CDF Silicon Radiation Protection Procedure

This procedure outlines the steps to be taken by the CDF Shift Crew with respect to the CDF silicon radiation protection and recovery from CDF initiated Tevatron aborts.

Editorial Hand-Processed Changes Other Than Spelling
Require CDF Operations Department Co-Head Approval

HPC Number	Date	Section Number	Initials
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Approvals:

(CDF Operations Department Co-Head) (Date)

(Particle Physics Division Head) (Date)

(Beams Division Head) (Date)

1.0 Controlled Copies of this procedure.

Seven controlled copies of this procedure will exist in the following locations:

1. The CDF Operations Department Office Library
2. Particle Physics Division Office
3. Accelerator Main Control Room
4. Beams Division Office

Two copies will be on the CDF web page at
http://www-cdf.fnal.gov/cdfsafe/cdfproclist.html
and at ADMIN.CDF/ES&H/Procedures

In addition, one copy of section 2.0 of this document will be in the CDF Control Room in an operator's aid called "CDF SVX Radiation Protection Handbook".

All other copies will be marked, "INFORMATIONAL COPY ONLY"

2.01 The Procedure.

2.1 General Description

See CDF Note 5414, "The Silicon Radiation Monitoring and Protection System for Run II" and references therein (attached) for a description of the system as it now exits.

2.2 "Alarm" and "Abort" levels

This procedure governs Alarms and both manual and automated Aborts of the Tevatron beam. The "Alarm" condition is a preliminary indication of radiation levels that may cause significant damage to the SVXII, ISL or L00 detectors. The "Abort" condition actually aborts the Tevatron beam to protect the SVX. By “automated” we mean that the Abort is generated by the radiation protection CAMAC electronics. In this case the Tevatron 5V enable/permit is dropped causing the beam to be dumped without human intervention. A “manual” Abort is caused by either CDF or MCR shift personnel affecting a beam abort. At CDF this is done using ACNET. The details for this procedure are covered in the shift training.

The suggested levels for both "Alarm" and "Abort" are outlined in Table 2 of CDF Note 5414 (attached). It is recognized that these levels may need to be adjusted during the Collider Engineering and Collider Run periods.

The levels can be adjusted only by mutual agreement among the following:

1. Beams Division Collider Run Coordinator
2. CDF Operations Manager
3. CDF SVX Radiation Damage Control Officer (RDCO).

The agreed upon "Alarm" and "Abort" levels should be entered in the CDF SVX Rad Log by the CDF Operations Manager.

2.3 Manual Aborts

2.3.1 Manual ABORT During Shots:

This procedure covers the period from the start of shot setup until the end of scraping.

1. At the start of this period, the MCR crew chief should record the value of E:SVRAD1 in the MCR logbook and start monitoring E:SVRAD1 on a Fast Time Plot. The MCR crew chief should adjust the limits and alarm status of E:SVRAD1 such that it will alarm when it increases by the Manual Shot Alarm value (given in line 3 of Table 2 in CDF5414). The CDF shift crew must also monitor E:SVRAD1.

2. If E:SVRAD1 increases by more than the Manual Shot Alarm value, the CDF SciCo must call MCR and inform them of a possible problem. The MCR crew chief should attempt to understand the nature of the problem and correct it if at all possible. This may mean calling Tevatron experts. The MCR crew chief must call the Collider Run Coordinator at the earliest convenient time.

3. In any case, if E:SVRAD1 increases by more than the MCR Manual Shot Abort value (Table 2, line 4) the MCR crew chief should abort the beam.

4. If the MCR crew chief fails to abort the beam, the CDF SciCo can manually abort the beam if E:SVRAD1 increases by more than the CDF Manual Shot Abort value (Table 2, line 5). The ultimate responsibility for the protection of the CDF silicon detectors rests with the CDF department.

2.3.2 Manual ABORT During Stores:

This procedure covers the period after scraping is complete.

1. At the start of this period, the MCR crew chief should record the value of E:SVRAD1 in the MCR logbook and start monitoring E:SVRAD1 on a Fast Time Plot. The MCR crew chief should adjust the limits and alarm status of E:SVRAD1 such that it will alarm when it increases by the Manual Store Alarm value (given in Table 2, line 6). The CDF shift crew must also monitor E:SVRAD1.

2. If E:SVRAD1 increases by more than the Manual Store Alarm value, the CDF SciCo must call MCR and inform them of a possible problem. The MCR crew chief should attempt to understand the nature of the problem and correct it if at all possible. This may mean

calling Tevatron experts. The MCR crew chief must call the Collider Run Coordinator at the earliest convenient time.

3. In any case, if E:SVRAD1 increases by more than the MCR Manual Store Abort value (Table 2, line 7), the MCR crew chief should abort the beam.

4. If the MCR crew chief fails to abort the beam, the CDF SciCo can manually abort the beam if E:SVRAD1 increases by more than the Manual CDF Store Abort value (Table 2, line 8). The ultimate responsibility for the protection of the CDF silicon detectors rests with the CDF Operations department.

2.3.3 Manual ABORT During Studies:

This procedure covers Collider Study periods, or any other time when beam is injected into the Tevatron, except for Shot or Store conditions.

1. At the start of each 8-hour shift, the MCR crew chief should record the value of E:SVRAD1 in the MCR logbook and start monitoring E:SVRAD1 on a Fast Time Plot. The MCR crew chief should adjust the limits and alarm status of E:SVRAD1 such that it will alarm when it increases by the Manual Studies Alarm value (given in Table 2, line 9). The CDF shift crew must also monitor E:SVRAD1.

2. If E:SVRAD1 increases by more than the Manual Studies Alarm value, the CDF SciCo must call MCR and inform them of a possible problem. The MCR crew chief should attempt to understand the nature of the problem and correct it if at all possible. This may mean calling Tevatron experts. The MCR crew chief must call the Collider Run Coordinator at the earliest convenient time.

3. In any case, if E:SVRAD1 increases by more than the MCR Manual Studies Abort value (Table 2, line 10), the MCR crew chief should abort the beam.

4. If the MCR crew chief fails to abort the beam, the CDF SciCo can manually abort the beam if E:SVRAD1 increases by more than the CDF Manual Studies Abort value (Table 2, line 11). The ultimate responsibility for the protection of the CDF silicon detectors rests with the CDF Operations department.

2.3.4 Response to SVX Manual ABORT

Only the CDF Operations Manager can authorize the reset of the SVX ABORT. This is done by toggling SVX ABORT RESET switch after software reset of the Abort system.

The decision to reset will be made by CDF Operations Manager in consultation with the SVX Radiation Damage Control Officer (RDCO) and Accelerator Operations.

This consultation will consider data from the SVX Radiation Monitors (SVRM), and other TeV diagnostics, and will follow guidelines below.

Conclusions will be logged in SVX Rad Log.

Manual Abort Reset Guidelines:

a) If the TeV problem is curable and understood by the CDF Operations Manager, the ABORT is reset, and operations continue.
b) If the Tev problem is not curable, or is recurring, or is not understood by the CDF Operations Manager, the CDF Operations Manager may elect to consult the CDF Operations Department Head (or his designee) and the CDF Department Operations Head may elect to consult the CDF Spokesperson before the ABORT is reset.
c) If the problem is believed to put the SVX at serious risk, the CDF Operations Department Head /CDF Spokesperson may elect to delay resetting the abort until appropriate discussions have taken place among CDF, Research Division, and Beams Division.
d) If necessary the Directorate will be consulted.

2.4 Automated Aborts and Alarms

2.4.1 Response to Automated Aborts

Only the CDF Operations Manager can authorize the reset of the SVX ABORT.

This is done by toggling SVX ABORT RESET switch after software reset of the Abort system.

The decision to reset will be made by CDF Operations Manager in consultation with the SVX Radiation Damage Control Officer (RDCO) and Accelerator Operations.

This consultation will consider data from the SVX Radiation Monitors (SVRM), and other TeV diagnostics, and will follow guidelines below.

Conclusions will be logged in SVX Rad Log.

Automated Abort Reset Guidelines:

a. If the measured does at CDF was actually above the SVX threshold, then the abort is considered to be valid.

   1. If the TeV problem is curable and understood by the CDF Operations Manager, the ABORT is reset, and operations continue.

   2. If the Tev problem is not curable, or is recurring, or is not understood by the CDF Operations Manager, the CDF Operations Manager may elect to consult the CDF Operations Department Head (or his designee) and the CDF Operations Department Head may elect to consult the CDF Spokesperson before the ABORT is reset.

      If the problem is believed to put the SVX at serious risk, the CDF Operations Department Head /CDF Spokesperson may elect to delay resetting the abort until appropriate discussions have taken place among CDF, Research Division, and Beams Division.

      If necessary the Directorate will be consulted.

b. If the measured dose at CDF is below the SVX ABORT threshold, the abort is considered to be FALSE.

   The SVX RDCO will be responsible for trouble shooting the cause of the FALSE ABORT.

   Time to next store will be absolutely minimized, by simply swapping suspect modules if necessary.

2.4.2 Response to Automated Alarms

The CDF Scientific Coordinator on shift will consult with the SVX RDCO and the Accelerator Main Control Room to understand the reasons for the observed losses.

The CDF Scientific Coordinator will log the occurrence and conclusions in the SVX Rad. Log.

Alarm Guidelines:

a. If the dose at CDF is above the ALARMTHRESHOLD, the CDF Scientific Coordinator will request that the accelerator MCR investigate to determine the source of the problem.

b. If the dose at CDF is below ALARM THRESHOLD, the SVX RDCO is responsible for trouble shooting the cause of the FALSE ALARM.

2.4. On Abnormal Termination of Store but SVRM below Abort threshold.

The CDF Scientific Coordinator (SCICO) will assign a shift member to interpret SVRM data.

Unusually large losses at B0 require consultation with SVX RDCO.

The SVX RDCO will decide whether to contact CDF Operations Manager.

2.5. Monitoring.

The CDF shift crew is responsible for routine monitoring of data from the SVRM.

At the end of every run and every store, they record integrated totals for SVX radiation scalars and loss monitors in the SVX Rad Log.

Unusually large losses at B0 required consultation with SVX RDCO.

The RDCO will decide whether to contact CDF Operations Manager.

3.0 Checklist

None required.

The sequence of events should be recorded in the CDF SVX Rad logbook in the CDF Control Room.

4.0 Deviations from the Procedure

None are allowed.

5.0 Required Training and Authorized Training Personnel.

The following personnel must be trained for this procedure:

- CDF Operations Managers
- CDF Aces
- CDF Consumer SciCo's
- CDF Radiation Damage Control Officers

Authorized training personnel are listed below:

Steven Blusk ID# V5480
Paul Tipton ID#V4544
Andy Hocker ID#V07436
Additional training personnel can be added with approval of the CDF Department Head.

Name and ID#	Approval	Date

6.0 Training Materials.

No special written materials exist.

A handout of section 2.0 of this procedure should be used.

A lecture must be given by one of the authorized training personnel.

This lecture must include a tour with stops and instruction at:

1. SVX Radiation Protection CAMAC Crate
2. SVX Abort Reset Switch
3. SVX Applications Pages in ACNET

7.0 List of Trained People for this procedure.

The list of trained people for this procedure should exist in written form in the CDF Department copy of this procedure.

Aces and SciCo's

Name and ID#	Approval	Date

8.0 References and Supporting Documentation.

CDF Note #5414
Nucl. Instr. And Meth. In Phys. Res. A 350 (1994) Page 112 and following
CDF Note #1685
CDF Note #1585
CDF Note #1484
CDF Note #1337
CDF Note #1234
CDF Note #1022
CDF Note #991
SVX Radiation Summary Guide

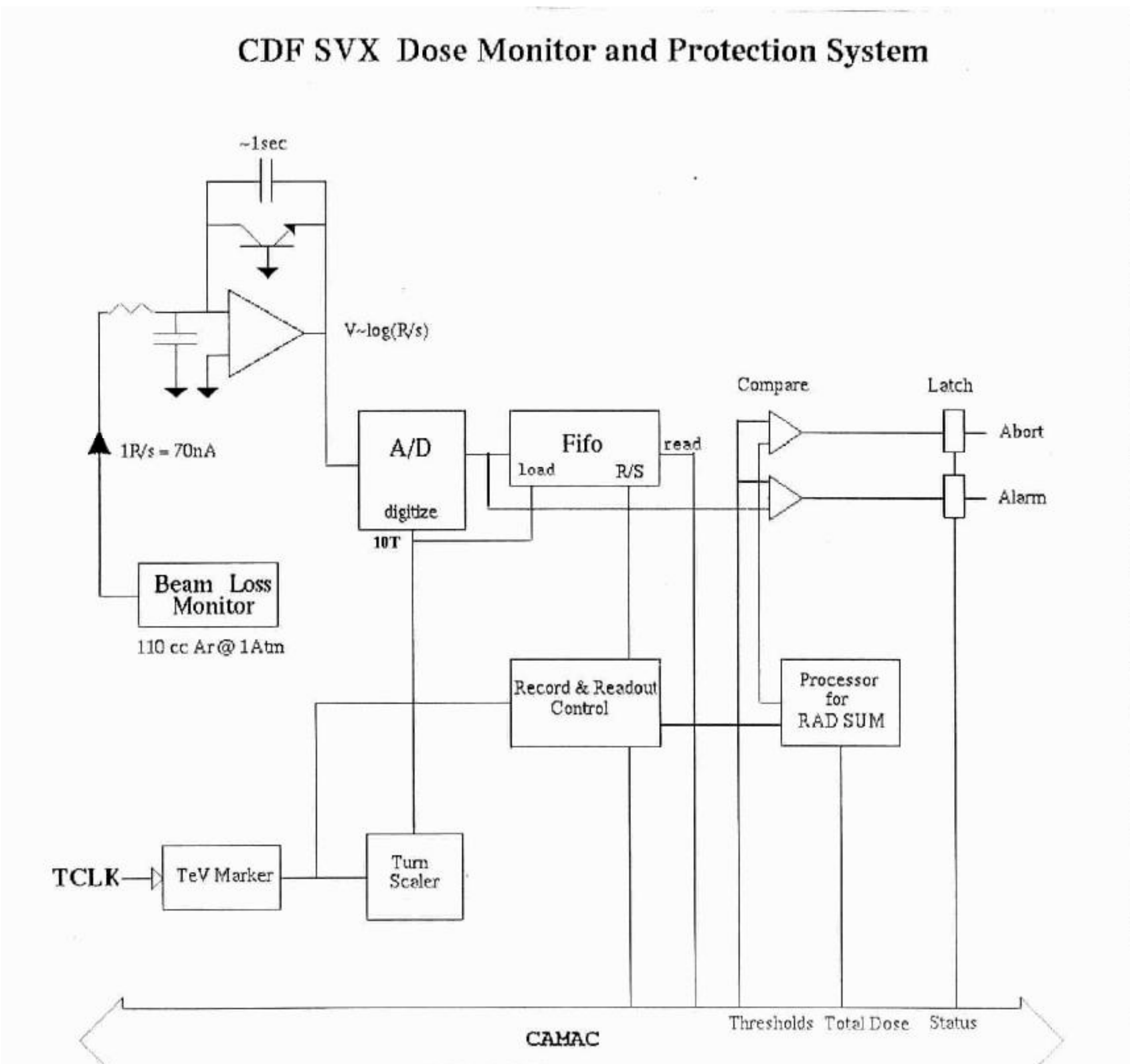
CDF/DOC/CDF/PUBLIC/5414

The Silicon Radiation Monitoring and Protection System for Run II

S. Blusk, P. Derwent, A. Hocker, P. Tipton

1. Overview and Hardware Description

The CDF radiation protection system is designed to both monitor and limit the radiation dose incurred by the silicon tracking system during Run II and beyond. The system, shown in the following schematic, is essentially identical to the one used in Run I.



The radiation is measured with two pairs of Beam Loss Monitors (BLM) that for Run II will be in the horizontal plane +4.3m and -4.3m from the center of the interaction region at an average radius of 10.7 cm from the beamline. Each BLM is a sealed glass ion chamber that contains 110cc of argon at STP. This yields an ionization current of 70 nA for 1 Rad/s. The BLMs are read out through a logarithmic integrating amplifier housed in what is called the BLM Chassis.

The BLM chassis used by CDF has one slight modification from the Tevatron standard. The signal rise time is the standard 24 microseconds, but the signal decay time constant has been altered from the standard 61ms to 940ms. Thus the BLMs, as read out through this system, are sensitive to extraordinary single-turn accidents and also slower but persistent beam losses. Note that the position of the BLMs is the only essential difference between the system used in Run I and the proposed Run II system. In Run I the BLMs were 2.0m from the center of the interaction region and were centered at a radius of 8.3 cm from the beamline.

The Run II system provides some additional BLM monitoring capabilities over Run I. Since the BLM HVs are daisy-chained together on each side, the two HVs will be run back to the CDF control room where they will be divided down and monitored/alarmed in ACNET. In addition the BLM outputs will be outfitted with 50-Ω feed-through terminators, allowing one to use line-termination tests to easily check that the signal cables are connected to the BLMs.

Also placed 4.3m away for the interaction region are thermo-luminescent devices (TLDs) used to measure the r-phi distribution of the dose and cross check the BLM calibration. The TLDs are lithium fluoride crystals, the luminescent properties of which change after exposure to radiation. The TLDs are to be replaced approximately monthly. Early in Run 1 we also used a silicon PIN diode detector system but these were found to be too sensitive and the system was therefore abandoned.

The output from the integrating amplifier in the BLM chassis is processed by a CAMAC-based system developed by the Beams Division in collaboration with Paul Derwent and the University of Michigan CDF group. One double-wide CAMAC card, the so-called 335-336 modules handles inputs from two BLMs. The 335-336 modules actually have two boards, a 335 and a 336 card in each. The 335 card samples and digitizes the BLM signal every 210 microseconds, corresponding to 10 turns of the beam.[*] This signal is compared to alarm and abort thresholds that are downloaded to the 335 card through ACNET. These thresholds are set depending on the Tevatron state; there are separate thresholds for Shot Setup and for Store conditions. The 335 card or's the condition of the two BLM signals and sends the abort status via the CAMAC backplane to the Abort Combiner Card. This card takes the 2 potential abort signals from the two 335 cards and or's them, dropping a 5V line if any are in abort status. The 5V line is connected to the TeV abort system at TeV CAMAC crate $1B in the B0 service building, approximately 400 ft away.

The digital signal for each BLM from the 335 card is also sent to the 336 card which holds the signal in a 2048 deep FIFO. A second FIFO keeps the integral of the dose for each BLM.

A slightly more thorough description of the radiation monitoring system can be found starting on Page 112 of Nucl. Instr. And Meth. In Phys. Res. A 350 (1994), provided in this document.

1.1 Alarm, Abort, and Manual Abort Thresholds

Table 1 contains relevant physical parameters of the detectors and radiation monitoring system. It also gives the expected radiation dose for both Run I and Run II conditions. During Run I the dose at the innermost layer of the SVX was a factor of approximately 2.5 higher than the dose at the BLM. In Run II this ratio is likely to change because (1) the above mentioned change in the BLM position (2) the SVXII innermost layer is at 2.5cm instead of 3.0cm (3) there is more material in front the BLMs in Run II. To estimate the physics dose at the BLM we simply extrapolated the Run I value of rads/s to larger radius. To do this we use the observed Run I radial dependence of the dose, r**(-1.68). Thus we are essentially assuming the larger z position of the BLM and the additional material in front of the BLM will effectively cancel leaving only the affect of the change in radii.

Table 1

Item	Run I	Run II
Radius of SVX L0	3 cm	2.5 cm
BLM Z Position	2m	4.3 m
BLM radius	8.3 cm	10.7 cm

[*] The schematic shows the readout being clocked by the TeVatron $AA marker. In order to protect the abort system from possible failures of $AA, an independent 47.7 kHz clock will be used instead and continuously monitored for possible failure.

Dose due to Physics at L0 of SVX	0.0025 Rad/sec at 1x10**31	0.067 Rad/sec at 2x10**32
Max estimated dose at L0 in a 15 hour store	135 Rads	3.6Krads
Dose due to Physics at BLM	0.001 Rads/sec at 1x10**31	0.0131 Rad/sec at 2x10**32
Max estimated dose at BLMs in a 15 hour store	54 Rads	707 Rads

Table 1. Relevant positions of the BLM and inner silicon layers. Also given are dose estimates for Run I and Run II. The affects of the larger z position and more material in front of the BLMs have not been included in the Run II BLM dose estimates.

Table 2 contains the Abort and Alarm thresholds for Run I and the proposed thresholds for Run II.

Table 2

Threshold	Description	Run I	Run II
1. Automated Shot Abort	CAMAC Trip Threshold during Shot setup	10 Rad/sec	10 Rad/sec
2. Automated Store Abort	CAMAC Trip Threshold during stores and at all other times	2 Rad/sec	2 Rad/sec
3. Manual Shot Alarm	CDF to alert MCR of high losses during shot setup	Integrated dose of 50 Rads	Integrated dose of 1Krad
4. MCR Manual Shot Abort	MCR to abort shot	Integrated does of 150 Rads	Integrated dose of 2Krads
5. CDF Manual Shot Abort	CDF to abort shot	Integrated dose of 250 Rads	Integrated dose of 3Krads
6. Manual Store Alarm	CDF to alert MCR of High losses during a store	Integrated dose of 50 Rads	Integrated dose of 3Krad
7. MCR Manual Store Abort	MCR to Abort Store	Integrated dose of 150 Rads	Integrated dose of 4Krad
8. CDF Manual Store Abort	CDF to Abort Store	Integrated dose of 250 Rads	Integrated dose of 5Krads
9. Manual Studies Alarm	CDF to alert MCR of High losses during a shift of Acc. Studies	Integrated dose of 50 Rads	Integrated dose of 4Krad
10. MCR Manual Studies Abort	MCR to Abort Studies	Integrated dose of 150 Rads	Integrated dose of 5Krad
11. CDF Manual Studies Abort	CDF to Abort Studies	Integrated dose of 250 Rads	Integrated dose of 6Krads

Table 2. Alarm and Abort Thresholds for the Run I and Run II Radiation Protection System. Items 1 and 2 are the proposed automatic aborts, downloaded to the 335 CAMAC Card. Items 3-11 are the proposed thresholds for manual action by either CDF or MCR shift members during Shot Setup, Store or Tevatron Study periods. All radiation levels are as recorded by the BLMs, NOT the value extrapolated to the innermost silicon layer of the SVXII.