

**KNXYZ/EN/HL-LHC**

**ADDENDUM No. 1**

**to**

**THE MEMORANDUM OF UNDERSTANDING FOR  
COLLABORATION IN THE HIGH LUMINOSITY LHC PROJECT  
AT CERN**

**between**

**THE EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH  
(CERN)**

**and**

**THE UNIVERSITY OF MISKOLC (the “University”)**

**concerning**

**Collaboration to assess the mechanical properties of niobium after  
forming and heat treatment in the framework of the High Luminosity  
LHC Project**

(CERN and the University hereinafter individually referred to as a "Party" and collectively as the "Parties")

**CONSIDERING:**

- The Memorandum of Understanding for Collaboration in the High Luminosity Project LHC Project (“HL-LHC Project”) at CERN (the “MoU”) signed by CERN as the Host Organization of the HL-LHC Project and the institutes, laboratories, universities and funding agencies contributing to the HL-LHC Project (individually referred to as the “Participant”);
- That CERN and the University signed the MoU on **xxxxx**.
- That Article 2.2 of the MoU provides that each Participant’s contribution to the HL-LHC Project and all related details shall be set out in an Addendum completing the MoU;
- That the University now wishes to provide to the HL-LHC Project the contribution set out below, which shall be covered by the provisions of this Addendum **KNXYZ/EN/HL-LHC** (the “Addendum”). This Addendum shall be subject to the provisions of the MoU, it being understood that in case of divergence, the provisions of this Addendum shall prevail;

**THE PARTIES AGREE AS FOLLOWS:**

**1. Scope**

This Addendum covers tasks related to the mechanical properties of niobium in the framework of the High Luminosity upgrade for the LHC at CERN. The work covered by this Addendum concerns the assessment of mechanical properties of niobium after forming and heat treatment (the “Activity”).

**2. Personnel**

Contact persons:

CERN: Adrià Gallifa Terricabras, [adria.gallifa@cern.ch](mailto:adria.gallifa@cern.ch)

The University: Valéria Mertinger, [femvali@uni-miskolc.hu](mailto:femvali@uni-miskolc.hu)

Or such successor as each Party may designate.

**3. Duration**

The Activity shall commence on 1 February 2019 and shall, subject to the continued validity of the MoU, be completed no later than 31 January 2020, it being understood that this Addendum shall also cover any activities related to its subject-matter executed by the Parties prior to its entry into force. The duration of the present Addendum can be automatically extended for one extra year (thus until 31 January 2021) upon agreement by the Parties.

**4. Each Party’s contribution**

**4.1 The University’s contribution**

The Activity shall consist of the tasks as per summarized in the Annex 1 of this Addendum. In particular, the University shall:

- Perform studies of the mechanical properties of the RRR300 Niobium after cold work and heat treatments described in the EDMS document 2061227 v.2.

The University shall execute its contribution through scientists and associates (students and fellows) at its premises, making use of the University’s facilities for microscopy and mechanical property measurements.

**4.2 CERN’s contribution**

CERN shall contribute to the Activity by:

- Providing samples of pure niobium, providing the samples characteristics, performing tensile tests at room temperature and liquid helium temperature and giving access to properties

measured either at CERN or at associated laboratories, as will be required to perform the analysis within the scope of the Activity at the University;

- Report of the results obtained in the mechanical tests on niobium.
- Organizing regular video-conference or meetings related to the work planning, data processing and analysis;

## **5. Technical Coordinators**

CERN and the University shall each nominate a Technical Coordinator whose role shall be to coordinate the activities related to the performance of the tasks covered by this Addendum. The Technical coordinators shall also act as Safety Correspondents and be responsible for safety matters.

The Technical Coordinators and Safety Correspondents shall be:

For CERN:

Adrià Gallifa Terricabras, [adria.gallifa@cern.ch](mailto:adria.gallifa@cern.ch)

Ignacio Aviles Santillana, [ignacio.aviles.santillana@cern.ch](mailto:ignacio.aviles.santillana@cern.ch)

For the University:

Valéria Mertinger, [femvali@uni-miskolc.hu](mailto:femvali@uni-miskolc.hu)

Arpad B. Palotas, [arpad.palotas@uni-miskolc.hu](mailto:arpad.palotas@uni-miskolc.hu)

Or such successor as each Party may designate.

## **6. Deliverables and milestones**

The deliverables and related milestones of the Activity are described below:

- Workplan by the University by xxxx;
- Report with the preliminary results (performed in december 2018 and January 2019) from rolling activities (it can include pictures, quantitative and qualitative information) by xxxx.
- Intermediate report on rolling activities (it can include pictures, quantitative and qualitative information about the advancements of the activities) by xxxx;
- Shipping of niobium samples after rolling according to EDMS 2061227 v.2 by xxxx.
- Report with results of the eventual measurements of texture, residual stress, hardness and microstructure assesment, according to EDMS 2061227 v.2 by xxxx.

## **7. Acceptance**

The CERN Technical Coordinator shall grant acceptance of the tasks (detailed at Article 4.1 and Annex 1 of this Addendum) completed by the University within one (1) month from the date of such completion or the provision by the University of all associated documentation, whichever comes later.

The planning and deliverables can be modified upon written agreement by the Parties.

**8. Publications**

The Parties shall strive to jointly publish the results of the Activity as Open Access publications. Insofar as the parties do not jointly publish the results of the Activity, publications by one Party involving results developed by the other Party shall be subject to the latter's prior written approval, which shall not be withheld unreasonably. Publications shall acknowledge the collaboration between the Parties including, whenever appropriate, the personnel having taken part in the development of the results covered by the publication.

**9. Miscellaneous**

This Addendum may be amended solely by written agreement by the Parties.

Thus drawn up in two copies in the English language and signed by the authorized representatives of the Parties.

The European Organization  
for Nuclear Research (CERN)

The University of Miskolc

.....  
Dr. Roberto LOSITO

.....  
Prof. Dr. András TORMA

Engineering Department Head

Rector

On:.....2019

On:.....2019

The University of Miskolc

.....  
Dr. Csaba DEÁK

Chancellor

On:.....2019



## **Annex 1: General description of the tasks to be completed by the University**

### **Assessment of the mechanical properties of niobium for the HL-LHC project**

#### **List of tasks to be performed by Miskolc University:**

##### - Within the preliminary tests:

- Study of the rolling parameters on niobium sheet
- Assess homogeneity of deformation along thickness when cross-rolling Nb sheet
- Hardness measurements, microstructure assessment and other tests that the University wish to conduct
- Provide report with results upon agreement of the parts

##### - Within the mechanical test campaign:

- Rolling of niobium sub-sheets to achieve the thickness reductions specified in EDMS document 2061227.
- Perform hardness measurements, microstructure assessment, texture analysis, residual stress analysis and/or other tests that the University wish to conduct.
- Send niobium sheet after rolling and send samples to CERN when required and agreed by the parties.
- Cut samples by water jet cut (or other means which do not alter the mechanical properties of the material) when required and agreed by the parties.
- Provide report with results on the tests conducted by the University upon agreement of the parts.
- Collaborate in the organisation of regular video-conference or meetings related to the work planning, data processing and analysis.
- Collaborate in the redaction and reviewing of eventual publications related with the Activity.

#### **List of tasks to be performed by CERN:**

##### - Within the preliminary tests:

- Provide niobium samples and corresponding material certificate for the preliminary test studies
- Provide metallographic preparation methodology
- Provide images of the microstructure and hardness measurements of the samples

- Provide information on the flow curve for Nb at room temperature and data about hardenability of the material.

- Within the mechanical test campaign:

- Send niobium sheet material to perform the rolling activities
- Cut samples by water jet cut, electrical discharge machining (or other means which do not alter the mechanical properties of the material) when required and agreed by the parties.
- Perform buffered chemical polishing (BCP) on the samples before the tensile tests.
- Perform the heat treatment to half of the samples as specified in EDMS document 2061227.
- Perform tensile tests at room temperature and 4 K as specified in EDMS document 2061227.
- Send back samples after cutting and heat treatment for the analysis of Miskolc University, upon agreement.
- Provide report with the mechanical tests results and other results.
- Organise of regular video-conference or meetings related to the work planning, data processing and analysis.
- Collaborate in the redaction and reviewing of eventual publications related with the Activity.

**Related documentation:**

- Minutes of the videocall meeting held on 13/12/2018. **EDMS 2066374**
- Specification of tests campaign - Assessment of mechanical properties of RRR300 niobium after cold work and heat treatment. **EDMS 2061227**
- A proposed approach for choosing the thickness reduction by cold rolling (test campaign on the mechanical properties of niobium). **EDMS 2061413**