



Memo

To: D. Beavis, Chair, C-AD Radiation Safety Committee
From: J. Tuozzolo, C-AD Chief Mechanical Engineer
Date: June 14, 2010
Subject: EBIS Beam Stops

Reference: D. Beavis, email Radiation Protection for EBIS, 2/5/2010

The referenced e-mail includes two important concerns related to the EBIS beam stops which are given bellow:

- 2) The beam stops are in not in place. There is a vacuum valve downstream of the beam stops so that these two stops are intended to be used only as critical devices and not vacuum. There will be a profile monitor in the front of the first beam stop. Lou S. and been working to ensure that the engineering reviews are completed on the stops. These devices will need orange tags and memos associated with them as well as the appropriate engineering acceptance form. Attention should be given to the air system that can generate common modes of failure. **(CK-FY2010-EBIS-673)**
- 3) The beam stops are required to have at least one reachback device it the beam stops do not close in a specified time. I would suggest 3 seconds unless someone thinks this is too short for the beam stops. Jim will decide on one of two vacuum valves upstream of the Linac. These will be used for vacuum isolation so I asked him to select one that would have the least potential interference between vacuum work and radiation protection. Any switches that put values into remote must have a lock mechanism over them so that the access controls system is not compromised. The issue of common mode failures with the beam stops must be considered and potentially another device used if the risk is too high. This valve will require orange tags and an associated memo. **(Ck-EBIS-FY2010-674)**

The following information is provided in response.

For item 2: The primary beam stops have been installed and certified by me as Chief ME. This description is from the certification:

The EBIS Beam Stop consists of two identical assemblies for safety redundancy. Each assembly consists of a pneumatic cylinder, spring-loaded to extend, a connecting rod joining the cylinder to the bottom beam stop through a bellows, tungsten beam stop disks, and electro-pneumatic controls. The actuator assembly is a standard, Type DL-050 NTG unit, identical to those used in the TTB line and at TVDG for beam stops, and multi-wire and faraday cup beam monitoring devices. The actuator has been modified by using longer stroke air cylinders, similar to original FESTA cylinders, and longer connecting rods. The beam stop position is sensed by two upper and two lower Honeywell Microswitch limit switches, *PIN 111SM1*, also the same type as used on the *TTB/TVDG* units. A brass block attached to the connecting rod guide piston actuates the limit switches.

There are concerns that both devices being identical could fail in a common mode at the same time. This can include air system failure because they use the common instrument air system in the building. The stops are air open and spring close so failure of the air system (and electrical system – the stop solenoids are normally closed) will close the stops. There are on separate dryers to provide some separation of the systems.

As noted above both stops use identical limit switches with the same concern that a common mode failure could occur. Each stop has two sets of switches for redundancy. Two switches are provided to indicate that the stop is inserted. If both switches do not indicate closed, than a reach back will occur and a fault indication will be generated. Each stop also and two switches to indicate that the stop is out or open for beam. The failure of either the open switch to indicate properly when the system is commanded open or to show that the stop has left the open position when the close command is given will generate a fault indication.

Reliability test data indicates that these switches are reliable. To provide additional margin, a different switch type will be substituted for one switch of each type on both units to prevent a common mode failure before run 11.

For item 3: As noted a VAT vacuum valve has been chosen as the reachback beam stop. Using working vacuum valves as a backup is a common method at C-AD – they are reliable commercial products and they are monitored for faults in there operation by the vacuum electronics. If a valve fails to close when commanded or the limit switches do not indicate as they should a fault is generated and a repair action is initiated to prevent equipment failure. A separate certification is being generated for the valve for its plate thickness and ability to handle the beam energy. The valve solenoid is set up as normally closed – a system failure will close the valve – and it is in a separate section of the common building pneumatic system. The valve will have both open and closed limit switches without the redundancy. As noted herein, failure of either switch to indicate properly in accordance with the command given will generate a fault in vacuum system and the access controls system.