G Alignment
UC G1: Determine the value of all linear alignment potentiometers corresponding to the “nominal”¹ chamber position

Characteristic Information

Goal in context: The surveyors make a high resolution photograph of the units mounted on the big wheel with the big wheel on the cavern wall. The TGC alignment sensors (linear potentiometers) must be read out at the time the photograph is taken. The photographs are measured to give the locations in x-y of the four alignment pins in each TGC unit. The potentiometer readings for the chambers at their nominal¹ positions are determined. The big wheel is then moved into position and the sensors are read again and the new positions calculated.

Scope: Alignment

Level: Primary task

Preconditions: All units mounted on the big wheel. All alignment sensors calibrated (if needed). DCS system to read all sensors is operational.

Success end condition: Recording of 2D locations of all chambers with corresponding alignment sensor measurements.

Failed end condition: Incomplete or inconsistent survey data; no alignment sensor data recorded within a few minutes of the measurement.

Primary actor: TGC alignment expert

Trigger:

Main success scenario

Step G1.1: At the surface, a high resolution photograph (200µm accuracy) of each "super-set" (1/12h of a wheel) is taken after its assembly. (There are four alignment pins on each unit.) At the same time, the TGC alignment sensors (linear potentiometers with ±100µm accuracy) which are internal to the super-set are read out and the potentiometer readings for the nominal locations are determined.

Step G1.2: On the cavern wall, after assembly of the whole big wheel, the alignment sensors linking across super-sets are installed, a global high resolution photograph is taken again, and the new values are read out from the TGC alignment sensors.

Step G1.3: A cross check is then performed between the relative displacements observed by the surveyors and the ones measured by the linear potentiometers, and a new reference value for the nominal positions is established.

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¹ The nominal position and orientation of a chamber is the position where the Slave Board coincidence matrix $AR$ (or $A\bar{R}$) = 0 output corresponds to an infinite momentum track (i.e. -N to +N outputs are used, not e.g., -N+1 to +N+1) and physical overlaps match the electronic OR’s exactly.
Step G1.4: Store the values of the potentiometers corresponding to the nominal positions in the database.

Scenario extensions

Step G1.3: The measurement inconsistent with that of Step G1.1: The procedure must be repeated.

Sub-variations

Related Information

Priority:
Performance target: 2 days
Frequency: on initial installation. Also any time a chamber is replaced, all the chambers in that super-set must be re-surveyed.

Superordinate use case:
Subordinate use cases:
Channel to primary actor:
Secondary actors:
Channel to secondary actors:

Open Issues

What about Inner chambers? (EI mounted on barrel toroid, FI on the cryostat.)
What happens when a chamber is replaced? How do we survey it on the big wheel with the big wheel in place?

Schedule

Due Date:

Revision history

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UC G2: Determine current $R-\phi-Z$ position of chambers from current MDT optical alignment and TGC alignment system data

Characteristic Information

Goal in context: Deliver exact position and orientation of every chamber, wire group and strip so that the trigger configuration can be altered to reflect the current geometry and so that the RDAQ can calculate (via a Look-Up Table) the current $R(\phi)$ and $Z$ of each wire group (strip).

Scope: Alignment

Level: Primary task

 Preconditions: Success of UC G1: (Determine the value of all linear alignment potentiometers corresponding to the “nominal”1 chamber position)

Success end condition: alignment data base contains spatial position and orientation of each wire group and strip.

Failed end condition: The alignment database does not contain a valid current reference alignment record.

Primary actor: TGC alignment expert

Trigger: On decision of alignment expert who must receive DCS messages when one or more alignment sensor measurements are outside of tolerance.

Main success scenario

Step G2.1: A measurement of the linear sensors is performed.

Step G2.2: Using the end-cap muon optical alignment system, the absolute locations ($\Delta x=\Delta y=200\mu m$, $\Delta z=2$ mm) of the units crossed by the light beam are determined and a global constrained fit is performed to measure the actual absolute $x,y$ position of each chamber; as far as $z$ is concerned, a model of the big wheel deformation is used to estimate the absolute $Z$ location of each unit from the 8+8 measurements in EndCap and Forward units.

Step G2.3: The alignment expert evaluates if the new $R-\phi-Z$ reference values are sensible.

Step G2.4: If sensible, update the new reference values, the new $\Delta R(\phi)$ offsets for the Sector Logic and the wire groups (strip) coordinates for the RDAQ in the database.

Scenario extensions

Step G2.1: The measured values are inconsistent: Repeat the measurements.

Step G2.2: The measured values are inconsistent: Repeat the measurements.

Step G2.3: The new reference set is not sensible: Diagnostic action on the alignment system must be taken.
Sub-variations

Related Information

Priority:

Performance target: less than one hour or two

Frequency: will be known only after installation

Superordinate use case:

Subordinate use cases:

Channel to primary actor:

Secondary actors:

Channel to secondary actors:

Open Issues

Schedule

Due Date:

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UC G3: Verify precise chamber alignment in R using high momentum muons and/or magnetic field-off data

Characteristic Information

Goal in context:

Scope:

Level: Primary task

Preconditions:

Success end condition:

Failed end condition:

Primary actor: TGC alignment expert

Trigger:

Main success scenario

Step G3.1:
Step G3.2:

Scenario extensions

Step G3.2a: <condition>: <description of action to be performed or the id of sub-use case>

Sub-variations

Related Information

Priority:

Performance target:

Frequency:

Superordinate use case:

Subordinate use cases:

Channel to primary actor:

Secondary actors:

Channel to secondary actors:
Open Issues

Which is preferred: high momentum muons from normal running or tracks from a zero or low field dedicated run? Would a zero or low field run provide data more quickly? A low field run might be cleaner than zero field. Would a run with only the solenoid on be useful?

Can we compare the TGC coordinate of a track determined only by the MDT with the TGC to verify the TGC position? OR do we need the TGC to find the correct MDT hits for such a track?

Can we estimate how many tracks are needed to deliver a specific accuracy? This would determine how long a dedicated alignment run would have to be.

Schedule

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UC G4: Calibrate transverse momentum, $p_T$

Characteristic Information

Goal in context: Simulation is used to define windows in $R$ and $\phi$ corresponding to three high-$p_T$ and three low-$p_T$ thresholds for the Sector Logic. After some period of data taking, the actual thresholds of each TGC sub-sector must be calculated by plotting the $p_T$ as determined by the MDTs for tracks triggered by that sub-sector. The Sector Logic windows must then be redefined.

Scope:

Level: Primary task

Preconditions:

Success end condition:

Failed end condition:

Primary actor: TGC alignment expert

Trigger:

Main success scenario

Step G4.1:
Step G4.2:
Step G4.3:

Scenario extensions

Sub-variations

Related Information

Priority:

Performance target:

Frequency:

Superordinate use case:

Subordinate use cases:

Channel to primary actor:

Secondary actors:
Channel to secondary actors:

Open Issues

Schedule

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