and*
- *surface-mounted fixing plates with or without injection, cast fixing plates, and associated retaining bolts, nuts and washers*

A2. The meaning of event classes in these conditions is the same as stated in SSM 15-36 chapter 4 on the design and construction of the ESS facility.

The terms used in this condition are:

Qualification: Examination and demonstration to show that a person or a testing, process or assembly process fulfils their specified task

Mechanical equipment: Generic term for equipment or components that serve to:

- *receive external or internal pressure*
- *bear mechanical loads*
- *protect such pressure- and load bearing equipment referred to in the first and second indents (above)*
- *hold or control components in the intended manner*

In the definition of mechanical equipment ESS also include supports, holders, hangers, locking devices and similar in SSC (System, Structure and Components) are also mechanical equipment [17]. However, if they are part of systems that lift or move components or equipment, they belonging to the lifting discipline and are not mechanical equipment.

1.3. Divisions

This rule is divided into three sections as follows:

Sections A: General QC rules

Sections B: Inspection and testing requirements (EIP)

Sections C: Inspection procedures (EEP) see Table of Contents EEP [58]

1.4. Purpose and use

ESS shall use this document “ESS Rules for Quality Regulations for Mechanical Equipment” for:

- Purchasing of mechanical equipment
- In-house and manufacturing of mechanical equipment
- Purchasing of installations and repairs
- Installations or repairs under own management

1.5. Application

This document shall be used together with ESS’s common technical regulations such as:

- ESS Rules for Technical requirements for Mechanical Equipment [10]

- ESS Rules for Technical requirements applicable to HVAC systems and components [11]
- ESS Rules for quality requirements applicable to HVAC systems and components [60]
- ESS Rules for radiation safety classification of Electrical and I&C equipment including technical and quality requirements [12] (when the equipment also contains electrical parts)

1.6. Area of application

This regulation applies to all the mechanical pressure retaining and load bearing and non-pressure parts in main area of the ESS facility in Lund.

PART A – QC RULES

2. QUALITY AND AUTHORISATION

This document “ESS Rules for Quality Regulations for Mechanical Equipment” is one of the interpretative documents at ESS.

Mechanical equipment in any of the quality classes MQC2 to MQC3 shall be designed, manufactured, installed and inspected, *according to SSM 15-36, chapter 5, section D3-6 and D9-13*. ESS applies the French code, year 2012 Afcen, RCC-MRx [3] to fulfill the above requirements.

For the design and manufacturing of pressure retaining devices in quality class MQC4, where deficiencies or malfunction cannot cause emission of radioactive substances, the regulations AFS 2016:1 [4] (PED, 2014/68/EU [14]), AFS 2016:2 [5] and AFS 2017:3 [6] issued by the Swedish Work Environment Authority (AV), apply. Any additional ESS requirements shall be taken into account.

For quality class MQC4 inspection class A-B, the inspection and testing of installations, repairs, replacements, modifications and extensions of equipment are governed by the inspection class defined in AFS 2017:3 [6]. For inspection class A and B, an AB or AIB shall participate to the necessary extent, in order to issue a Certificate of Compliance, (CoC). An AB or AIB shall not participate in inspections of MQC4 inspection class C. Inspection class C are defined by ESS, as “non-classified” in AFS 2017:3 [6].

3. GENERAL QUALITY AND INSPECTION REGULATION

3.1. Commitments for ESS and External provider's

ESS shall provide documentation for the external provider's undertaking, by specifying and referring to documents containing:

- Rules for Quality Regulation
- Rules for Technical Requirements

- HVAC – Heating Ventilation Air Conditioning
- Equipment Specification (Design Basis Mechanical, KFM and Design Specification Mechanical, KS-Mek)
- Information regarding relevant quality class, and where applicable, function class
- General inspection requirements including related inspection procedures
- Other requirements related to the equipment

ESS shall:

- ensure that the relevant quality control tasks carried out by ESS fulfill and comply with the relevant authority requirements
- unless otherwise specified, pay for all costs related to a third party review and inspection carried out by an AIB, and also ensure that it is ordered and that applicable documents have been reviewed
- be entitled to attend the inspection work at the external providers, and also to carry out their own inspections without additional cost from the external provider
- be entitled to participate, on specific request, to participate in discussions on inspection issues that are held between the supplier and the inspection companies or subcontractors engaged by the external provider

External providers shall:

- unless otherwise specified, pay for the costs related to all third party inspections by contracted Accredited Laboratories and Accredited Bodies (hereinafter referred to as AL and AB) in conjunction with manufacturing and installation
- unless otherwise specified, pay for the costs related to third party inspection, as a result of repairs, re-inspections, dealing with deviations and/or resulting down-time in conjunction with manufacturing and installation
- ensure that detailed manufacturing and inspection documentation is prepared and sent to ESS for review and approval
- ensure that all approved documentation for manufacturing and inspection is listed in a separate document (document list), stating the title and valid revision of the approved documents. The list of approved documents shall be kept up to date by the external provider and be included in the final quality control documentation
- be responsible for and administer the inspection and records that are required in accordance with the approved manufacturing and inspection documentation.
- be responsible for and pay for all inspections necessary to assume full responsibility for the quality of the equipment
- have and adhere to a well-recognised quality assurance system, see. section 4.1
- be prepared, in the event of a special additional order, to carry out further inspections above or beyond the original agreement
- provide ESS with the name of the person in charge of the inspection work

- on ESS's request, report the result of the assessments of the subcontractor(s)

3.2. Regulations, Codes and Standards

Unless a special edition of a standard is stated; the latest edition of the standard shall be applied. If a standard is withdrawn and replaced by a new standard; the new standard shall be applied. If there is a need for a new standard ESS Quality Division shall be notified, in due time, to be able to evaluate the new standard before it is approved to be implemented in the design work.

ESS and the external provider shall jointly agree on the standards, codes and regulations that shall apply for the order. Both parties shall approve possible deviations from the agreement at the time of ordering and, if applicable, these shall also be approved and reviewed by the regulatory authority or AIB, see section 3.8.

3.3. Safety Categories and Quality Classification

Classification is done in accordance to SSM 15-36 chapter 5 sections D1 and by following documents ESS Rule for identification and classification of safety important components [16] and ESS Rule for Radiation Safety Classification of Mechanical Equipment [17].

Mechanical equipment is divided into different safety categories and mechanical quality classes that in turn provide design requirements and quality assurance measures applicable for the design, manufacture and installation, as well as repair of, components, intended for use at the facility. Mechanical equipment's must be designed so that the quality corresponds to the requirements of the safety-related function.

Process systems are divided into different mechanical quality classes. The mechanical quality class shall be evident in flowcharts or in a classification list that are based on requirements and principles in the ESS specific Safety Analysis Report (SAR), chapter 3 [43] and ESS Rule for Radiation Safety Classification of Mechanical Equipment [17]. These requirements and principles for the division into different mechanical quality classes shall be submitted to and accepted by SSM.

According to RCC-MRx code there are three differences of classes, N1_{Rx} to N3_{Rx} used for manufacturing and installation.

As written in [17], the ESS mechanical systems are intended to be designed not to have any functions requiring N1_{Rx}. Therefore the quality requirements for N1_{Rx} are not addressed in current document. The classifications of ESS facility, applies only to N2_{Rx} to N3_{Rx} with respect to the current design requirements, risk of radiological emissions and safety.

These means:

- N2_{Rx} is applicable to MQC2
- N3_{Rx} is applicable to MQC3

In MQC3, RCC-MRx allows the possibility to use European Standards and a set of additional requirements for the following equipment; unfired pressure vessels using EN 13445 [47], pipes using EN 13480 [48]. The provisions for such cases can be found at Section II REC 2000. REC2000 describes the rules and cover material, design, fabrications and testing. This is more described in the rules for technical requirements [10].

The requirements to following this opportunity is named as, 'MQC3 according to REC2000' in ESS Examination Procedures (EEP), part C.

For manufacturing in MQC4 the Pressure Equipment Directive (PED 2014/68/EU) [14] AFS 2016:1 [4], AFS 2016:2 [5] and AFS 2017:3 [6] applies with harmonized standards.

For installation in MQC4 the division into inspection classes follow AFS 2017:3 [6], as below:

- Class 4 inspection class A and B is applicable to MQC4 A-B
- Class 4 inspection class C is applicable to MQC4 C. Inspection class C is defined by ESS, as "non-classified" according to AFS 2017:3 [6]

3.4. Radiation damage criteria

ESS has defined three levels of irradiation dos that could affect the equipments lifetime in the facility which are exposed to Neutron and Proton radiation of its material:

Negligible:	The level of radiation damage doesn't affects the design
Non-negligible:	The radiation damage should be taken into account in design, but the equipment has a lifetime of the facility
Significant:	The radiation damage should be taken into account in design, and the equipment has a finite dose limited lifetime requiring periodic replacement

For information about dose limited lifetime for system, equipment and materials see ESS Materials Handbook [15].

The radiation damage criteria shall be identified and reported in the Design Specification Mechanical (KS-MEK).

3.5. Equipment specifications (Design Basis Mechanical (KFM) and Design Specification Mechanical (KS-MEK))

The equipment specifications according to RCC-MRx are divided for ESS in two parts:

- Design Basis Mechanical (designated by SSM as KFM)
"Konstruktionsförutsättningar")
- Design Specification Mechanical (designated by SSM as KS-MEK
"Konstruktionsspecifikationer-MEK")

For installation of equipment in quality classes MQC2 to MQC3, where SSM chapter 5, (sections D3-6 and D9-13) is applicable, the design basis mechanical (KFM) that's included in the Design Specification Mechanical (KS-MEK) shall be safety reviewed and submitted to the Swedish Radiation Authority (SSM), see "Required submittals for mechanical safety systems" [61].

Further details regarding the content of equipment specifications can be found in the template documents on the preparation and review, Design Basis Mechanical (KFM) [54], and Design Specification Mechanical [55].

3.5.1. Design Basis Mechanical (KFM)

The design basis mechanical shall be established by ESS in conjunction with the ordering of replacement equipment, installation of work, or repairs. Whenever agreed in the purchase order, the external provider of certain designs shall provide the documentation and in-data necessary for ESS's preparation of the design basis mechanical and design specification mechanicals.

In the event of modifications or replacement work where the design basis mechanical remains unchanged, the design bases including responses from SSM shall be submitted to the AIB.

3.5.2. Design Specification Mechanical (KS-MEK)

For the design of replacement parts that are in principle identical to the parts that are intended to be replaced, design verification may be performed by demonstrating that the replacement parts, as a minimum, fulfil the original strength requirements.

The AIB shall approve the design specification mechanical (KS-MEK) in quality class MQC2 to MQC3.

3.6. Documentation before Manufacturing, Installation or Repair

Before manufacturing, installation or repair work may begin in the facility, the external provider shall provide ESS with applicable documents, such as drawings, calculations, procedures, procedure qualifications, inspection documentation etc., for review and approval.

The documentation shall be based on and contain the necessary information, according to the technical and quality regulations specified by ESS.

Following approval, ESS shall, unless otherwise agreed, be responsible for the documentation being third party-reviewed, by an AIB, and for manufacturing in MQC4 by a Notified Body (hereinafter referred to NB) or an AB, and for installation and repair by an AB.

3.7. Inspection Requirements, Procedures and Descriptions

In SSM 15-36 chapter 5 section D9, the materials, moulded products and welded joints shall be subject to the inspections necessary to ensure that no faults or general deviations persist that are of importance for safety.

3.7.1. Inspection plan and procedures

The Inspection Plan and associated documents, as follow-up documents, define the requirements for external provider qualification, material procurement, manufacturing, installation, inspection and testing according to RCC-MRx Sec I, RDG-3400.

The external provider shall transfer relevant and applicable inspection requirements into a detailed inspection plan for the manufacturing, installation and repair of deficiencies. The Inspection plan shall also include those inspections and tests considered necessary by the external provider in order to achieve full responsibility.

The external provider shall also prepare written procedures in cases where is stated in these rules or in the purchase order. The written procedures shall fulfil and contain the necessary information given in the description of inspection procedures, included in part B of these rules.

In cases where qualification of the procedures is required, the qualification reports shall be attached, to the documentation packet.

The above-mentioned documentation shall be reviewed and approved by ESS before the work may start.

After ESS has approved the documentation, ESS shall, unless otherwise agreed, arrange for the documentation to be third party-reviewed by an AIB for quality class MQC2 to MQC3, and for MQC4 inspection class A and B, for manufacturing by a NB or an AB, and for installation and repair by an AB.

Deviation from the requirements on preparing detailed quality control documentation and written procedures is not allowed without a written permission from ESS. The external provider is responsible for applying for such permission.

3.7.2. Materials

Material shall be appropriately selected for the intended purpose and conditions. For radiation damage criteria see section 3.4

The proper material shape (plate, forgings, bars etc) must be selected for the corresponding loads. Selection and procurement of the material shall be made according to ESS Rules for Technical requirements for Mechanical Equipment [10]. For any others materials not mentioned in above documents an elaboration and procurement concept must be sent to ESS for validation.

The use of different materials within equipment shall follow the requirements in ESS Rules for Technical requirements for Mechanical Equipment [10].

Choosing appropriate material for the task shall follow the requirements in ESS Rules for Technical requirements for Mechanical Equipment [10].

The external provider shall ensure that the testing, inspection, marking and documentation of material is carried out to the extent, and in accordance with the procedures, stipulated in the approved inspection documentation.

The external provider shall ensure that the marking is transferred in such a manner that all identification of material against relevant inspection reports is assured.

The external provider shall ensure that the material's dimensions and surface finish fulfil the requirements that are specified in codes and technical regulations, and otherwise comply with ESS requirements.

Repair of base metals, by means of welding may only occur following written consent from ESS. If repair by welding is accepted by ESS, a procedure for repair shall be prepared in which requirements for the testing, inspection, welding procedure, welding procedure qualification, possible heat treatment and other requirements shall be specified.

The welding plan and procedure shall be reviewed and approved by ESS and if applicable, also by an AIB before the repair work may start.

3.7.3. Processing of austenitic materials

When storing materials, and before and during manufacturing or installation, austenitic and ferritic materials must be distinctly separated. This also applies to the appropriate tools and equipment used for manufacturing and installation. Tools such as jigs, fixtures etc. shall be provided with sufficient stainless cladding to prevent contact with other materials such as carbon steel, copper, bronze, lead and zinc.

ESS shall approve all working methods that will be used.

The following additional rules apply to the operation of stainless steel:

- Especially care shall be taken to prevent contamination from halogens and carbon steels, copper, zinc, lead, and other heavy metals
- When use blasting clean glass media, is preferred that has not been used for blasting of different type of material. If other blasting media is used this has to be approved by ESS
- Wire brushes shall be made of the same material group and must not have been used for cleaning of other material
- External areas not in contact with media, a limited number of small paint stains, rust stains and traces of paint markings are permitted
- Not be bundled with band of carbon steel unless use of spacers
- Be stored indoors on clean and dry surface
- Material of austenitic stainless steel and nickel base alloys must not come into contact with packing material, tape etc. containing in water leachable halogens

- Grinding and blasting of austenitic stainless steels or nickel-based alloys requires the consent of ESS, if the zone in question will subsequently be in contact with primary water at a temperature above 100°C.
- Polishing or wire brushing as well as glass blasting for removal of the surface oxide is however permitted.
- Also well sharpened rotating file may be used, since this prevents against high temperatures on surfaces.
- Rotating power wire brushing shall be avoided, and may only be used after approval from ESS.
- Stainless steel welds must be cleaned with stainless steel wire brushes and/or iron-free abrasive discs that are not used on carbon steel.

Stainless steel surfaces in water containing process systems shall satisfy the requirements as per oxide reference "C", in FORCE Reference Colour Charts 1, Report 1337-4-da-en-2016 (ESS-0235489 [10]). For reference chart see EEP 3/5-711.

3.7.4. Lubricants

Lubricants that are in use shall be classified, approved and registered for chemical products by ESS.

3.8. Manufacturing, installation and repair inspection

3.8.1. Inspection of manufacturing

Before manufacturing can begin, the external provider shall check that drawings, inspection plans, and other relevant documents are reviewed and approved by ESS and, in applicable cases, by an AIB. The external provider's inspection plans shall be prepared in such a way that produced items and sub-assemblies can be approved prior to installation, and that an associated certificate from an AIB and ESS is issued prior to the installation.

Unless otherwise stated, the external provider shall be responsible for, and pay for, all testing and inspection according to the approved inspection plan, and also be responsible for the documentation thereto.

The external provider is responsible for submitting notification of manufacturing inspection to ESS, in due time, as agreed in the order.

During on-going manufacturing, the external provider shall supply ESS with the requested documents necessary to be able to follow the manufacturing process.

ESS shall inspect the final product, as well as review and approve the associated inspection records. If, for reasons of access, the equipment cannot be inspected at a later time, the external provider shall contact ESS to agree on a suitable time for inspection.

If so required, inspection and review of inspection records shall also be carried out by an AIB prior to installation of the equipment in the facility. This may, following agreement

with the AIB, either be performed as a delivery inspection at the external provider's site or as an acceptance at ESS's facility.

The AIB has the possibility to engage another inspection body for performing an inspection at the external provider's site, following approval from ESS.

3.8.2. Installation and repair inspection associated with deficiencies in the facility

Before installation or repair work may begin, the inspection documentation shall be approved by ESS and, in applicable cases by an AIB.

The external provider and ESS shall, upon request, agree on whom order, pay for, and suborder possible third party inspections. This also applies to the payment of any re-inspections.

3.9. Deviations- and Non-Conformance Reports

The external provider shall obtain ESS's written approval of any deviations from this "ESS Rules for Quality Regulations for Mechanical Equipment", as well as "ESS Rules for Technical requirements for Mechanical Equipment [10] and other requirements, from ESS previously approved documentation, or other requirements stated in the order.

After the review and possible approval of the deviations, ESS shall apply for any disposition that may be required by the authorities and the AIB.

The external provider shall clearly describe the nature of the deviation and suggest corrective actions in the non-conformance report.

The external provider shall also report the corrective actions it is considering taking in order to prevent repetitions.

The non-conformance report shall be issued and signed in accordance with the external provider's quality assurance system.

All deviations shall be considered, addressed and approved before the relevant work elements can be completed.

The external provider shall ensure that all the deviations are appropriately registered and numbered. The non-conformance reports shall be included in the final quality control documentation.

Unless otherwise agreed, the external provider is responsible for all the inspection costs related to deviations caused by the external provider.

3.10. Final Quality Control Documentation

3.10.1. After manufacturing in MQC2 and MQC3

The external provider shall, in a clear manner, compile records of the reviews, testing and inspections included in the order and stipulated in the applicable inspection plans.

All documents, except documents related to manufacturing, must be prepared in English. However, some manufacturing documents written in native languages may be necessary to translate into English if required by ESS.

A document list shall be included and at least contain:

- Manufacturing specification
- Manufacturing document
- Applicable certificates and reports produced during the work
- Any deviation reports

The external provider shall ensure that the final quality control documentation package, such as drawings, inspection plans, procedures, qualification programs, qualification reports, test reports, certificates etc., are signed and approved by manufacture. The documentation shall also be signed by ESS or its representative and/or the AIB, AB or NB, to the extent stated, in the inspection plan.

The external provider shall ensure that certificates are identifiable against the inspection plan and the item to which the certificate corresponds. The certificates can be made traceable against the inspection plan through the specification of a consecutive number on the certificate. This consecutive number is noted in the inspection plan for the inspection activity and item to which the certificates corresponds.

It shall be apparent that external provider has reviewed and approved the quality control documentation. They shall also certify that the product and the executed work are approved and fulfil ESS's requirements.

When manufacturing materials and components in MQC2 and MQC3, ESS shall, in cooperation with external provider, ensure that the AIB issues a CoC, of the requirements, if so stated in the inspection plan.

The external provider shall archive radiographs and other testing and manufacturing records of material and components in an appropriate manner, and make them available to ESS for at least 10 years after delivery. If the supplier has to discontinue the archiving, ESS shall be notified, even after the 10-year period. Alternatively, radiographs and documents may be turned over to ESS for archiving. Unless otherwise agreed, the supplier shall provide ESS with the final quality control documentation when materials and components are delivered. It should be clear at the time of order in which format the final quality control documentation should be presented (paper or/and .pdf).

3.10.2. After manufacturing in MQC4

In MQC4, manufacturing according to PED 2014/68/EU [14] - AFS 2016:1 [4], 2015/1535/EU [56] - AFS 2017:3 [6], 2014/29/EU [57] - AFS 2016:2 [5], shall be reviewed by an AB or NB in category II-IV and by the external provider for category I and §8.

The documents in the following table are the minimum to be delivered after manufacturing, by the external provider to ESS.

Pressure retaining components (Valves, Pressure vessels, Safety equipment etc.)	Cat I ¹⁾	Cat II –IV ¹⁾	§8 ¹⁾
Technical specification of the device (PS, TS, volume, fluid etc. and catalog sheet)	X	X	X
Risk analysis	--	X	--
Drawings (incl. list of all drawing with revision status)	X	X	--
Calculations report	--	X	--
Quality inspection plan	--	X	--
Material certificates for base materials	--	X	--
Material certificates for filler materials	--	X	--
Welding documents	--	X	--
Heat treatment documents	--	X	--
NDT documents	--	X	--
Pressure test or equivalent testing documents	X	X	--
Operation instruction/manual	X	X	X
Maintenance instruction for equipment/components	X	X	X
Declaration of compliance (DoC) ²⁾	X	X	--
Type approval certificate ³⁾	X	X	--

Remarks:

1) PED 2014/68/EU - (AFS 2016:1)

2) The DoC can be replaced by a type-approval certificate.

3) The contents of the final documentation shall normally follow the requirements in the type-approval certificate.

3.10.3. Receiving inspection

During the receiving inspection of materials and components, ESS shall review and approve the quality control documentation, submitted by the external provider. As an alternative to a receiving inspection, materials and components may be approved by ESS as a delivery inspection at the external provider. This can also be done by an AIB, following agreement with ESS.

3.10.4. Installation or repair

Prior to installation in the facility or, if possible, prior to handover to storage, an inspection and review of inspection records shall, whenever required, also be performed by an AIB.

Following installation or repair work, the external provider shall turn over the final quality control documentation to ESS for approval and archiving. The external provider shall state

that it has inspected the installation according to the drawings and has reviewed and approved the quality control documentation.

Following an own review and approval of the installation or repairs, ESS shall, whenever required, arrange for an AIB to issue a CoC, for the stipulated requirements.

4. REQUIREMENTS ON MANUFACTURERS QUALITY ASSURANCE AND ACCREDITATION

4.1. Quality System and Quality Plans

External providers and their subcontractors shall have and adhere to a quality assurance system that meets the requirements in the applicable parts of EN ISO 9000 series [18], or another equal, acknowledged standard.

In case the external provider lacks an approved quality assurance program a project adapted quality plan can be prepared, after ESS approvals, according to ESS Template for project quality plan [51] by the external provider.

If additional quality plans are required for “specific” projects, these are to follow the guidelines of ISO 10006 “Quality management systems – Guidelines for quality management in projects” [19] or similar.

For an external provider who is carrying out welding work, the quality system shall in additionally, contain the requirements of ISO 3834-2 [20] for quality class MQC2 to MQC3. In quality class MQC4, ISO 3834-3 [21] is sufficient if nothing else is stated in the agreement.

The above requirements are applicable for the procurement of materials, moulded products, mechanical equipment, components and services, both for individual parts of and total commitments.

A copy of the following documents shall be submitted to ESS to the extent of applicable:

- the supplier’s certification of the quality system
- possible sub-contractor’s certificates of quality systems
- the certificate issued by an Accredited Certification Body
- the type approval certificate issued by an AIB

Essential changes within the organisation and routines of the company that can affect the quality shall be reported to ESS, this applies for the entire duration of ESS’s approval of the external provider.

4.2. Accreditation

According to SSM 15-36 chapter 5 section B9; *“Bodies that are performing certification- or inspection services, and laboratories performing testing tasks under these regulation, shall*

have an third party position and be accredited for the tasks in question in accordance with 4–5 §§ Act (2011:791) on accreditation and technical inspection”.

A "CoC" with the stipulated requirements is issued by an AIB what's accredited according to the SSM regulations 15-36.

Testing in conjunction with repairs of deficiencies in the facility, during installation and in-service inspections shall be carried out by an AL in a third party position.

Testing in conjunction with manufacturing shall be performed by an AL, or as in-house inspection randomly supervised by an AB, depending on the type of testing.

When testing in conjunction with manufacturing, according to PED in quality class MQC4, NDT can be performed by personnel with relevant expertise, in according with EN ISO 9712 [22].

Testing in conjunction with manufacturing of materials and moulded products can be performed as in-house inspections providing that the external provider applies a quality system, certified by an AB in a of third party position, for the testing activities.

In Sweden pressure testing with gas requires accreditation according to AFS 2006:8 [23].

4.2.1. Accredited Body in a third party position

An AB in a third party position is defined as a body performing certification or inspection duties, and laboratories performing testing duties.

A copy of the certificate of accreditation issued by SWEDAC or equivalent foreign authority shall be sent to ESS.

4.2.2. Accredited Laboratories in a third party position within Sweden

Testing Laboratories performing prescribed NDT and activities at material laboratories shall be accredited by SWEDAC for the activities in question. In addition, for testing in conjunction with installation, repair of deficiencies, and in-service inspections, these Testing Laboratories shall be accredited in a third party position. Laboratories accredited by SWEDAC for testing in conjunction with repair of installed equipment and installations, shall at least fulfil the requirements in EN ISO/IEC 17025 [24], and be accredited to SWEDAC's regulations, STAFS, for testing laboratories and shall also fulfil any special requirements from SSM.

4.2.3. Accredited Laboratories in a third party position in a another country

For manufacturing in another country, the external provider may use a foreign Testing Laboratories, permitted to perform the testing, providing they are accredited according to requirements similar to those in Sweden, according to section 4.2.2. This means that the laboratories shall be accredited for the task in question by an organisation that fulfils and applies the regulations equivalent to the requirements, of the standard EN-ISO/IEC 17025 [24].

4.2.4. Accredited Inspection Body and Certification Body in a third party position within Sweden

The AIB that will perform inspections and issue CoC's for the requirements in regulations shall be accredited by SWEDAC for the entire category 1, according to STAFS 2015:8 "Styrelsens för ackreditering och teknisk kontroll (SWEDAC) föreskrifter och allmänna råd om ackreditering" [25], and the relevant EN ISO/IEC standards, requirements stated by SSM.

Accredited Certification Bodies performing activities, such as, certification of quality systems and certification of personnel for joining of material and testing, shall be accredited by SWEDAC and as a minimum fulfil the requirements in EN-ISO/IEC 17021 [26] and EN-ISO/IEC 17024 [27].

For certification according to ISO 3834-2 [20] and -3 [21], the Certification Body shall be accredited as per EN-ISO/IEC 17065 [28], alternatively as per Guideline EA-6/02 [29] for the use of EN 45011 [30] and EN ISO/IEC17021 [26].

4.2.5. Accredited Inspection Body and Certification Body in a third party position in a another country

When manufacturing in another country, the external provider may use a foreign inspection and certification body permitted to perform the inspection and certification duties, providing that they are certificated according to requirements similar to those in Sweden, see section 4.2.4. This means that they shall be accredited for the tasks in question by an organisation that fulfils and applies regulations equivalent to the requirements in EN ISO/IEC 17011 [31].

Inspection Bodies shall be accredited for the tasks in question according to regulations equivalent to the requirements in EN ISO/IEC 17020 [32].

Certification Bodies shall be accredited for the tasks in question according to regulations equivalent to the requirements in EN ISO/IEC 17021 [26] and EN ISO/IEC 17024 [27].

For further information on the European co-operation for Accreditation (EA), see their homepage www.european-accreditation.org.

4.2.6. Notified Body

A body for review, inspection or surveillance shall fulfil the requirements for NB according to AFS 2016:1 [4] (PED 2014/68/EU [14]).

The NB shall be accredited according to EN ISO/IEC 17020 [32].

The NB for "Certification of Products, Processes and Services" shall be accredited as per EN-ISO/IEC 17065 [28] alternatively as per Guideline EA-6/02 [29] for the use of EN 45011 [30] and EN ISO/IEC17021 [26].

4.3. Assessment of External provider

Assessment of external providers shall be carried out and be reported, according to ESS Guideline for Quality Evaluation of External Providers [59].

5. TYPE INSPECTION CERTIFICATE

According to SSM 15-36 Chapter 5 section E3; *In cases of mass production which take place in a controlled manner and, according to documentation, meet conditions D3-6 and D9-11, the licensee may request that the accredited body which assessed the manufacturing organisation issue a Type Inspection Certificate instead of individual Product Inspection Certificates (PKI) which form the basis for a certificate of compliance in accordance with condition 2.*

Type inspection certificates can replace individually issued CoC or Declaration of Compliance (hereinafter referred to DoC) for series manufactured equipment, components and of the shelf.

The certificate is an agreement between the manufacturer in question and an AIB. The agreement regulates conditions related to the design, manufacturing, inspection, testing, marking and documentation, and the regularity of the follow-up of quality assessments. In order for ESS to accept the type inspection certificate process, during procurement, the external provider design, manufacturing, inspection, marking and documentation shall satisfy the basic requirements in these quality regulations. ESS shall verify the credibility of the documents.

5.1. Scope

Type inspection certificates can be issued for series production of pipe, fittings, components etc.

5.2. Obtaining of Type Inspection Certificates

Type inspection certificates can be issued for series manufactured equipment, that following of the design, manufacturing and inspection documentation, has shown the requirements in SSM 15-36 chapter 5 section E3 in "Special conditions for ESS Facility in Lund" [1], and the code RCC-MRx [1] are fulfilled.

An AIB shall issue the type inspection certificate.

5.3. Procurement according to Type Inspection Certificate

When purchasing equipment according to type inspection certificates, ESS shall ensure that the equipment according to the type inspection certificate fulfils all the requirements, from the design criteria up to final marking and documentation, required in these regulations. ESS shall define applicable design criteria, such as the load basis, design pressure and temperature, quality class, materials etc. and this shall be included in the associated procurement documentation.

Should ESS have requirements beyond that is stated in the type certificate, this shall be specified in the procurement documentation.

5.4. Documentation when using Type Inspection Certificate

The necessary quality control documentation according to the type inspection certificate shall be delivered together with any further documentation requested in the procurement documentation.

6. AUTHORISATION FOR WELDING AND OTHER JOINING PROCESSES

In SSM 15-36 chapter 5 sections D6, welding and other joining processes shall be governed and performed in accordance with procedures and by personnel who are qualified for the purpose. ESS shall ensure that the qualification of procedures and personnel are supervised and assessed by an AB.

Authorisation for welding and other joining processes is required during manufacturing, installation and repair of pressure-, and load-bearing equipment or other mechanical equipment in all mechanical quality classes.

6.1. Authorisation requirements for manufacturers and welding companies

Welding or other joining processes shall be carried out by companies with the necessary technical resources and with personnel with expertise in the tasks.

An external provider shall be quality assurance certified for welding, according to the requirements of EN ISO 3834-2 [20] for quality class MQC2 to MQC3. For quality class MQC4, ISO-3834-3 [21] is sufficient if nothing else is stated in the agreement. An Accredited Certification Body shall perform the certification.

External providers that continuously perform welding work on automatically welded pipes or other welded pipes in pipe mills should have a type inspection certificate issued by an AIB.

No requirements for type inspection certificates in quality class MQC4 on pipe mills that fulfil applicable manufacturing standards, EN 10217 [33] and EN 10253-2 [34] and EN 10253/4 [35].

Pipe mills that manufacture welded pipes and do not hold a type inspection certificate, or are certified according to the above, shall have valid documentation and authorisation according to section 6.2 and 6.3

External provider of materials, which are permitted by ESS to carry out welding repairs in conjunction with the manufacture of steel castings, shall have the expertise in welding techniques, that welding repaired areas have at least equivalent strength properties to the relevant parent metal.

For welding repair after final heat treatment at the external provider, the sections 6.2 and 6.3 apply.

6.2. Requirements for qualification of welding procedure

Welding procedures (WPS) shall undergo procedural inspection according to the applicable sections of EN ISO 15614 [36].

All welding procedural qualifications, including qualifications according to ASME, shall be supervised and assessed by an AB that fulfilling the requirements in section 4.2.4 or 4.2.5.

Where the differences compared to the requirements in EN ISO 15614 [36] are judged to be too great, additional tests shall be required. The additional testing shall be based on the difference between the EN-standard in force and the performed qualification.

The following additional requirements apply for qualification according to the above:

Welding or another joining procedure shall, in the following cases, be qualified by corresponding procedure qualifications that are adapted to welding methods, materials, welding conditions, and other circumstances.

- For welding or another joining procedure where the standards above are not applicable.
- For welding of material combinations, or with methods not covered by the named standards and rules.
- For repair welding of parent metals, or when an earlier qualified welding procedure for manufacturing is not representative for the intended weld.

The person responsible for the welding shall have proper training and hold a certificate issued by EWF/IIW according to level EWE/IWE, or other equal training and certification.

Symbol	Designation
EWf	European Welding Federation
IIW	International Institute of Welding
IWE	International Welding Engineer
EWE	European Welding Engineer

6.3. Requirements for certification of welders

Welders and welding operators shall have passed the welding examination with approved results, according to EN ISO 9606 [37] or EN 287-1 [38] respectively EN ISO 14732 [39]. The certification shall be carried out by an Accredited Certification Body.

In the following cases, welders shall be tested by means of corresponding examinations adapted to the relevant welding methods, materials, welding conditions and other conditions:

- Welding where the above standards are not applicable.

- Welding of material combinations, or with methods not covered by the named standards.
- Repair welding of parent metal or when earlier certification for welding is not relevant for the intended repair welding.

Welders are regarded as approved when they have passed the welder qualification with approved results and where the welder qualification was supervised, evaluated, and approved by an AB.

Personnel joining plastic pipes and fittings are regarded as authorised for their task if they have passed examination and are certified according to EN 13067 [40] or EWF 581 [41].

6.4. Personnel qualification for installation and repair welding

6.4.1. Personnel Qualification for installation

The following apply for special installation welding:

- Welders carrying out welding during installation under conditions that are judged to be different from the conditions prevailing during the examination, as per section 7.3 above, must also be qualified under realistic conditions. Adapted qualification tests/training programmes for welding shall be developed in this case.
- The Qualification tests shall be inspected and tested in a corresponding way and according to the inspection documentation (Inspection plan and WPS), applicable for the intended installation work.
- ESS's responsible welding engineer is to determine when a welder is approved for the intended work for quality class MQC2 to MQC4. This approval shall be reviewed by an AIB for quality class MQC2 to MQC3, and by an AB or NB for MQC4.

6.4.2. Personnel Qualification for repair (installed equipment)

In SSM 15-36 chapter 5 section D8; *“if the damage is of such scale that the necessary strength and functional margins cannot be maintained, the device or component shall be replaced or repaired. Before repair or replacement measures begin, the probable cause of the incident shall be clarified and necessary measures taken to prevent new damage from occurring. Repairs shall be performed according to the repair program which has been classified for this purpose, and with sufficient margins, restore the properties required for the equipment to meet the basic conditions for use in accordance with condition B1. The licensee shall ensure that the classification of the repair program is supervised and assessed by an accredited body where the repair measures involve equipment which forms part of the safety system or performs a safety function”.*

For welding repair of installed equipment for the facility, following applies:

- as a minimum, the welder shall have undergone welding examination with an approved result, according to section 7.3 above, and also by means of a qualification test, under realistic conditions, demonstrated his/her ability to achieve the necessary quality of welding for the intended repairs

- the performance, scope, welding position, geometry, relevant safety equipment, and amount of training required etc., shall be stated in the programme for repairs applicable to the work
- qualification tests shall be inspected and tested according to the requirements and acceptance criteria stated in the programme for repairs
- qualification of a programme for repair of equipment in quality class MQC2
- shall be supervised and evaluated by an AIB

7. ESS'S APPROVAL OF COMPANIES PERFORMING HEAT TREATMENT DURING MANUFACTURE AND INSTALLATION

ESS's approval of companies performing heat treatment is required during:

- manufacturing
- installation
- damage repairs in the facility

in pressure- and load-bearing equipment, or other mechanical equipment made of metallic material.

The requirement is applicable for all mechanical quality classes (MQC).

7.1. Authorisation requirements

Heat treatment shall be carried out by companies with the necessary technical resources and with personnel that have the training, experience and technical knowledge for the tasks.

Companies performing heat treatment of welding and materials shall work according to quality system equivalent to EN ISO 3834-2 [20], and following ISO 17663 [42]. For material manufacturers, heat treatment shall be including in the certified quality system, in accordance with section 4.1.

Heat treatment of manufactured materials must comply with the requirements for the corresponding material standard.

7.2. Scope

ESS approval of heat treatment is required for stress-relieving annealing, normalising, solution heat treatment or other heat treatment which, if carried out in an unsatisfactory manner, can affect the mechanical strength properties and heat-treated condition guaranteed by the material manufacturer.

Pipe mills carrying out heat treatment in conjunction with pipe welding should hold a type inspection certificate issued by an AIB.

In quality class MQC4, if the pipe mills fulfils the current delivery standard EN 10217 [33] and EN 10253-2 [34] and EN 10253-4 [35], there is no requirement for a type inspection certificate.

Pipe mills not in possession of a type inspection certificate, according to the above, shall have valid qualification, in according to section 8.1 above.

8. AUTHORISATION FOR TESTING AND INSPECTION

Testing in the text below refers to non-destructive testing (hereinafter refereed at NDT) and mechanical testing of material, so called “destructive testing”.

NDT shall be carried out according to “well proven” and documented NDT standards and procedures.

External providers carrying out testing shall have and adhere to a quality system that governs testing activities.

Personnel carrying out NDT tasks shall have undergone training, examination and certification according to EN ISO 9712 [22] or an equivalent system.

Personnel trained and examined according to the ASNT system may also be accepted following approval from ESS and the AIB.

Mechanical testing, so-called “destructive testing”, shall be carried out according to proven and documented standards.

External providers were carrying out other types of inspections, such as visual and dimensional inspection, inspection of cleanliness, pressure and tightness testing etc. during manufacturing, installation and repairs of deficiencies in installed equipment, shall have the necessary technical resources and personnel, with the necessary education, training, experience and technical knowledge for the tasks in question.

8.1. Well proven NDT system in accordance with SSM 15-36

According to SSM 15-36 chapter 5 sections D11, the non-destructive testing in conjunction with the inspection in chapter 5 section C7 shall be performed with either:

- “well proven” test systems, which experience has shown to reliably detect and characterize the defects and deviations that the repair-, manufacturing- and installation process can cause, or
- test systems which, to the extent applicable, have been qualified and evaluated in accordance with condition C7

“Well proven” non-destructive test systems is in this context are systems based on standardised practices referred to in acknowledged product standards, or in similar rules for inspection of the type of equipment in question and for which similar quality requirement are stipulated and:

- have been used for a long time and with documented experience of their detection and discrimination capabilities, and
- whose practical application is detailed in technical instructions or examination procedures which include necessary calibration and- operating instructions and associated method- and technology-based acceptance standards.

Where such “well proven” test systems are unavailable the suitability of the test procedures intended to be used shall be demonstrated through qualification to the relevant extent, according to the principles in chapter 5, section D11 first paragraph, and evaluated by a Qualification Body, according to chapter 5, section D11 second paragraph to SSM 15-36.

8.2. Authorization for testing during the manufacture of base materials

NDT carried out in conjunction with the manufacturing of base material, such as plate, bars, beams, extruded and rolled piping, as well as rough forgings and castings, may be carried out as an in-house inspection provided that the external provider applies a quality system certified by an AB.

8.3. Authorisation for testing during the manufacture of mechanical equipment

Testing in conjunction with manufacturing shall be carried out by an AL in the a third party position or in the form of an in-house inspection with random supervision by an AB (NB according to AFS 2016:1 [4] (PED 2014/68/EU) [14], AL or AIB with accreditation for the entire category 1, according to STAFS 2015:8 [25] and relevant EN ISO/ICE standard.

Should the external provider engage an independent testing company, this company shall be an AL in a third party position and fulfil the requirements according to section 4.2.2 in Sweden, and section 4.2.3 in a another country.

If the testing is performed by the external provider’s organisation with random supervision by an AB the testing service shall be audited according to section 4.1 and 4.2.

An AB engaged by the external provider, shall be accepted by ESS and an AIB before the testing is carried out, in accordance to SSM 15-36 chapter 5 section D10.

For the manufacturing of pressurised equipment in quality class MQC4, testing equivalent to requirements in AFS 2016:1 [4] (PED 2014/68/EU) [14] may be accepted.

8.4. Authorisation for NDT during the installation and repairs of installed equipment

Testing laboratories carrying out the prescribed NDT shall be accredited in a third party position by SWEDAC for the activities they perform.

The accreditation requirements are described in section 4.2.2

9. OTHER COMPETENCY REQUIREMENTS

9.1. Installation of pipe couplings

Installation of pipe couplings shall be carried out by personnel qualified and certified for the task, as per the external provider's guidelines. A certificate, or a summary list of approved personnel, shall be part of the final quality documentation.

9.2. Installation of approved fasteners in concrete

Installation of approved fasteners in concrete (expansion bolts) shall be carried out by personnel qualified and certified for the task, as per the external provider's guidelines. A certificate or a summary list of approved personnel shall be part of the final quality documentation.

PART B – INSPECTION AND TESTING REQUIREMENTS

10. GENERAL

This handbook Part B is a general description of the requirements for:

- inspection
- testing
- documentation

that are necessary for ESS to ensure, that delivered parts and services with regard to the quality and design fulfills the specified design criteria and other parts of requirements, as bellow.

It also describes ESS requirements and descriptions of examination procedures, form the bases for preparation of the detailed quality control documents for current manufacturing, installation or repair of installed equipment.

The requirements also states the level, for both prescribed and other inspections and testing, required to fulfill affected authority requirements and thereby make it possible for AIB to issue an “CoC” with applicable regulations, for the final installation.

With reference to the mechanical equipment, part of equipment, system or repairs which is applicable for request for quotation or order, ESS shall inform the external provider of the relevant general Inspection Points (EIP) including the Examination Procedures (EEP).

ESS Inspection Points, “EIP”:

- indicate the general scope of the inspection, which the manufacturer shall consider for selection of inspection for the applicable mechanical equipment or service.

ESS Examination Procedures “EEP”, according to Part C - Table of Contents EEP [58]:

(These EEP are not approved in this release, an internal and external specialist review is currently on-going. The release of the EEP’s will be on a regular basis with focus on the most used, the target is to have all completed at Q1 2018.)

- gives in a corresponding way references and instructions regarding scope, performance, acceptance criteria and reporting of testing and inspection activities that shall be observed by the manufacturer for application and selection of procedures.

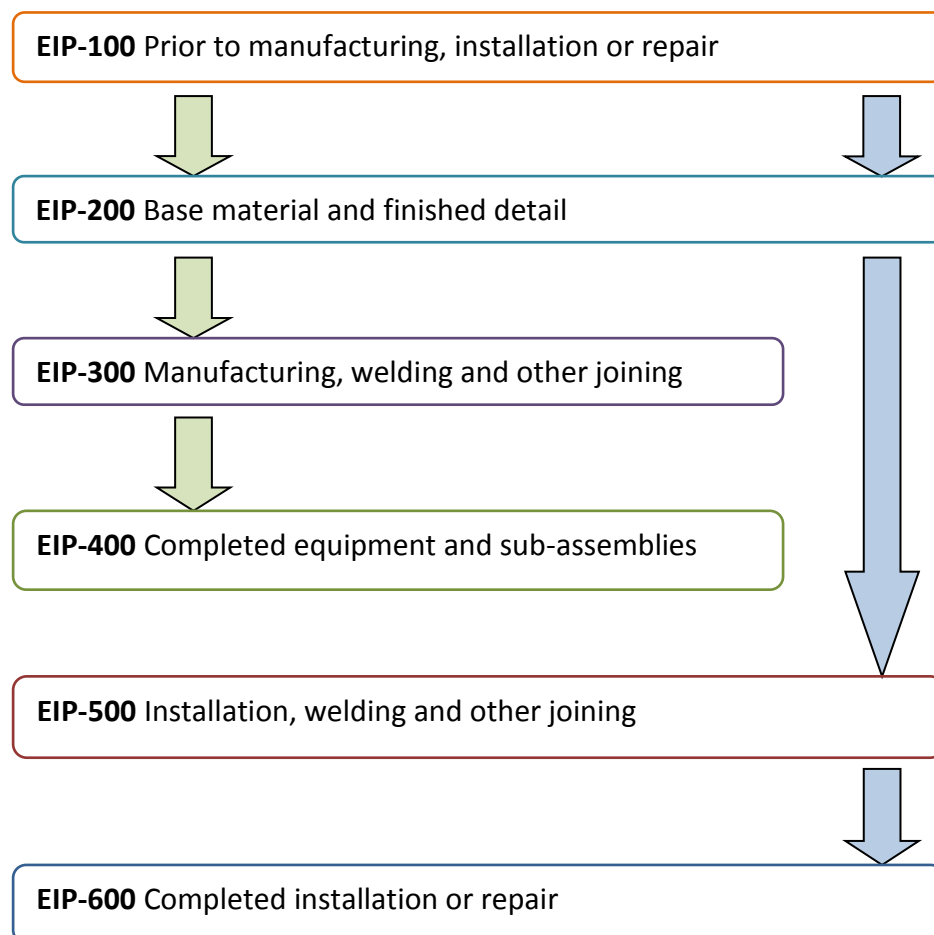
The external provider may, after permission from ESS, use other equal inspection and testing technique as replacement for the above specified, in the general inspection requirements.

If required, depending of the quality classes, it is ESS responsibility that the acceptance is approved by the AIB or AB.

11. GENERAL INSPECTION REQUIREMENTS, DIVISION AND CONTENT

11.1. Division and content

The general Inspection Points (EIP) has been prepared for the above types of mechanical equipment and systems in the quality classes MQC2 to 4 and with the following blocks of division and content:



11.2. EIP-100 Prior manufacturing, installation or repair of installed equipment

General Inspection Points EIP-100 lists the documentation for prior-manufacturing and inspection, which, to an applicable extent, shall be reviewed and approved by ESS before manufacturing, installation or repairs is started.

ESS is responsible, that the documents approved by him, also are reviewed by designated AIB for MQC2 to 3.

For manufacturing according to AFS 2016:1 (PED) [4] in MQC4 the external provider is responsible that the documents in MQC4 inspection class A-B are reviewed by an AB or a NB. MQC4 inspection class C is by ESS defined, as “non-classified” in AFS 2017:3 [6], does not require the participation of AB or NB.

The documentation shall be approved by the external provider according to his quality

assurance routines and be implemented in the detailed inspection plan that is applicable for the respective work.

By preparation of the detailed quality control documents special consideration has to be taken to inspections of parts that are not accessible at the final inspection.

11.3. EIP-200 Base material and shapes

The inspection requirements for pressure retaining and load bearing material and shapes are normally evident from respective material standard or material specification, including technical delivery and inspection regulations thereto. These usually comprise information about the visual and dimensional inspection and non-destructive testing that has to be carried out, and type of defects or other deviations that can be accepted.

The material that should be used shall have well documented characteristics, necessary strength at highest design temperature, necessary impact value at lowest design temperature, high durability with regard to ageing, good resistance to ambient environment and good weld ability if it will be welded.

Material standard or material specification shall be selected according to the directions from ESS Rules for Technical requirements for Mechanical Equipment [10].

General Inspection Points EIP-200 together with the material procurement specification generally state the inspection and testing required for base material i.e. material and finished product within specified group of shapes.

The inspection requirements for pressure retaining and load bearing equipment state the prescribed inspection and also include inspection of finished surfaces.

The descriptions of the Examination Procedures "EEP", also state the level of inspection and testing, ESS regard is suitable.

Material for details for internal parts shall be inspected and tested according to the external provider's material and standard, this requirement and others stated in order.

The external provider's requirements for inspection and testing shall, together with reference to the procedures, in detail be evident from the detailed documentation for manufacturing and inspection.

Testing in conjunction with manufacturing of material and shapes can (provided that the external provider is applying a certified quality system for control of testing activities) be performed as in-house inspection, see Part A section 9.2.

11.4. EIP-300 and EIP-500 Manufacturing/Installation, welding and other joining

General ESS Inspection Points EIP-300 state the general inspection and testing requirements at welding and other joining at the manufacturing.

General ESS Inspection Points EIP-500 state the general inspection and testing requirements at welding and other joining in conjunction with installation and repairs of deficiencies in installed equipment.

Inspection of joining and other manufacturing processes shall be carried out in such a manner that securing that:

- the work is carried out by authorized personnel
- approved documents are used for the work
- other conditions enables an optimum result to be achieved

Non destructive examination (NDT) shall be carried out with well-proven testing systems which by experience have proven ability to detect defects and discrepancies which can be caused from the used process for manufacturing, installation and repairs.

Acceptance criteria in standards shall be judged towards each individual design case.

The necessary weld quality for steel in pressure retaining and load bearing parts is normally regarded (unless otherwise is prescribed in drawing, inspection plan or in the procurement documents) are to meet quality level B or C in EN ISO 5817 [44] according to the below table or equivalent by experience, known acceptable level.

Quality Class	Pressure retaining parts	Load bearing parts	Non-pressure parts
MQC2-3	Level B	Level B	Level C
MQC4	Level C ^{a)}	Level C ^{a)}	Level C
MQC4 C	Level C	Level C	Level C

^{a)} The quality level is depending on the operating conditions. If there is any risk of damage like fatigue or creep, Level B should be used.

In case standardized testing procedures or well proven testing systems are missing, see Part A section 8.1, it is required to prepare qualification documents and perform the NDT qualification in applicable parts similar to the principles as for in-service inspection [45]. The detailed documentation for manufacturing and inspection has to be approved by ESS, and shall contain the external provider's selected requirements for inspection and testing with reference to the procedures.

Testing in conjunction with manufacturing shall be performed by an AL in a third party position or through random inspection, by an AB of the external provider's in-house inspection, see Part A section 8.2.

11.5. EIP-400 Completed equipment or sub-assemblies

General ESS Inspection Points EIP-400 generally state the final inspection and testing requirements for completed equipment or sub-assemblies.

The inspection requirements also state requirements for cleanliness, packing, compilation and review of the final quality control documentation.

After ESS own following-up the manufacturing, against approved documentations and reviews, ESS shall approve the equipment or sub- assembly.

In the review of the quality control documentation shall also the verification be performed by AIB, if required, has performed the random supervision according to the detailed inspection plan.

ESS shall thereafter request the AIB to perform review of the final quality control documentation, carry out object adopted inspections and issue his own inspection certificate, type PKI or accept certificate issued by the external provider or ESS.

The final inspection and review by ESS and the AIB can be performed as a receiving inspection at the facility, or as a final inspection at the manufacturer's shop. Final inspection consisting of internal and external inspection carried out by AIB could be needed at manufacturing of complex equipment, where a large part of the pressure related part will be inaccessible for inspection in conjunction with installation.

11.6. EIP-600 Completed installation or repair of installed equipment

General ESS Inspection Points EIP-600 is generally specifying the test requirements, testing, review of inspection records, and reporting that is required for completed installation of system, system part or performed repair.

The detailed documentation for installation and/or repair, which has to be approved by ESS, shall contain relevant requirements for inspection and testing and also references to detailed procedures.

Operational test shall be performed at installation of a new system part or if an action has been performed that effects or may effect a system function.

ESS shall after installation report that the operational test has been carried out, to check that safety valves and other safety equipment functions as intended and to ensure that the system or equipment in general demonstrates proper function. All interlocks should be set for valves, in the open or closed position according to an updated interlock list.

ESS shall enable AIB or AB (depending of the mechanical quality class) to follow the installation work and possible operational tests, and thereby make sure that the work has been carried out according to final approved installation documents

After the installation or repair ESS shall certify that:

- the work has been carried out according to approved inspection plan, drawings, procedures and other approved documentation for installation or repair
- the mechanical components and other equipment being part of the installation are approved by AIB or AB/NB
- system, components or other mechanical equipment are provided with permanent and unique identity marking, to enable identification against the documentation for design, manufacture and inspection
- for the quality class MQC2 to MQC3 the quality control documentation is reviewed by an AIB and that a CoC has been issued
- for class MQC4 A-B according to AFS 2017:3 [6], the quality control documentation is reviewed by an AB and that an Final Inspection Certificate (IKI) or equal, has been issued
- for class MQC4 inspection class C are, by ESS defined, as "non-classified" in AFS 2017:3 **Error! Reference source not found.**, the final quality control ocutmentation shall be reviewed by an external provider or ESS and that an Final Inspection Report (IKI) or equal, has been issued

12. ESS EXAMINATION PROCEDURES (EEP)

12.1. Descriptions

ESS Examination Procedures, EEP, contain references and instructions for inspection and testing, procedures, scope, acceptance criteria and requirements for reporting of the carried out inspection or testing.

The external provider's selection of examination procedures, extent of inspection and acceptance criteria shall be made with regard to how the mechanical equipment or system in question is designed, selection of material, geometrical shape, welding methods, strength margins, accessibility for testing, etc.

The examination procedures constitute part of ESS purchasing documentation for inspection and testing.

The examination procedures may be transformed or replaced by the external provider's own adapted instructions for inspection or procedures, when so are considered desirable. The requirements in the Table of Contents EEP [58] shall be considered.

12.2. ESS Examination Procedures Numbers

In front of the "-X numbers" there is one or more digit numbers with the following meaning:

- EEP 2-7X = Examination of base material and finished part
- EEP 3-7X = Examination of manufacturing, welding and other joining
- EEP 4-7X = Examination of completed mechanical equipment or sub-assemblies
- EEP 5-7X= Examination of installation, welding and other joining
- EEP 6-7X= Examination of completed installation of a system, parts of a system or repair of installed equipment

For example:

The Examination Procedure for Visual examination could be used for the all Inspection Points (EIP), therefore are named; EEP 2/3/4/5/6-708.

When referring to the examination procedures (EEP) in the detailed documentation for inspection or certificate of inspection, the applicable number is given in front of the relevant inspection procedure.

12.3. Compulsory, other examination and notified points

The following symbols for allocation are used for extent of testing and inspection:

External provider:

- M** Inspection or testing has to be carried out and documented by the external provider, as per the requirements of the external provider or ESS. (Not prescribed by authority)
- MQ** Compulsory in-house inspection and testing, has to be carried out and documented by the external provider's independent inspection organization. In regulation, Code or standard imperative testing or inspection

Accredited parties:

- A1** Review, inspection or supervision and certification carried out by AIB, Accredited Inspection Body, with accreditation for a whole so called category 1
- A2** Review, inspection or supervision and certification carried out by AB, Accredited Body, or NB, Notified Body, according to AFS 2016:1 [4] (PED) with its ruled module. Where applicable, also an AIB, Accredited Inspection Body, may be used for these assignments
- L** Testing has to be carried out and documented by L, Accredited Laboratory. Testing in conjunction with manufacturing of material and shape material may be performed as in-house inspection if the requirements according to 8.2 are fulfilled. Testing at other manufacturing may be performed according to 8.3

ESS activities:

- E** Activity to be supervised, verified, reviewed and/or approved by ESS affected organization
- EQ** Independent review, inspection or testing, to be carried out and/or approved by the inspection organization of ESS

SSM activities:

- SSM** Activity to be review by The Swedish Radiations Safety Authority

For components in all mechanical quality classes (MQC) shall ESS have the possibility to set a mark for selected operations in the inspection plan, when ESS which to be notified by the external provider.

The notified points can be as follow:

Hold Point

- H** This point is marked with a letter “H” and is used to designate an operation that the external provider is not allowed to perform or begin without ESS permission (unless ESS has given the permission to another organization to carry out the verification).

Witness point

- W** This point is marked with a letter “W” and is used to designate an operation that ESS wishes to be notified about. This operation is normally incorporated in the other used symbols. The summoned representatives are present during the inspections and the review is carried out on site. The external provider may perform the inspections if ESS representatives not are present.

13. SCOPE OF THE INSPECTION

The scope of the inspection stated in ESS general inspection points and examination procedures shall in general be taken into consideration. The scope shall serve as guidance for the supplier at the preparation of his detailed inspection plans.

Depending on the quality class of the equipment, design characteristics, selected material, manufacturing methods, strength margins, function and size, alternative NDT methods may be used and in specific cases a reduction of the scope of the inspection may be used.

The conditions for a reduction of NDT extent can be:

- The design is oversized in a way that the stress falls substantially below permitted limit for the material
- The design and the method of manufacture are well proven

In specific cases the external provider can already at preparation of the inspection plan, foresee that certain inspection activities cannot be carried out or be assessed meaningful from a quality and inspection technologic point of view. In these cases alternative NDT methods or other alternative procedures shall be stated in a detailed inspection plan with the object to achieve corresponding safety.

13.1. Random inspection

Supervision of welding quality through random inspection shall unless otherwise agreed follow the guidelines of EN 13445-5 [47] respectively EN 13480-5 [48]. When the prescribed extent of non destructive testing is less than 100% the prescribed NDE of the manufacturing process to be performed as early as practically possible, this to ensure that the welds are free from defects.

The random inspection of welds shall be:

- Randomly selected
- Representative for a group of welds

The entire length of at least one randomly selected weld shall be tested. If the number of prescribed randomly inspected welds are few, the combination of thicker sections, smaller diameters or thinner sections and larger diameters to prevail. All welders or welding operators shall be represented.

A group of welds is defined as a number of welds, welded with the same WPS, of the same welder or welding operator.

Extension of the inspection at random inspection shall unless otherwise agreed follow the guidelines of EN 13445-5 [47] or EN 13480-5 [48].

13.2. Extension of inspection when pressure and tightness test is not performed

When impossible or it's a great difficulties, are present or when assessed unsuitable to carry out the prescribed pressure and tightness testing of the equipment in question, the testing may be replaced by extended inspection and/or NDT after ESS approval and acceptance from AIB in MQC2 and 3.

Welded joints with requirements for pressure and tightness testing which are not carried out shall at least pass the following inspection in quality class MQC2, 3 and 4

All type of welds:

- 100 % visual and dimensional examination

For butt welds and penetrating corner welds:

- 100 % volumetric testing with radiographic testing. Alternatively ultrasonic testing may be carried out if considered more suitable
- 100% surface testing with PT or MT of completed weld
- If neither RT or UT can be performed on completed butt weld, examination of the root pass and every third layers shall be tested for MQC2

For fillet welds:

- 100 % surface testing with PT or MT of completed weld

The testing and the inspection above may be necessary to carry out in steps during welding in order to obtain adequate safety. When this is required may be considered from case to case depending on the reliability in the NDT method selected, the geometry of the welded joint, quality class, weld-efficiency factor, material etc.

All types of welds for MQC4 C with a weld joint efficiency factor $z \leq 0,7$:

- 10 % volumetric testing or surface testing with PT or MT of completed weld

Coupling joints for MQC 2-3:

- Coupling joints, which are not pressure and tightness tested, shall be subjected to 100 % examination of the installation. The inspection shall in these cases be supervised by ESS, Quality Control organization or there's representative.

14. ABBREVIATIONS FOR NDT METHODS

The following abbreviations are used for testing methods in ESS general inspection points and examination procedures:

RT - Radiographic Testing
UT - Ultrasonic Testing
ET - Eddy Current Testing
MT - Magnetic Particle Testing
PT - Liquid Penetrant Testing
LT - Leak Test
VT - Visual Testing

15. CERTIFICATE OF CONFORMITY (COC) AND INSPECTION OF FINAL INSTALLATION (IOI)

15.1. Basic regulation

Before the facility, or parts of the facility, is taken into operation, for quality classes MQC2 and MQC3 after major repairs, modifications or extensive works etc, a "CoC" to requirements in *SSM 15-36 chapter 5 sections E2*, shall be presented. AIB shall be applied by ESS, to issue the certificate.

For quality class MQC4 inspection class A-B according to AFS 2017:3 [6], an AB shall issue an inspection of final installation (IoI).

For quality class MQC4 inspection class C are, by ESS defined, as "non-classified" in AFS 2017:3 [6], does not require the participation of AB or NB.

15.2. Activities to be performed by an Accredited Inspection Body (AIB) according to *SSM 15-36 chapter 5 section E2*, to issue Certificate of Conformity (CoC)

By modification work in the facility according to *SSM 15-36 chapter 5, section D3*, or change of operating conditions, ESS is obliged to ensure that an AIB is engaged to review the Design Specification Mechanicals and other design documents to assess that:

- the division into quality classes is based on principles that are notified to the Swedish Radiation Safety Authority (SSM) and that consideration has been taken to resolutions, taken by the Inspectorate, concerning the notifications that's have been made

- the used design basis mechanical are notified to SSM and that consideration has been taken to resolutions, taken by the Inspectorate, concerning the notifications that's have been made

When changes, exchanges and other actions are involved in the mechanical equipment, ESS shall also make sure that an AIB:

- reviews the design loadings, strength analysis and other documents for inspection that *SSM 15-36 chapter 5 section D2*, first part, has been fulfilled.
- performs inspection during and after the installation as well as supervise operational tests according to *SSM 15-36 chapter 5 sections D12* and check marking according to *section D13*.
- will be given opportunity to take part of the installation times plan and get access to the installation sites in order to perform the inspections and monitoring. The inspection that cannot be performed at the final inspection shall be performed in an earlier stage.

If these reviews, supervisions and inspections prove that defined requirements are fulfilled, the AIB shall issue the "CoC".

15.3. Inspection in quality class MQC4 according to non SSM requirements to issue a Inspection of Installation (IOI)

For inspection and testing of equipment where *SSM 15-36* is not applicable and SSM is not a supervising authority, the requirement AFS 2016:1 [4], AFS 2016:2 [5], AFS 2017:3 Error! Reference source not found..applies for repairs and installation of pressure retaining quipment.

The AB participation in quality class MQC4 are of importance for the safety of pressure vessels and their integrity also is of importance for the health and safety of the personnel, the division into object categories made in AFS 2017:3 Error! Reference source not found..nspection class A and B and by ESS defined inspection class C as, "non-classified" in AFS 2017:3 Error! Reference source not found..

The design, installation and repairs in inspection class MQC4 inspection class C, is thereby carried out as in-house inspection or other inspections.

After repair or installation in quality class MQC4 C, the external provider or ESS shall issue an Inspection of Installation (IOI) certificate or equal.

16. LISTING OF GENERAL INSPECTION POINTS

16.1. ESS Inspection points prior to manufacture, installation and repair mechanical equipment, sub-assemblies system

Designation	Equipment	Quality Class
EIP-100 (A/B)	<ul style="list-style-type: none"> - Pressure retaining and load-bearing equipment - Internal parts in mechanical equipment - Repair: pressure retaining and load-bearing equipment 	MQC2-3
EIP-101 (A/B)	<ul style="list-style-type: none"> - Pressure retaining and load-bearing equipment - Internal parts in mechanical equipment - Repair: pressure retaining and load-bearing equipment 	MQC 4

16.2. ESS inspection points EIP-100 and 101

The list of required documents that is applicable for equipments of mechanical quality class MQC2 to MQC4 C are listed below.

The documents are divided in two parts:

Type A - document that should be provide by ESS

Type B - document that should be provide by the external provider

The contract or a detailed inspection plan shall specify which documents that needs to be handed over to the relevant parties.

EIP-100 Type A (MQC2-3):

Review of the document that shall be prepared, reported and handed over by ESS to the external provider	Specification RCC-MRx	Specification Handbook Section:	Symbols (sec 12.3) acc. to the quality class
			MQC2-3
Description and report	RDG 3000	18.1	E, EQ
Equipments Specification <ul style="list-style-type: none"> - Design Specification Mechanical (KSmek) - Design Basis Mechanical (KFM) 	RDG 3100 RB 3170	18.2	E, EQ
		18.3	E, EQ, A1
		18.3	E, EQ, SSM
Load basis	RDG 3100	18.4	E, EQ, A1
Valid assessment of suppliers	RDG 5200	18.5	MQ, E, EQ
Updating flow charts	RDG 3100	18.6	E, EQ, A1
Updating of classification list/charts	RDG 3100	18.7	E, EQ, A1

EIP-100 Type B (MQC2-3):

Review of document that shall be prepared, reported and handed over by the external provider to ESS for approval	Specification RCC-MRx	Specification Handbook Section:	Symbols (sec 12.3) acc. to the quality class
			MQC2-3
Valid supplier assessment of subcontractors	RDG 5400	19.1 19.2	MQ, E, EQ
Project adapted QA Plan	RDG 5400	19.2	MQ, E, EQ
Comprehensive layout and referencing documents (Drawings etc)	RDG 3210	19.4	MQ, E, EQ, A1
Component part list	RDG 3220	19.4	MQ, E, EQ, A1
Design review/report	RA 3310 RB 3180 RB 3200	19.3	MQ, E, EQ, A1
Calculation review/report	RB 3200 RA 3310 RB 3180	19.5 19.6 19.7	MQ, E, EQ, A1
Material procurement specification ^{b)}	RB 2000	19.8	MQ, E, EQ, A1
Heat treatment procedure ^{a)}	RF 8000 RS 7500	19.9	MQ, E, EQ, A1
Qualification report for heat treatment ^{a)}	RM 016-0	19.9	MQ, E, EQ, A1
Forming procedure	RF 4100 RF 4200	19.9	MQ, E, EQ, A1
Procedure installation of couplings	N/A	19.9	MQ, E, EQ, A1
Procedure of installation of fasteners in concrete	N/A	19.9	MQ, E, EQ, A1
Procedures for cleanliness inspection of installation	RF 6000	19.9	MQ, E, EQ
Inspection plan	RA 3400	19.10	MQ, EQ, A1
Certification of the company's authorization for heat treatment	N/A	19.16	MQ, EQ, A1
The NDT company's certificate of accreditation and the extent of the accreditation	N/A	19.17	MQ, EQ, A1
The NDT personnel certificate of examination	RMC 8000	19.17	MQ, EQ, A1
Review of authorization for coupling installation/Qualification of personnel	N/A	19.18	MQ, EQ, A1
Review of authorization for installation fasteners in concrete/Qualification of personnel	N/A	19.19	MQ, EQ, A1
Welding data package	RS 1210	N/A	N/A
- WPS + WPQR	RS 1220 RS 3130	19.9 EEP 3/5-745	MQ, EQ, A1
- Certification of the company's authorization for joining materials	RS 6000 RS 7000	19.13	MQ, EQ, A1
- Certification of welders	RS 4130	19.14 EEP 3/5-746	MQ, EQ, A1

- Qualification of welding personnel	RS 4130	19.15 EEP 3/5-746	MQ, EQ, A1
NDT procedures	RMC 2123 RMC 3122 RMC 4122 RMC 5122 RMC 6122 RMC 7122	19.11	MQ, EQ, A1
Program for pressure and tightness testing - installation	RMC 7400 RB 5200 REC 3257	19.12	MQ, E, EQ, A1
Deviations- and Non-conformance report	RDG 3300	Part A section 3.8	MQ, E, EQ, A1
Removal or repair of induced deficiencies, at site	RF 3700 RS 7600	19.20 19.21	MQ, E, EQ, A1

Remarks:

^{a)} Could be a part of the welding procedure

^{b)} Shall include the scope and requirements in the detailed IP 200 moments according to shape and material

EIP-101 Type A (MQC4):

Review of the document that shall be prepared, reported and handed over by ESS to the external provider	Specification According to relevant harmonized standards and ESS additional requirements	Specification Handbook Section:	Symbols (sec 12.3) acc. to the quality class	
			MQC4 A-B	MQC4 C
Description and report		18.1	E, EQ	E, EQ
Equipments Specification		18.2	E, EQ	E, EQ
- Design Specification Mechanical (KSmek)		18.3	E, EQ	
- Design Basis Mechanical (KFM)		18.3	E	
Design Loads		18.4	E, EQ	E
Valid assessment of suppliers		18.5	MQ, E, EQ	MQ, E, EQ
Updating flow charts		18.6	E, EQ, A2	E, EQ
Updating of classification list/charts		18.7	E, EQ	E, EQ
Risk analysis		18.8	E	N/A

EIP-101 Type B (MQC4):

Review of document that shall be prepared, reported and handed over by the external provider to ESS for approval	Specification According to relevant harmonized standards and ESS additional requirements	Specification Handbook Section:	Symbols (sec 12.3) acc. to the quality class	
			MQC4 A-B	MQC4 C
Valid supplier assessment of subcontractors		19.1 19.2	MQ, E, EQ	MQ, E, EQ
Project adapted QA Plan		19.2	MQ, E, EQ	MQ, E, EQ
Comprehensive layout and referencing documents (Drawings etc)		19.4	MQ, E, EQ A2	MQ, E, EQ

Component part list		19.4	MQ, E, EQ	MQ, E, EQ
Design review/report		19.3	MQ, E, EQ A2	MQ, E, EQ
Calculation review/report		19.5 19.6 19.7	MQ, E, EQ A2	MQ, E, EQ
Material procurement specification ^{b)}		19.8	MQ, E, EQ	MQ, E, EQ
Heat treatment procedure ^{a)}		19.9	MQ, E, EQ	MQ, E, EQ
Qualification report for heat treatment ^{a)}		19.9	MQ, E, EQ	MQ, E, EQ
Forming procedure		19.9	MQ, E, EQ	MQ, E, EQ
Procedure installation of couplings		19.9	MQ, E, EQ	MQ, E, EQ
Procedure of installation of fasteners in concrete		19.9	MQ, E, EQ	MQ, E, EQ
Procedures for cleanliness inspection of installation		19.9	MQ, E, EQ	MQ, E, EQ
Inspection plan		19.10	MQ, EQ A2	MQ, EQ
Certification of the company's authorization for heat treatment		19.16	MQ, EQ	MQ, EQ
The NDT company's certificate of accreditation and the extent of the accreditation		19.17	MQ, EQ	MQ, EQ
The NDT personnel certificate of examination		19.17	MQ, EQ, A2	MQ, EQ
Review of authorization for coupling installation/Qualification of personnel		19.18	MQ, EQ	MQ, EQ
Review of authorization for installation fasteners in concrete/Qualification of personnel		19.19	MQ, EQ	MQ, EQ
Welding data package		N/A	N/A	N/A
- WPS + WPQR		19.9 EEP 3/5-745	MQ, EQ A2	MQ, EQ
- Certification of the company's authorization for joining materials		19.13	MQ, EQ	MQ, EQ
- Certification of welders		19.14 EEP 3/5-746	MQ, EQ, A2	MQ, EQ
- Qualification of welding personnel		19.15 EEP 3/5-746	MQ, EQ	MQ, EQ
NDT procedures		19.11	MQ, EQ	MQ, EQ
Program for pressure and tightness testing - installation		19.12	MQ, E, EQ A2	MQ, E, EQ
Deviations- and Non-conformance report		Part A section 3.8	MQ, E, EQ A2	MQ, E, EQ
Removal or repair of induced deficiencies, at site		19.20 19.21	MQ, E, EQ	MQ, E, EQ

Remarks:

^{a)} Could be a part of the welding procedure

^{b)} Shall include the scope and requirements in the detailed IP 200 moments according to shape and material

17. INSPECTION SPECIFICATION AND DOCUMENTS

Bellow chapter 18 and 19 describes the documentation that should be prepared by ESS and the external provider. The requirements for manufacturing, installation and repair documentation that shall be prepared and approved before the work are started. The documentation shall be reviewed and approved by the manufacturer and ESS in accordance with the quality assurance program of the companies in question, and shall whenever applicable also be reviewed by AIB or an AB.

Verification of performed inspection shall be part of the final inspection documentation, together with copies of reports, authorizations, certificates and other documents mentioned below.

18. DOCUMENTATION THAT SHOULD BE PREPARED BY ESS

18.1. Description and reports

A description of the work has to be drawn up as a project report, modification memorandum or equivalent document. The reports shall include how it's shall be done, the conditions for the work and planning.

Example of contents:

- Documentation needed for the evaluation of effects on the existing facility
- Clarification of effects on safety, availability and protection
- Clarification that the modification, maintenance work or repair satisfies prescribed requirements
- Clarification of prescribed requirements according to code, function and other requirements
- Clarification of classification and Design Specification Mechanical
- Documentation serving as a basis for the detailed design

18.2. Equipment Specification

The equipment specification according to the code RCC-MRx [3] are a set of documents that present the essential data for specific equipment or a mechanical component/part, i.e. extent of work, design data, operational data, safety class, quality class, cleanliness class, loads, welding, testing etc. This document is used by ESS to specify technical and quality assurance requirements to the external provider in conjunction with purchase of replacement equipment, installation work or repair.

The Equipment specification specifies in particular following information in a different of documents:

- scope
- scope of supplies
- description of the action
- reference documents, particularly the rules in SSM 15-36 Specific requirements

for ESS-facility in Lund [1], [2], the code RCC MRx [3] or EN, together with details of their conditions of application, where necessary

- identifications and requirements for the materials
- plans needed for calculation and providing functions
- seismic analyses
- shapes, dimensions of parts
- limits and interconnections with other parts
- list and definitions of conditions and corresponding loads
- type and extent of maintenance and inspection actions
- in-service inspection
- special requirement for e.g. welding and testing

Some of above data are normally included in ESS produced documents as:

- Design Specification Mechanical (KS-MEK)
- Design Basis Mechanical (KFM)

18.3. Design Basis Mechanical (KFM) and Design Specification Mechanical (KS-MEK)

For quality class MQC2 to MQC3 the design basis mechanical (KFM) and loading criteria, based on valid Safety Analysis Reports (SAR) [43], shall be specified according to the principles in the template for Design Basis Mechanical (KFM)" [54].

For modification work according to *SSM 15-36 chapter 5 section D3*, Design Specification Mechanical (KS-MEK) according to the principles [55] shall be prepared and approved.

The design basis mechanical (KFM) shall be safety reviewed and notified to SSM. The notification shall be responded by SSM prior to the AIB's issuance of CoC as per the requirements of *SSM 15-26 in chapter 5 section E2*.

For modifications or changes in operation conditions where the design criteria will be changed, the new valid design basis mechanical (KFM) shall be safety reviewed and notified to SSM.

For modifications where the design criteria not have been changed, the valid design basis mechanical shall be presented.

The detailed design basis mechanical and possible decision from SSM shall be enclosed to the documentation and has to be reviewed according to section 15.2 by AIB.

18.4. Design loadings

In the design basis mechanical (KFM) events and combinations of events are defined, that have to be considered for mechanical equipment. Events including the event class and unlikely event shall be considered in the design loadings. All loadings (e.g. for earthquake) are documented according to the status and approvals by ESS and AIB in a Design loadings Status report.

18.5. Supplier Assessment

Suppliers and their subcontractors shall possess and adhere to a quality assurance system that meets applicable parts of the requirements of EN-ISO 9001 [50], or other equivalent acknowledged standard.

Further details concerning assessment of suppliers, see Part A section 4.1

18.6. Updating of flow charts

Flow charts, inter-locking lists and records of the set pressure for the safety valves, shall be kept up-to-date and be final approved by AIB or AB, and ESS, depending of the quality class.

18.7. Updating classification list/flow chart

Classification lists or colored flow charts shall be kept up-to-date and the latest list/flow chart should be final approved by AIB and/or ESS, depending of the quality class.

18.8. Risk analysis

In the Work Environment Authority's regulations according to AFS 2001:1 [51], AFS 2008: 15 [51] and AFS 2017: 3 [51] for systematic work environment, there are rules for how ESS shall regularly analyse and inspect the working conditions, and assesses risks that may arise in any operations. There are also rules on how to take measures to prevent risks. The risk analysis and inspections are handled by ES&H written routines.

19. DOCUMENTATION TO BE PREPARED BY THE EXTERNAL PROVIDER

19.1. Supplier assessment of sub-contractors

On ESS demand, the supplier shall report the results of his assessment of sub-contractors.

19.2. Quality plan for installation and repairs of installed equipment

Works concerning equipment important for safety and operational availability must be carried out under well-controlled conditions. A quality assurance program shall cover the activities or a project adapted quality plan has to be prepared according to ESS Template for Project Quality Plan [51]. The plan are follow the guidelines of ISO 10005 "Quality management – Guidelines for quality plans in project" [52], and should be adapted to the particular work and the need for control so that performance and documentation is carried out in accordance with the applicable requirements.

19.3. Design review

The design review shall assure that the design documents is cohesive with the design criteria, stated by ESS from the requirements in ESS Rules for Technical requirements for Mechanical Equipment, [10] and from other specifications that is valid for the equipment, issued by ESS.

19.4. Comprehensive layout and referencing document, drawing

The scope of these documents is to provide an overall description of a new or modified pipe system, equipment or a major component part. They shall determine geometrical characteristics and give a comprehensive description of the inner connection of parts, particularly from an operational and from the manufacturing and assembly point of view.

The review shall comprise drawings for design, welding and adherent material specifications.

The review shall also verify that the documentation contains the data of importance for the pressure vessel safety, function, manufacture, inspection, installation and in-service inspection, and also verify that they are correctly specified.

For external purchasing of equipment, the external provider may due to proprietary reasons be unwilling to disclose data about e. g. fit and tolerances to other companies, this will normally be accepted.

Drawing shall to an applicable extent, comprise or refer to at least the following information:

- Meet the requirements of international standards (SI units) concerning scale, structure etc.
- System and component identification
- Design pressure and design temperature and data of test pressure
- Quality classification (MQC2-4)
- Inspection plan No
- Material specification and material grade
- MDimensional standard and pressure rating of parts and components
- Dimensions and measurements shall be detailed to the extent required for the design calculations
- Calculation Report No
- Welding specifications (WPS)
- Part list

19.5. Structural verification

All loads (static and dynamic) that are expected to occur over the facility lifetime or that are associated with postulated design basis mechanical accidents should be identified and grouped according to the probability of occurrence.

For safety classified mechanical equipment (quality class MQC2-3), the design basis mechanical documents (KFM) and the belonging design specification mechanical (KS-MEK) specifies the different loading conditions for the events H1-H4. For mechanical equipments in quality class MQC4, structural verification shall be made in accordance to the rules specified in the applicable KFM.

19.6. Calculations

The review of strength calculations shall be carried out to the extent that's required, to verify that the criteria of the design basis mechanical (KFM) and the belonging detailed

design specification mechanical (KS-MEK) are satisfied.

The report shall contain references to design loadings, drawings, methods used for calculations and other information that's important for the verification of the result. The review shall verify that strength calculations have been carried out and that the results meet the specific requirements.

Calculation in quality class MQC2 shall meet the RCC MRx Code (N2_{Rx} RC3000) [3].

For MQC3, RCC MRx Code N3_{Rx} [3] or if REC 2000 is applicable, EN 13445 [47] (unfired pressure vessels) or EN 13480 [48] (metallic industrial piping) can be used with the additional requirements in REC 2000.

For calculation in MQC4 the EN regulations [47] or [48] shall be fulfilled.

19.7. Design and calculations report

The design and calculation reports shall contain references to applicable drawings, information about loads, calculation methods, as well as calculation software qualification and other information that's important for the verification of the results. The report shall be drawn up according to section RA 3310 and RB 3180 in RCC MRx Code Section III – Tome 1- Subsection A and B [3].

19.8. Material procurements specification

This document shall describe the requirements for material that's are permitted to use for the equipment, installation or repair for the specific mechanical quality class MQC2, 3 and 4. The material procurement specification can be a part in e.g. design and construction rules or be specified in the inspection plan.

For quality class MQC2, the materials must meet the requirements in RCC-MRx Code Section III – Tome 1 – Subsection C (Class N2_{Rx} Section RC 2000) [3].

For MQC3, the material shall meet the requirements in the Subsection D (Class N3_{Rx} Section RD 2000) [3].

If REC 2000 is applicable, EN 13445 [47] (unfired pressure vessels) or EN 13480 [48] (metallic industrial piping) can be used for MQC3, with the additional requirements in REC 2000.

Material used for MQC4 shall fulfill the EN regulations [47] or [48].

19.9. Manufacturing and installation procedures

A description of the manufacturing or installation company's documents shall describe a general overview of the work.

Examples of procedures and procedure qualification reports, which to applicable extent shall be presented:

- Welding procedures (WPS) according to EEP 3/5-745
- Welding procedure and Qualification report (WPQR) according to EEP 3/5-745
- Heat treatment procedure
- Heat treatment procedure and Qualification report
- Forming procedure and Qualification report
- Procedure for installation of couplings
- Procedure for installation of fasteners

- Procedures for cleanliness inspection
- Procedure for function inspection
- Procedure for corrosion protection

Review of manufacturing and installation procedures and qualification reports, shall verify the fulfillment of the requirements from the ESS Rules for Technical requirements for Mechanical Equipment [10], this documents and other requirements stated by the ESS.

Procedure for installation of fasteners in concrete and for installation of pipe couplings shall comprise instructions to ensure a safe and satisfactory installation.

19.10. Review of detailed inspection plans

For all design, manufacturing, installation and repairs it shall be possible to demonstrate that the required level of quality has been adequately defined, that the activities have been performed and reported in a satisfactory manner and that the required degree of quality has been reached.

The review shall verify that the detailed inspection plans includes the right inspection and testing requirements according to this document.

The detailed inspection plans shall include:

- Reference to detailed drawing
- Mechanical Quality Class (MQC)
- Type and extent of tests and inspections at different stages, before, during and after manufacturing, installation or repair
- Allocation of inspection assignments
- Reference to the detailed inspection documentation, which the manufacturer intends to use for the inspection and testing activity
- Reference to the external provider's detailed procedures for NDT
- Reference to the ESS examination procedure (EEP) in case these are used as a detailed inspection basis
- The tests and inspections the external provider's considers needed for his full responsibility for the device
- The added inspection, which is required when no pressure and tightness test is intended to be made

19.11. NDT Procedures

The review shall verify that the detailed NDT procedures fulfils the requirements of applicable examination procedure (EEP), and applies to all the procedures that according to the examination procedure require preparation of procedure.

NDT procedures shall contain all necessary data for performance of the testing, evaluation and reporting of the result. The procedures shall comply with the requirements of the ESS examination procedures. Requirements on the content of the NDT procedures are specified in the applicable (EEP) examination procedures and in the RCC MRx Code Section III Tome 3: Examination Methods [3].

For the testing with well proven and well suited methods there is normally not a requirement to prepare a detailed procedure, providing that this is not stipulated by the standard in question.

NDT procedure for testing of machined surfaces in conjunction with repairs of operational induced deficiency shall in applicable extent be qualified and evaluated according to *SSM 15-36, chapter 5, section D11*.

19.12. Pressure and tightness test program

The external provider or in certain cases ESS in Lund, shall in conjunction with the installation or repair, prepare a program for pressure and tightness testing according to RCC-MRx Code Section III – Tome 1, RB 5200, Tome 3, RMC 7400 and Section II: additional requirements and special instructions, REC 3257 [3].

Pressure and tightness testing at the manufactures workshop shall follow a written procedure for the final pressure retaining component.

Requirements of the content in the program/procedure are defined in the ESS examination procedures; see Table of Contents for EEP [58].

The program/procedure shall be reviewed and approved by ESS according to his routines and shall verify compliance with the applicable examination procedure.

19.13. Review of the company's welding authorization

A valid certificate of welding license or certificate, issued by an Accredited Certification Body against EN 3834 [20] or [21], shall be presented to ESS.

The requirements for authorization for welding and other joining methods are stated in Part A, section 6.1 and in RCC MRx Code Section III Tome 4: Welding [3].

Authorization for the above mentioned welding shall comprise all the welding methods, combinations of materials and geometry's required for the welding to be performed.

19.14. Certification of welders

Copies of valid certificates for welder qualification shall be presented to ESS. The requirements for certification of welders are stated in Part A, section 6.3 and in RCC MRx Code Section III Tome 4: Welding [3] and in EEP 3/5-746.

19.15. Qualification of welding personnel

Certificates of all qualification tests according to requirements in the qualification program shall be presented to ESS.

The requirements for personnel qualification are stated in Part A, section 6.4 and in RCC MRx Code Section III Tome 4: Welding [3] and in EEP 3/5-746.

19.16. Review of the company's heat treatment authorization

Heat treatment of welding shall be a part of the welding procedure qualification, according to section 6.2 and in RCC MRx Code Section III Tome 4: Welding [3].

Other requirements for heat treatment are stated in Part A, section 7 [3].

19.17. Review of the company's NDT authorization

The following records shall be available for review during the testing and also be included in the final inspection records:

- The company's certificate of accreditation and the extent of the accreditation
- Personal certificate of examination or diploma
- Authorization given by the company/laboratory

The requirements for the company's authorization are stated in Part A, section 8 and in RCC MRx Code Section III Tome 3: Examination Methods [3].

19.18. Certification of personnel for couplings

Installation of pipe couplings shall be performed by personnel that is qualified and certified for the task as per the external provider's guidelines. The certificate or a summary list over approved personnel should be part of the final quality documentation.

19.19. Certification of personnel for fasteners in concrete

Installation of approved fasteners in concrete (expanded bolts) shall be performed by personnel that is qualified and certified for the task as per the external provider's guidelines. The certificate or a summary list over approved personnel should be part of the final quality documentation.

19.20. Review of documentation for removal of induced deficiencies

Service induced deficiencies in installed equipment may be removed without repair of the material or weld material if, at least, below defined documents are safety reviewed and approved by ESS and reviewed by an AIB:

- machining procedure
- qualification program for machining procedure
- qualification report

Qualification of method for machining intended for use in equipment belonging to quality class MQC2-3 shall be supervised and assessed by an AIB.

In addition to the above mentioned documents cause of:

- defect analysis
- design specification, Mechanicals
- design basis, mechanical
- design loadings
- strength analysis

shall be prepared to the extent that's required for the intended measure.

This type of measure is by SSM considered to be a plant modification and shall be reviewed by an AIB to the extent specified in section 15.2.

19.21. Review of documentation for repair of induced deficiencies (normally welding)

Repairs of installed equipment shall be carried out according to a qualified repair program for the specific purpose, which can restore the required properties by safe margin for the equipment to meet the basic requirements for proper use.

Qualification of a method for machining and repair intended for equipment belonging to the quality classes MQC2-3, shall be supervised and evaluated by an AIB.

The external provider shall supply ESS with detailed repair documentation for review and approval as stated below:

- Repair procedure
- Qualification program for the repair
- Qualification report
- Qualification of personnel and equipment

20. GENERAL INSPECTION POINT FOR BASE MATERIAL, (EIP-200) IN MQC2-3

20.1. Pressure –retaining equipment or parts

Designation	Material/Shape	Quality Class
EIP-201	Forgings and bars, castings and plates	MQC2-3
EIP-202	Pipes and pipe fittings, heat exchanger tubes	MQC2-3
EIP-203A	Bolts and nuts (special)	MQC2-3
EIP-203B	Bolts and nuts (standard)	MQC2-3
EIP-204	Bellows for valves and pressure vessels and pipes	MQC2-3

EIP-201 Inspection of base material Forgings, bars, casting and plates	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
Remarks: See chapter 30		MQC2-3
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ
Additional mechanical testing of material ¹⁾	2-702	MQ
Cobalt content test/purity class ²⁾	2-703	MQ
Intergranular corrosion test ^{1), 2)}	2-704	MQ
Determination of Grain size ^{1), 2), 3)}	2-705	MQ
Marking and identification	2-706	MQ
Dimensional inspection	2-707	MQ
Visual inspection	2-708	MQ
Heat treatment	2-709	MQ
Ultrasonic testing of plate ^{1), 5)}	2-717	MQ
Ultrasonic testing of forgings and bars ^{1), 4)}	2-718	MQ
Radiographic examination of castings	2-723	MQ

EIP-202 Inspection of base material Pipes, pipe fittings and heat-exchange tubes Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ
Additional mechanical testing of material ¹⁾	2-702	MQ
Cobalt content test/purity class ²⁾	2-703	MQ
Intergranular corrosion test ^{1), 2)}	2-704	MQ
Determination of Grain size ^{1), 2)}	2-705	MQ
Marking and identification	2-706	MQ
Dimensional inspection	2-707	MQ
Visual inspection	2-708	MQ
Heat treatment	2-709	MQ
Pressure and tightness testing ^{1), 7)}	2-712	MQ
Liquid penetrant testing of final surfaces ¹⁾	2-713	MQ
Magnetic particle testing of final surfaces ¹⁾	2-714	MQ
Eddy Current testing of pipes/tubes ^{1), 4)}	2-715	MQ
Ultrasonic testing of pipes/tubes ^{1), 4)}	2-719	MQ
Cold bending of heat exchanger tubes and qualification report	2-725	MQ, EQ

Welded pipes and -fittings shall also be inspected as per EIP-301 and EIP-401.

EIP-203A Inspection of base material Bolts and Nuts (Special) Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ
Additional mechanical testing of material ¹⁾	2-702	MQ
Marking and identification	2-706	MQ
Dimensional inspection	2-707	MQ
Visual inspection	2-708	MQ
Heat treatment	2-709	MQ
Liquid penetrant testing of final surfaces ¹⁾	2-713	MQ
Magnetic particle testing of final surfaces ¹⁾	2-714	MQ
Ultrasonic testing of material if > M24 / 1" ^{1), 4)}	2-718	MQ

EIP-203B Inspection of base material Bolts and Nuts (Standard) Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Material certificate acc. to EN 10204-2.1 ^{1), 8)}	2-701	MQ
Marking and identification ⁸⁾	2-706	MQ
Dimensional inspection	2-707	MQ
Visual inspection	2-708	MQ

EIP-204 Inspection of base material Bellows for valves, pressure vessels and pipes Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ
Intergranular corrosion test ^{1), 2)}	2-704	MQ
Determination of Grain size ^{1), 2), 10)}	2-705	MQ
Marking and identification	2-706	MQ
Dimensional inspection	2-707	MQ
Visual inspection	2-708	MQ
Heat treatment	2-709	MQ

20.2. Load-bearing equipment or parts

Designation	Material/Shape	Quality Class
EIP-205	Plates and forgings for load-bearing equipments and parts, or in material for fasteners in concrete	MQC2-3

EIP-205 Inspection of base material Material for loading bearing equipment and parts, or in material for fasteners in concrete Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Material certificate acc. to EN 10204-2.1 ¹⁾	2-701	MQ
Marking and identification ^{6), 14)}	2-706	MQ
Dimensional inspection	2-707	MQ
Visual inspection	2-708	MQ
Heat treatment	2-709	MQ
Ultrasonic Testing of plates ^{4), 5), 11)}	2-717	MQ

Material for anchor elements such as:

- Spring assemblies
- Constant load hangers
- Snubbers for dynamic loads

shall be inspected and tested to the extent that is stated in the external provider's approved product specification or the type inspection certificate for the element in question.

20.3. Internal parts or in equipment and components

Designation	Material/Shape	Quality Class
EIP-206	Material for internal parts or in mechanical equipment (Plate, bars, pipe and forgings)	MQC2-3

"The mechanical quality class refers to the main component"

EIP-206 Inspection of base material Material for internal parts or in mechanical equipment Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
Material certificate acc. to EN 10204-3.1 ¹⁵⁾	2-701	MQC2-3 M

21. GENERAL INSPECTION POINTS AT MANUFACTURE, WELDING, OTHER JOINING AND PIPE BENDING, (EIP-300) IN MQC2-3

21.1. Mechanical equipment or parts of devices

Designation	Material/Shape	Quality Class
EIP-301	Inspection of welding, other joining and pipe bending	MQC2-3

EIP-301 Inspection of welding, other joining and pipe bending Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Dimensional inspection ¹⁶⁾	3-707	MQ
Visual inspection ¹⁶⁾	3-708	MQ
Inspection of heat treatment	3-709	MQ
Test of weld filler metal	3-710	MQ
Inspection of welding ¹⁶⁾	3-711	MQ
PT of weld ¹⁸⁾	3-713	L
MT of weld ¹⁸⁾	3-714	L
UT of welded joint ^{4), 18), 21), 22)}	3-720	L
UT of surfacing weld ^{4), 18)}	3-721	L
RT of welded joint ^{4), 18), 23)}	3-722	L
Review of radiographic ¹⁸⁾	3-722	L
Inspection of pipe bending ²⁴⁾	3-724	MQ
Inspection of installation of couplings ²⁴⁾	3-727	MQ

22. GENERAL REQUIREMENTS FOR FINISHED EQUIPMENT, (EIP-400) IN MQC2-3

22.1. General inspection points for completed mechanical equipment or part of device

Designation	Material/Shape	Quality Class
EIP-401	Pipes, pipe fittings and tubes	MQC2-3
EIP-402	Valves and pumps	MQC2-3
EIP-403	Heat exchangers, pressure vessels and tanks	MQC2-3
EIP-404	Load bearing equipment such as; hangers and supports	MQC2-3
EIP-405	Non-pressure, "completed" internal parts	MQC2-3

EIP-401 Inspection pipes, pipe fittings and tubes Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Marking and identification	4-706	MQ, EQ
Dimensional inspection	4-707	MQ, EQ
Visual inspection	4-708	MQ, EQ
Pressure and tightness testing ²⁵⁾	4-712	MQ, EQ, A1
PT of final surfaces ¹⁾	4-713	L
MT of final surfaces ¹⁾	4-714	L
Final Inspection ²⁶⁾		A1
Inspection of cleanliness	4-728	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A1
Inspection of packing and preservation	4-732	M
Issuing Product Certificate ²⁶⁾	4-747	A1
Certificate of compliance/conformity	4-749	MQ

EIP-402 Inspection of valves and pumps Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Marking and identification	4-706	MQ, EQ
Dimensional inspection	4-707	MQ, EQ
Visual inspection	4-708	MQ, EQ
PT of final surfaces ¹⁾	4-713	L
MT of final surfaces ¹⁾	4-714	L
Final Inspection ²⁶⁾		A1
Inspection of cleanliness	4-728	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A1
Inspection of packing and preservation	4-732	M
Balancing of pumps	4-733	M
Strip Test of pumps etc.	4-734	M
Pressure and tightness testing of valves	4-735 4-736 4-737 4-738	MQ, EQ, A1 ³²⁾
Function test of valves	4-739 4-740	M

Function and pressure test of pumps	4-741 4-742	MQ, EQ, A1 ^{30, 32)}
Inspection of corrosion protection	4-744	M
Issuing Product Certificate ²⁶⁾	4-747	A1
Certificate of compliance/conformity	4-749	MQ

EIP-403 Inspection of heat exchangers, pressure vessels and tanks Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Marking and identification	4-706	MQ, EQ
Dimensional inspection	4-707	MQ, EQ
Visual inspection	4-708	MQ, EQ
Pressure and tightness testing ¹²⁾	4-712	MQ, EQ, A1
PT of final surfaces ¹⁾	4-713	L
MT of final surfaces ¹⁾	4-714	L
Final Inspection ²⁶⁾		A1
Inspection of cleanliness	4-728	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A1
Inspection of packing and preservation	4-732	M
Inspection of corrosion protection	4-744	M
Issuing Product Certificate ²⁶⁾	4-747	A1
Certificate of compliance/conformity	4-749	MQ

EIP-404 Inspection of Load bearing equipment such as: hangers and supports Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Marking and identification	4-706	MQ, EQ
Dimensional inspection	4-707	MQ, EQ
Visual inspection	4-708	MQ, EQ
Final Inspection ²⁶⁾		A1
Inspection of cleanliness	4-728	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A1
Inspection of packing and preservation	4-732	M
Inspection of corrosion protection	4-744	M
Issuing Product Certificate ²⁶⁾	4-747	A1
Certificate of compliance/conformity	4-749	MQ

EIP-405 Inspection of non-pressure “completed” internal parts Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Marking and identification	4-706	M
Dimensional inspection	4-707	M
Visual inspection	4-708	M
Inspection of cleanliness	4-728	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ
Inspection of packing and preservation	4-732	M
Inspection of corrosion protection	4-744	M
Certificate of compliance/conformity	4-749	MQ

23. GENERAL REQUIREMENT FOR INSTALLATION AND REPAIR INSPECTION (EIP-500) IN MQC2-3

23.1. General inspection points – installation or repair

Designation	Material/Shape	Quality Class
EIP-501	Mechanical equipment or parts thereof	MQC2-3

EIP-501 Inspection of welding and other joining Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Dimensional inspection ¹⁶⁾	5-707	MQ
Visual inspection ¹⁶⁾	5-708	MQ
Inspection of heat treatment	5-709	MQ
Test of weld filler material	5-710	MQ
Inspection of welding ¹⁶⁾	5-711	MQ
PT or MT of weld	5-713 5-714	L
UT of surfacing weld ^{4), 18)}	5-721	L
UT of welded joint ^{4), 18), 21), 22)}	5-720	L
RT of welds ^{4), 18), 23)}	5-722	L
Review of radiograph ¹⁸⁾	5-722	L
Inspection of pipe bending ²⁴⁾	5-724	MQ
Inspection of fasteners in concrete ¹³⁾	5-726	MQ
Inspection of installation of couplings ^{9), 24)}	5-727	MQ, EQ

24. GENERAL REQUIREMENT FOR INSTALLED SYSTEM, PART OF SYSTEM OR REPAIR (EIP-600) IN MQC2-3

24.1. General inspection points – Installed system, part of system or repair

Designation	Material/Shape	Quality Class
EIP-601	Mechanical equipment or parts thereof	MQC2-3

EIP-601 Inspection of pipes, piping and associated load bearing equipment Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class
		MQC2-3
Marking and identification	6-706	MQ, EQ
Dimensional inspection	6-707	MQ, EQ
Visual inspection	6-708	MQ, EQ
Pressure and tightness testing	6-712	MQ, EQ, A1
Final inspection ²⁶⁾		A1
Cleanliness of installed system	6-729	M
Review of final quality control documentation	6-730	MQ, EQ, A1
Operations test	6-731	E, EQ, A1
Inspection of corrosion protection	6-744	M
Inspection of installation (End of installation)	6-748	E, EQ, A1
Certificate of compliance/conformity	6-749	A1

25. GENERAL INSPECTION POINT FOR BASE MATERIAL, (EIP-200) IN MQC4

25.1. Pressure –retaining equipment or parts

Designation	Material/Shape	Quality Class
EIP-210	Forgings and bars, castings and plates	MQC4
EIP-211	Pipes and pipe fittings, heat exchanger tubes	MQC4
EIP-212A	Bolts and nuts (special)	MQC4
EIP-212B	Bolts and nuts (standard)	MQC4
EIP-213	Bellows for valves and pressure vessels and pipes	MQC4

EIP-210 Inspection of base material Forgings, bars, casting and plates Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ	MQ
Additional mechanical testing of material ¹⁾	2-702	MQ	MQ
Intergranular corrosion test ^{1), 2)}	2-704	MQ	N/A
Marking and identification	2-706	MQ	MQ
Dimensional inspection	2-707	MQ	M
Visual inspection	2-708	MQ	M
Heat treatment	2-709	MQ	M

EIP-211 Inspection of base material Pipes, pipe fittings and heat-exchange tubes Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ	MQ
Additional mechanical testing of material ¹⁾	2-702	MQ	M
Intergranular corrosion test ^{1), 2)}	2-704	MQ	N/A
Marking and identification	2-706	MQ	MQ
Dimensional inspection	2-707	MQ	M
Visual inspection	2-708	MQ	M
Heat treatment	2-709	MQ	M
Pressure and tightness testing ^{1), 7)}	2-712	MQ	MQ
Cold bending of heat exchanger tubes and qualification report	2-725	MQ, EQ	MQ, EQ

Welded pipes or -fittings in quality class 4 are accepted if they are manufactured according to EN 10217-7 [33] respective EN 10253-2 [34] and EN 10253-4 [35]

EIP-212A Inspection of base material Bolts and Nuts (Special) Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ	MQ
Additional mechanical testing of material ¹⁾	2-702	MQ	MQ
Marking and identification	2-706	MQ	MQ
Dimensional inspection	2-707	MQ	M
Visual inspection	2-708	MQ	M
Heat treatment	2-709	MQ	M

EIP-212B Inspection of base material Bolts and Nuts (Standard) Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Material certificate acc. to EN 10204-2.1 ^{1), 8)}	2-701	MQ	MQ
Marking and identification ⁸⁾	2-706	MQ	MQ
Dimensional inspection	2-707	MQ	M
Visual inspection	2-708	MQ	M

EIP-213 Inspection of base material Bellows for valves, pressure vessels and pipes Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Material certificate acc. to EN 10204-3.1 ¹⁾	2-701	MQ	MQ
Intergranular corrosion test ^{1), 2)}	2-703	MQ	N/A
Marking and identification	2-706	MQ	MQ
Dimensional inspection	2-707	MQ	M
Visual inspection	2-708	MQ	M
Heat treatment	2-709	MQ	M

25.2. Load-bearing equipment or parts

Designation	Material/Shape	Quality Class
EIP-214	Plates and forgings for load-bearing equipment and parts, or in material for fasteners in concrete	MQC4

EIP-214 Inspection of base material Material for loading bearing equipment and parts, or in material for fasteners in concrete Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Material certificate acc. to EN 10204-2.1 ^{1), 6)}	2-701	MQ	MQ
Marking and identification ^{6), 14)}	2-706	MQ	M
Dimensional inspection	2-707	MQ	M
Visual inspection	2-708	MQ	M
Heat treatment	2-709	MQ	M

Material for anchor elements such as:

- Spring assemblies
- Constant load hangers
- Snubbers for dynamic loads

shall be inspected and tested to the extent that is stated in the external provider's approved product specification or the type inspection certificate for the element in question.

25.3. Internal parts or in equipment and components

Designation	Material/Shape	Quality Class
EIP-215	Material for internal parts or in mechanical equipment (Plate, bars, pipe and forgings)	MQC4

"The mechanical quality class refers to the main component"

EIP-215 Inspection of base material Material for internal parts or in mechanical equipment Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Material certificate acc. to EN 10204-3.1 ¹⁵⁾	2-701	M	M

26. GENERAL INSPECTION POINTS AT MANUFACTURE, WELDING, OTHER JOINING AND PIPE BENDING, (EIP-300) IN MQC4

26.1. Mechanical equipment or parts of devices

Designation	Material/Shape	Quality Class
EIP-302	Inspection of welding, other joining and pipe bending	MQC4

EIP-302 Inspection of welding, other joining and pipe bending Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Dimensional inspection ¹⁷⁾	3-707	MQ	M
Visual inspection ¹⁷⁾	3-708	MQ	M
Inspection of heat treatment	3-709	MQ	M
Test of weld filler metal	3-710	MQ	M
Inspection of welding ¹⁷⁾	3-711	MQ	M
PT of weld ¹⁸⁾	3-713	L	L ¹⁹⁾
MT of weld ¹⁸⁾	3-714	L	L ¹⁹⁾
UT of welded joint ^{4), 18), 21), 22)}	3-720	L	L ¹⁹⁾
UT of surfacing weld ^{4), 18)}	3-721	L	L ¹⁹⁾
RT of welded joint ^{4), 18), 23)}	3-722	L	L ¹⁹⁾
Review of radiographic ¹⁸⁾	3-722	L	L ¹⁹⁾
Inspection of pipe bending ²⁴⁾	3-724	MQ	M
Inspection of installation of couplings ²⁴⁾	3-727	MQ	M

27. GENERAL REQUIREMENTS FOR FINISHED EQUIPMENT, (EIP-400) IN MQC4

27.1. General inspection points for completed mechanical equipment or part of device

Designation	Material/Shape	Quality Class
EIP-405	Pipes, pipe fittings and tubes	MQC4
EIP-406	Valves and pumps	MQC4
EIP-407	Heat exchangers, pressure vessels and tanks	MQC4
EIP-408	Load bearing equipment such as; hangers and supports	MQC4
EIP-409	Inspection of non-pressure, “completed” internal parts	MQC4

EIP-405 Inspection pipes, pipe fittings and tubes Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Marking and identification	4-706	MQ, EQ	MQ
Dimensional inspection	4-707	MQ, EQ	MQ
Visual inspection	4-708	MQ, EQ	MQ
Pressure and tightness testing ²⁵⁾	4-712	MQ, EQ, A2	MQ
Final Inspection ²⁰⁾		A2	N/A
Inspection of cleanliness	4-728	M	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A2	MQ, EQ
Inspection of packing and preservation	4-732	M	M
Issuing Product Certificate ²⁰⁾	4-747	A2	N/A
Certificate of compliance/conformity	4-749	MQ	MQ

EIP-406 Inspection of valves and pumps Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Marking and identification	4-706	MQ, EQ	MQ
Dimensional inspection	4-707	MQ, EQ	MQ
Visual inspection	4-708	MQ, EQ	MQ
Final Inspection ²⁰⁾		A2	N/A
Inspection of cleanliness	4-728	M	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A2	MQ, EQ
Inspection of packing and preservation	4-732	M	M
Balancing of pumps	4-733	M	M
Strip Test of pumps etc.	4-734	M	M
Pressure and tightness testing of valves	4-735 4-736 4-737 4-738	MQ, EQ, A2 ³²⁾	MQ
Function test of valves	4-739 4-740	M	M
Function and pressure test of pumps	4-741 4-742	MQ, EQ, A2 ^{31, 32)}	MQ
Inspection of corrosion protection	4-744	M	M
Issuing Product Certificate ²⁰⁾	4-747	A2	N/A
Certificate of compliance/conformity	4-749	MQ	MQ

EIP-407 Inspection of heat exchangers, pressure vessels and tanks Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Marking and identification	4-706	MQ, EQ	MQ
Dimensional inspection	4-707	MQ, EQ	MQ
Visual inspection	4-708	MQ, EQ	MQ
Pressure and tightness testing ¹²⁾	4-712	MQ, EQ, A2	MQ
Final Inspection ²⁰⁾		A1	N/A
Inspection of cleanliness	4-728	M	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A2	MQ, EQ
Inspection of packing and preservation	4-732	M	M
Inspection of corrosion protection	4-744	M	M
Issuing Product Certificate ²⁰⁾	4-747	A2	N/A
Certificate of compliance/conformity	4-749	MQ	MQ

EIP-408 Inspection of Load bearing equipment such as: hangers and supports Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Marking and identification	4-706	MQ, EQ	MQ
Dimensional inspection	4-707	MQ, EQ	MQ
Visual inspection	4-708	MQ, EQ	MQ
Final Inspection ²⁰⁾		A2	N/A
Inspection of cleanliness	4-728	M	M
Review of final quality control documentation ²⁷⁾	4-730	MQ, EQ, A2	MQ, EQ
Inspection of packing and preservation	4-732	M	M
Inspection of corrosion protection	4-744	M	M
Issuing Product Certificate ²⁰⁾	4-747	A2	N/A
Certificate of compliance/conformity	4-749	MQ	MQ

EIP-409 Inspection of non-pressure, “completed” internal parts Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Marking and identification	4-706	M	N/A
Dimensional inspection	4-707	M	N/A
Visual inspection	4-708	M	M
Inspection of cleanliness	4-728	M	M
Review of final quality control documentation ²⁷⁾	4-730	M	M
Inspection of packing and preservation	4-732	M	M
Inspection of corrosion protection	4-744	M	M
Certificate of compliance/conformity	4-749	MQ	MQ

28. GENERAL REQUIREMENT FOR INSTALLATION AND REPAIR INSPECTION (EIP-500) IN MQC4

28.1. General inspection points – installation or repair

Designation	Material/Shape	Quality Class
EIP-502	Mechanical equipment or parts thereof	MQC4

EIP-502 Inspection of welding and other joining Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Dimensional inspection ¹⁷⁾	5-707	MQ	M
Visual inspection ¹⁷⁾	5-708	MQ	M
Inspection of heat treatment	5-709	MQ	M
Test of weld filler material	5-710	MQ	M
Inspection of welding ¹⁷⁾	5-711	MQ	M
PT or MT of weld	5-713 5-714	L	L ¹⁹⁾
UT of welded joint ^{4), 18), 21), 22)}	5-720	L	L ¹⁹⁾
UT of surfacing weld ^{4), 18)}	5-721	L	L ¹⁹⁾
RT of welds ^{4), 18), 23)}	5-722	L	L ¹⁹⁾
Review of radiograph ¹⁸⁾	5-722	L	L ¹⁹⁾
Inspection of pipe bending ²⁴⁾	5-724	MQ	M
Inspection of fasteners ¹³⁾	5-726	MQ	M
Inspection of installation of couplings ^{9), 24)}	5-727	MQ	M

29. GENERAL REQUIREMENT FOR INSTALLED SYSTEM, PART OF SYSTEM OR REPAIR (EIP-600) IN MQC4

29.1. General inspection points – Installed system, part of system or repair

Designation **Material/Shape** **Quality Class**
EIP-602 Mechanical equipment or parts thereof MQC4

EIP-602 Inspection of pipes, piping and associated load bearing equipment Remarks: See chapter 30	Examination procedure EEP No:	Symbols (sec 12.3) acc. to quality class	
		MQC4 A-B	MQC4 C
Marking and identification	6-706	MQ, EQ	MQ, EQ
Dimensional inspection	6-707	MQ, EQ	MQ, EQ
Visual inspection	6-708	MQ, EQ	MQ, EQ
Pressure and tightness testing	6-712	MQ, EQ, A2	MQ, EQ
Final inspection ²⁰⁾		A2	N/A
Cleanliness of installed system	6-729	M	M
Review of final quality control documentation	6-730	MQ, EQ, A2	MQ, EQ
Operations test	6-731	E, EQ, A2	E, EQ
Inspection of corrosion protection	6-744	M	M
Inspection of installation (End of installation)	6-748	E, EQ, A2	E, EQ
Certificate of compliance/conformity	6-749	A2	MQ

30. REMARKS

- ¹⁾ If the manufacturer's quality system fulfils the requirements of part A section 8, it can be performed as symbol MQ
- ²⁾ Applies to austenitic stainless steel material
- ³⁾ Does not intend to castings
- ⁴⁾ A detailed procedure shall be drawn up and be approved by ESS. For MQC2-3 it must also be approved by an Accredited Inspection Body
- ⁵⁾ Applies to plate with a thickness $\geq 10\text{mm}$
- ⁶⁾ For anchoring elements the marking and identification should be as in approved material standard
- ⁷⁾ Can be replaced by ET or UT according to applicable material standard or technical delivery conditions
- ⁸⁾ Requirements:
 - For carbon steel, if the parts are marked with the manufacturer's name and strength classes, no certificates are required
 - For stainless steel, if the parts are marked with the manufacturer's name, strength class and the material designation e.g. A2, A4 and 660, no certificate are required
- ⁹⁾ If not pressure and tightness testing can be carried out, the extent of the visual inspection shall be 100 %
- ¹⁰⁾ Applies not to material for bellows in valves
- ¹¹⁾ Applies for details that is transmitting lateral loads
- ¹²⁾ For open tanks only tightness testing, is required
- ¹³⁾ Shall be carried out according to the instructions in the type approval documentation
- ¹⁴⁾ For type approval expanded fasteners, according to the National Swedish Board of Buildings / SITAC (Swedish Institute for Technical approval in construction) or corresponding body e.g. within European Organization for Technical approvals (EOTA), the material testing prescribed in the type approval certificate are accepted
- ¹⁵⁾ Certificate according to EN 10204-3.1 applies to parts that are not a series produced parts. For series produced parts and in quality class MQC4 C it's sufficient with EN 10204-2.1 or equivalent
- ¹⁶⁾ Supervision by the Accredited Inspection Body should be performed by these own routines
- ¹⁷⁾ Supervision by the Accredited Body or a Notified Body should be performed by these own routines. Applies not to MQC4 inspection class C
- ¹⁸⁾ Authorization for testing, see part A, section 8
- ¹⁹⁾ If required by ESS
- ²⁰⁾ According to the Accredited Body's or the Notified Body's own routines
- ²¹⁾ Applies to weld in ferrites steel with thickness $\geq 10\text{ mm}$
- ²²⁾ Applies to butt weld, corner weld, T-joint weld and weld buttering
- ²³⁾ Applies to weld, corner weld and weld buttering
- ²⁴⁾ The inspection shall be performed according to approved procedure
- ²⁵⁾ Can be performed at the manufacturer's workshop
- ²⁶⁾ According to the Accredited Inspection Body's own routines
- ²⁷⁾ Can be performed as a receipt inspection at the ESS facility or as a final inspection at the manufacturers shop. ESS can determine where the inspection will be carried out
- ²⁸⁾ Applies to valves
- ²⁹⁾ Applies to pumps
- ³⁰⁾ Symbol A1, only applies to the pressure testing
- ³¹⁾ Symbol A2, only applies to the pressure testing
- ³²⁾ Can be supervised by AIB or AB (depending of quality class)

31. GLOSSARY

Term	Definition
AFS	The Swedish Work Environment Authority's Statute Book
ASNT	American Society for Non-destructive Testing
ASME	American Society for Mechanical Engineers
AV	The Swedish Work Environment Authority
AIB	Accredited Inspection Body according to SSM
AL	Accredited Testing Laboratory
AB	Accredited Body according to SWEDAC or similar foreign authority
BFS	Statutes of National Board of Housing, Building and Planning
CoC	Certificate of Conformity
DB	Design Basis Mechanical (KFM)
DDS	Design Specification Mechanical (KS-MEK)
DoC	Declaration of Compliance
DUP	Detailed Ultrasonic Testing Procedure
ESS	European Spallation Source
EXTERNAL PROVIDER	Producer (Manufacturer/Supplier/In-Kind), distributor, retailer or vendor of a product or a service, according to ISO 9000:2015
HAZ	Heat Affected Zone
HVAC	Heating, Ventilation and Air Conditioning system
IoI	Inspection of Installation
ISI	In-Service Inspection
MQC	Mechanical Quality Class
NDT	Non-Destructive Testing
NB	Notified Body according to AFS accredited according to EN ISO/IEC 17020
P&P	Plant & Process design
PED	Pressure Equipment Directive, 2014/68/EU
PIC	Product Inspection Certificate
PSAR	Preliminary Safety Analysis Report
RCC-MRx	2012 Afcen RCC-MRx Code "For design and construction rules for mechanical components of nuclear installations"
REESQ - MECH	ESS Rules for Quality Regulation – Mechanical Equipment
SAR	Safety Analysis Report
SIS	Swedish Standards Institute
SSM	The Swedish Radiation Safety Authority
STAFS	Statute-book of The Board of Technical Inspection
SWEDAC	The Board for accreditation and technical inspection

32. REFERENCES

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DOCUMENT REVISION HISTORY

Revision	Reason for and description of change	Author	Date
1	First issue	Cecilia Lowe	2017-05-02
2	Title of this document changed Chapter 1.2, 3.3, 3.4 and 3.4.2 are updated Chapter 3.6.3 to 3.6.5 are added Chapter 3.9, 13.2, 16.2, 18.1, 19.3, 19.6, 19.8, 21.1–24.1, 26.1–29.1, 31 and 32 are updated Title updated on References [10], [11], [17] and [60]	Kent Ödbratt/ Cecilia Lowe	2017-09-27
3	Chapter 1.2, 2, 3.3, 3.6, 3.7.2, 3.7.3, 11.2, 11.6, 12.3, 15.1, 15.3, 20.1, 20.3, 21.1, 22.1, 23.1, 25.3, 26.1, 27.1 and 28.1 are updated Chapter 3.4, 3.10.1 to 3.10.3, 18.8 are added Chapter 30 New remarks are added ³⁰⁾ to ³²⁾ Chapter 32 New references are updated or added [6], [15], [46] and [62]	Kent Ödbratt	2018-03-20