Pierre Auger Observatory Communications Task

Coihueco Communications Tower Specification

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Introduction
This document describes the specification for the communications tower due to be located on the ridge known as ‘Coihueco Norte’ approximately 45km north of the town of Malargue in Mendoza province, Argentina. The tower forms part of the infrastructure of the Southern Observatory site of the Pierre Auger Project. The tower will be placed adjacent to the Coihueco Fluorescence detector facility.

The location is approximately 45 km north of Malargue along national Route 40. Access to the site is very good. Route 40 passes within 2-3 km of the site and it is envisaged that a construction road will be provided to the site itself in advance of the construction of the tower. This construction road is required for the construction of a larger observatory building located at the same site.
1  Tower Specification and Location
Height: 20 meters
Type: Self supporting (TAS)
Position: UTM 19H 0445324 6114107
Altitude: 1706 meters
Orientation: One face of the tower should be parallel to 27 degrees East of North (True bearing).

2  Ground Plan
Please refer to figures 1 and 2 for details of the orientation and location of the tower with respect to the FD building.

![Diagram of ground plan](image)

Figure 1: Coihueco Tower ground plan within FD building compound

3  Shelter Building and Internal Equipment
The tower must be provided with a single-storey, 3m x 3m communications shelter building as detailed in Figure 2. Plans for this building may follow the general design of the shelter provided at the Pierre Auger project central observatory tower in Malargue. A photograph of this existing shelter building is shown in figure 3 for reference purposes only and should not be used as a literal design.

Note the following requirements for the shelter building:

1. The shelter building must have a **1-meter wide door** in the centre of the **Eastern wall**.

2. An aperture for a **cable access panel entry port** in the centre of the **Southern wall** is required. This aperture should be adjacent to the cable bridge and the centre of it should be at a height of 2.5 meters above ground.
level. The entry port that will be used is Andrew Corp part number 204673-12. Details of the dimensions are given in the figure 4. The wall aperture for the entry panel should be 25 x 25 inches and the aperture should be lined with a 2-inch wide wooden frame that is level with the outer edge of the wall. This will permit the entry panel to be screwed to the wood.

3. The shelter must be equipped with lighting, power outlets and an automatic heating and cooling system that is capable of keeping the internal temperature of the shelter between +5 deg C and +30 deg C. The power dissipation of the equipment within the shelter is not expected to exceed 1kWatt.

4. The shelter must be equipped with an internal grounding cage using 50mm sq. copper.

5. The shelter must be equipped with a wall-mounted fire extinguisher suitable for electrical fires.

**Figure 2: Coihueco Tower detailed ground plan**

Tower Position

17 meters West,
33 meters South of FD Reference Point
= UTM 19H 0445324, 6114107, Alt.1706m
Figure 3: Example of Shelter Building
4  **Antenna Mounts**

The tower must be able to support a total of 10 ‘cellular-style’ panel antennas. These antennas are 3 meters in height by 0.3 meters in width. In addition, the tower must accommodate up to 2 parabolic antennas of 1.2 meters diameter. The required pipe-mount structure is shown in figure 5 with a detailed drawing of each section shown in figure 6. Figure 7 shows the orientation of the antenna mounts with respect to the tower. The tower and antenna mounts should have a minimum **survival wind-speed** of **250 km/h** when carrying the antennas listed above.

**Important Note:** In order to ensure the long-term safety of the antenna mounts, all brackets associated with the antenna mounts must be fitted with **double nuts** and the vertical pipes must be fitted with **welded anti-torpedo safety rings or clamps**.
Figure 5: Coihueco Tower Antenna Mounting Pipe Scheme
5 Cable ladder
The tower must be equipped with a vertical cable ladder, (also known as a ‘feeder ladder’), to support the cables to the antennas. This cable ladder must be provided with specially drilled horizontal members in order to receive the cable clips that will
be used. Figure 8 shows the spacing between the horizontal supports of the ladder and figure 9 shows the detailed drilling pattern for one of the horizontal supports. Figure 10 shows the vertical support detail and figure 11 shows the required depth of concrete foundation for the ladder to rest on. The ladder must be securely attached to the centre of the North face of the tower as shown in figure 7.

![Diagram of Cable Ladder Horizontal Support Spacing]

**Figure 8: Cable Ladder Horizontal Support Spacing**

12 holes Ø19.0mm spaced 80.0mm
Material: 3mm Hot-Dip Galvanised Tower Steel

![Diagram of Cable Ladder Horizontal Support Detail]

**Figure 9: Cable Ladder Horizontal Support Detail**
Figure 10: Cable Ladder Vertical Support Detail

Figure 11: Cable Ladder Foundations
6 Cable Bridge/ Ice shield
A horizontal covered Cable Bridge/Ice Shield is required to run between the vertical Cable Ladder on the tower and the Entry Panel in the Shelter building. This bridge serves to support the weight of the cables and to protect them from damage from falling ice. Figure 7 shows the orientation of the cable bridge with respect to the tower. Figures 12 and 13 show examples of a suitable design employed at the Auger Observatory campus in Malargue. Note that the Cable Bridge must have the following specification

1. An overall height of 3 meters minimum.
2. An overall width of 0.8 meters minimum.
3. A length of 3 meters; suitable to pass between the tower and shelter with no gaps in the overhead coverage. It is permissible for the Ice Shield to overhang the roof of the shelter.
4. The Cable bridge must have 3 cable support sections at a horizontal distance of 0.5, 1.5 and 2.5 meters from the tower. Refer to figure 9 for an example.
5. Each section must have 3 horizontal supports, each support must have adjustable height and must be 0.8 meters long and punched with a series of 19mm diameter holes at a spacing of 80mm between holes. These holes are intended to take cable clips in an identical manner to the cable ladder, please refer to figures 8 and 9 for further information.

Figure 12: Example Ice-Shield
The tower and shelter require a buried double-ring grounding system as shown in figure 14. The grounding loops must remain at least 1 meter away from the concrete of the tower foundations wherever possible. Several grounding spikes (Javelins) must be provided as shown in figure 14 with detail in figure 15. At each position where cables and/or ground spikes are joined, an inspection hatch must be provided. All inspection hatches must be provided with iron covers.
The ground conductivity at Coihueco has been measured and has been found to be of poor quality. The resistance was measured as 4.5 kilo-ohms in May 2001 (PDJ Clark-PF Walker). Consequently it is necessary to use high conductivity ‘Bentonite’ soil surrounding all of the underground copper cables and grounding spikes. Figure 15 illustrates the method that must be used.

**Figure 14: Tower Grounding Scheme**
Figure 15: Grounding Spike, Inspection Hatch and Bentonite Detail
8 Lightning rod and Lightning Conductor
The tower must be provided with a lightning rod at the top of the tower as per figure 5. The lightning rod should be connected to a 50mm sq. cross-section vertical lightning conductor. The lightning conductor must be connected to a grounding stake that is bonded to the tower grounding ring system as shown in figure 14.

9 Tower Working Platforms
Four small working platforms must be provided on the inside of the East Face of the tower as shown in figure 7. These working platforms should have a minimum size of 1.2 meters by 0.5 meters and should be located at the following heights;

1. one platform at 19 meters height.
2. one platform at 17 meters height.
3. one platform at 12.5 meters height.
4. one platform at 7.5 meters height.

10 Tower Safety ladder
An enclosed safety ladder must be provided extending to 20 meters height. This ladder may be located either inside the tower on the Western corner or outside the tower on the South-Western face.

11 Tower Exterior painting
The tower must be provided with regulated exterior red-white tower colour scheme.

12 Tower Nocturnal Lighting
The tower must be provided with automatic night lighting in accordance with local statutes and regulations.

13 Fence
The tower and shelter are located inside the FD building compound which is protected by a 2 meter high security fence. However, a 1 meter high safety fence must be also be provided around the tower and shelter to prevent unauthorised personnel approaching the tower. This is required to protect people from the danger of ice falling from the tower. Details of the dimensions of the fence may be obtained from Figure 2. The fence must be earth bonded to the main tower grounding ring at any 2 opposite corners.
14 Inspections during Construction
The following inspections must be carried out by representatives of the Pierre Auger Collaboration during construction, to ensure that the relevant specifications are being met.

1. Inspection of the tower foundation reinforcing steel-work **before** the concrete is poured.

2. Inspection of the grounding system trenches, grounding stakes and cables **before** the trenches are filled with Bentonite.

3. Inspection of the grounding system trenches **after** the trenches are filled with Bentonite, but **before** they are covered with normal top-soil.

4. Final acceptance inspection of the tower and shelter structures including antenna mounts, cable ladder, cable bridge and entry panel aperture.

15 Other Items
Any quotation offered must also include the following items:

1) Soil quality survey
2) Delivery of the tower and antenna mounts to the site
3) Erection of the tower and fitting of the antenna mounts
4) Foundations for the tower
5) Foundations and platform for the shelter building

16 Important Note on Variations
Please note that this document describes in detail the specification for the Coihueco communications tower and shelter. **No variations or deviations** from this specification **will be acceptable** to the Pierre Auger observatory without the prior written consent of an authorised member of the Auger project team.