

**EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH
ORGANISATION EUROPEENNE POUR LA RECHERCHE NUCLEAIRE**

CERN – PS DIVISION

CERN-NUFACT Note 81

**NUFACT PROTOTYPE HORN INSTALLATION
& MEASUREMENTS**

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INTRODUCTION

A possible 300 kA horn, type H40-400, is described in the note given hereafter in reference. This horn has a 40 mm waist radius (outer radius of the inner conductor neck) and a 400 mm inner radius on the external conductor. Further pion collection studies have shown that the external conductor radius can be decreased to 200 mm.

The proposal is thus to produce a 300 kA horn type H40-200 with the following tentative construction and test programme.

1.-PRODUCE ONE HORN type H40-200 INCLUDING COOLING CIRCUIT AND STRIPLINES

1.1-Measurement of horn natural resonance frequencies and comparison with calculated ones.

Action: EP

1.2 -Verification of thermal behaviour of horn with D.C. current up to $I \cong 15$ kA. To this effect get access to DC power supply ~ 8 V/ ~ 15 kA; implement DC connections to horn, cooling system and measuring stand.

Action: EP

2.- INSTALL IN BUILDING BA7 ENTIRE CAPACITOR BANK AND PROVIDE CABLES TO STRIP LINES.

- BUILD SOME THYRISTOR SWITCHING BRANCHES (one or two depending on peak current delivered by each branch)

Action: PS

2.1 - Measure strains and vibrations induced in horn with :

$$I_{\max} = 30 \text{ kA}$$

$$C \cong 1450 \text{ } \mu\text{s}$$

$$\text{Pulse duration } \tau \cong 100 \text{ } \mu\text{s}$$

$$\text{Pulse Repetition Frequency (PRF)} = 1 \text{ Hz}$$

$$\text{Charging voltage } \cong 630 \text{ V.}$$

$$\text{Stored energy in capacitors: } \leq 300 \text{ J}$$

This mode of operation corresponds to full capacitor bank discharged through reduced number of thyristor branches at reduced peak current and PRF.

Displacement measurements with capacitive method will be done at ambient temperature and at increasing temperature (with heated water) up to 70 °C.

Action: EP

3.- PRODUCE ADDITIONAL THYRISTOR SWITCHING BRANCHES UP TO ENTIRE NUMBER

Action: PS

3.1 - Measure strains and vibrations induced in horn with :

$$I_{\max} = 30 \text{ kA, } 100 \text{ kA, } 200 \text{ kA, } 300 \text{ kA .}$$

$$C \cong 1450 \text{ } \mu\text{s}$$

$$\text{Pulse duration } \tau \cong 100 \text{ } \mu\text{s}$$

$$\text{Pulse Repetition Frequency PRF} = 1 \text{ Hz}$$

$$\text{Charging voltage up to } \sim 6300 \text{ V}$$

$$\text{Stored energy in capacitors: } \leq 30 \text{ kJ}$$

This mode of operation corresponds to full capacitor bank discharged through nominal number of thyristor branches up to full peak current and at reduced PRF.

Displacement measurements will be repeated with capacitive method at 30 kA and then with interferometric method at 30kA, 100 kA, 200 kA, 300 kA.

Action: EP

4.- DEVELOP AND PROCURE FAST CHARGING POWER SUPPLY

(Prototype ~10÷30 A/6500 V and final unit ~100 A/6500 V)

Action: PS

4.1 - Measure strains and vibrations induced in horn with :

$I_{\max} = 30 \text{ kA}, 100 \text{ kA}, 200 \text{ kA}, 300 \text{ kA} .$

$C \cong 1450 \mu\text{s}$

Pulse duration $\tau \cong 100 \mu\text{s}$

Pulse Repetition Frequency PRF = 10 Hz

Charging voltage up to 6300 V.

r.m.s current in horn ~ 6.7 kA at 300 kA

Stored energy in capacitors: $\leq 30 \text{ kJ}$

This mode of operation corresponds to full capacitor bank discharged through nominal number of thyristor branches at up to nominal peak current and at intermediate PRF.

Displacement measurements will be repeated with capacitive method at 30 kA and then with interferometric method at 30kA, 100 kA, 200 kA, 300 kA

Action: EP

4.2 - Measure strains and vibrations induced in horn with :

$I_{\max} = 30 \text{ kA}, 100 \text{ kA}, 200 \text{ kA}, 300 \text{ kA}.$

$C \cong 1450 \mu\text{s}$

Pulse duration $\tau \cong 100 \mu\text{s}$

Pulse Repetition Frequency PRF = 50 Hz

Charging voltage up to 6300 V.

r.m.s current in horn ~15 kA at 300 kA

Stored energy in capacitors: $\leq 30 \text{ kJ}$

This mode of operation corresponds to full capacitor bank discharged through nominal number of thyristor branches at nominal peak current and PRF.

Displacement measurements will be repeated with capacitive method at 30 kA and with interferometric method at 30 kA, 100 kA, 200 kA, 300 kA.

Action: EP

5.- TENTATIVE PLANNING

Rate of progress will depend on effort available at CERN as well as on delivery time of components from industry. The preliminary design and drafting phase is expected to take 3 months.

The tentative target planning is as follows:

Points (1 + 2) to be ready end of 2001.

Point (3) to be ready in spring 2002

Point (4 + 5) to be ready in spring 2003.

Reference :

CERN-NUFACT Note 80

J-M.Maugain, S.Rangod, F.Voelker ; Study of a Horn with integrated Target for a Neutrino Factory (May 16, 2001)