



FRAMKVÆMDASÝSLA RÍKISINS

AVALANCHE DEFENCES FLATEYRI, ICELAND

**Snowdrift measures above starting zones at
Eyrarfjall
Production of snow fences**

TECHNICAL SPECIFICATIONS

TENDER NO. xxx



March 2021

Table of contents

| | | |
|-------------|---|-----------|
| 1. | TECHNICAL SPECIFICATIONS | 1 |
| 1.0. | General | 1 |
| 1.0.0. | Summary | 1 |
| 1.0.1. | About flateyri | 1 |
| 1.0.2. | Work site..... | 1 |
| 1.0.3. | Documents | 1 |
| 1.0.4. | Design criteria and experience..... | 2 |
| 1.1. | Production of snow fences | 6 |
| 1.1.0. | General | 6 |
| 1.1.1. | Snow fences | 7 |
| 1.2. | Consultation with the Buyer..... | 9 |
| 1.2.0. | General | 9 |
| 1.2.1. | Communications..... | 9 |
| 2. | BILL OF QUANTITIES | 10 |

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

1. TECHNICAL SPECIFICATIONS

1.0. GENERAL

1.0.0. SUMMARY

The project comprises the production of steel snow fences. The production includes; design, construction and delivery to Flateyri (Westfjords). The snow fences will be located at Eyrarfjall above the town of Flateyri. Execution of the snow fence installation will be under a separate contract.

The design and production of the snow fences shall be in accordance to the rules and regulations of the European standard EN 1991-1-4 *General actions – Wind actions* [1] and the Swiss Federal Institute for Snow and Avalanche Research; Swiss Guidelines [2] along with the inherent Adaption for Icelandic conditions and the Icelandic addendum [3, 4], cf. chapter 1.0.4.1, *Standards and key information*.

The Seller shall deliver the snow fences at a designated deport area in Flateyri as further delineated in the contract documents.

1.0.1. ABOUT FLATEYRI

The town is a part of the Ísafjarðarbær community further information is on the website www.isafjordur.is. The town of Flateyri is located in Öndarfjörður-fjord, just south of Ísafjarðardjúp. Scheduled flights are daily from Reykjavík to Ísafjörður, which is approx. 22 km from Flateyri.

1.0.2. WORK SITE

The designated deport area will be by Flateyrarvegur-road at Stapi, an area approximately 1 km west of the town, see drawing U61.06.112. The Seller shall consult with the supervision about where to deliver the material.

1.0.3. DOCUMENTS

The Tenderer shall submit the following information (in addition to the general information mentioned in the tender documents):

- Information on all the material he provides.
- Information on galvanization of steel parts.
- Drawings, showing the steel parts in the snow fences along with a description of the steel material.

The Seller shall submit the following:

- Information about supervision of the steel production along with material certificates.
- Thorough information about the snow fences' design criteria for the project and results of the pertinent structural design complete with calculations. Included shall be values for the structure's design loads and loads acting on its parts along with calculated reaction forces, all the necessary drawings of

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

the structure and technical information about the design in consultation with the Buyer's representative. This information shall be handed in for approval before any production begins.

1.0.4. DESIGN CRITERIA AND EXPERIENCE

1.0.4.1. Standards and key information

Standards, regulations, handbooks and reports, referenced in the tender documents indicate the accuracy, quality, material categories, deviations etc. the project shall be based on. The latest versions always apply. Other equivalent standards, regulations or handbooks may be used pending approval by the Buyer before construction begins.

Following is a list of standards, regulations, handbooks and reports the Tenderers need to be familiar with and the Seller has to follow.

- [1] European committee for standardization, „EN 1991-1-4:2005,“ European committee for standardization, Brussels, 2005.
- [2] S. Margreth, „Defense structures in avalanche starting zones. Technical guideline as an aid to enforcement. Environment in practice no. 0704.,” WSL. Swiss Federal Institute for Snow and Avalanche Research, SLF, Davos, 2007.
- [3] Tómas Jóhannesson, Stefan Margreth, „Adaption of the Swiss Guidelines for supporting structures for Icelandic conditions,“ Veðurstofa Íslands, Reykjavík, 1999.
- [4] Tómas Jóhannesson, „Addendum to the "Adaption of the Swiss Guidelines for Supporting Structures for Icelandic Conditions",“ Icelandic Meteorological Office, Reykjavík, 2003.
- [5] EISLF, „Richtlinien für den Lawinenverbau im Anbruchgebiet / BUWAL, Eidgenössische Forstdirektion, WSL.,“ Eidgenössisches Institut für Schnee- und Lawienforschung. , Bern, 1990.
- [6] Vegagerðin, Orion ráðgjöf, Snjósöfnunargrindur. Handbók, Reykjavík: Vegagerðin, 2000.
- [7] Ronald D. Tabler, „Snow Fence Guide,“ Strategic Highway Research Program. National Research Council., Washington, DC, 1991.
- [8] Verkís, Flateyri - Frumathugun, Endurskoðun 2020, Reykjavík: Verkís, 2021.
- [9] Vegdirektoriatet, Veger og drivsnø. Veiledning, Norge: Statens vegvesen, 2014.
- [10] ÍST EN ISO 1461, „Hot dip galvanized coatings on fabricated iron and steel articles - Specification and test methods“.
- [11] ÍST EN ISO 9001, „Quality management systems - Requirements“.
- [12] ISO 80000-1, „Quantities and units - part 1: General“.

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

- [13] ÍST EN ISO 17637-2, „Non-destructive testing of welds - Visual testing of fusion - welded joints“.
- [14] ÍST EN ISO 14713, „Guidelines and recommendations for the protection against corrosion of iron and steel in structures - part 1 - 3“.
- [15] ÍST EN 10025, „Hot rolled products of structural steels - part 1 - 2“.
- [16] ÍST EN 17640, „Non-destructive testing of welds - Ultrasonic testing - Techniques, testing levels and assessment“.
- [17] ÍST EN ISO 12944, „Paints and varnishes - Corrosion protection of steel structures by protective paint systems - Part 1 to part 8“.
- [18] ÍST EN 10160, „Ultrasonic testing of steel flat product of thickness equal or greater than 6 mm (reflection method)“.
- [19] ÍST EN ISO 5817, „Welding - Fusion-welded joints in steel, nickel, titanium and their alloys (beam welding excluded) - Quality levels for imperfections“.
- [20] ÍST EN ISO 17636-1, „Non-destructive examination of welds - Radiographic testing - part 1: X- and gamma-ray techniques with film“.
- [21] ÍST EN ISO 17637-2, „Non-destructive examination of welds - Radiographic testing - part 2: X- and gamma-ray techniques with digital detectors“.

The rules and regulations of the Swiss Federal Institute for Snow and Avalanche Research (WSL) from 1990 [5] have been updated and republished [2]. Both of these are referenced in this document. However, The Adaption for Icelandic conditions and the Icelandic addendum [3, 4] still refer to the regulation from 1990.

The republished regulations exist in a pdf-format at Bundesamt für Umwelt BAFU homepage (www.bafu.admin.ch/publikationen/index.html). Further information about WSL rules and regulations can be acquired at Eidg. Forschungsanstalt für Wald, Schnee und Landschaft (<http://www.wsl.ch>).

Icelandic standards are published by Icelandic Standards (Staðlaráð Íslands), <http://www.stadlar.is/>.

The documents of the Icelandic Meteorological Office is at its website <http://www.vedur.is/ofanflod/varnarvirki/> while the documents [2] [3] [4] [5] [6] [7] [8] can be provided by the buyer by request.

1.0.4.2. Units

All units in the tender documents are in accordance to the SI-system. ISO 1000.

1.0.4.3. Quality management

The producer shall operate in accordance with a quality management system according to ÍST EN ISO 9001.

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

1.0.4.4. Drawings and documents provided by the Buyer

The drawings included in this tender provide information about the prevailing work site conditions as well as showing the location and arrangements of the snow fences at Eyrarfjall.

The drawings are:

| No. | Description |
|------------|--|
| U61.06.110 | General map of the NW Iceland showing project location |
| U61.06.111 | Approximate location of snow fences on Eyrarfjall |
| U61.06.112 | Location of the designated deport area |

The drawings are for information purposes about the project and are neither applicable in design, production nor installation.

1.0.4.5. Design requirements

Load design of the snow fences shall be in accordance to the rules of the European standard EN 1991-1-4 [1] *General actions – Wind actions*.

Requirements regarding galvanization and corrosion protection of snow fences shall be in accordance with the rules of *Defense structures in avalanche starting zones. Technical guideline as an aid to enforcement* [2], along with the Adaption for Icelandic conditions and the Icelandic addendum [3, 4].

The following is a general description of the Icelandic design criteria according to [2, 3]. This comprises excerpts but do not include every item of the pertinent reports. The name of the chapters is the same as in [3], the adaption to the Icelandic conditions, where a Swedish standard is referenced (SS 3583:1988), note that this standard is no longer valid. However, the requirements regarding the issues that are referenced still apply. Galvanization shall be in accordance with ÍST EN ISO 1461 and ÍST EN ISO 14713. For steel thickness ≥ 6 mm a requirement for the average thickness is presented (NOTE 8 in table 2 in ÍST EN ISO 14713 – 1 category C4 and duration exceeding 20 to 40 years). The standard makes a requirement for thicker coating, therefore the rules of SS3583:1988 are used. Regarding Steel thickness < 6 mm the requirements are listed in a table A1.

Wind loading according to EN 1991-1-4

Gumbel distributions of the 10 min mean velocity with a 50-year return period yield the fundamental value of the basic wind velocity, $v_{b,0} = 52$ m/s from NE. Wind from both directions should be considered; $v_{b,0} = 31$ m/s for wind from SW.

The external wind pressure shall be calculated according to EN 1991-1-4 ch. 4 – 5 for terrain category I and other factors as recommended.

Corrosion protection of steel parts above groundⁱ

Steel parts shall be hot-dip galvanized in accordance to the Swedish standard SS 3583, class B (SIS, 1998). Designations on drawings shall be "Fe/Zn class B SS 3583".

ⁱ Note the changes described earlier in this chapter.

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

The requirements of the standard for steel thickness exceeding 6 mm are listed in the following table, Table A1.

Table A1ⁱⁱ: Swedish standard SS 3583 for hot-dip galvanized steel, material thickness \geq 6mm

| Class | Minimum zinc thickness (μm) | Average zinc thickness (μm) |
|-------|---|---|
| A | 85 | 95 |
| B | 100 | 115 |
| C | 190 | 215 |

Corrosion protection of subsurface steel parts

Tubes and other subsurface steel parts shall be produced with an additional steel thickness of 2 mm on each side in order to compensate for corrosion as specified in ch. 5.2.4.3, pg. 55 of the Swiss guidelines [2] (paragraph 42.3, pg. 55 in [2]).

This applies to each side of flat parts and the surface of rounded parts. In addition, tubes and other steel parts shall be hot-dip galvanized according to the standard SS 3583, class B. Designation on drawings shall be "Fe/Zn class B SS 3583".

Bolts, nuts, washers and shackles

All bolts, nuts, washers and shackles shall be hot-dip galvanized according to corrosion protection of steel parts.

1.0.4.6. Experience requirements

The Seller shall submit information about his experience from snow fence design and snow fence production, or he has an expert on snow fences, working on the Seller's behalf.

1.1. PRODUCTION OF SNOW FENCES

1.1.0. GENERAL

1.1.0.1. Seller's drawings

The Seller shall submit to the Buyer for approval his design drawings and work drawings along with calculations before production begins and as-built drawings after the project has been accepted. The Seller shall submit to the Buyer all design documents within one month after his bid has been accepted. Note that production of material is not permitted unless these documents have been submitted and approved by the Buyer.

ⁱⁱ Table A1 in the report's appendix *Adaptation of the Swiss Guidelines for supporting structures for Icelandic conditions*. Note the standard referenced in the document is no longer valid, still requirements presented earlier in this chapter shall be met.

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

1.1.0.2. Material quality

The Buyer shall approve all material. The buyer may demand from the Seller a quality certificate, for all the project's metal parts.

All material shall be new and flawless and shall fulfill set requirements regarding strength and categorization. All building steel shall have the minimum strength and categorization requirements of S235J2 according to ÍST EN 10025-2 (or S235J2G3 and S235J2G4 according to EN 10025). Building steel shall be free of all internal flaws such as laminations. In the case an internal flaw is discovered this shall be evaluated according to ÍST EN 10160. Steel plates shall fulfill the requirements of B1 of the standard.

1.1.0.3. Welding

All welding shall be first class, performed by experienced welders with valid licenses from Nýsköpunarmiðstöð Íslands, or equivalent. Qualifications shall be in accordance with ÍST EN 9696-1 and correspond to the methods that are to be applied.

The Buyer will evaluate qualifications from foreign institutes, and whether these constitute equivalent or stronger requirements to the welders

For each area of welding, this shall be performed to keep deformations and internal stresses to a minimum. The supervision may request from the Seller a welding program that includes fusion, welding methods, direction of welding and type of core wire.

Welding shall be performed in accordance with ÍST EN 1011-1.

Welding over weld pools or weld areas is not permitted. Surfaces that will be enclosed by a weld shall be smooth, dry and clean.

All welds shall be enclosed with an arc welding, or with enough space between materials for the zink to penetrate into cracks.

The minimum crack width between material parts to be welded shall be 2 mm. Fusion may also be used to close cracks where zink cannot penetrate.

Welding will not be permitted if the ambient temperature is below 0°C.

Filler material shall be selected with regard to the parent metals and the particular application.

Joining of members by either butt weld or fillet weld shall be in accordance with the standard ÍST EN ISO 5817, welding class C. The welder estimates how the welding should be carried out in consideration of the required quality. This applies to manual metal arch welding as well as mechanical arch welding. Neither cracks nor end cracks will be permitted within the weld. The extent of weld examination/testing shall be at least 10-20% in at least two inspections. The extent depends on the outcome of the first inspection.

The Buyer may, during the execution of the project, have the welds visually examined according to ÍST EN ISO 17637, ultrasonically examined according to ÍST EN ISO 17640 or the testing supplemented by radiographic examination in accordance with ÍST EN ISO 17636, depending on which of these best suit each occasion. If imperfections are discovered, the Seller is obligated to repair these at his own cost. Furthermore, the Seller is obligated to perform re-testing and make arrangements so that such flaws or imperfections will not reoccur. The welder responsible for the flawed weld shall present a new qualification certificate before continuing. The supervision may demand the welder to be removed from the project in case of repeated flaws.

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

1.1.0.4. Surface treatment

All steel shall be acid pickled and hot-dip galvanized. In case the steel is furnished or painted this shall be sandblasted before hot-dip galvanization.

Sandblasting

All surfaces shall be thoroughly sandblasted in accordance to ÍST EN ISO 12944, class Sa 2.5, with all rust removed.

In sandblasting, only approved material shall be used. The sandblasting material shall be of hardness, shape and size to fulfill requirements of surface roughness and cleanliness. The material shall neither contain more than 1% silicium nor 2% heavy metals. The use of salt-mixed sand is not permitted. Sandblasting material depends on the Buyer's approval.

Hot-dip galvanization

Steel shall be corrosion protected according to the requirements in [3, 4]. Steel parts shall be hot-dip galvanized in accordance with ÍST EN ISO 1461 and ÍST EN ISO 14713, see chapter 1.0.4.5 Design requirements.

The Seller shall grant the supervision an opportunity to examine the steel galvanization before completion and before it is sent off to work site.

Damages on the galvanization, for example due to transportation to work site, shall be cleaned and coated with one or two rounds of zink paint. Thickness of at least 115 µm is required. The buyer's inspector shall approve the repairing method. It shall be assumed that zink-coating repair is necessary in all bolts and nuts after tightening.

The snow fence design shall aim at avoiding the development of closed surfaces where water and dirt can accumulate and increase the likelihood of corrosion. Upper ends of anchor heads are especially vulnerable in this context.

1.1.1. SNOW FENCES

Design of snow fences

The snow fence's design height is $H = 5,0$ m and their approximate location is presented on drawing U61.06.111.

All design, production and finish regarding snow fences shall be in accordance with the rules presented in [1, 2, 3, 4].

Production of snow fences

Two rows of 120 to 150 m long snow fences are to be installed.

The Seller shall produce the snow fences according to the design he submits for approval, which has been approved by the Buyer and is in accordance with the arrangement shown on drawing U61.06.111 and fulfill the set requirements in these tender documents.

The Seller shall submit load calculations regarding the foundations. Ground investigations have not been performed in the area, but investigations are planned in summer 2021. Drilling and grouting conditions in this area are assumed to be poor. In similar areas in Northwest Iceland, the Vestfirðir area, the bedrock is covered with 3-4 m of loose scree, where fine material is missing (see photographs included in the tender documents).

The snow fences shall be made of steel and shall be hot-dip galvanized after production. These will be installed at the work site with hot-dip galvanized connections.

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

If welding is necessary after hot-dip galvanization, the outside of the welds and surrounding area shall be cleaned and coated with one or two rounds of zink paint as described in ch. 1.1.0.4 *Surface treatment*.

Material quality shall take Icelandic weather conditions into consideration, which in many cases are more extreme than the average, e.g. due to wind loading, frequent freeze – thaw cycles, snow load and salt in the atmosphere. The Seller shall be familiar with the references used in this project as presented in [3] with later addendum [4].

The Seller shall transport the materials to the designated deport area in Flateyri as directed and approved by the Buyer’s supervision. The material will be approved for payment upon the supervision’s acceptance. The Seller shall be responsible for the material until approval and acceptance. Further information on the delivery is in the Contract documents.

Cost items

Each meter of a snow fence will be paid for, ISK/m according to unit cost for a snow fence in Seller’s bid for design, production, hot-dip galvanization, transport and delivery to work site all as approved by the supervision. Final lengths are reached upon surveying cf. 1.2. The snow fence line shall be measured as the surveyed line along the ground, from the outermost part of one structure to the outermost part of another. Openings in snow fence lines larger than 2 m shall be deducted from the total length. Where the snow fence lines form an angle, a small increase in length of connecting beams will occur. The cost of this increase in steel shall be included in the measurement along the ground cf. above.

The height of the snow fences will be 5 m.

Unit price shall be given separately for 240 m of snow fences and additional 60 m. The buyer reserves the right to reduce the unit for additional snow fences in item 2.1.1.2 or cancel this part entirely after receiving results from this tendering.

Included in the unit cost shall be all material cost, design cost, production, hot-dip galvanization, bolts, connections, connections for steel bedplates and other accessories including delivery to the storage area in Flateyri all as approved by the supervision. Also included in the unit cost, shall be the Seller’s cost of answering questions regarding design, solution etc. of the snow fences during installation time, see 1.2.0 General.

| No. | Cost item | Unit |
|---------|---------------------------------------|------|
| 2.1.1.1 | Snow fence (height 5.0 m) | m |
| 2.1.1.2 | Additional snow fences (height 5.0 m) | m |

1.2. CONSULTATION WITH THE BUYER

1.2.0. GENERAL

The Seller shall answer the Buyer’s questions about the snow fences during installation time. The cost of consultation with the Buyer concerning clarifications on the Seller’s design and solutions shall be included in the unit cost.

The installation contractor, upon the Seller’s consultation on the final design, performs the line surveying of the final design.

Avalanche defence in Flateyri – Eyrarfjall - Production of snow fences

1.2.1. COMMUNICATIONS

The project involves participating with representatives of the Buyer and the installation contractor in a visit to the work area. All this work shall be prepared with the installation contractor and determined in consultation with the Buyer. Additionally, the Seller shall determine and approve the final location of ground plates and anchors in consultation with the installation contractor.

Cost item

Working hours: Working hours for consultation and cooperation at work site with representatives from the installation contractor and the Buyer, will be paid for in accordance with the indicated hourly unit cost.

The unit cost shall include all the Seller's cost regarding such work, i.e. for preparation and the processing of field work, travel cost to work site, overnight and other accommodation and other costs necessary and incident to finish the preparation of the project's design at the work site.

| No. | Cost item | Unit |
|------------|------------------|-------------|
| 2.2.1.1 | Communications | h |

Avalanche defence in Flateyri-Eyrafjall - Production of snow fences

2. BILL OF QUANTITIES

| NO | COST ITEM | UNIT | QUANT. | UNIT COST (ISK/unit) | COST (ISK) |
|--|----------------------------------|------|--------|-------------------------|---------------|
| 2.1.1 | SNOW BRIDGES | | | | |
| | Snow bridges | | | | |
| 2.1.1.1 | (height $D_k=5.0$ m) | m | 240 | | |
| | Additional snow bridges | | | | |
| 2.1.1.2 | (height $D_k=5.0$ m) | m | 60 | | |
| 2.2.1 | Communications, surveying | | | | |
| 2.2.1.1 | Communications, surveying | h | 50 | | |
| TOTAL AMOUNT EXCL. VAT: 2.1.1.1 + 2.2.1.1 | | | | | ISK |
| TOTAL AMOUNT EXCL. VAT: 2.1.1.1 + 2.1.1.2 + 2.2.1.1 | | | | | ISK |