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Vodilo za elektromehansko opremo malih hidroelektrarn

Electromechanical equipment guide for small hydroelectric installations

Anleitung für die elektromechanische Ausrüstung von kleinen Wasserkraftanlagen

Guide pour l'équipement électromécanique des petits aménagements hydro-électriques

Ta slovenski standard je istoveten z: prEN IEC 61116:2024

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TITLE:

Electromechanical equipment guide for small hydroelectric installations

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ELECTROMECHANICAL EQUIPMENT GUIDANCE FOR
SMALL HYDROELECTRIC INSTALLATIONS

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FOREWORD

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99 all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international
100 co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and
101 in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports,
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106 Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.

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130 IEC 61116 has been prepared by IEC technical committee 4: Hydraulic turbines. It is an
131 International Standard.

132 This second edition cancels and replaces the first edition published in 1992. This edition
133 constitutes a technical revision.

134 This edition has been subject to a thorough review and incorporates many comments received
135 at the various revision stages.

136 The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

137

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

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

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

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

- 148 • reconfirmed,
- 149 • withdrawn,
- 150 • replaced by a revised edition, or
- 151 • amended.

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ELECTROMECHANICAL EQUIPMENT GUIDANCE FOR SMALL HYDROELECTRIC INSTALLATIONS

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1 Scope

160 This document is used as a guidance that applies to hydroelectric installations containing
161 impulse or reaction turbines with unit power up to about 15 MW and reference diameter of about
162 3 m. These figures do not represent absolute limits.

163 This document deals only with the direct relations between the purchaser or the consulting
164 engineer and the supplier. It does not deal with civil works, administrative conditions or
165 commercial conditions.

166 This document is intended to be used by all concerned in the installation of
167 electromechanical equipment for small hydroelectric plants.

168 This document, based essentially on practical information, aims specifically at supplying
169 the purchaser of the equipment with information which will assist him with the following:

- 170 – preparation of the call for tenders;
- 171 – evaluation of the tenders;
- 172 – contact with the supplier during the design and manufacture of equipment;
- 173 – quality control during the manufacture and shop-testing;
- 174 – follow-up of site erection;
- 175 – commissioning;
- 176 – acceptance tests;
- 177 – operation and maintenance.

178 The document comprises the following:

- 179 a) general requirements for the electromechanical equipment of small hydroelectric
180 installations;
- 181 b) technical specifications for the electromechanical equipment, excluding its
182 dimensioning and standardization;
- 183 c) requirements for acceptance, operation and maintenance.

184 Bearing in mind the type of installation considered, the necessary documents are intended
185 to be as simple as possible but to satisfactorily define the particular operation conditions.
186 Over-specification is harmful to the economy of the project.

187 This document does not cover the initial stage of investigations, that is to say the preliminary
188 study and feasibility study. Neither does it deal with the economic study concerning the
189 supply and demand of energy.

190 To conclude, the document does not replace the necessary engineering studies for the
191 selection, design, manufacture, installation and testing of the equipment. It is intended only
192 to make the purchaser aware of the important points and data to be furnished, specified
193 and kept in due consideration in the construction of small hydroelectric plants.

2 Normative references

195 There are no normative references in this document.

196 **3 Terms, definitions, symbols and units**

197 **3.1 General**

198 For the purposes of this document, the following terms and definitions apply.

199 ISO and IEC maintain terminological databases for use in standardization at the following
200 addresses:

201 • ISO Online browsing platform: available at <https://www.iso.org/obp>

202 • IEC Electropedia: available at <https://www.electropedia.org>

203 **3.2 General terminology**

204 **3.2.1**

205 **power station**

206 An installation whose purpose is to generate electricity and which includes civil engineering
207 works, energy conversion equipment and all the necessary ancillary equipment.

208 [SOURCE: IEC 60050-602:1983, 602-01-01]

209 **3.2.2**

210 **hydroelectric installation**

211 An ordered arrangement of civil engineering structures, machinery and plant designed chiefly to
212 convert the gravitational potential energy of water into electricity.

213 [SOURCE: IEC 60050-602:1983, 602-01-03]

214 **3.2.3**

215 **hydroelectric power station**

216 A power station in which the gravitational energy of water is converted into electricity.

217 [SOURCE: IEC 60050-602:1983, 602-01-04]

218 **3.2.4**

219 **run-of-river power station**

220 A hydroelectric power station which uses the river flow as it occurs, the filling period of its
221 own reservoir by the cumulative water flows being practically negligible.

222 [SOURCE: IEC 60050-602:1983, 602-01-05]

223 **3.2.5**

224 **reservoir power station**

225 A hydroelectric power station in which the filling period of the reservoir based on the
226 cumulative water flows is longer than several weeks.

227 Note 1 to entry: A reservoir power station generally permits the cumulative water flows to be stored during the high
228 water periods to enable the turbine to operate during later high load periods.

229 [SOURCE: IEC 60050-602:1983, 602-01-07]

230 **3.2.6**

231 **gross head of a hydroelectric power station**

232 The difference in height between the headwater and tailwater levels under specified conditions.

233 [SOURCE: IEC 60050-602:1983, 602-01-11, modified – Replacement of “water intake and tail-
234 race” with “headwater and tailwater”.]

235 **3.2.7**

236 **net head of a hydroelectric power station**

237 The gross head of a hydroelectric power station less a height equivalent to the hydraulic losses
238 excluding those in the turbines.

239 [SOURCE: IEC 60050-602:1983, 602-01-12]

- 240 **3.2.8**
241 **generating set**
242 A group of rotating machines transforming mechanical or thermal energy into electricity.
- 243 [SOURCE: IEC 60050-602:1983, 602-02-01]
- 244 **3.2.9**
245 **hydroelectric set**
246 A generating set consisting of a hydraulic turbine mechanically connected to an electrical
247 generator.
- 248 [SOURCE: IEC 60050-602:1983, 602-02-03]
- 249 **3.2.10**
250 **dam**
251 A structure to retain water inflows for specific uses.
- 252 [SOURCE: IEC 60050-602:1983, 602-02-05]
- 253 **3.2.11**
254 **penstock**
255 A pipeline bringing water under pressure to the turbine.
- 256 [SOURCE: IEC 60050-602:1983, 602-02-09]
- 257 **3.2.12**
258 **surge tank; surge shaft**
259 An open-surface reservoir of water decreasing the effects of shock pressure waves in the
260 penstock.
- 261 [SOURCE: IEC 60050-602:1983, 602-02-10]
- 262 **3.2.13**
263 **impulse type turbine**
264 A turbine in which a fluid acts chiefly by its kinetic energy.
- 265 [SOURCE: IEC 60050-602:1983, 602-02-11]
- 266 **3.2.14**
267 **reaction type turbine**
268 A turbine in which a fluid acts both by its kinetic energy and by its pressure.
- 269 [SOURCE: IEC 60050-602:1983, 602-02-12]
- 270 **3.2.15**
271 **Pelton turbine**
272 A hydraulic impulse type turbine usually operated from a high head source with small flow rate.
- 273 [SOURCE: IEC 60050-602:1983, 602-02-13]
- 274 **3.2.16**
275 **Francis turbine**
276 A hydraulic reaction type turbine with fixed runner blades usually operated from a medium or
277 low head source with medium flow rate.
- 278 [SOURCE: IEC 60050-602:1983, 602-02-14]
- 279 **3.2.17**
280 **Kaplan turbine**
281 An axial hydraulic reaction type turbine with adjustable runner blades operated with a high
282 flow rate.
- 283 [SOURCE: IEC 60050-602:1983, 602-02-15]

284 **3.2.18**285 **bulb-type unit**

286 A hydroelectric set with its casing containing the generator and turbine immersed in the water
287 flow.

288 [SOURCE: IEC 60050-602:1983, 602-02-16]

289 **3.2.19**290 **propeller turbine**

291 A Kaplan type turbine with non-adjustable runner blades suitable for non-varying head sources.

292 [SOURCE: IEC 60050-602:1983, 602-02-17]

293 **3.2.20**294 **unit generator transformer**295 **set transformer**

296 A transformer connected to the generator terminals through which output power of the generator
297 set is transmitted to the system.

298 [SOURCE: IEC 60050-602:1983, 602-02-31]

299 **3.2.21**300 **auxiliary transformer of a unit [of a powerstation]**

301 A transformer supplying auxiliaries of a unit [of a power station].

302 [SOURCE: IEC 60050-602:1983, 602-02-32(33)]

303 **3.2.22**304 **gross output of a set**

305 The electrical power produced at the terminals of the main and auxiliary generators of the set.

306 [SOURCE: IEC 60050-602:1983, 602-03-04]

307 **3.2.23**308 **gross output of a power station**

309 The electrical power produced at the terminals of the main and auxiliary generators of a power
310 station.

311 [SOURCE: IEC 60050-602:1983, 602-03-05]

312 **3.2.24**313 **net output of a set**

314 The gross output less the power consumed by the associated auxiliaries.

315 [SOURCE: IEC 60050-602:1983, 602-03-06]

316 **3.2.25**317 **net output of a power station**

318 The gross output less the power consumed by the associated auxiliaries and less the losses in
319 the associated transformers.

320 [SOURCE: IEC 60050-602:1983, 602-03-07]

321 **3.2.26**322 **power demand from the system**

323 The power which has to be supplied to the system in order to meet the demand.

324 [SOURCE: IEC 60050-602:1983, 602-03-13]

325 **3.3 Units**

326 The International System of Units (SI, see ISO 80000-4) has been used throughout this
327 document.

328 All terms are given in SI Base Units or derived coherent units (for example N instead of
329 $\text{kg}\cdot\text{m}\cdot\text{s}^{-2}$). The basic equations are valid using these Units. This has to be taken into account

330 if other than coherent SI-Units are used for certain data (for example kilowatt or megawatt
331 instead of watt for power, kilopascal or bar instead of pascal for pressure, min^{-1} instead of
332 s^{-1} for rotational speed, etc.). Temperatures may be given in degrees Celsius because
333 thermodynamic (absolute) temperatures (in Kelvins) are rarely required.

334 Any other system of units may be used, but only if agreed to in writing by the contracting
335 parties.

336 **4 Methodology**

337 In the interests of clarity, the sequence of the necessary steps for the construction of a
338 small hydroelectric power plant is represented diagrammatically in Figure 1.

339 It principally covers the preparation of technical specifications, the examination of tenders,
340 the manufacture, and finally the commercial operation and maintenance of equipment.

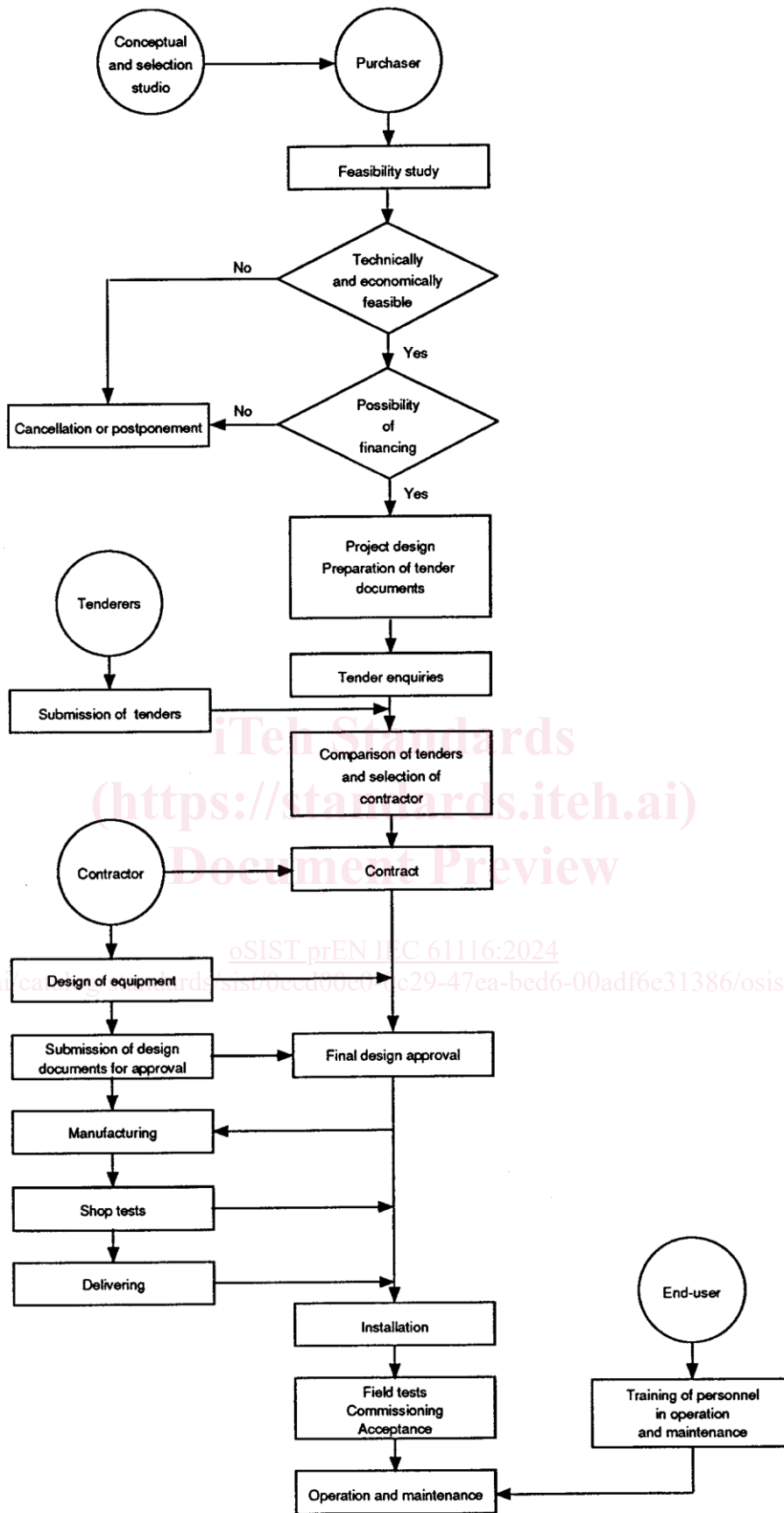
341 This sequence also shows the relationship between the different phases and areas of
342 responsibility of all the parties concerned (consulting engineer, chief resident engineer, and
343 users).

344 If the purchaser does not have in-house engineering capabilities or the services of a consulting
345 engineer he may call for, to facilitate relations with contractors, a "turn-key" supply, or have
346 at least a leading contractor responsible for the supply of all or part of the electromechanical
347 equipment (e.g. the turbine/generator package, or a "water-to-wire" package).

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Figure 1 – Example of sequence of events

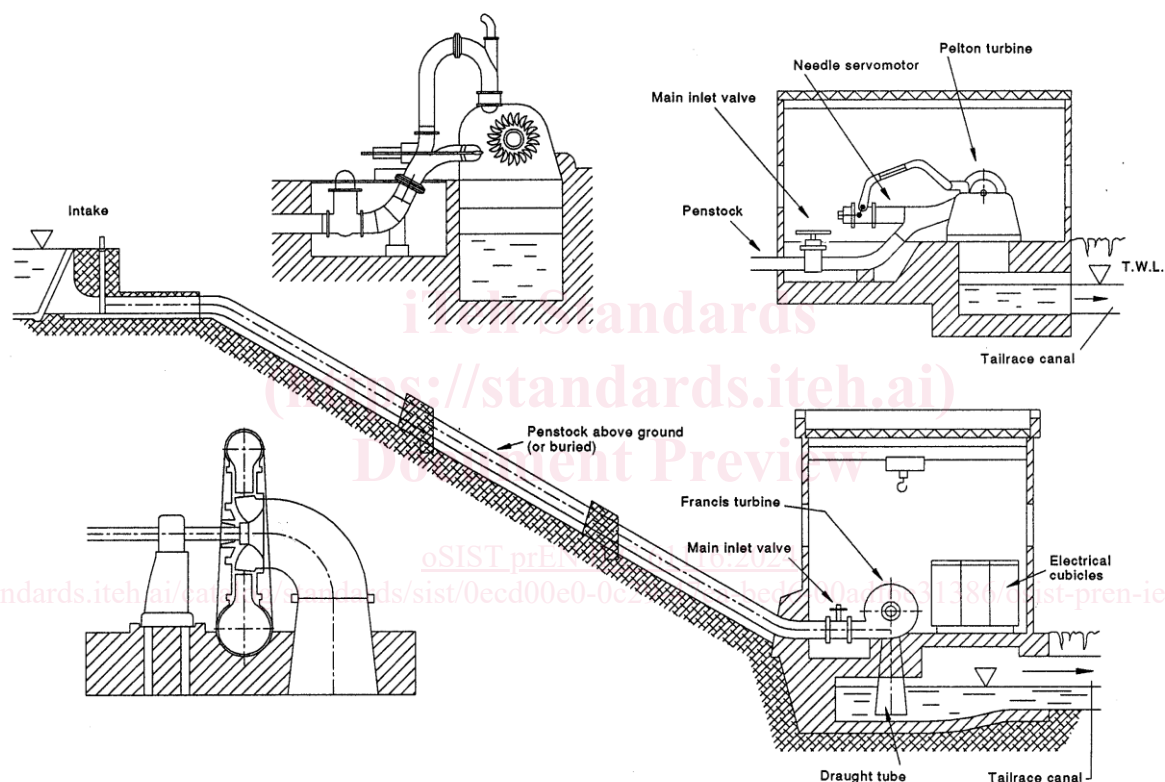
350 5 Description of installation and operating conditions of power station

351 The following data is generally required by the equipment supplier and should appear in
 352 the enquiry. In some cases, all these data are not always readily available. Nevertheless, it
 353 must be emphasized that the more information that is given the better will the project be
 354 understood and therefore the better the technical solution which will result.

355 5.1 Site conditions

356 5.1.1 Supply a topographic survey (plan and profile) giving the altitude of the points
 357 indicated and the position desired for the main works (see Figure 2), water intake, reservoir,
 358 channel, surge tank or head pond, penstock, power plant, headwater, tailwater and their
 359 main characteristics (sections, lengths, materials of the channels and penstocks, etc.).
 360 Indicate the foundation conditions (sand, rock, soft ground, etc.).

361 a)



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363