

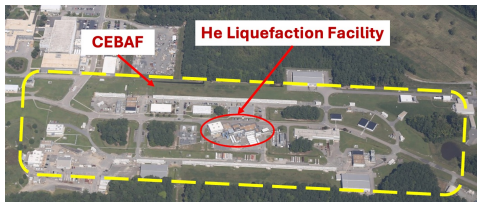
“Hazard Mitigation for SRF Accelerators and Cryogenics”

Introduction

Akira Yamamoto (KEK and CERN)

**TTC-IBS-2024: Hot Topics Session,
Daejeon, April 10, 2025**

An experience at JLab, 2003



ings of 2005 Particle Accelerator Conference, Knoxville, Tennessee

SRF PERFORMANCE OF CEBAF AFTER THERMAL CYCLE TO AMBIENT TEMPERATURE *

R. A. Rimmer, J. Benesch, J. Preble, C. Reece, JLab, Newport News, VA 23606, USA

Abstract

In September 2003, in the wake of Hurricane Isabel, JLab was without power for four days after a tree fell on the main power lines feeding the site. This was long enough to lose insulating vacuum in the cryomodules and cryogenic systems resulting in the whole accelerator warming up and the total loss of the liquid helium inventory. This thermal cycle stressed many of the cryomodule components causing several cavities to become inoperable due to helium to vacuum leaks. At the same time the thermal cycle released years of adsorbed gas from the cold surfaces. Over the next days and weeks this gas was pumped away, the insulating vacuum was restored and the machine was cooled back down and re-commissioned. In a testament to the robustness of SRF technology, only a small loss in energy capability was apparent, although individual cavities had quite different field-emission characteristics compared to before the event. In Summer 2004 a section of the machine was again cycled to room temperature during the long maintenance shutdown. We report on the overall SRF performance of the machine after these major disturbances and on efforts to characterize and optimize the new behavior for high-energy running.

INTRODUCTION

GeV in 2002 for physics running with a test run achieving 6.0 GeV for a short period. When Hurricane Isabel blew through in September 2003 and the resulting power outage resulted in the warm up of all the cavities the arc rate models had to be re-established from scratch and in many cases were quite different from those developed previously.

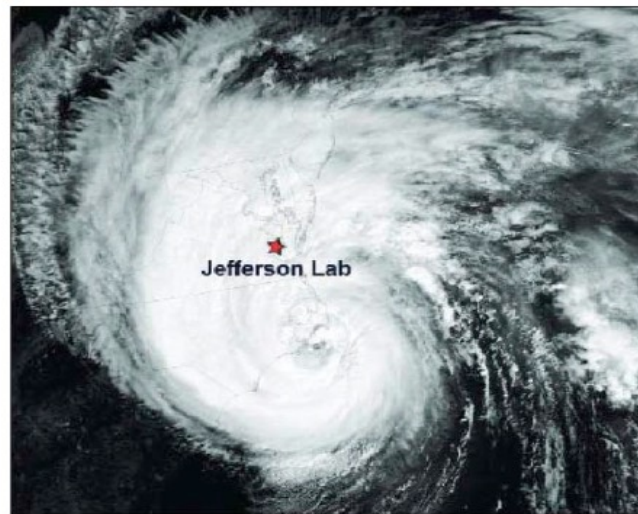


Figure 1: Hurricane Isabel, September 2003.

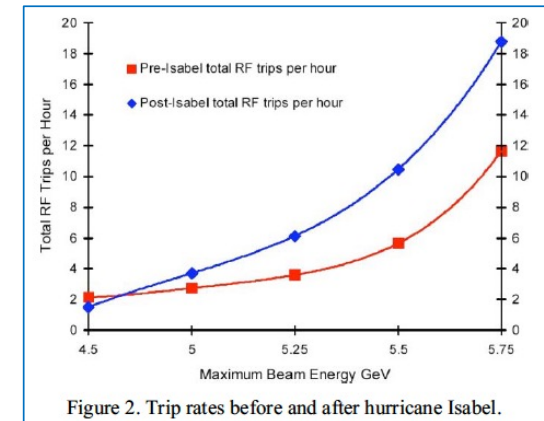


Figure 2. Trip rates before and after hurricane Isabel.

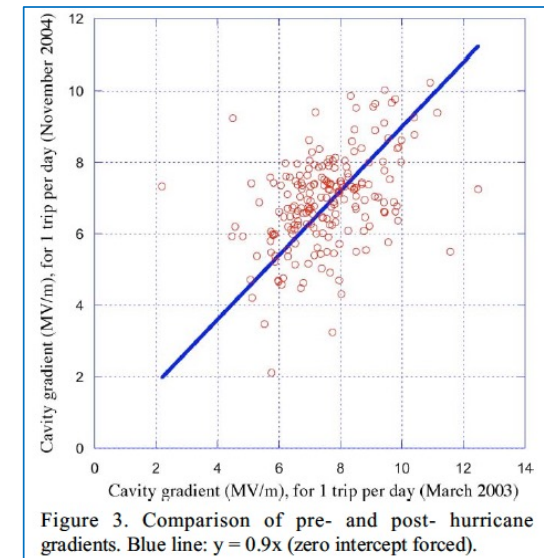


Figure 3. Comparison of pre- and post- hurricane gradients. Blue line: $y = 0.9x$ (zero intercept forced).

An experience at JLab, 2003

Communication with JLab (c/o B. Rimmer), for introduction

RR Robert Rimmer <rrimmer@jlab.org>
Re: [EXTERNAL] Fwd: Time to be corrected, Re: The meeting proposal to be shifted ! Re: New publication: ozone cleaning to enhance FE onset
宛先: Akira Yamamoto <akira.yamamoto@kek.jp>,
CC: Roger Ruber <ruber@jlab.org>

受信 - iCloud 昨日 23:05

非表示



Hi Akira,

I am sorry I will not be able to attend IPAC this year, this sounds like an interesting discussion. I will search for the original files for these papers. The main impact for CEBAF from this event was loss of site power for about 4 days. Because much of the cryogenic insulation relied on active pumping this led to a loss of insulation vacuum and rapid loss of the 65,000l inventory of liquid helium, followed by an uncontrolled warm up of all the cryomodules. This stressed all of the indium seals leading to fears of helium to beamline vacuum leaks (this risk is unique to the old CEBAF CM design I think), however in the end I think only one CM was not recoverable. The thermal cycle did however randomize the field emission performance of the cavitites with some improving and some degrading. The net result was a slight degradation overall. This was partly the motivation for starting the cryomodule rework program which continues even today. Every cavity had to be recommissioned and it's new trip rate established when the machine was restored. Major improvements and lessons learned included:

Increased back-up power (generators) to keep vital vacuum and control systems operational in case of site power outage.

Dual site power feeds from two different substations to provide redundancy.

Redundant Cryoplants with valving so that so that either can keep the machine cold (but not operating) in case of major failure

New cryomodule designs (C100) eliminating helium to beamline indium seals.

More automated cavity and cryomodule recovery procedures.

It would be nice to have enough gas storage and back-up compressor capacity to retain the helium inventory in case of uncontrolled warm up but this is not practical for large machines (for planned warm ups e.g. 12 GeV upgrade we negotiated to send our helium back to the supplier).

Happy to discuss on Zoom, please let me know when is a convenient time for you.

Best regards,
Bob.

From: Akira Yamamoto <akira.yamamoto@kek.jp>

Sent: Thursday, March 20, 2025 10:00 PM

To: Robert Rimmer <rrimmer@jlab.org>

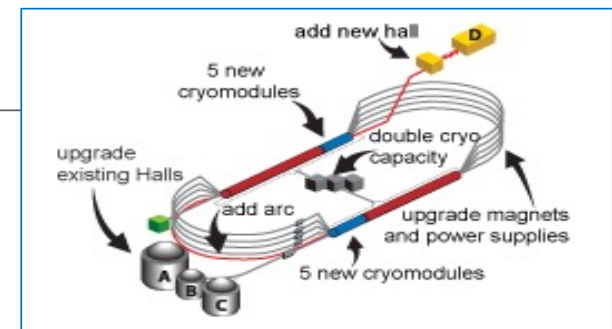
Cc: Akira Yamamoto <akira.yamamoto@kek.jp>

Subject: [EXTERNAL] Fwd: Time to be corrected, Re: The meeting proposal to be shifted ! Re: New publication: ozone cleaning to enhance FE onset

Dear Bob

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we will discussion on "Hazard mitigation for SRF accelerators and Cryogenics.



TTC-IBS-2024: Hot Topics Session:

“Hazard Mitigation for SRF Accelerators and Cryogenics”

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TTC-IBS-2024: Hot Topics Session:

“Hazard Mitigation for SRF Accelerators and Cryogenics”

Introduction for "Hazard Mitigation for SRF Accelerators and Cryogenics"

Akira Yamamoto (KEK & CERN)

Auditorium, Science Culture Center (2F)

16:00 - 16:05

Consequences of big earth quake resulting in damages in accelerators and associated systems including cryogenics

Yasuhiro Kondo (JAEA/J-PARC), Yasuhiro Makida (KEK/J-PAR...

Helium management during emergency events for the LCLS superconducting linac at SLAC

Sebastian Aderhold (SLAC), Eric Fauve (SLAC)

Hazard mitigation and Helium conservation for future large-scale SRF-based Accelerator Cryogenics

Kota Nakanishi (KEK), Boyan-Kaloyanov Naydenov (CERN)

Discussion and Summary

Akira Yamamoto (KEK & CERN)

Auditorium, Science Culture Center (2F)

17:20 - 17:30

→ **Discussions, Lessons learned** and **Preparation for the Future**