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CONF-890270--19

LBL-26246

Lawrence Berkeley Laboratory
UNIVERSITY OF CALIFORNIA

Accelerator & Fusion Research Division

Paper submitted to the First International
Industrial Symposium on the Super Collider
New Orleans, LA, February 9–10, 1989

An Industrial Cabling Machine for the SSC

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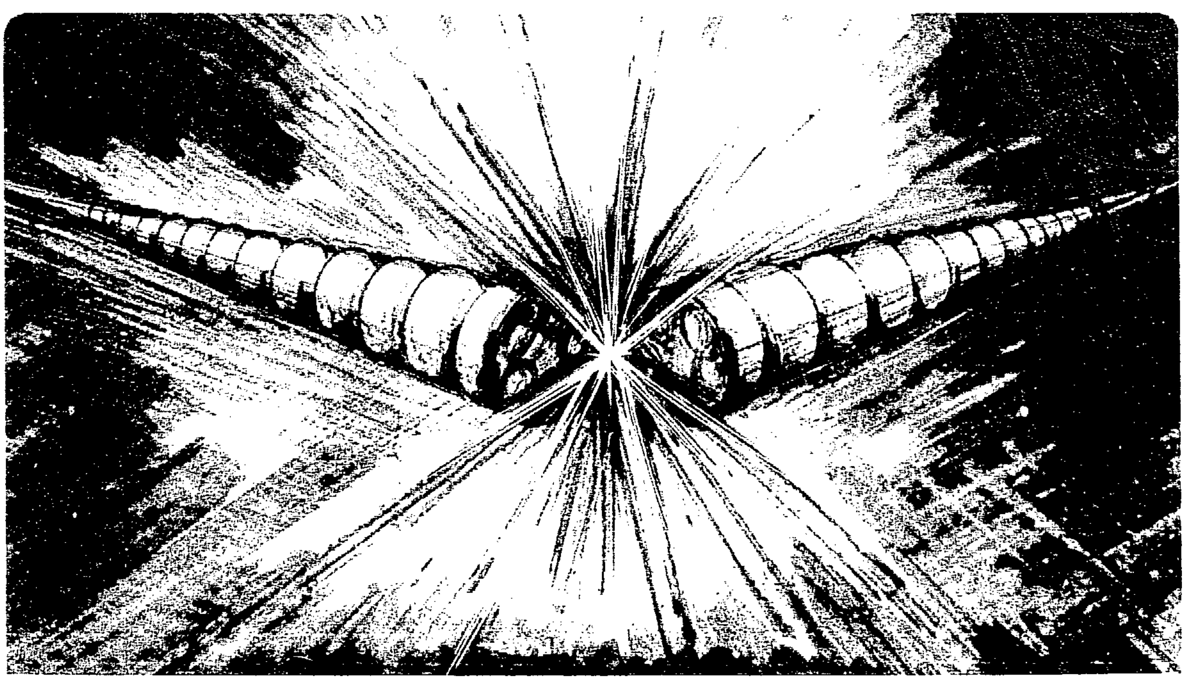
February 1989



Prepared for the U.S. Department of Energy under Contract Number DE-AC03-76SF00098.

LBL--26246

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*This work was supported by the Director, Office of Energy Research, Office of High Energy and Nuclear Sciences, Divison of High Energy Physics, of the U.S. Department of Energy under Contract No. DE-AC03-76SF00098.

SSC-MAG-228
LBL-26246

AN INDUSTRIAL CABLING MACHINE FOR THE SSC*

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ABSTRACT

The SSC project will need the manufacturing of some 25,000 kilometers of keystoned flat cable. The technical specifications of the various cables to be produced are the result of five years of research and development work at LBL.

An experimental cable machine was built and run in the laboratory; many improvements were implemented and tested. Semi-industrial production of the various cables was performed, and the resulting cables were used and tested in the one-meter model magnets and 17.5 meter dipole prototypes.

From these experiments an industrial cabler specification was generated and used for an international RFQ. The winner of the contract is Dour Metal, a Belgium company that built the first industrial prototype which is now in a production line at New England Electric Wire Company.

In this paper we describe the main characteristics of the machine and give the first industrial production results of superconducting keystoned cable for the SSC project.

INTRODUCTION

We have already reported at the 1988 Applied Superconductivity Conference, San Francisco, CA, August 21-25, 1988 that Dour Metal, A Belgium company was the successful bidder for the industrial cabler prototype to be used in the SSC development program.

The machine was tested and accepted in Dour Metal plant on June 28, 1988.

This cabling machine was sent to the United States and installed in New England Electric Wire plant in Lisbon, New Hampshire. (See picture XBC 8810-10074)

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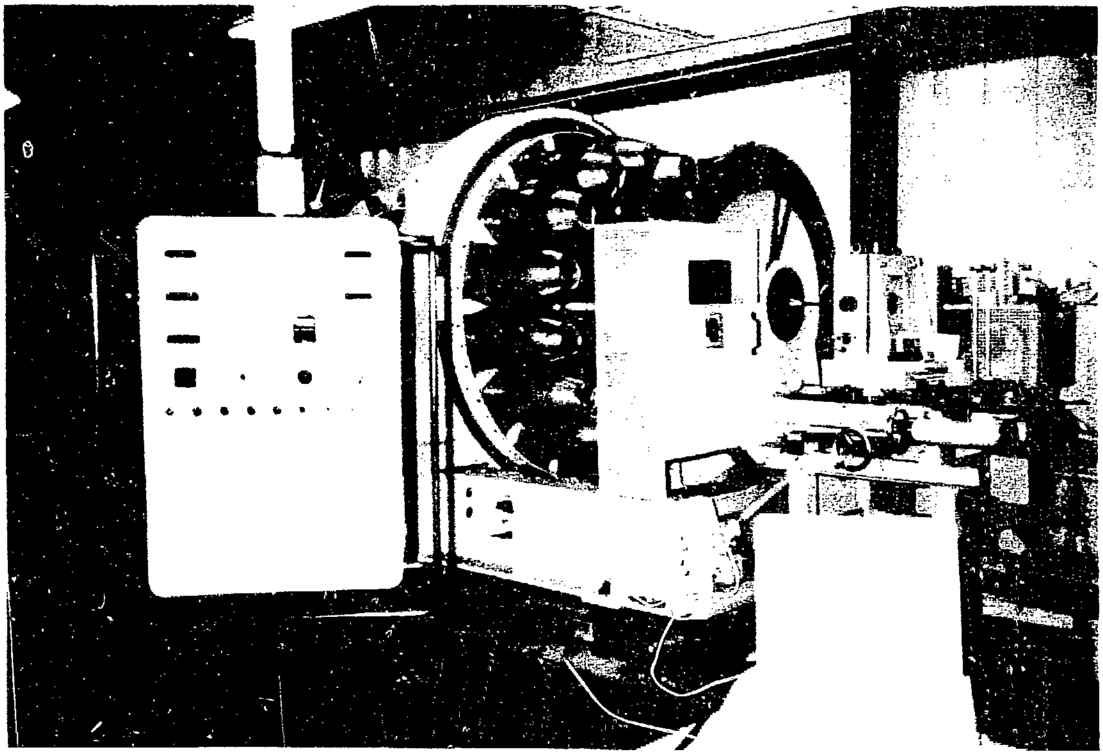

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This location was chosen due to the geographic situation of several superconducting wire manufacturers in the Northeast of the U.S. After installation in this new location, the cabler was tested again in order to detect possible adverse effects of the transportation, then harnessed to the production of the s.c. cables for the SSC development program, relaxing the LBL research machine from its production burden.

CHARACTERISTICS REMINDER

The main characteristics of this cabling line are:

- high speed capability: up to 10 meters/minute
- up to 30 strands cable definition
- 5 planetary ratios in each direction
- equal path length for each strand
- constant wire tension
- broken strand detector
- quick emergency stop
- thermal stability and control
- accurate and stable mandrel position
- adjustable Turkshead position
- electronic monitoring and recording of the main cable parameters
- accurate monitoring of the caterpillar tension
- constant take up traction at variable speed with the associated dancer
- compatibility with the in line measuring machine developed at Fermi National Accelerator Laboratory

Some of the characteristics differ slightly from the LBL experimental machine:

The Dour Metal machine:

- is 2 times faster
- has 30 strands maximum possibility according to SSC specification (the LBL is 36 strands)
- has a planetary ratios geared permanently at ±1, ±2, ±2.8, ±4, and ±5.6. The LBL machine has optional ratios according to a wide gear reserve.
- The cable tension monitoring is excellent and continuous. (Air cushions and strain gauges).
- The motorized Turkshead was required in the specifications and will be the object of a detailed experimentation which was not possible on the LBL machine.
- The caterpillar is a very powerful one capable of one ton pulling force.
- The Dour Metal cabling line is equipped with a transverse take up with bobbin lateral motion and is associated with a dancer which keep the cable tension constant and regulates the cable respooling according to production rate of the cabler in any occurance, including emergency stop.
- The measuring machine has to be altered to match the high production rate of the Dour Cabler.

RESULTS AFTER 12 PRODUCTION WEEKS

During those 12 weeks the Dour cabler production was some 17 km of 23 and 30 strands cable to be used in the long magnets needed in the SSC development program.

This production length represents about 20% of the total amount of cable made on the LBL machine during the 3 years of development operation.

Problems

We have very few accidents to report:

- one broken strand and two "cross-over". However, as our research commitment was no cross-over, we have to improve the technique to avoid such defects:
  - Perfect wire respooling under constant tension.
  - Safety secondary brake device as close as possible to the Turkshead to keep a certain wire tension in case of broken wire up stream. This secondary brake is under development at LBL.
  - The amount of degradation of the Superconducting Wire was similar to the degradation observed on LBL machine: 1 - 5% depending on the type of wire.

Motorized Turkshead

At the occasion of those production runs, we have had the opportunity to harness the motor of the Turkshead (through the adjustable magnetic torque clutch).

The response of the line was immediate and accurate as expected: It was possible to reduce the cable tension between Turkshead and caterpillar by a factor 4. There was no measurable effect on the dimensional characteristics of the cable, however, the cable surface aspect seems to be slightly weavy with a reduced tension. This is not surprising because the cable tension after the Turkshead is a straightening factor of the strands composing the cable as the deformation process between the Turkshead rollers is not uniform due to several factors, the main of them being the keystone shaping, if the tension in this section is reduced the chances of local wire segment length equalization is reduced accordingly.

The main advantage of a power Turkshead is to reduce the collapsing tendency of a flat wide cable under too high a tension. The mechanical stability of the SSC cables 23 and 30 strands is good enough and the safety factor large enough and I do not think that such cable require the use of a power Turkshead. More experimental runs will be performed to document these preliminary results.

CONCLUSION

The design, construction, and installation of the cabling line in an industrial environment is a success for the technology transfer program which is one of the goal of the U.S. National Laboratories.

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