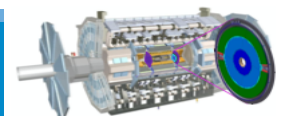

ATLAS HGTD Baseline Schedule Review

WBS 8.5.5

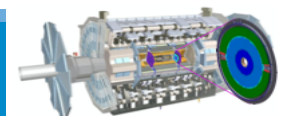
March 24 – April 10, 2020



WBS 8.5.5: Nitrogen system – Dictionary

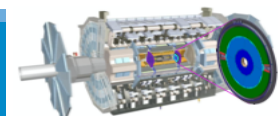
The nitrogen system is necessary for the reason described below.

The HGTD hermetic vessel will be flushed with dry nitrogen to prevent condensation on the detector components, keeping the dew point at $-60\text{ }^{\circ}\text{C}$ or below. For this purpose, the HGTD vessel was designed to be as hermetic as possible. Considering the leak rate from the vessel volume to be better than 1.75×10^{-3} mbar.l/sec, nitrogen volume of 125 liters, acceptable pressure drop of 10%, the nominal over pressure of 5 mbar must be maintained inside the vessel volume. This requirement can be achieved by permanent flushing with dry nitrogen at an overpressure of 0.5% above the atmospheric reference. The nitrogen flow will renew the gas in the vessel volume up to 10 times per hour, which is equivalent to 750 l h^{-1} per end-cap. For gas circulation, one inlet pipe and one outlet pipe, with an inside cross section of approximately 2 cm^2 and 1.3 cm^2 , will be installed for each vessel. For safety reasons, over- and under-pressure relief valves must be installed on the vessel or on the gas lines in proximity to the vessel.



WBS 8.5.5: Nitrogen system – Dictionary

A dedicated for HGTD nitrogen gas plant will be installed in USA15 gas room. The rigid gas pipes of approximately 100 m long will be installed between the gas plant and the experimental cavern. Currently two options are considered for the gas lines inside the service cavern: flexible lines to be installed in flexible chains, such a solution would avoid the disconnection of the gas lines for ATLAS opening, and the rigid pipes up to the calorimeter end cap, which will require disconnecting the pipes and, therefore, stopping the nitrogen flushing before opening ATLAS. The choice depends on space availability in flexible chains and must be studied in collaboration with ATLAS Technical Coordination.



WBS 8.5.5: Nitrogen system – Production Structure/Institutes

The Nitrogen gas plant will be designed and built in collaboration with EP-DT gas group.

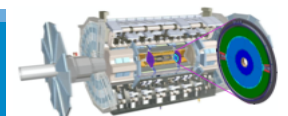
ATLAS Technical Coordination will have responsibility for the planning and installation of the gas plant and the piping up to the calorimeter end caps. The installation of the proximity gas pipes on the calorimeter will be done by HGTD.

At the time of the TDR, CERN expressed an interest to take an overall responsibility for the HGTD Nitrogen gas system.

WBS 8.5.5: Nitrogen system – Schedule Overview

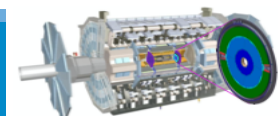
Milestones schedule

PBS	Task Name	Duration	Start	End	Quarter	End Quarter
8.5.5	Nitrogen System	1133 days	17.01.21	30.06.25	Q1 2021	Q2 2025
	SPR	0 days	01.02.21	01.02.21	Q1 2021	Q1 2021
	PDR	0 days	05.07.21	05.07.21	Q3 2021	Q3 2021
	FDR	0 days	15.06.22	15.06.22	Q2 2022	Q2 2022
	PRR	0 days	04.09.22	15.08.22	Q3 2022	Q1 2023
	Production (0-100%)	597 days	16.01.23	04.09.24	Q1 2023	Q3 2024



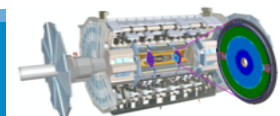
WBS 8.5.5: Nitrogen system – Before SPR 11.05.20 - 01.02.21

- Work out requirements for the dry gas system
 - Complete/optimize the proximity pipes routing on the calorimeter end cap
 - Decide on the routing of gas pipes in collaboration with ATLAS Technical Coordination (TC)
 - Estimate the length of pipes in collaboration with TC
 - Select the candidates for the pressure sensors
 - Review the options for the humidity measurements
-
- The specifications for the N₂ gas system will be released after the SPR for the
 - HGTD Hermetic vessel on 20.01.2021 (according to the planning in TDR).



WBS 8.5.5: Nitrogen system – SPR 01.02.2021

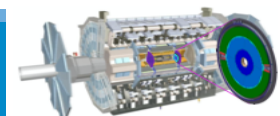
- **In the SPR review and validate:**
 - Specifications of the has system:
 - gas plant performance
 - piping
 - control
 - safety
 - Gas lines disconnection (stop gas supply) procedure for openings



WBS 8.5.5: Nitrogen system – Before PDR 01.02.21-05.07.21

- Develop the gas plant layout, define parameters of the components for gas rack
- Do the routing of pipes in collaboration with TC
- Define parameters of each type of pipes
- Select the pressure sensors for HGTD vessel
- Define the humidity measurements and dew point calculation algorithm
- Develop the algorithmic diagram for gas control
- Define the communications between gas system and DSS and Interlock system

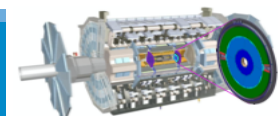
The PDR of the HGTD Hermetic vessel (planned on) to be done before the Nitrogen system PDR



WBS 8.5.5: Nitrogen system – PDR 05.07.21

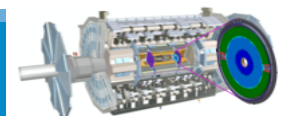
In the PDR review and validate:

- Gas plant design (schematic diagram and components) and performance
- Control, interface between Nitrogen system control and HGTD DCS and DSS/Interlock
- Piping layout and routing
- Parameters of pipes
- Pressure sensors
- Humidity sensors/measurement



WBS 8.5.5: Nitrogen system – Before FDR 05.07.21-15.06.22

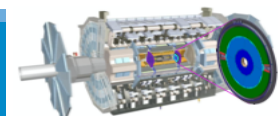
- Select the final components for the nitrogen system and control
- Order and evaluate most critical components, if needed
- Produce necessary drawings of piping and components of gas rack



WBS 8.5.5: Nitrogen system – FDR 15.06.22

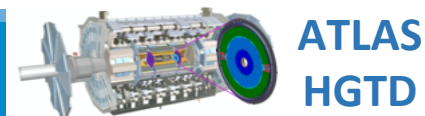
Review and validate:

- Final design of the gas system
- Purchasing and production planning



WBS 8.5.5: Nitrogen system – Before PRR 15.06.22-04.09.22

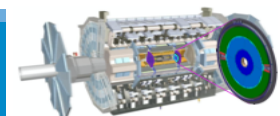
- Obtain and test the pressure sensors and humidity sensors



WBS 8.5.5: Nitrogen system – PRR 04.09.22

Review and validate:

- The final design
- Manufacturers and purchasing plan
- Installation planning and people efforts



WBS 8.5.5: Nitrogen system – Procurement/Production

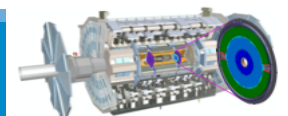
Production 16.01.23 - 04.09.24, 597 days.

The HGTD Nitrogen system will be developed by PH-DT gas group and produced under their supervision, in synergy with the Nitrogen gas plant for ITk.

The rack, the instrumentation of the gas rack and the pipes are available to purchase from industry. The purchasing will take several months.

Taking into account that the PH-DT gas group will also be occupied by other projects, sufficient time is foreseen for the production of the HGTD gas plant.

The production of the piping elements will be planned and organized in synergy with TC.



WBS 8.5.5: Nitrogen system – Risks

The nitrogen gas system is a fairly common system, similar to those that will be used for ATLAS ITk and in CMS. The estimated risks are low.

