

ASE Controls and Bases for Radiation Safety for 1 W Low Power Test at CeC PoP

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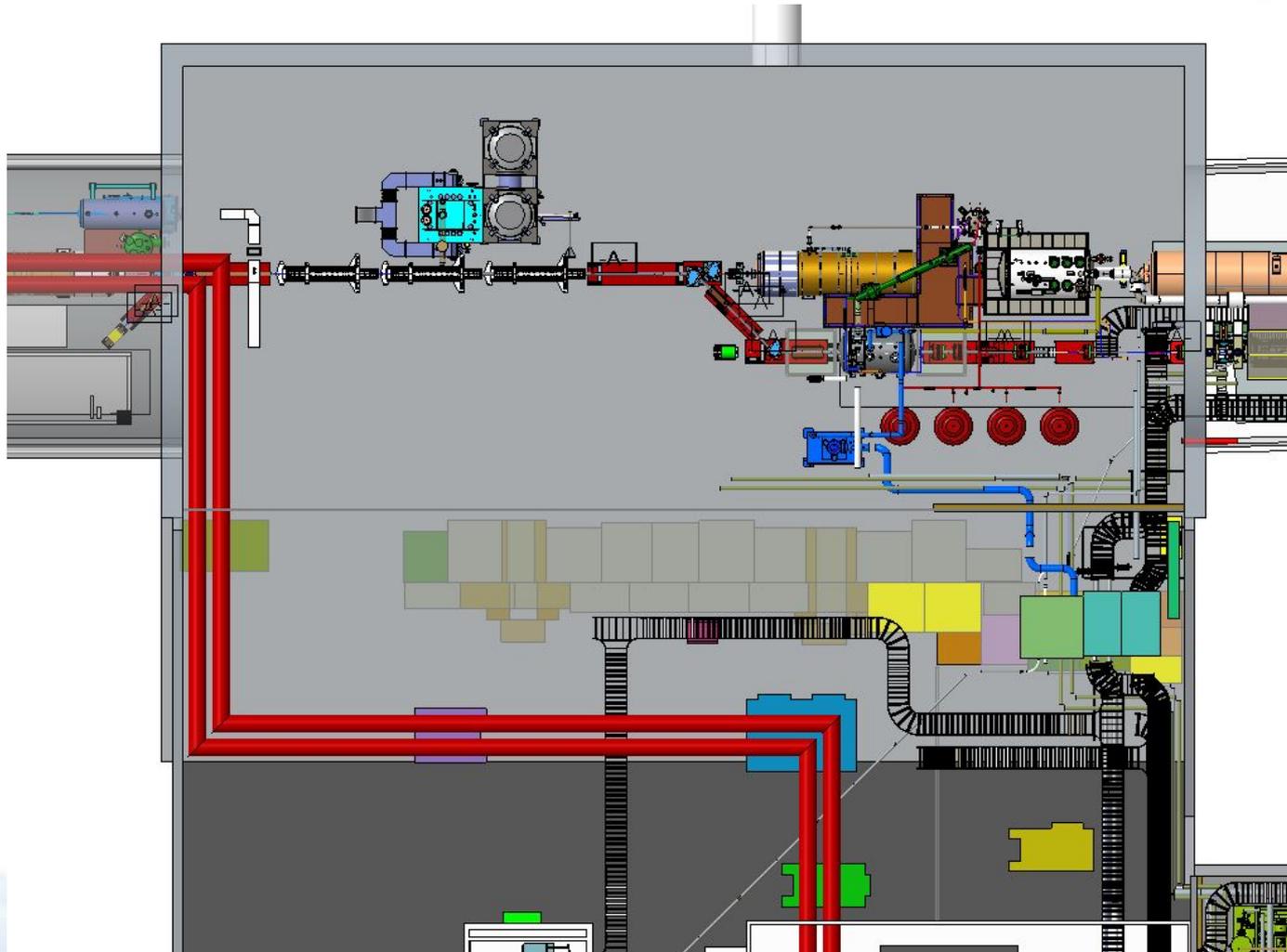
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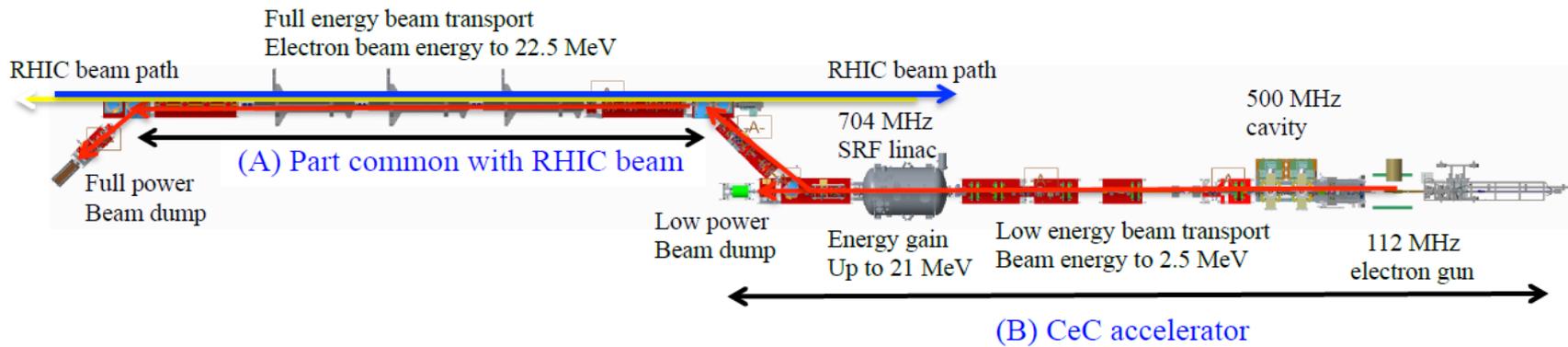
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CeC Layout in IP2





Layout of CeC system: (A) part common with RHIC beam; (B) CeC accelerator. Electron pulses will be generated in a 2-mev 112-mhz SRF gun and then pass through two 300-kv 500-mhz bunching cavities and transported to the 704-mhz SRF linac for acceleration to full energy up to 25 MeV. The beam will be delivered to the RSC approved dump. Shielding and access controls have been designed for the future full power mode up to 8000 watts. Beam power in the low power test mode is less than 1 watt.

CeC Authorization Basis (AB) Documents for Low Power Testing

- The following documents are driven by requirement for an IRR prior to Low Power Testing
 - Draft CeC PoP Safety analyses
 - Draft version of a new RHIC ASE
 - Draft OPM 2.5.2 RHIC ASE Procedure
 - Draft CeC PoP Low Power Test Plan
 - Draft Low Power Test Exemption USI
 - Draft OPM 2.5.2.2 CeC ASE Procedure

Anticipated Approval Process

- LESHC review and BNL approval of AB documents ~ December 10, 2015
- An IRR will occur on December 21 and 22, 2015 and they are charged to review the proposed CeC PoP Experiment's readiness for commissioning, and review the readiness for a low-power test
- BHSO must approve the Draft Low Power Test Exemption USI ~ January 4, 2016
- An ARR will occur in the second week of February 2016
- A period of six to eight weeks of RHIC operations may occur between the IRR and ARR/BHSO approval when low-power testing of could be performed to help ensure control of CeC PoP electron beams in RHIC
- BHSO must concur on the CeC Safety Analyses and approve new RHIC ASE for commissioning to commence ~ March 1, 2016

Controls for Exemption Request for Low-Power Testing

- An approved RHIC Safety Envelope Procedure ([Draft OPM 2.5.2](#)) will contain the Draft RHIC ASE controls; a separate ASE Procedure for low-power testing ([Draft OPM 2.5.2.2](#)) will contain an additional set of limits specifically for low-power testing:
 - Draft RHIC ASE implemented
 - The electron beam power in all conditions shall be limited to 1 W averaged over 1 hour
 - Simultaneous operation may only occur with ion beam circulating in Yellow RHIC ring
 - Hadron beam in Blue ring will be prohibited during simultaneous RHIC-CeC operation
 - Low-power beam testing will be conducted at 1 Hz or less repetition rate
 - Bunch charge will not exceed 10 nC
 - CeC dipoles are to be powered in series providing full transparency for hadron beams
 - Control of the beam power will be done through the setting of the photocathode drive laser, pulse energy and repetition rate

CeC Safety Envelope in Draft RHIC ASE

- The electron kinetic energy shall be limited to 25 MeV
- The electron beam power to the low-power dump shall not exceed **2000 W** averaged over 1 hour
- The electron beam power to the high-power dump shall not exceed **8500 W** averaged over 1 hour
- The shield blocks in or around penetrations and local beam line shielding will be properly in place and configuration controlled
- Relevant portions of the ACS must be functional if they are preventing exposure to CeC beam radiation or CeC RF-generated x-rays inside enclosures, and the ACS must remove beam, or turn off RF, when excessive beam loss or x-ray dose occurs
- ***RHIC may operate Yellow ring with up to 12 ion bunches with nominal intensity not exceeding 10^9 ions per bunch and total intensity of 12×10^9 ions***
Or
- ***RHIC may operate with electron beams in the abort only***

Safety Basis for Exemption Request for Low-Power Testing

- The CeC PoP Experiment will rely on bulk shielding of the RHIC tunnel and the RHIC Access Control System for radiation protection
- Cableways have been blocked with additional shielding
- The beam dumps have been evaluated for a series of radiological issues for 1 W of beam at 2 and 22 MeV; these include dose rate outside the enclosure, beam dump heating, ozone production, air activation, soil activation, and residual activity; the results are well below any exposure or environmental limits
- 25 MeV electron beam at 1 W cannot change the orbit or stability of the 10 to 250 GeV RHIC hadron beams in the same space
- Less than 1% of the ion beam is likely trapped in the abort gaps, which is where the CeC electron beam will be located, and these abort-gap hadrons are normal chronic RHIC losses

Specific Assurance Methods for Low-Power Testing

- The CeC PoP Experiment Physicist and engineered-safety-system owners shall sign the RSC Check-off list prior to enabling low-power tests
- The CeC PoP Experiment Physicist shall be required to be present during any period of testing with low-power electron beam
- Radiation surveys shall be performed during the testing
- The CeC PoP Experiment Physicist shall re-sign the RSC checklist if more than seven days elapses between sequential low-power beam tests after checking that other signatures on list remain valid
- The IP2 experimental area shall be subject to the C-AD RHIC sweep search procedures, and equipment operation will be subject to the relevant RHIC PASS interlocks during CeC PoP Experiment testing
- The laser delivery system would be commissioned inside the dedicated trailer and its delivery to the SRF gun will be tested when the area is secured according the laser safety requirements
- Laser operators will be qualified to a BNL approved Laser SOP

Backup Slide

CeC ODH Safety Envelope in RHIC ASE

- For RHIC IP2 and Building 1002A when the CeC is operating with LHe:
 - Building 1002A ODH exhaust fan must be operational
 - Authorized Alternative: If Building 1002A ODH fan is not operable, entry to 1002A is allowed if each entrant has their own 5-minute escape pack (or a self-contained breathing apparatus) and a portable oxygen monitor
 - At least three ODH exhaust fans serving RHIC IP2 must be operational, and
 - The ODH portion of the RHIC ACS must be operable; that is, when the oxygen concentration falls below 18% (nominal), the ODH fans serving RHIC IP2 must turn on
 - Authorized Alternative: If less than three ODH fans are operable or the ODH portion of the RHIC ACS is out of service, entry to IP2 is allowed if each entrant has their own 5-minute escape pack (or a self-contained breathing apparatus) and a portable oxygen monitor