Water cooling system basic standards

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Contents

1. General information

This document summarises the principal guidelines with respect to the cooling water system in the SOLARIS synchrotron.

2. Technical description

2.1 The synchrotron technology in relation to the cooling water system

2.1.1 Storage ring (SR)

The cooling water system for the components in the storage ring has the following elements (concerns each ring sector):

1. Main distributing pipeline for straight section front end components: supply and return including balancing valves and cut-off valves, parallel (duplex) filter with degree of filtration 250 µm, finished with threaded ball valve DN 40 (G 1-1/2" internal thread),
2. Main distributing pipeline for magnet section front end components: supply and return including balancing valves and cut-off valves, parallel (duplex) filter with degree of filtration 250 µm, finished with threaded ball valve DN 32 (G 1-1/4" internal thread),
3. Main distributing pipeline for aluminium chambers of the insertion device: supply and return including balancing valves and cut-off valves, mesh filter with degree of filtration 400 µm, finished with threaded ball valve DN 20 (G 3/4" internal thread).

2.1.2 Experimental hall (EH)

The cooling water system in the experimental hall is provided with the following components:

1. Main connections for the beamline infrastructure: supply and return including flange cut-off valves DN32,
2. Infrastructure – frame structure including the sector infrastructure for measuring lines

2.2 Cooling water installations for the synchrotron technology

2.2.1 Cooling water technological parameters

Cooling water is used to heat removal and stabilise the temperature of the synchrotron devices.
The cooling water in the main pipeline has the following parameters:

1) De-ionised low-conductivity cooling water (LCW) for the front end and beamline components:
    a. electrical conductivity within the range from 0.10 to 2.00 µS/cm at +23.5°C
    b. pH value within the range from 7.5 to 8.5
    c. dissolved oxygen content at +23.5°C within 6 to 50 ppb
    d. supply water temperature +23.5±0,5°C
    e. maximum admissible increase of temperature of the return water coming out following the cooling of the device is 10 K
    f. available pressure 6.0 bar
    g. available pressure in the beamline backbone/frame infrastructure 4.5 bar
2) demineralized cooling water (DCW) for aluminium chambers for insertion devices:
    a. electrical conductivity ranging from 10 to 50 µS/cm at +23.5°C; the water is not softened
    b. temperature of supply water +31.0±0,5°C
    c. maximum admissible increase of temperature of the return water coming out following the cooling of the device is 10 K
    d. available pressure 6.0 bar

2.2.2 Materials and fittings used in backbone/frame infrastructure installations and cooling water supply and return manifolds

Depending on the flow and devices supplied with water, the following materials are used in the synchrotron technology.

1. The main circuit of the de-ionised low-conductivity cooling water (LCW), regardless of the intended use of the room is made from the seamless pipelines from stainless steel (marking according to PN: 1H18N9T, marking according to European standard: 1.4541).
2. The main demineralized cooling water system (DCW), regardless of the intended use of the room is made from the double-side galvanized steel and mounted in the Geberit Mapress C-Stahl clamped system.
3. The installation sections defined in this document as copper pipelines should be made, depending on their location using two technologies:

- From installation, hard-brazed copper – should be used in the storage ring. SOLARIS prefers Cupori 110 Premium copper type.
- From clamped copper – in other parts of the building. SOLARIS prefers the connections of Geberit Mapress Kupfer or IBP Instalfittings class. SOLARIS prefers Cupori 110 Premium copper type of its equivalent.

  To avoid vibrations and pipe degradation, the flow rate in copper pipes cannot extend 1 m/s. If this condition cannot be fulfilled, the pipeline must be made from stainless steel.

4. SOLARIS gives in Table 1. the standards currently used for fittings with their producer/supplier:

Tabel 1: Standards for fittings of cooling water

No.	Item	Typ/Model Alternatywnie	Producer/Dostawca Alternatywnie
1.	Flow switch without flow indicator	MRK1K-…GK… and/or DS02.4.2.1.W…	Honsberg and/or PKP Prozessmesstechnik
2.	Flow switch with flow indicator	MRK1K01-…GK… and/or DS02.4.2.1.W…ind	Honsberg and/or PKP Prozessmesstechnik
3.	Flow meter	FLEX-XF-…	Honsberg
4.	Needle valve	240. … ES	Riegler
5.	Spigots at components	Swagelok	Swagelok

2.2.3 Materials and fittings used in the Vacuum Components that require cooling (front-end and beamline)

1. SOLARIS does not define exactly which type of materials should be used in front end, insertion devices and beamline components. The applied materials must be suitable for under and above specified cooling water conditions and material used in SOLARIS backbone/frame infrastructure.
2. The Contractor takes full responsibility for realization of internal cooling system for beamline components that require cooling, in particular when the material is copper or aluminium. However, it is recommended that the water flow should be restricted to 3 m/s (to avoid vibrations and pipe degradation)

2.2.4 Storage Ring

Scope of works and delivery

1. **The Contractor:**

    a. provides executive design of supply and return manifold for the front end components cooling water system, including the fittings specified by SOLARIS containing the hydraulic parameters of the components,

    b. based on the executive design, the Contractor selects, provides and installs: supply and return manifold for the front end components cooling system (including fittings); prefabricates all necessary connections between supply and return manifold and the connection pieces of the individual front end components; where necessary – the adjoining and/or parallel and/or serial connection between the connection pieces of the same component and between the components. The selected fittings, materials and hydraulic connections as well as all other elements not defined but necessary for proper assembly and operation of the front end cooling system should be used at the factory acceptance test (FAT) and delivered to SOLARIS in a reconstituted state and assembled or ready for reassembly by SOLARIS at the installation stage,

    c. provides schematic diagram (executive design is not needed) of cooling water supply and return manifold for the insertion devices components, including the fittings specified by SOLARIS, containing the hydraulic parameters of the components and detailed specification of connections,

    Note: please also provide:

    - the maximum and minimum working pressure, if different then in the Solaris' requirements (for the whole circuit)
    - the pressure difference between supply and return when all components are connected and cooling sub-circuits mounted (for the whole circuit)
    - required flow rates and pressure drop for each component, or a branch (if there is more than one component in series)

    d. execute the connections between supply and return manifold and the individual component connection pieces of the insertion device (usually by using flexible hoses, that will be provided by SOLARIS during the installation phase); where necessary, parallel connection and/or serial connection between the connection pieces of the same component and between the components.

2. **SOLARIS**

    a. based on the executive design, it selects, provides and installs: single connection (usually by using flexible hoses) between main pipeline and supply and return manifold for the front end components cooling system and perform hydraulic balancing,

    b. based on the executive design, mounts during the installation phase: supply and return manifold for the front end components cooling system (incl. fittings); in case the supply and return manifold will be subdivided into several components, SOLARIS installs parallel connection and/or serial connection between all sections of the manifold,

    c. in case of delivery by the Contractor of all defined necessary materials and hydraulic connections, based on the executive design, installs all necessary connections between supply and return manifold and the connection pieces of the individual front end

components; where necessary – the adjoining and/or parallel and/or serial connection between the connection pieces of the same component and between the components,

d. based on schematic diagram, provides executive design and selects, provides and installs: supply and return manifold for the insertion device cooling system (incl. fittings),

e. based on the executive design, it selects, provides and installs: single connection (usually by using flexible hoses) between main pipeline and supply and return manifold for insertion device cooling system.

2.2.5 Experimental Hall

Scope of works and deliveries

1. **The Contractor:**

   a. provides schematic diagram (executive design is not needed) of:

      - beamline components cooling system, including the fittings specified by SOLARIS, containing the hydraulic parameters of the components,
      - and, where necessary – local cooling water supply and return manifolds for the individual or group line components, including suitable fittings.

   b. execute the connections between supply and return manifold (backbone/frame infrastructure) and the connection pieces of the individual beamline components (usually by using flexible hoses, that will be provided by SOLARIS during the installation phase).

   c. in case of necessity to use local manifolds – make connections between local supply and return manifolds and the connection pieces of the individual beamline components (usually by using flexible hoses, that will be provided by SOLARIS during the installation phase).

   d. where necessary, parallel and/or serial connections between the connection pieces for the same component and between the components

2. **SOLARIS:**

   a. provides an executive design of the backbone/frame infrastructure cooling water installation, including the necessary fittings and diagnostics,

   b. based on the executive design, SOLARIS selects, provides and installs the backbone/frame infrastructure including fittings, diagnostics and cooling water connection pieces (supply and return) for components and local distributors of the beamline components.

   c. based on schematic diagram, provides executive design and selects, provides and installs: supply and return manifold for the beamline components (incl. fittings)

   d. carries out hydraulic balancing of the installation

2.3 Industry guidelines

2.3.1 Cooling water system

SOLARIS requires meeting the following requirements to avoid the use of adapters, reduction, non-standard hydraulic elements, etc .:

1. diameters and types of connection spigots on the supply and return manifolds should be the same as the diameters and types of connection spigots on the main distribution pipeline; no requirement is defined for an identical type of connection: external or internal,
2. diameters and types of connection spigots of fittings elements mounted on power supply and return manifolds or other parts of the installation, should be the same as diameters and types of connecting spigots on the front end components and beamline; no requirement is defined for an identical type of connection: external or internal
3. In any other case, the Contractor will provide appropriate adapters, reductions, non-standard elements that ensure compliance with the aforementioned requirements.

Depending on their location, the connection spigots for the main supply and return water connections should be installed at the following distances from the finished floor level:

a) vertical arrangement: bottom edge not lower than 450 mm,
b) horizontal arrangement: bottom edge not lower than 100 mm.

All threaded connections should be sealed witch use of plumbing hemp or Teflon thread. Use of any type of glue or adhesive is not allowed.

All tubes and pipes should be cut to size and assembled during FAT, allowing easy installation process in SOLARIS.

2.3.2 Automation and control

Connection to the PLC system of the control and measuring devices for the cooling water are to be carried out by SOLARIS. These devices should be provided with the analogue outputs 4-20 mA (preferred) and/or 0-10 V.

2.3.3 Installation take-over

During the installation works, the Contractor is obligated to carry out detailed documentation of work progress, covering such subjects as pipeline connections, rinsing and deaeration of pipelines, pressure tests, leak detections and repairs.