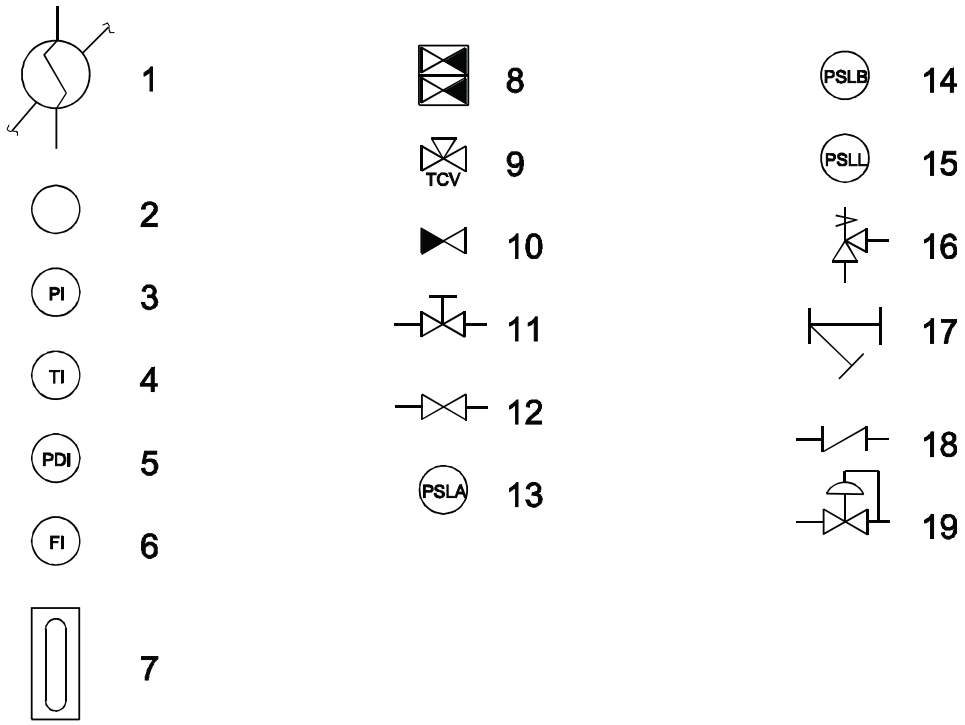
Annex B
(normative)

Cooling water and lubrication system schematics

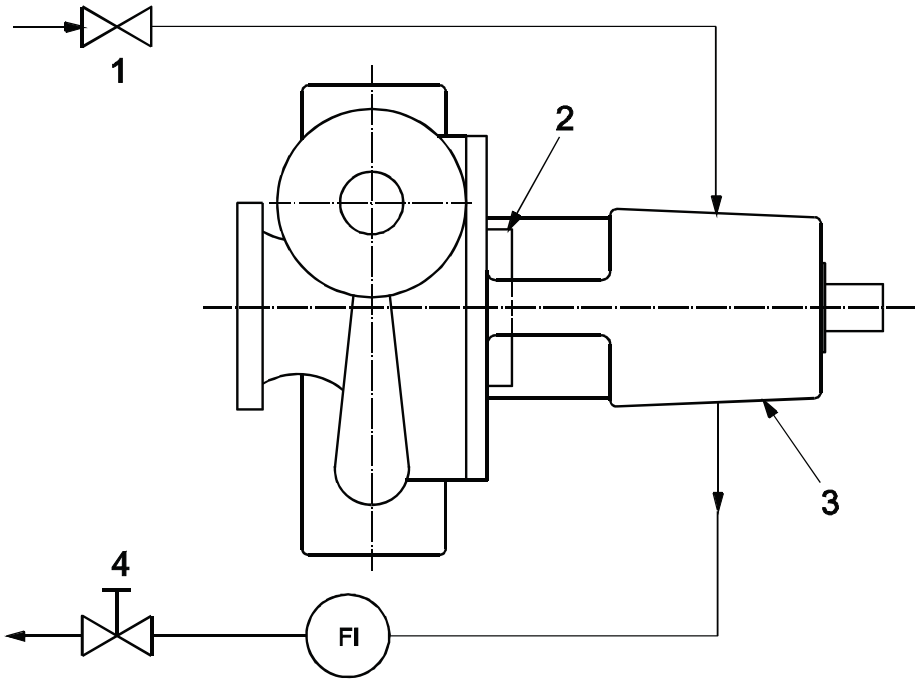
This annex contains schematic diagrams for cooling water and lubrication systems. The symbols used in Figure B.2 through Figure B.8 are shown and identified in Figure B.1. These symbols represent commonly used systems. Other configurations and systems are available and may be used if specified or if agreed upon by the purchaser and the vendor.



Key

1 heat exchanger
2 instrument (letters indicate function)
3 pressure indicator
4 temperature indicator
5 pressure differential indicator
6 flowrate indicator
7 reflex-type level indicator
8 manual 3-way valve (or single transfer valve)
9 temperature control valve
10 block and bleed valve
11 flow-regulating valve
12 block valve (gate valve)
13 low-pressure switch (auxiliary pump start)
14 low-pressure switch (alarm)
15 low-pressure switch (trip)
16 relief valve
17 line strainer
18 check valve
19 pressure control valve

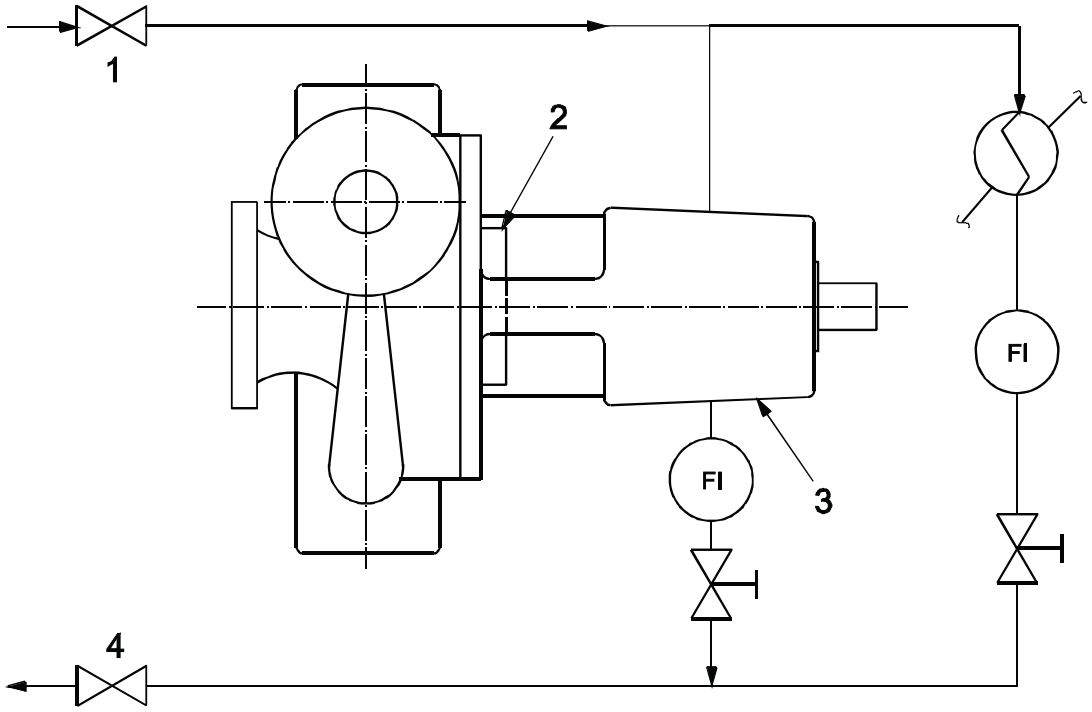
Figure B.1 — Symbols used in Figures B.2 to B.8



Key

1 inlet valve
2 gland
3 bearing housing
4 exit valve

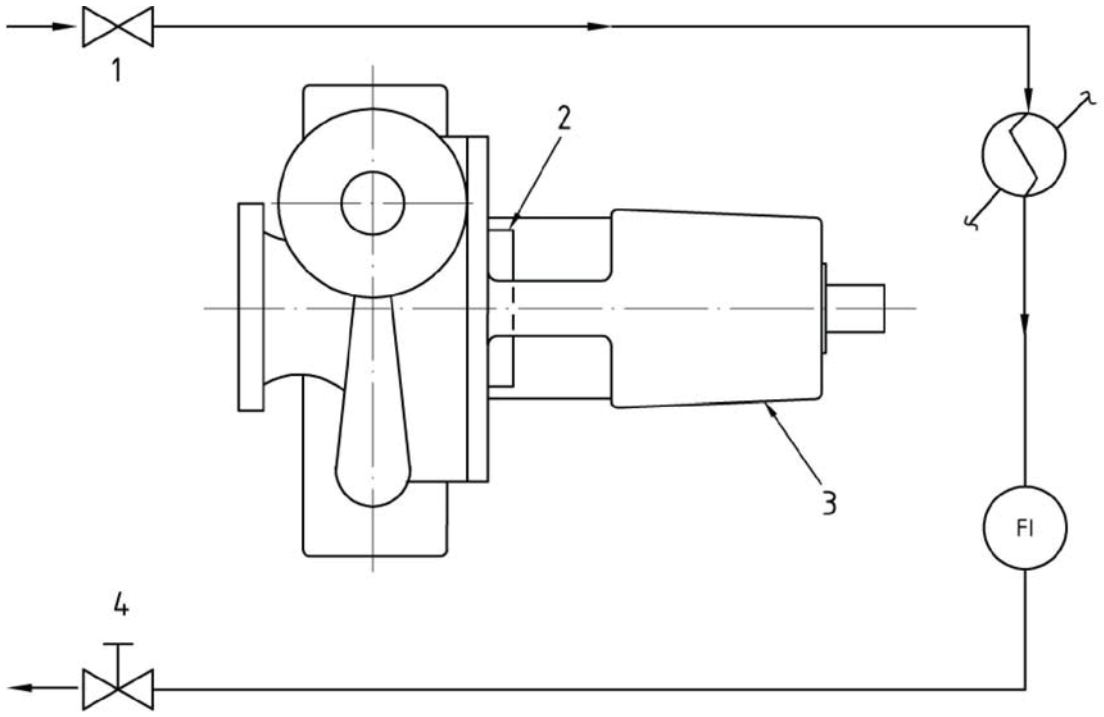
Figure B.2 — Piping for overhung pumps — Plan A, cooling to bearing housing



Key

1 inlet valve
2 gland
3 bearing housing
4 exit valve

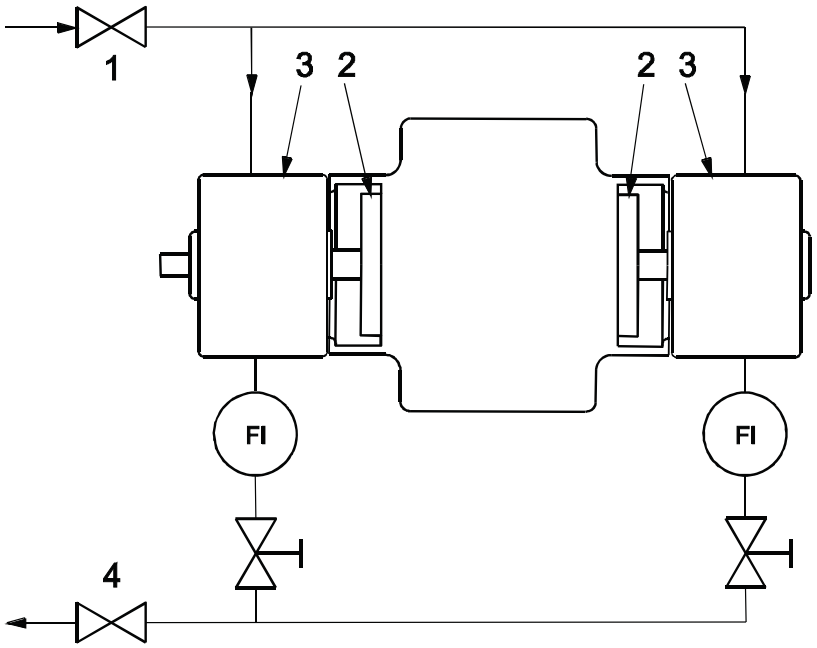
Figure B.3 — Piping for overhung pumps — Plan K, cooling to bearing housing with parallel flow to seal heat exchanger



Key

1 inlet valve
2 gland
3 bearing housing
4 exit valve

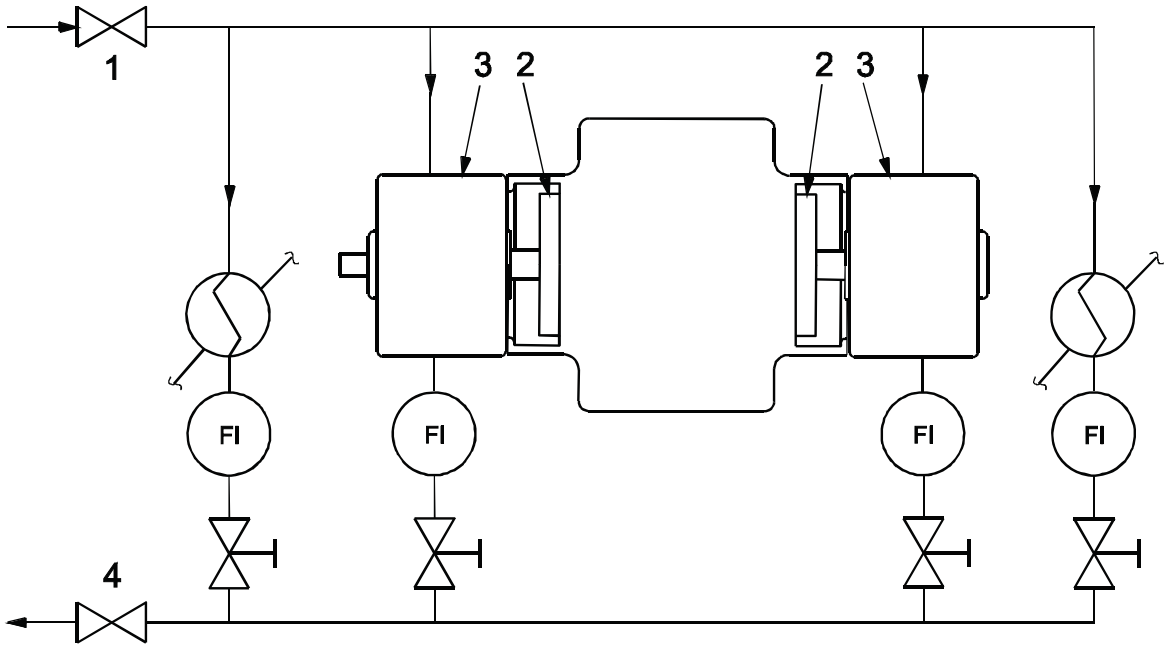
Figure B.4 — Piping for overhung pumps — Plan M, cooling to seal heat exchanger



Key

1 inlet valve
2 gland
3 bearing housing
4 exit valve

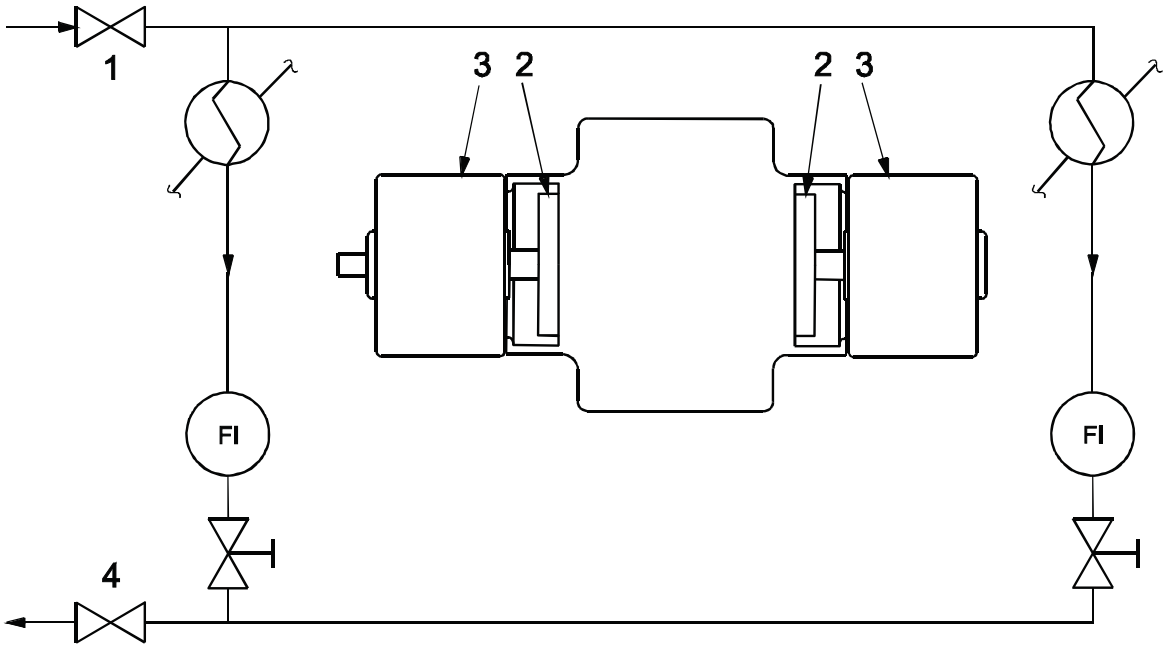
Figure B.5 — Piping for between-bearing pumps — Plan A, cooling to bearing housings



Key

1 inlet valve
2 gland
3 bearing housing
4 exit valve

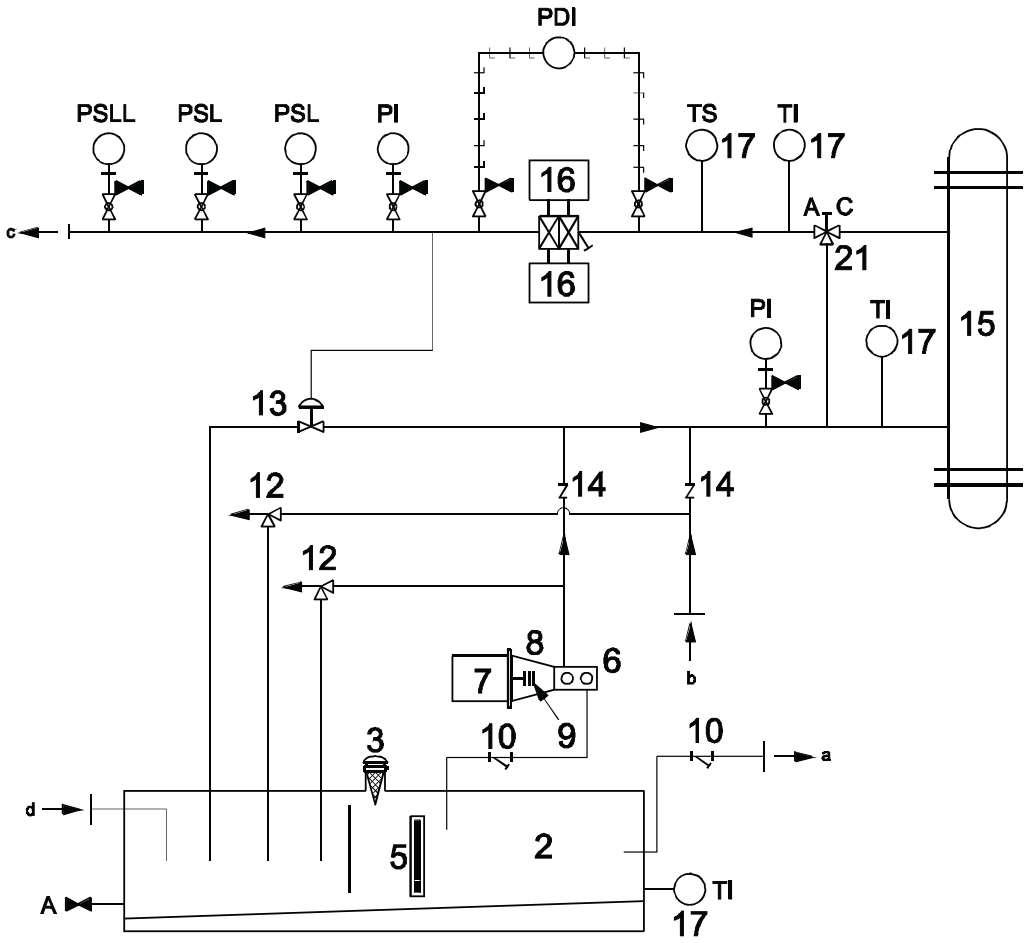
Figure B.6 — Piping for between-bearing pumps — Plan K, cooling to bearing housings with parallel flow to seal heat exchangers



Key

1 inlet valve
2 gland
3 bearing housing
4 exit valve

Figure B.7 — Piping for between-bearing pumps — Plan M, cooling to seal heat exchangers



See Table B.1 for description of key items and console class.

NOTE 1 In the title, "BP0" indicates that the baseplate is part of equipment, "BP1" indicates a stand-alone console, reservoir-mounted. The P&IDs are similar.

NOTE 2 Figure modified from ISO 10438-2:2007, Figure B.1. For the purposes of this provision, API 614-08 is the equivalent of ISO 10438-2:2007.

Figure B.8 — Class II-P0-R1-H0-BP0-C1F2-C0-PV1-TV1-BB0 or Class II-P0-R1-H0-BP1-C1F2-C0-PV1-TV1-BB0

Table B.1 — Key items for Figure B.8 with additional requirements

Key item	Identification/subclause	Note/option	Comments
	Basic design, 4.1	Specify	Console class & code Class II – P0-R1-H0-BP0-C1F2-C0-PV1-TV1-BB0
1	Baseplate		
2	Oil reservoir, 4.4	Specify	4.4.2 Bottom sloped to drain
3	Filter/breather		
4	Drain	Specify	4.4.3 Drain connection (with valve and blind flange) at least 5 cm diameter
5	Level gauge	Specify	4.4.5 d) Oil level glass
6	Lube oil pump		
7	Lube oil pump motor		
8	Pump/motor bracket		
9	Coupling		
10	Strainer		
11	Foot valve/strainer		
12	Pressure-limiting valve		
13	Pressure-control valve		
14	Check valve		
15	Cooler, 4.6		
16	Filter		
17	Thermowell		
18	Vent		
19	Drain		
20	Reservoir heater	Option	4.4.7 a) Electric immersion heater is optional
21	Temperature control valve	Option	4.6.13 Thermostatically operated three-way temperature control valve (TV1) is optional
	Oil piping, 5.2		
	Instrumentation, Clause 6		
PSLL, PSL, PI	Pressure indicators/switches		See ISO 10438-2:2007, Figure B.25.
PDI	Differential pressure		See ISO 10438-2:2007, Figure B.32.
[a]	To shft-driven pump		
[b]	From shft-driven pump		
[c]	To equipment bearing housings		
[d]	From equipment bearing housings	Change	Oil drain piping shall have a minimum slope of 1:50 (20 mm/m [0,25 in/ft])
		Add	6.2 Table 3: a) PSLL for shutdown on low-low oil pressure b) TS for high oil temperature at cooler outlet c) TI in the oil drain line from each bearing or lubricated coupling

Annex C
(normative)

Hydraulic power recovery turbines

C.1 General

This annex applies to hydraulic power recovery turbines (HPRTs).

Power recovery is generally achieved by the reduction of liquid pressure, sometimes with a contribution from vapour or gas evolution during the pressure reduction. A hydraulic power recovery turbine may be a pump operated with reverse flow.

C.2 Terminology

This International Standard uses terms that need to be changed or ignored when the standard is applied to HPRTs. The direction of flow through the HPRT is the reverse of that through the pump. In such a context, the word "pump" should be interpreted as meaning "HPRT", the term "pump suction" should be interpreted as meaning the "HPRT outlet", and the term "pump discharge" should be interpreted as meaning the "HPRT inlet".

C.3 Design

C.3.1 Liquid characteristics

- **C.3.1.1** The purchaser shall advise the HPRT manufacturer whether any portion of the process stream entering the HPRT can flash to vapour and whether absorbed gas in the stream can evolve at any pressure less than the inlet pressure.

- **C.3.1.2** The purchaser shall specify the volume percentage of vapour or gas, or both, at the turbine outlet and the pressure and temperature at which the vapour can flash off.

C.3.1.3 If known, the liquid composition, and the liquid and vapour (or gas) density versus pressure, should also be specified. It can be necessary to control the HPRT outlet pressure to limit the amount of liquid that flashes to vapour or the amount of gas coming out of solution.

C.3.2 Seal-flushing system

To avoid shortening seal life, consideration shall be given to the evolution of gas and vaporization in seal-flushing streams. If this potential exists, a seal flush from other than the HPRT inlet is generally recommended.

C.3.3 Overspeed trip

C.3.3.1 An overspeed trip should be considered if the HPRT and other equipment in the train cannot tolerate the calculated runaway speed (the maximum speed reached by the HPRT when unloaded and subjected to the worst combination of specified inlet and outlet conditions). Typically, overspeed trips are set in the range of 115 % to 120 % of rated speed. It is important to realize that runaway speed with inlet liquids rich in absorbed gas or with liquids that partially flash as they flow through the HPRT can be several times higher than the runaway speed with water. With such liquids, the runaway speed cannot be accurately determined.

C.3.3.2 The risk of overspeed is reduced if the driven equipment, such as a pump or fan, cannot realistically be expected to lose load. The risk is increased if the driven equipment is a generator, since a sudden disconnection from electric power circuits unloads the HPRT. In the latter case, automatic sensing and dummy-load switching should be provided.