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**WP2 target systems target wheel, drive and shaft Design Specification for  
pressure- and load retaining parts**

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Review

Analysis Report  
Document Number ESS-0037038  
Date Jul 15, 2015  
Revision 1 (20)  
State Review  
Classification

## DOCUMENT REVISION HISTORY

Revision	Reason for revision	Date
1	New Document	2015-09-07

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## **SUMMARY**

This documents defines system parts, design data and classification relevant for the structural verification of target wheel, drive and shaft.

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## **1. INTRODUCTION**

This document serves to form a baseline of data and requirements necessary to be able to review the design of the target wheel, drive and shaft in accordance with SSM Special rules for the ESS facility.

Loads, operational limits and detailed requirements on testing, documentation and reporting are defined in references [8], [9] and [10].

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## 2. SYSTEM AND SYSTEM PARTS

<b>System part</b>
Tungsten blocks
Cassettes
Shroud
Shaft inlet, including inlet side of rotational feedthrough and connection to helium system
Shaft outlet, including outlet side of rotational feedthrough and connection to helium system
Drive unit, bearings, etc
Rotational feedthrough between helium system and drive unit
Vacuum seal between shaft and monolith.

### 3. DESIGN DATA

According to RCC- MRx [2] Section 3 Article RB 3324, Design Pressure and Design Temperature is defined as the actual pressure and temperature during each operating condition.

The selection of Design Pressure, Test Pressure and Relief valve opening pressure is defined according to Pressure Equipment Directive.

System part	Operational Pressure	Operational Temperature	Design Pressure	Design Temperature
Tungsten blocks	-	40- 450 °C	-	-
Cassettes	-	40- 240 °C	-	-
Shroud	1,1 MPa	40- 240 °C	1,3 MPa	250 °C
Shaft inlet, including inlet side of rotational feedthrough and connection to helium system	1,1 MPa	40- 150 °C	1,3 MPa	200 °C
Shaft outlet, including outlet side of rotational feedthrough and connection to helium system	1,1 MPa	40- 240 °C	1,3 MPa	250 °C
Drive unit, bearings, etc	-	20 °C- 50 °C	-	-
Vacuum seal between Monolith and Shaft including bellows	10 <sup>-4</sup> mbar	20 °C- 50 °C	0,1 MPa	100 °C

#### 4. CLASSIFICATION

All components have been defined as safety- related systems, structures and components in [3]. Assigning of mechanical quality class follows [4].

System parts included in the scope of RCC- MRx	Mechanical Quality Class
Tungsten blocks	N/A
Cassettes	MQC2
Shroud	MQC2
Shaft	MQC2
Pressure-retaining parts of Drive Unit, including rotational feedthrough and connection to Helium cooling system	MQC3
Vacuum seal between Monolith and Shaft including bellows	MQC3

System parts outside of RCC-MRx	Classification reference
Not pressure retaining parts of drive unit	2006/42/EG Machinery Directive

##### 4.1. RCC- MRx classification

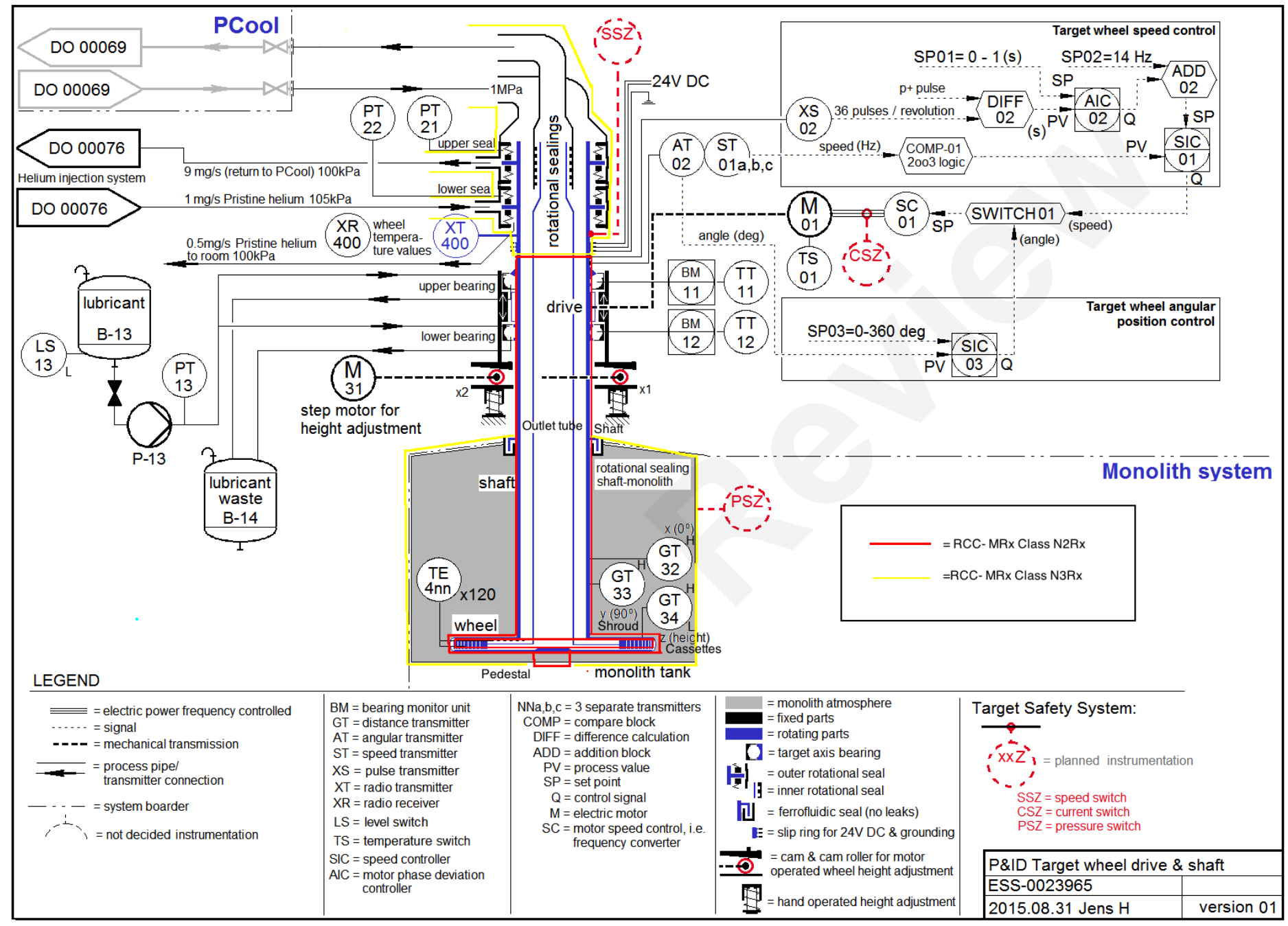
Classification according to RCC- MRx is done using provisions in RCC- MRx Article RDG 4000.

System Part (Table 1)	Key 2	Key 3 and Key 4	Key 6	Note
MQC2	N2rx	*1)	Section III	
MQC3	N3rx	*1)	*1)	

\*1) Analyst's decision



### 5. CLASSIFICATION CHART



## 5.1. Quality Requirements for system parts in class N3Rx

The analyst may qualify components in Class N3Rx according to the European Standards EN 13445 for Pressure vessels, and EN 13480 for piping.

Certain additional demands, specified in [4] and RCC MRx Article REC2000 must be applied.

## 6. INTERFACES AND FORCES

Coordinates are expressed in relation to Target Coordinate System [xx].

Figures express interfacing structures Movement/ Forces relative to Target

Interface	Dimension	Dx	Dy	Dz	Mx	My	Mz	Fx	Fy	Fz
Helium inlet connection	DN 200 PN 25	0	0	-5/+15	0	0	0	0	0	0
Helium outlet connection	DN 250 PN 25	0	0	-5/+15	0	0	0	0	0	0

## 7. PROTECTION AGAINST OVERPRESSURE

The system is protected against overpressure through system 1010 Primary Helium Cooling System.

## 8. MECHANICAL INTERLOCKS LOCKED OPEN- LOCKED CLOSED

There are no mechanical interlocks.

## **9. INNER- AND OUTER ENVIRONMENT**

### **9.1. Inner environment**

Helium

### **9.2. Outer environment**

Atmosphere	Pressure	Temperature
Helium	99,7 kPa	80°C
Vacuum	<10 <sup>-3</sup> mbar	N/A

## **10. RADIATION**

The material is affected by radiation above negligible. Effects of radiation are defined in [11].

## **11. REQUIREMENTS ON CLEANLINESS**

Detailed requirements on cleanliness according to [7].

## **12. REQUIREMENTS RELATED TO INSPECTION**

Detailed requirements on inspection according to [8].

## **13. MATERIAL REQUIREMENTS**

Detailed requirements on material according to [8].

## 14. REFERENCES

- [1] SSM 13-3285 Särskilda villkor till ESS- anläggningen I Lund
- [2] RCC-MRx Rules for Design of Components in Nuclear Plants
- [3] ESS- 0016468 ESS Rule for identification and Classification of Safety related Components
- [4] ESS- 0033258 ESS Rule for Radiological Safety Class
- [5] CEN/ CR 13445:7:2005 Application of EN 13445
- [6] ESS-0003310 Beam on Target Requirements
- [7] ESS-0057344 Monolith Vacuum rules
- [8] ESS-0059807 Detailed requirements on inspection, testing, manufacturing
- [9] ESS-0060625 Description of loads and operational limits
- [10] ESS-0060792 Design Basis for target wheel
- [11] ESS-0037287 Radiation damage analysis for the target wheel