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Documents d'appel d'offres –

Partie 2:
Guide des spécifications techniques pour les turbines Francis

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

HYDRAULIC TURBINES, STORAGE PUMPS AND PUMP-TURBINES – TENDERING DOCUMENTS –

Part 2: Guidelines for technical specifications for Francis turbines

FOREWORD

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The main task of IEC technical committees is to prepare International Standards. In exceptional circumstances, a technical committee may propose the publication of a technical report of one of the following types:

- type 1, when the required support cannot be obtained for the publication of an International Standard, despite repeated efforts;
- type 2, when the subject is still under technical development or where for any other reason there is the future but no immediate possibility of an agreement on an International Standard;
- type 3, when a technical committee has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

Technical reports of types 1 and 2 are subject to review within three years of publication to decide whether they can be transformed into International Standards. Technical reports of type 3 do not necessarily have to be reviewed until the data they provide are considered to be no longer valid or useful.

IEC 61366-2, which is a technical report of type 3, has been prepared by IEC technical committee 4: Hydraulic turbines.

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The text of this technical report is based on the following documents:

Committee draft	Report on voting
4/110/CDV	4/122/RVC

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

Technical Report IEC 61366-2 is one of a series which deals with Tendering Documents for hydraulic turbines, storage pumps and pump-turbines. The series consists of seven parts:

Part 1: General and annexes (IEC 61366-1)

Part 2: Guidelines for technical specification for Francis turbines (IEC 61366-2)

Part 3: Guidelines for technical specification for Pelton turbines (IEC 61366-3)

Part 4: Guidelines for technical specification for Kaplan and propeller turbines (IEC 61366-4)

Part 5: Guidelines for technical specification for tubular turbines (IEC 61366-5)

Part 6: Guidelines for technical specification for pump-turbines (IEC 61366-6)

Part 7: Guidelines for technical specification for storage pumps (IEC 61366-7)

Parts 2 to 7 are "stand-alone" publications which when used with IEC 1366-1 contain guidelines for a specific machine type (i.e. Parts 1 and 4 represent the combined guide for Kaplan and propeller turbines). A summary of the proposed contents for a typical set of Tendering Documents is given in the following table 1 and annex A. Table 1 summarizes the arrangement of each part of this guide and serves as a reference for the various chapters and sections of the Tendering Documents (see 3.2 of this part).

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A bilingual edition of this technical report may be issued at a later date.

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Table 1 – Summary of guide for the preparation of Tendering Documents for hydraulic turbines, storage pumps and pump-turbines

CONTENTS OF GUIDE IEC 61366-1 TO IEC 61366-7		
Part	**Clause**	**Title**
1		General and annexes
1	–	
1	1	Object and scope of this guide
1	2	Reference documents and definitions
1	3	Arrangement of Tendering Documents
1	4	Guidelines for tendering requirements
1	5	Guidelines for project information
1	6	Guidelines for general conditions, special conditions and general requirements
1		Annexes
	A	Sample table of contents of Tendering Documents for Francis turbines
	B	Comments on factors for evaluation of tenders
	C	Check list for tender form
	D	Examples of technical data sheets
	E	Technical performance guarantees
	F	Example of cavitation pitting guarantees
	G	Check list for model test specifications
	H	Sand erosion considerations
2 to 7		Technical specifications
2		Francis turbines
3		Pelton turbines
4		Kaplan and propeller turbines
5		Tubular turbines
6		Pump-turbines
7		Storage pumps

SAMPLE TABLE OF CONTENTS OF TENDERING DOCUMENTS (TD) (Example for the Francis turbines; see 61366-1, annex A)	
Chapter	**Title**
1	Tendering requirements
2	Project information
3	General conditions
4	Special conditions
5	General requirements
6	Technical specifications
6.1	Technical requirements
6.1.1	Scope of work
6.1.2	Limits of the contract
6.1.3	Supply by Employer
6.1.4	Design conditions
6.1.5	Performance and other guarantees
6.1.6	Mechanical design criteria
6.1.7	Design documentation
6.1.8	Materials and construction
6.1.9	Shop inspection and testing
6.2	Technical specifications for fixed/embedded components
6.3	Technical specifications for stationary/removable components
6.4	Technical specifications for guide vane regulating apparatus
6.5	Technical specifications for rotating parts, bearings and seals
6.6	Technical specifications for thrust bearings
6.7	Technical specifications for miscellaneous components
6.8	Technical specifications for auxiliary systems
6.9	Technical specifications for instrumentation
6.10	Spare parts
6.11	Model tests
6.12	Installation and commissioning
6.13	Field acceptance tests

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HYDRAULIC TURBINES, STORAGE PUMPS AND PUMP-TURBINES – TENDERING DOCUMENTS –

Part 2: Guidelines for technical specifications for Francis turbines

0 Introduction to technical specifications

The main purpose of the technical specifications is to describe the specific technical requirements for the hydraulic machine for which the Tendering Documents (TD) are being issued. To achieve clarity and to avoid confusion in contract administration, the Employer should not specify anything in the Technical Specifications which is of importance only to the preparation of the Tender. Such information and instructions should be given only in the Instructions to Tenderers (ITT). Accordingly, the ITT may refer to other chapters and sections of the Tendering Documents but not vice versa. *As a general rule the word "Tenderer" should be confined in use only to TD chapter 1 "Tendering Requirements"; elsewhere the term "Contractor" should be used.*

Special attention should be given to items of a project specific nature such as materials, protective coating systems, mechanical piping systems, electrical systems and instrumentation. It is common for the Employer to use technical standards for such items which would apply to all contracts for a particular project or projects. In this event, detailed technical standards should be specified in TD chapter 5 "General requirements".

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Technical specifications for the various types of hydraulic machines included in this guide are provided in the following parts:

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– Francis turbines (Part 2);
– Pelton turbines (Part 3);
– Propeller and Kaplan turbines (Part 4);
– Tubular turbines (Part 5);
– Pump-turbines (Part 6);
– Storage pumps (Part 7).

The guidelines for preparation of Francis turbine specifications include technical specifications for the following:

– Design conditions: Project arrangement, hydraulic conditions, specified conditions, mode of operation, generator characteristics, synchronous condenser characteristics, transient behaviour data, stability of the system, noise, vibration, pressure fluctuations and safety requirements.
– Technical performance and other guarantees:
  • power;
  • discharge;
  • efficiency;
  • maximum momentary pressure;
  • minimum momentary pressure;
  • maximum momentary overspeed;
  • maximum steady state runaway speed;

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- cavitation pitting;
- hydraulic thrust;
- maximum weights and dimensions for transportation, erection and maintenance.

– Mechanical design criteria: design standards, stresses and deflections and special design considerations (earthquake acceleration, etc.).

– Design documentation: Contractor's input needed for the Employer's design, Contractor's drawings and data, Contractor's review of the Employer's design and technical reports by Contractor.

– Materials and construction: material selection and standards, quality assurance procedures, shop methods, corrosion protection and painting.

– Shop inspection and testing: general requirements and reports, material tests and certificates, dimensional checks, shop assembly and tests.

– Fixed/embedded components: spiral case with compressible wrapping (if any), stay ring, foundation ring, discharge ring, draft tube, draft tube liner, pit liner, and foundation plates and anchorage.

– Stationary removable components: headcover, bottom ring (may be fixed), facing plates, stationary wearing ring, guide vanes.

– Regulating apparatus for guide vanes: servomotor, connecting rods, regulating ring, guide vane linkage system, guide vane overload protection and locking devices.

– Rotating parts, bearings and seals: runner, main shaft, intermediate shaft, guide bearing with oil supply, oil/water cooler, main shaft seal, standstill (maintenance) shaft seal.

– Thrust bearing (when part of the hydraulic machine supply): bearing support, thrust block, rotating ring, thrust bearing pads and pivots, oil sump with oil supply (common with guide bearing, if any), oil/water coolers, instrumentation.

– Miscellaneous components: walkways, lifting fixtures, special tools, standard tools, turbine pit hoist, nameplate, draft tube maintenance platform.

– Auxiliary systems: runner pressure balancing and pressure relief lines, turbine pit drainage and other drainage systems; lubrication, draft tube air admission, tailwater depression, cooling water supply for runner seal for blow-down operation.

– Instrumentation: controls, indication and protection.

– Spare parts: basic spare parts.

– Model tests: test requirements.

– Site installation and commissioning: installation procedures and commissioning tests.

– Field acceptance tests: scope of field tests, reports and inspection of cavitation pitting.

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An example of the proposed table of contents for Tendering Documents for a Francis turbine is given in annex A. The example does not include technical specifications for the control system, relief valves, or high and low pressure side valves or gates which, at the Employer's option, may be included in the Tendering Documents for the Francis turbine, or may be specified in separate documents.

Chapter 6 (technical specifications) of the Tendering Documents should be arranged as follows:

6.1 Technical requirements;

6.2 Technical specifications for fixed/embedded components;

6.3 Technical specifications for stationary/removable components;

6.4 Technical specifications for guide vane regulating apparatus;

6.5 Technical specifications for rotating parts, guide bearings and seals;

6.6 Technical specifications for thrust bearing;

6.7 Technical specifications for miscellaneous components;

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6.8 Technical specifications for auxiliary systems;

6.9 Technical specifications for instrumentation;

6.10 Spare parts;

6.11 Model acceptance tests;

6.12 Site installation and commissioning;

6.13 Field acceptance tests.

1 Scope

This technical report, referred to herein as the Guide, is intended to assist in the preparation of Tendering Documents and tendering proposals and in the evaluation of tenders for hydraulic machines. This part of IEC 61366 provides guidelines for Francis turbines.

2 Reference documents

IEC 60041:1992, *Field acceptance tests to determine the hydraulic performance of hydraulic turbines, storage pumps and pump-turbines*

IEC 60193:1965, *International code for model acceptance tests of hydraulic turbines*

IEC 60308:1970, *International code for testing of speed governing systems for hydraulic turbines*

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IEC 60609:1978, *Cavitation pitting evaluation in hydraulic turbines, storage pumps and pump-turbines*

IEC 60994:1991, *Guide for field measurement of vibrations and pulsations in hydraulic machines (turbines, storage pumps and pump turbines)*

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IEC 61362,— *Guide to specification of hydro-turbine control systems* [1)]

ISO 3740:1980, *Acoustics – Determination of sound power levels of noise sources – Guidelines for the use of basic standards and for the preparation of noise test codes*

3 Technical requirements

3.1 Scope of work

This subclause should describe the scope of work and the responsibilities which are to be conferred upon the Contractor. The general statement of scope of work presented in TD [2)] section 2.1 (5.1 of IEC 61366-1) shall be consistent with what is presented here. In a similar manner, pay items in the tender form, TD section 1.2 (4.2) should be defined directly from TD subsection 6.1.1.

The scope of work should begin with a general statement which outlines the various elements of the work including (where applicable) the design, model testing, supply of materials and labour, fabrication, machining, quality assurance, quality control, shop assembly, shop testing, spare parts, transportation to site, site installation, commissioning, acceptance testing, warranty and other services specified or required for the items of work.

The general statement should be followed by a specific and detailed list of the major items which the Employer wishes to have as separate payment items in the tender form, for example:

---

1) To be published.

2) All references to Tendering Documents (TD) apply to annex A of IEC 61366-1.

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Item	Description
1	six (6) vertical shaft Francis type hydraulic turbines each with a specified power of not less than 102 000 kW under a specified specific hydraulic energy of 1 960 J/kg (specified head of 200 m);
2	turbine model testing;
3	tools, slings and handling devices required for maintenance of the turbines;
4	transportation and delivery to site;
5	site installation, commissioning and acceptance testing of the turbines;
6	preparation and submission of operation and maintenance manual and training of Employer's operating and maintenance staff in optimum use of these manuals; and
7	Spare parts required for operation and maintenance.

3.2 Limits of the contract

This subclause, by making reference to the Employer's drawings and data, should describe in detail the limits of the Contract considering the following:

– details of the design and supply limits of the high and low pressure sides of the machine;
– details, location and responsibility for field connection to spiral case and penstock or valve on the high-pressure side;
– details and location of the downstream termination of the draft tube liner;
– details and location of gate(s) or valve(s) on low-pressure side;
– orientation and location of the turbine/generator shaft interface;
– responsibility for supply and installation of flange coupling bolts, nuts and guards at generator/turbine coupling, including drilling jig;
– responsibility for supply and installation of bolts, nuts, gaskets at piping termination;
– termination of governor piping;
– termination of spiral case and draft tube dewatering piping;
– termination of spiral air exhaust piping (if any);
– termination of pit drainage piping;
– termination of bearing lubricating oil piping;
– termination of piping (if required) to carry upper runner seal leakage to the draft tube;
– termination of shaft seal piping (if any);
– termination of piping for air admission system (if any) and for runner pressure balancing system (if any);
– termination of cooling water piping for bearings;
– turbine headcover mounted thrust bearing (if specified);
– termination points and junction boxes for wiring for power, control, indication, protection, and lighting;
– compressed air for service and other functions.

NOTE – Contract limits will change if other major items of equipment (such as hydro-turbine control system, turbine inlet valves, generators, excitation systems, control metering and relaying systems, switchgear, and power transformers) are included with the turbine equipment in a common set of Tendering Documents.

3.3 Supply by Employer

This subclause should be complementary to 5.6 of IEC 61366-1 (TD section 2.6), and should list the items and services which will be the responsibility of the Employer. The following items should be considered:

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