Minutes of meeting: Radiation Safety Committee, sub-committee.

Date: Thursday 28 March 1996


Subject: BTA co-injection current transformer.

As a statement of system design goals, “this co-injection current transformer should be designed such that its intended purpose is to not permit even one high intensity beam pulse to be extracted to the ATR beamline. However, area specifications and access controls will initially be defined with the assumption that one high intensity beam pulse could be extracted and lost in the most sensitive location. These constraints may be eased when actual beam fault measurements can be made.”

Operation of the AGS for high intensity SEB and ATR/RHIC in a PPM manner will have the constraint of the AGS main magnet cycles for each mode necessarily being within ~ 1.5MW. This means the repetition period will be approximately equal for the two modes.

A set of initial specifications is evolving as a result of these discussions; the following items represent some system design considerations.

1. System must be defined as low = no enable, (failsafe).
2. AGS facility is to operate in a PPM/Context Switching manner.
3. The mode of operation of primary concern is high intensity proton operation for SEB interleaved with low intensity proton cycles for RHIC use.
4. Not addressed at present is high intensity g-2 operation interleaved with RHIC, (although the additional interlock logic to permit this mode has been considered).
5. The system will provide an enable for FEB extraction devices, (G-10 and H-10 charging power supplies ON and capacitor banks shorting switches OPEN). Note: charging time for these two devices will be nominally 30ms since FEB extraction is to eventually operate at 30Hz.
6. An enable occurs at AGS T0 (AT0, AT1, ..., AT4) and “holds” until high intensity beam pulse (> high limit) removes enable, a hardware or self-test failure occurs or after a fixed delay timeout of ATn + 10 seconds. To assure the absolute coincidence of the ATn for the Siemens main magnet cycle and the co-injection transformer, the ATn for the co-injection system MUST be hardwired from the decoded ATn locally at Siemens. [It may be preferred to first drop the enable
and then re-apply the enable at ATn to maintain confidence in the “enable line”. This concept is at odds to the original view of applying the enable when < maximum threshold (see #7) but is consistent with the logical operation of chipmunk and NMC units. [Pepin Carolan will inquire as to whether there is a consensus within DOE with regard to active enable application or removal.]

7. The initial estimate of the enable logic was to give a system enable when the system senses beam current amplitude < high limit and there are no hardware or “self-test” failures.

8. Once an enable has been “dropped”, the system cannot be re-enabled until the next ATn. (The loss of enable due to a Booster transfer > maximum threshold is latched until the next ATn).

9. The loss of an enable due to a hardware or self-test failure is latched until manually reset.

10. The system integrates and “makes an decision to enable” for each Booster transfer since the integration period is 100μs and the Booster extracted beam spans < 1μs.

11. FEB extraction only occurs with the AND of the co-injection system enable and the machine controls system FEB request (e.g. begin charging, etc.).

12. Since this system cycles frequently between > maximum threshold and < maximum threshold, mechanical devices such as relays should be avoided.

13. Noise suppression of order < 10% of maximum threshold is necessary to eliminate spurious trips, (remove enable).

14. There should be no minimum threshold other than zero, (no non-zero minimum to allow an enable).

15. Nominal ATR/RHIC beam requirements are for ~ 1 x 10^{11} charges/bunch, an initial value for the maximum threshold should be ~ 5 x 10^{11} charges/Booster transfer. This provides sufficient protection from the ~ 0.8 x 10^{13} charges/bunch maximum AGS bunch intensity fault.

16. Options to be considered for attenuation of the Linac beam for ATR FEB should include the active inhibit of 1 + LEBT quadrupole magnets (to be empirically determined) to achieve the desired attenuation factor. This inhibit may be programmatic or hardwired dependant upon further review.

A preliminary proposal for FEB ATR and FEB g-2 PPM operation uses the VD3&4 magnets as critical devices. The 8° and 20° bend magnets have DC power supplies and must therefore remain ON.

<table>
<thead>
<tr>
<th>VD3&amp;4 ON</th>
<th>A</th>
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<tbody>
<tr>
<td>VD 3&amp;4 @ 95% of setpoint</td>
<td>N</td>
</tr>
<tr>
<td>Co-injection system &gt; maximum threshold</td>
<td>D</td>
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<tr>
<td>FEB request</td>
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<tr>
<td>ATR switching magnet I &lt; minimum</td>
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FEB enable for g-2

cc: RSC, RSC file