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| ICD PCool\_Target |
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|  | Name | Title |
| --- | --- | --- |
| **Owner** | Jens Harborn | Work unit leader - Target Cooling |
| **Reviewer** | Kristoffer Sjögreen | Work unit leader - Target Wheel, drive and shaft |
| **Approver** | Ulf oden |  |

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# Introduction

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Figure 1. Interfaces included in this document marked in red

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|  |

Figure 2. Flange interfaces id numbers and locations

# 2. INTERFACE agreement

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| --- | --- |
| **Description** | **Reference** |
| Signal interfaces  Note that the signals does not go directly between the two systems but via the Process Control system | Section 2.1 |
| Physical connection interfaces | Section 2.2 |
| Requirements put on target wheel | Section 2.3 |
| General process values and parameters | Section 2.4 |
| Cooling media purity requirements (particles < 5 µm, chemical and radiological purity) | ESS-0030664 |

## 2.1 Signal interfaces

| ID | **PCool-200** | **Cooling power order** |
| --- | --- | --- |
| **Requirement** | An order signal from Target wheel to PCool to set a fixed cooling helium flow | |
| **Rationale/Reference** | When e.g. the proton beam it shut off an increased cooling may be needed to remove the decay heat from the tungsten blocks | |

## Physical connection interfaces

| ID | **PCool-201** | **Pipe flange with flow to target** |
| --- | --- | --- |
| **Requirement** | Stainless steel\* DN200, PN16, max temp 150°C\*\*, operational pressure 1.00 MPa, Flow rate max 3.0 kg/s. Maximum leakage rate 10mg/h\*\*\*. | |
| **Rationale/Reference** | To fulfil basic functions | |

| ID | **PCool-202** | **Pipe flange with flow from target** |
| --- | --- | --- |
| **Requirement** | Stainless steel\* DN250, PN16, max temp 250°C\*\*, operational pressure 1.00 MPa. Maximum leakage rate 10mg/h\*\*\*. | |
| **Rationale/Reference** | To fulfil basic functions | |

| ID | **PCool-203** | **Pipe flange with seal flow to/from target** |
| --- | --- | --- |
| **Requirement** | Stainless steel\* DN20, PN16, max temp 50°C, operational pressure 1.00 MPa. Maximum leakage rate 5mg/h\*\*\*. | |
| **Rationale/Reference** | To fulfil basic functions. | |

(\*) Steel quality normal stainless austenitic; general requirement for all pipe parts and fittings

(\*\*) To secure tightness even if abnormal situation

(\*\*\*) To comply with the over-all maximum leakage rate for Target cooling systems [2]

## Requirements put on target wheel

| ID | **PCool-204** | **Maximum amount of particles formed** |
| --- | --- | --- |
| **Requirement** | Maximum amount of particles formed during 5000h of normal operation is 3.5kg | |
| **Rationale/Reference** | To put an upper limit for the total amount of particles to be handled by the filters | |

| ID | **PCool-205** | **Maximum pressure drop over Target** |
| --- | --- | --- |
| **Requirement** | Total pressure drop from target inlet flange to target outlet flange shall be maximum 90 kPa at nominal helium flow of 3kg/s and 40 °C inlet to target | |
| **Rationale/Reference** | To put an upper limit of 150 kPa; 90(target wheel and shaft) + 60(PCool circuit) for the circulators to achieve | |

## 2.4 General process values and parameters

| ID | **Wheel-200** | **Heat removal power** |
| --- | --- | --- |
| **Requirement** | Continuous heat removal of minimum 3.0 MW | |
| **Rationale/Reference** | Based on top level target design decision and proton beam power decision. Machine safety, basic function. | |

| ID | **Wheel-201** | **Cooling media** |
| --- | --- | --- |
| **Requirement** | Helium as cooling media | |
| **Rationale/Reference** | Based on ESS top level decision, according to TDR page 225 | |

| ID | **Wheel-202** | **Cooling media maximum normal flow** |
| --- | --- | --- |
| **Requirement** | Helium maximum normal flow rate is 3.0 kg/s | |
| **Rationale/Reference** | Based on reliability and costs, limited creep and thermal loads on systems, including thermal dilatation of the Target Wheel during operation; if lower flow the outlet temperature will be higher or the inlet temperature must be lower to fulfil requirement Wheel-200, also refer to requirement Wheel-203. | |

| ID | **Wheel-203** | **Cooling media temperature values** |
| --- | --- | --- |
| **Requirement** | Lowest allowed temperature of helium in to target 20°C. Maximum temperature of helium in to target 55°C. Maximum temperature of helium out from the target 250°C. | |
| **Rationale/Reference** | Based on ESS top level decision according to TDR page 225. Basic functions. Above stated limits the inlet temperature to not lower than 20°C but *lowest possible* is limited by the cooling water temperature in system Target Intermediate cooling. The requirement maximum temperature of helium out from the target is limiting the helium flow not below approximately 3.0 kg/s at full proton beam power. | |

| ID | **Wheel-204** | **Maximum operational pressure** |
| --- | --- | --- |
| **Requirement** | Maximum allowed operational pressure 1.1MPa (11 bar) | |
| **Rationale/Reference** | Based on engineering judgment by the target division [1], [3]. Basic functions, cost, safety. | |

| ID | **Wheel-205** | **Minimum operational pressure** |
| --- | --- | --- |
| **Requirement** | Minimum operational pressure 0.7 MPa (7 bar) | |
| **Rationale/Reference** | Based on engineering judgment by the target division [1]. Basic functions, cost. | |

| ID | **Wheel-206** | **Pipe connections adapted for plug removal** |
| --- | --- | --- |
| **Requirement** | The pipe connections to / from the target wheel shall have pipe parts to be disassembled to enable target plug removal | |
| **Rationale/Reference** | (discussed at the interface meeting Francois, Ulf, Kristoffer 14-11-04) | |

| ID | **Wheel-207** | **Seal gas mass flow** |
| --- | --- | --- |
| **Requirement** | Seal buffer gas mass flow shall be in the range of 5 – 100 mg/s | |
| **Rationale/Reference** | Depends on the final target rotational seal solution. The pressure in the seal gas pipe needs to be adopted for a certain flow. | |

| ID | **Wheel-208** | **Seal gas maximum temperature** |
| --- | --- | --- |
| **Requirement** | Seal buffer gas temperature shall be maximum 50 °C | |
| **Rationale/Reference** | Depends on the final target rotational seal solution | |

| ID | **Wheel-209** | **Concentration of particulates** |
| --- | --- | --- |
| **Requirement** | Cooling media maximum concentration of particulates >= 5 µm shall be 1 ppb | |
| **Rationale/Reference** | To limit the erosion effects on the target | |

# References

1. TDR (ESS Technical Design Report)
2. ESS-0012524 SDD-req. Target Helium Cooling
3. ESS-0012362 Decision basis for the pressure in the Target Helium Cooling System

List of Abbreviations

| Abbreviation | Definition |
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# Document Revision history

| Version | Reason for revision | Date |
| --- | --- | --- |
| 1.0 | New document (using new template) | 2015-04-16 |
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