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Fatigue assessment of hydraulic turbine runners: from design to quality assurance

CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references.....	5
3 Terms, definitions, symbols and units	6
3.1 General	6
3.2 General terms and definitions	6
3.3 Units	10
3.4 Acronyms	11
3.5 Subjective terms.....	11
4 Stress history from expected load events	11
4.1 Purpose and scope.....	11
4.2 Load events	11
4.3 Stress history and stress spectrum.....	13
4.4 Stresses determined by calculation	14
4.4.1 Stresses in steady state conditions.....	14
4.4.2 Stresses in transient conditions.....	18
4.5 Stresses determined from on-site strain measurements	18
4.5.1 General.....	18
4.5.2 Test procedure	19
4.5.3 Instrumentation, acquisition and signal treatment.....	19
4.5.4 Hotspot stress history determination	19
5 Fatigue life assessment.....	21
5.1 Purpose and scope.....	21
5.2 S-N curve assessment	22
5.2.1 Design S-N curve.....	22
5.2.2 Mean stress effect.....	23
5.2.3 Residual stress.....	24
5.2.4 Cumulated damage calculation.....	24
5.3 Fracture mechanics assessment	25
5.3.1 General.....	25
5.3.2 Loading conditions	25
5.3.3 Fatigue crack growth law	26
5.3.4 Fatigue crack growth threshold.....	27
5.3.5 Definition of flaw	28
5.3.6 Recommended crack growth limit for calculations.....	28
5.3.7 Stress intensity factor solution.....	29
6 Manufacturing and quality assurance.....	29
6.1 Purpose.....	29
6.2 Engineering instruction for manufacturing.....	30
6.2.1 Designer responsibilities.....	30
6.2.2 Hotspot area definition	30
6.3 Quality management.....	32
6.4 Manufacturing requirements.....	32
6.4.1 Material properties	32
6.4.2 Welding	32
6.4.3 Defects removal.....	33

6.4.4	Post-weld heat treatment	34
6.4.5	Non-destructive testing (NDT)	34
6.4.6	Corrosion protection.....	36
6.4.7	Manufacturing tolerances.....	36
Annex A (informative) Finite element analysis best practices		37
Annex B (informative) Guidance on the necessity of conducting a fatigue assessment.....		39
B.1	General	39
B.2	Suggested characteristic of runners for which a fatigue assessment is not required.....	39
B.3	Suggested requirements and allowable stresses when fatigue assessment is not required	40
Bibliography.....		41
Figure 1 – Constant amplitude loading illustration of the main fatigue stress parameters		10
Figure 2 – Example of load events included in a start-stop sequence.....		13
Figure 3 – Example of a Francis runner strain measurement history during a start-stop sequence with multiple power outputs [1].....		13
Figure 4 – Stochastic stress history of a steady state condition		16
Figure 5 – Standard normalized stochastic stress spectrum curve and stress spectra from real strain gauge data from which it was defined		17
Figure 6 – Stress spectra combination method for stochastic stresses and periodic stresses originating from (a) RSI and (b) part-load vortex rope.....		18
Figure 7 – Schematic representation of (a) the localisation of strain gauges, (b) the predicted strain pattern and (c) the superposition of the strain gauges within the predicted strain pattern [9].....		20
Figure 8 – Example of a goodness-of-fit representation between measurement and simulation results		21
Figure 9 – Design S-N curve for 13 %Cr-4 %Ni stainless steel in river water at $R = -1$ (see 4.3 for stress amplitude calculation).....		23
Figure 10 – Illustration of the effect of the modified Goodman's model on the design S-N curve for various mean stress values.....		24
Figure 11 – Creation of the design fatigue life load history based on typical 1-year load histories from assembled load sequences for fracture mechanics assessments		26
Figure 12 – Standardized crack propagation curves for 13 %Cr-4 %Ni stainless steel according to Equation (5)		27
Figure 13 – Definition of recommended initial flaw shapes for a) surface flaws b) embedded flaws		28
Figure 14 – Location and definition of hotspot areas on a Francis runner		31
Figure 15 – Location and definition of hotspot areas on a Kaplan runner blade		31
Table 1 – Example of specified expected steady state conditions		12
Table 2 – Example of specified expected transient conditions		12
Table 3 – Main sources of runner excitation		14
Table 4 – Design S-N curve coefficients for 13%Cr-4%Ni stainless steels in river water.....		22
Table 5 – Parameters of the 13 %Cr-4 %Ni fatigue crack growth law		27
Table 6 – Recommended PWHT parameters for runners.....		34
Table 7 – Acceptance criteria for non-destructive tests on surface excavations, finished hotspot areas weld reworks and finished hotspot areas		36

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

1 Scope

This International Standard applies to runners of reaction turbines, regardless of their size and capacity. These can include radial turbines such as Francis turbines, axial turbines such as Kaplan and propeller turbines, as well as diagonal turbines, in all possible configurations. In the case of turbine runners with adjustable blades, the internal mechanical components of the blades' adjustment mechanism are excluded from this document. Pelton turbines, storage pumps and pump-turbines are not covered in this first edition, even though several topics are applicable to these types of hydraulic machines. Specificities and applicability to Pelton turbine and pump-turbines will be discussed in a later revision of the standard

This document outlines the methodologies for conducting a fatigue assessment of turbine runners. It encompasses several key aspects, such as defining the load events to be considered during the assessment, determining stresses for each of these load events, as well as the detailed approaches for assessing fatigue of new and existing runners. Additionally, it includes manufacturing and quality assurance requirements to be complied with to achieve the desired material fatigue properties and effectively apply the proposed fatigue assessment methodologies. This document also contains best practices for performing and analysing on-site strain gauge measurements performed on existing runners to evaluate their fatigue life.

The purpose of this document is to provide guidelines to assess fatigue in new and existing turbine runners. It does not specify if a fatigue assessment should be performed or not for a given runner. However, Annex B provides guidance to evaluate the necessity of realizing a fatigue assessment or not for a given new runner. The methods described in this document can also be used for remaining life assessments of in-service runners. However, it is important to consider that the assessed runner materials' fatigue properties and quality level could differ from the prescriptions found in the manufacturing and quality assurance section of this document which have been defined for new runners. It is also important to mention that fatigue assessment alone is not sufficient for a complete validation of the mechanical integrity of a new runner design. Other mechanical validations not covered in this document are typically conducted.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60193:2019, *Hydraulic turbines, storage pumps and pump-turbines - Model acceptance tests*

BS 7910:2019, *Guide to methods for assessing the acceptability of flaws in metallic structures*

CCH 70-4, *Specification for Inspection of Steel Castings for Hydraulic Machines*

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