Cryo Ops 2008

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CERN

CRYOGENICS OPERATIONS 2008

Book of Abstracts

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OPERATION 2 / 1

Cryogenic improvements for the ATLAS accelerator energy upgrade

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The ATLAS accelerator is a product of staged construction beginning in 1978. It serves as a national user facility for accelerating heavy ions at energies in the vicinity of the Coulomb barrier. The accelerator is divided into 3 sections with a refrigerator cooling each section through an interconnected forced flow distribution system. ATLAS acquired a CTI model 2800 from Lawrence Livermore National Laboratory as part of a major upgrade to the ATLAS accelerator. This refrigerator was installed to provide cooling capacity for a new upgraded cryostat and to address other system issues related to the staged construction, forced flow distribution and narrow operating margin. The refrigerator sustained substantial damage during shipment and had several leaks which required extensive repair. An overview of the upgraded ATLAS cryogenic system and refrigerator repairs will be presented.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

Operation

CONTROL / 2

Unicos upgrade project of the CERN obsolete cryogenics control systems

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The cryogenic infrastructure at CERN was originated in the 1960s by bubble chambers and the associated superconducting solenoids. Since then, complex cryoplants have been installed to provide cooling power from 400 W to 18 kW at 4.5 K, requiring high technical capabilities from the control system. The LHC cryogenics has recently adopted the CERN standard control framework UNICOS in order to enhance ease of operation and maintenance and to provide long-term durability. After the completion of the LHC construction, CERN has undertaken a large project for the upgrade of the obsolete control system (total of 15) of helium cryoplants cooling superconducting magnet of various CERN detectors as well as large cryogenic test facilities. This paper describes the technical procedure used in order to meet the technological challenge in term of installation constraint, reduced manpower and minimal costs. Some examples are given.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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OPERATION 2 / 3

Refrigeration Recovery for Experimental Hall High Target Loads

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The End Station Refrigerator (ESR) at Jefferson Lab (JLab) supports three experimental halls. The refrigerator for the ESR, a CTI 1500 W 4.5-K refrigerator designed in the late 1970's, is capable of supporting a 1250 W target load at 15 K (simultaneously with a 1100 W 4.5-K refrigeration load). This plant has been routinely supporting 15-K target loads, as well as 4.5-K magnet loads, since 1994. In the summer of 2004, a single use, two week run duration, high powered target load required some low cost modifications to ESR in order to allow the target to be directly supplied with super-critical 4.5-K helium from JLab's Central Helium Liquefier (CHL). However, after the installation of these modifications, which included an air ambient vaporizer, there has been a consistent usage of this capability for the same sized target loads and a demand for an even higher target load by the planned Qweak experiment in mid 2009. In the Fall of 2004, after it was apparent that this capability was now routinely being sought, a method of integrating refrigeration recovery with the existing refrigerator was proposed. In April 2008, funding was given to execute the project. After completing the process studies, the mechanical design is now underway. The purpose of the modification is to recover the available refrigeration from the 20-K target return, resulting in reduced 4.5-K helium required from the CHL. In addition, these modifications are anticipated to result in an ESR input power reduction for present target loads and the capability to support the 2500 W 15 K Qweak target load.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

Operation

OPERATION 1 / 4

Continuous operation of liquefied noble gas calorimeters at CERN

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Two experiments at CERN are demanding the continuous cooling (24h/24h, 365 days/year) of liquefied noble gas calorimeters: the NA48 experiment equipped with a 10 m3 liquid krypton calorimeter and the ATLAS experiment equipped with a 85 m3 liquid argon calorimeter housed in three independent cryostats.
This presentation will focus on the design principles applied to allow for this highly demanding operation condition and on the experience gathered with these two cryogenic systems.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

operation

SAFETY / 5

Safety aspects concerning the operation of liquid krypton and liquid argon calorimeters in underground areas

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The operation of particle physics calorimeters using large quantities of liquid krypton or liquid argon in underground areas creates specific safety risks because of conflicting requirements. On one hand the walls of the cryostats, including electrical feedthroughs, must be as thin as possible to minimize the interaction of the particles passing through the structure, while on the other hand the risk of an eventual loss of krypton or argon must be avoided since it will give rise to an oxygen deficiency in the underground cavern.
A 10 m3 liquid krypton and a 85 m3 liquid argon calorimeter are installed at CERN in underground caverns. This presentation will focus on the measures taken to have an early detection of an eventual loss of cryogenics and on how to diminish the consequence of such a leak for its environment.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

safety

OPERATION 2 / 6

SPIRAL2 Cryogenic System

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SPIRAL2 is a rare isotope accelerator which will based at GANIL, it is dedicated for the production of high intensity radioactive beams (E=40Mev, I=5mA). The driver of SPIRAL2 is a Linac, it uses bulk niobium superconducting RF cavities cooled with liquid helium. The cryogenic transfer line of the Linac is composed of about 20 valves boxes which su[[ly two types of helium cryogenic lines: The first at T=4.2K to feed the cavities and the second at T=60K for the thermal shield of the cryomodules. The refrigerator of the cryogenic installation must evacuate a total heat loss of about 1kW at T=4.2K and 2.5kW at T=60K. In this presentation, the SPIRAL2 cryogenic installation design will be detailed and its different operation modes will be described. The preliminary cryogenic experimental test results of the first cryomodule B at IPN ORSAY will be also presented and interpreted.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

1- Operation

CONTROL / 7

The Control System for the cryogenics in the LHC tunnel

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The cryogenics process automation of each of the 8 LHC sectors is based on 2 Siemens-S7® Programmable Logic Controllers (PLC), each running 250 closed control loops, 300-500 alarms and interlocks, and the process phase sequencer.

Distributed along the LHC circumference, 15 000 cryogenic sensors and actuators are accessed through industrial field networks (Profibus® and WorldFIP®), running through optical fibres, copper cables and signal repeaters.

This presentation describes the main hardware and software components of the control system for the LHC tunnel cryogenics, together with their human interfaces and tools for operation and diagnosis.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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OPERATION 2 / 8

Floating pressure conversion and equipment upgrades of two 3.5KW, 20K, helium refrigerators

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Two helium refrigerators, each rated for 3.5KW at 20K, are used at NASA's Johnson Space Center (JSC) to provide cryo-pumping within two large thermal-vacuum chambers. These refrigerators were originally commissioned in 1996. Equipment refurbishment and upgrades of the controls of these refrigerators were recently completed. This paper describes some of the mechanical and control issues that necessitated the equipment refurbishment and controls change-over. It will describe the modifications and the new process control which allows the refrigerators to take advantage of the Ganni Cycle "floating pressure"control technology.

The upgrades have greatly improved the performance, stability, and efficiency of these two refrigerators. The upgrades have also given the operators more information and details about the operational status of the main components (compressors, expanders etc.) of the refrigerators at all operating conditions (i.e., at various loads in the vacuum chambers).

Capabilities, configuration, and performance data pre, and post, upgrading will be presented.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

1

OPERATION 3 / 9

The liquid nitrogen system for chamber A: a change from forced flow to a natural flow (thermo siphon) system

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NASA at the Johnson Space Center (JSC) in Houston is presently working toward modifying the original forced flow liquid nitrogen cooling system for the thermal shield in the environmental control chamber-A (65'dia x 120'high) to work as a natural flow (thermo siphon) system. The new thermo siphon system will improve the reliability, stability, and operating temperature while reducing the amount of liquid nitrogen used to operate the system.

This paper will present the requirements for the various operating modes. System level thermodynamic comparisons of the existing system to the various options studied and the selected option. A thermal and hydraulic analysis used to validate the selected option for the conversion of the current design will be discussed. The modifications to the existing system as well as design features that improve the operations and maintenance will be presented.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

1

CONTROL / 10

Web-based tool for reporting operational non-conformities and tracking associated corrective actions

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The cryogenic instrumentation of the LHC-machine includes 15000 sensors and actuators. In the first phase of the hardware commissioning of the accelerator the correct functioning of the measuring channels was checked, while in the second phase the operation-team did a fine-tuning of the cryogenic system based on the acquired measurements. For this purpose and when running the machine in the future, a quality assurance (QA)-tool for the operators and the instrumentation & controls-team had to be make available. The principle specifications of such a tool includes: tracking all operational non-conformities, resultant consequences and associated corrective actions, user-friendliness, delete-protection and well-defined accessibility.
The present paper describes how we coped with those requirements, the experiences made and an outlook for prospective upgrades.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

4

MAINTENANCE / 11

The procurement and distribution of cryogens for LHC

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CERN is a large user of industrially procured cryogens essentially liquid helium and nitrogen.
Recent contracts have been placed by the Organization for the delivery of quantities up to 320 tons of liquid helium and up to 70'000 tons of liquid nitrogen, both over a four years operational period. Main users are the very large cryogenic system of the LHC accelerator complex, the physics detectors using superconducting magnets and liquefied gases and all the related test facilities whether industrial or laboratory scale. The initial cool down of LHC requests the supply of in total 10'000 tons of liquid nitrogen to be delivered in batches of 1'250 tons for each of the 8 sectors. For the operation of LHC, a total helium inventory of 130 tons will be needed, of which up to 75 tons can be stored in situ in gaseous or liquid storage tanks. During maintenance shutdowns up to 55 tons might have to be stored at suppliers premises in collaboration with the industrial contractors. The presentation reviews the procurement and distribution strategy for liquid helium and nitrogen, including delivery rates, distribution methods and adopted safety standards.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

1- Operation

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Tools for the maintenance of Siemens PLCs and associated Profibus® fieldbuses and intelligent instrumentation

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Several tools have been developed to assist on the maintenance and diagnostics of the LHC control hardware. These tools run independently of the control infrastructure, do not require any particular computer configuration and are quite fast to load and run.

Two real-time tools based on TCP/IP communication between a PC and Siemens PLCs are implemented:
- PLCdiag: shows the status of all Siemens CPUs and associated Profibus master and slaves, allowing a fast diagnostics of the cryogenics control system.
- FastTrend: a multi variable real-time (50 ms refresh rate) visualization of instrumentation readings and other PLC data.

An offline tool for data visualization:
- "MultiGraph" is a multi-variable bar-graph animator, with adjustable time frame, that reads data directly from excel files; a future version might retrieve data from the LHC logging system.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

4 - Control

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Visit of CERN sites

1/ Visit of Point 18
- SM18
- Pt18

2/ Visit of the CCC: CERN Control Center
- CCC

3/ Visit of Point 8
- Point 8

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Workshop Dinner

OPERATION 3 / 18

Helium liquefaction and distribution at TIFR, Mumbai, INDIA

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The low temperature facility (LTF) of Tata Institute of Fundamental Research, (TIFR) Mumbai, India, has been operating and maintaining helium liquefiers and nitrogen generators for more than four decades. For the past sixteen years, helium is liquefied in KOCH's model 1610S helium liquefier (production during 2007: 60000 ltrs). A new helium liquefier (Linde L280) has been recently commissioned in June 2008. The facility also produces liquid nitrogen using a LINIT-25 and occasionally a Philips model PLN-430 plant with air separation column.

Liquid helium is dispensed to about 37 research laboratories including dilution refrigerator, adiabatic de-magnetization (for development of micro-kelvin refrigerator) and three NMR spectrometers. Many systems are kept cold continuously. TIFR has a large network of helium gas recovery lines (~1.6 km) and our recovery rate is about 80% to 85%.

We will present our experience in helium liquefier operation and maintenance, highlighting aspects such as: improved method to operate purifier with pre-cooling in impure mode, liquefier decontamination with quick and simple method, cold box vacuum valve modification, recovery of liquefier blow down helium gas, shifting-re-installation and commissioning of KOCH liquefier in ten days, repair and revival of cryogenic dewars, development of 'on-line'cryogen request form, helium gas accounting methods etc. Some details related to the recent installation of a helium liquefier (Linde L-280, including 5000 liters storage dewar with submersible liquid pump), which resulted in efficient commissioning within two weeks, will also be discussed.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

1-Operation

OPERATION 2 / 19

Description of the flexible large scale Cryogenic test facility at CEA Grenoble and various test experiments connected over the past years

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This test facility at CEA Grenoble mainly consists of an helium refrigerator whose flexible operation permits various types of experiments or test benches to be coupled to it. This presentation first introduces the qualification of the performances of our helium refrigerator, able to cover a wide range of temperature, from 1.5K to 4.5K. Then we describe through several experiments successively connected to our test facility the possible configurations of this cryogenic test facility.
Indeed we can cool down the experiment by a direct flow pumped by the refrigerator cold compressors producing superfluid helium as in the "cryoloop"experiment where we carried out thermohydraulics studies with two phases flow superfluid helium at 1.8K for LHC. Other possible connection is to use a heat exchanger immersed in the refrigerator superfluid helium bath to cool down a circulating loop.

This separate loop allows to adjust pressure mass flow and temperature in an independent way This was done for Turbulence studies in HeII and also in He I performed thanks to high Reynolds numbers achieved in this circulating loop.
The next step will allow to study the efficient pulsed loads smoothing, specific to tokamak (JT60SA and ITER) operation by testing a supercritical helium circulation loop in various operating conditions.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

operation

OPERATION 3 / 20

Design status of the cryogenic system of JT60-SA: optimization of the refrigeration capacity for different operation modes

Author: Christine HOA[1]

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The JT-60SA project is a combined project of the Japanese and European Satellite Tokamak Programme under the Broader Approach Programme. The tokamak will be operated in 2015 in Japan and will support ITER exploitation and research towards DEMO. This tokamak is currently in the conception design phase.
The cryogenic system of JT60-SA is designed to provide supercritical helium at 4.5 K, to cool down the superconducting magnets, their structures and cryopumps. The equivalent refrigeration capacity at 4.5 K will be around 11 kW (including thermal shields at 80K and current leads at 50K) and has to be optimised for different operation modes:
During the day, the refrigerator has to cope with the pulsed heat loads due to the heating of the plasma reactions. The peak heat loads can increase up to 40% of the average power. During the night, the tokamak is under holding operation mode and the heat loads are highly reduced.
The operation under pulsed heat loads can be critical for the refrigeration and the cryogenic devices, which cannot accept large variations in time. The presentation will focus on the different solutions for smoothing the heat loads, such as the use of a thermal buffer tank and the controls on cryogenic components in order to regulate the helium mass flow rate and to maintain a stable operation of the refrigerator. The design of the cryogenic system will be addressed taking advantage of the day/night cycles, in order to reduce the investment costs.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

operation

OPERATION 1 / 21

Design choices of the cryogenic system for the long-term operation of ATLAS and CMS detector magnets

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The design of detectors for High Energy Physic experiments is frequently based on large superconducting magnets generating the field for particle momentum measurements. The CMS experiment is built around a single large superconducting solenoid, whilst the magnetic configuration of ATLAS is based on a thin Central Solenoid surrounded by a large superconducting toroid consisting of three separate magnets, the Barrel and two End-Caps.
The cooling of all these magnets is achieved by an indirect method which greatly simplifies the cryostat design. For the two solenoids (CMS and ATLAS Central Solenoid), the simplest cryogenic principle to drive the helium flow into the cooling pipes has been adopted, i.e. the thermo-siphon which uses the hydrostatic pressure difference between the supplied liquid and the two-phase return. For the three ATLAS toroids, where the thermo-siphon could not be applied because of the unfavourable geometry and the complex helium internal distribution, a centrifugal pump was necessary to ensure the stability in the two-phase regime.
ATLAS magnets have the particularity to use two separate cryoplants; one unit to cool-down all magnets from 80K down and operate them at 4.5K and a second simple plant dedicated to the cooling of the thermal shields between 40K and 80K with minimized interruption for maintenance.
This talk presents the reasons of these design choices which should ensure the easiest - while still flexible - operation of these LHC detectors during the next 15 years.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

Operation

OPERATION 3 / 22

Collection of data related to the operation experience on the Tore Supra cryogenic system

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Operating modes of the cryoplant are reconstructed for the considered years, thus allowing a more precise calculation of the system availability relatively to its exploitation period and to the plasma exploitation period.
Operating times, number and type of failures, failure rates and mean time between failures are given for the main components of the system.
The study focuses on the years 2004 to 2007, which provide the most relevant data.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

Operation

CONTROL / 23

Process control systems for the LHC cryogenic systems

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The LHC Cryogenic control system launched in 1999 followed a maturation process to reach the present layout. This evolution led by technical and operational issues will be reviewed in the presentation together with the initial operational requirements.
We will present the current operational tools such as control infrastucture monitoring, access control principle, process simulation… already implemented in the process control system.Finally we will assess the future improvements to be introduced.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

control

MAINTENANCE / 24

Industrial contributions to the maintenance of CERN helium cryoplants

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CERN has the largest concentration in the world of high capacity helium cryoplants for the LHC and its experiments. Production and distribution systems have been designed to ensure a minimum service in case of a major failure of a sub-system. But the availability of cryoplants also relies on spare parts strategy, maintenance methods and capability to get the best plant follow-up and time to repair.

CERN is working together with industrial partners to ensure a high level of expertise in the field of maintenance, and to implement a comprehensive maintenance policy for its key assets. The core of this policy is based on a preventive maintenance plan managed and performed by the contractor during annual shut down. This plan is also completed with predictive and corrective maintenance during standard operation to provide adapted technical support.

The presentation will give a general overview of the maintenance policy and focus on benefits of predictive maintenance tools and indicators for screw compressors vibration analysis, and benefits of advanced portable devices for field work interconnected with Computerized Maintenance Management Software.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

2- Maintenance

SAFETY / 25

CERN's cryogenics safety record

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CERN operates an extensive park of cryogenic refrigeration and distribution systems and CERN is about to terminate an extremely demanding project with the putting into service of the LHC. There is not only a large variety of cryogenic systems, but there are also many particularities due to the installation conditions comprising surface and underground locations. Due to the often quite exceptional conditions safety plays an important role in design, construction and operation. As a matter of fact CERN can today present for both, the operational installations as well as the commissioned installations, an enviable safety record.
This paper shall recall the main safety considerations for the cryogenic installations and it shall review the incidents linked to cryogenic installations that have occurred during the years of the LHC construction as well as the lessons learned from these incidents.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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MAINTENANCE / 26

Application of a computer aided maintenance management system to CERN's cryogenic installation park

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With the end of the commissioning of the cryogenic refrigeration and distribution systems, CERN shall enter a new period. It will be demanding not only for operation, but also for the services that support and ensure operation as e.g. maintenance. In order to ensure the best possible maintenance services for an extensive cryogenic refrigeration and distribution system, industrial maintenance management methods must be applied. Maintenance management comprises tasks of asset management, warehouse management as well as work order management.
This paper shall present CERN's maintenance management strategy. It shall furthermore present the current state of the deployment of an industrial maintenance management system (CAMMS) to the cryogenic installations as well as the future prospects.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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OPERATION 1 / 27

The world of cryogenics at CERN

Author: Dimitri Delikaris[None]

Today at CERN, cryogenics is largely used in the LHC project under commissioning for cooling the 27 km magnet ring which requires the largest 1.8 K helium refrigeration and distribution systems

in the world as well as its two largest detectors (ATLAS and CMS), which incorporate a variety of cryogenic equipment. In addition, cryogenics is used for cooling specific experiments not related to the LHC complex. Finally, CERN wide, liquid helium is produced and distributed for specific users and cryogenic test facilities.
This presentation will introduce the CERN cryogenics world with emphasis on operation challenges and specificities.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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OPERATION 1 / 28

LHC Cryogenics: Cool-down of the ring for commissioning and first beams

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A recall of the LHC cryogenics architecture and hardware equipment will be given, including the organization and achievements for cool-down of the eight geographical sectors. The hardware commissioning procedures of the cryogenic system and machine will be described. A brief introduction to the preparation work in view of the first beam injection will be presented. Finally the long-term cryogenic operation perspectives will be summarized.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

1- Operation

OPERATION 1 / 29

Welcome and introduction to CERN

Author: Philippe Lebrun[None]

OPERATION 4 / 31

The ITER cryogenic system overview

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The ITER (International Thermonuclear Experimental Reactor) cryogenic system is in its final design phase to be constructed at Cadarache, South of France. With a refrigeration capacity equivalent to 65 kW at 4.5 K distributed via complex and compact cryogenic distribution system it will represent the next large scale cryogenic installation to go into operation in the next decade.
The refrigeration capacity equivalent to 65 kW at 4.5 K is distributed for the cooling of superconducting magnets, their HTS current leads and small users. It includes also the cooling and regeneration in sequence of the cryogenic pumps. A 1300 kW nitrogen plant cools the 80 K thermal shields. The key design requirement is the capability to cope with large pulsed heat loads deposited in the magnets due to magnetic field variations and neutron production from the fusion reaction.
ITER is designed to be operated 365 days per year in order to optimize the available time of the Tokamak. It is foreseen to operate continuously for up to two weeks with short maintenance periods of few days. Major shutdown will take place only every 16 months for routine maintenance of Tokamak and plant system installations.
After recalling the basic features we will present the expected performances and requirements for operation and maintenance of the cryogenic installations.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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Overview of cryogenics operations at DESY

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DESY has a long tradition on Cryogenics. Each of the three refrigerators of the HERA cryogenic plant, being used at the DESY Laboratory in Hamburg, Germany, has a cooling capacity of 6.5kW at 4.4K and 20kW at 40K-80K.Operating and maintenance was led by a mixed group of operators/experts and under LINDE KRYOTECHNIK AG supervision. We describe the cryogenic installations, how they operated and experiences we have made over the past years.

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Overview of the 12 GeV cryogenic system upgrade at Jefferson Laboratory

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As part of the planned Jefferson Laboratory's electron accelerator (CEBAF) power upgrade, ten additional superconducting RF cryomodules will be added to its accelerator linacs. Although physically the same size as each of the original 40 linac cryomodules, each new cryomodule will have approximately 4 times the acceleration power. To support the new additional cryomodule heat loads generated the existing 2K, 4600W Central Helium Liquefier (CHL) plant capacity will be doubled to a total of 9200W at 2K plus 24,000W at 35K for shield loads. The specified base line process cycle has been modeled after the laboratory's "Ganni Helium Cycle"process technology. In addition, a fourth physics experimental "Hall D"will be constructed which will have an additional stand alone 200W at

4K helium cryogenic plant. While the project is currently in the engineering project phase, the construction project phase (CD-3) is scheduled to begin in October of 2008. An overview of the planned cryogenic systems and current design baseline as it relates to operations will be presented.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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Focus of Jefferson Laboratory's Collins Cryogenic Institute Research and Development

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Recognized as a key core laboratory technology, Jefferson Lab established the Collins Cryogenic Institute in 2006 to complement its other research areas inclusive of SRF technology. Combining graduate engineering degree thesis work with applied research and development of helium refrigeration technology, the Institute's focus areas include improved process cycles, higher system efficiencies (lower utility requirements), lower capital equipment cost, higher reliability, and lower maintenance. In collaborative partnership with research laboratories, industry, national programs, and educational institutions, the collaborations includes a wide range of helium plant capacities, applications and temperatures. Special attention is paid to development of solutions to current technical problems and future applications that can not be addressed by a single organization due to the lack of R+D funding or technology base in specific areas. This includes solutions for energy and helium gas conservation to curb ever increasing utility and helium costs and preservation of natural resources. An overview of the range of the current research and development activities conducted by the institute, along with findings, will be presented.

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JT60 SA : Baking scenarios studies

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Performing high quality plasma requires "clean"vacuum vessel obtained by frequent bakings. Baking consists of heating the vacuum vessel to 473K for several days. This operation requests a particular operational mode of the cryogenic system. Because of the increase of radiation heat loads on thermal shields, the helium mass flow in 80K cryogenic circuits should increase of 50%.
To avoid an over capacity of the cryogenic plant, different scenarios are studied in order to reduce mass flow during baking.
Depending on the durations of the baking and the associated cool down conditions, an optimisation of this operational mode must be carried out considering the total mass flow, the repartition at low and middle pressure in the warm compression station and electrical consumption.

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Design remodeling of warm helium screw compressor skid assembly

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A good portion of the typical helium refrigeration system inefficiency is attributed to the warm helium compressor subsystem. Much of the current helium refrigeration system efficiency improvement R+D centers on the refrigerator components which extract the energy from the gas but very little is research and development has gone into the portion of the system in which the energy is being put into the cycle. With rapidly rising utility costs and raw materials such as carbon steel, the continued optimization of helium compression systems in terms of performance and equipment cost has never been greater. An overview of the Jefferson Lab's redesign activity in cooperation with industry will be presented.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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Presentation of the visits of Friday 26th September

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Presentation of the visits of Friday 26th September

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Cyclotron Tank Cryopumping and Cryogenics for Superconducting Facilities at TRIUMF

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A modern helium refrigerator has replaced a 30-year old Philips cryogenerator on the 500 MeV cyclotron. Two ˜11m long cryopanels are cooled down to 4.5K from the previous 17K, increasing pumping speed and improving reliability of the 90 m3 cyclotron tank vacuum system.
A 600 Watts helium refrigerator, supporting the ISAC Phase-I SC-linac, is now in routine operation. The Phase-II SC-linac will be cooled with an identical refrigerator, already commissioned and tested on the Phase-I section of the linac. This second refrigerator is being used for Phase-II linac developments, including new SC-cavity performance tests.
A 50 MeV, 500kW superconducting electron linac, with its 2K refrigeration system, is proposed as a primary development for the Laboratory.

Relevant design choices for the above systems, as well as results from recent operational and commissioning experience will be discussed.

Proposed for workshop session (see call for abstracts): 1- Operation 2- Maintenance 3 - Safety 4 - Control:

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