C-AD

Radiation

Safety

Committee

Issued: April 6, 2016

Minutes of RSC Subcommittee of April 5, 2016

Subject: Status of UED and CeCPoP Issues

Present: I. Pinayev, D. Beavis, C. Naylor, J. Reich, M. Fedurin, E. Lessard, C. Montag, R. Karol, and C. Theisen

The purpose of the meeting was to examine issues that have arisen for UED and CeCPoP and give the committee a chance to discuss the issues. This is especially important for UED as the IRR will occur on April 7, 2016. The issues for CeCPoP are important to be closed in the near future so that CeCPoP can operate above 1 Watt to full power (8500 Watts).

UED Issues

A Powerpoint presentation[1] was prepared that covered the UED and CeCPoP items that the Chair wanted the committee to discuss or be updated. The UED items included the final shielding design, area monitoring, radiation surveys, and a design issue that recently arose on the Klystron.

The final bulk shielding drawings are in the process of being signed. A report on the estimated dose rates has been distributed[2] to the committee in the past. The experiment requested that the dose rates during operations be between 0.05 and 0.5 mrads/hr with preference to as low as possible. The dose rates are based on the dark current creating 100 times more radiation then the pulsed beam generated with the laser. This may be an overestimate and if so the radiation levels will drop accordingly. One change in the shielding was made after the report was generated and documented via an e-mail. It was agreed that adding the e-mail as an addendum to Footnote 2 would be an appropriate way to document the change. A summary of the shielding analysis is shown in the table below, which is taken from Footnote 2.

(CK-UED-April 16, 2016-D. Beavis-1020) Update shielding memo.

The dose rates are low and within the desired range for all areas the users are expected to work. There are elevated levels over the top of the shielding wall that typically approach 1

[1] D. Beavis, "Status of UED and CeCPoP", April 5, 2016;

[2] D. Beavis, Feb. 12, 2016,"Update on UED Shielding Design"; http://www.c-ad.bnl.gov/esfd/RSC/Memos/2_12_16_UED.pdf

mrem/hr. Additional controls were not discussed but additional controls should be examined after the actual radiation levels are measured. The highest dose rate is behind the gun in an area not intended for users. The dose rate is estimated to be 6 mrem/hr. This is on the north-west side of the Environment Room (ER), which will be posted as a Radiation Area until review of the actual radiation levels. There is an expectation that this can be reposted as a Controlled Area-TLD required after the radiation source terms are better documented.

The intent of the present design is to allow trained radiation workers to have access to the ER roof for ventilation system work and electrical panels distributed around the perimeter. There was discussion whether this was appropriate under the standing RWP for radiation areas. The Chair looked at OPM 9.5.4 and concluded such activity was allowed up to 20 mrem of exposure to an individual worker. Naturally supervisors and workers should conduct proper work planning.

Table 1: Summary of UED Dose Rate at Location near the UED

Location description	Dose rate (mrads/hr)
Entrance gate	0.029
Laser port	Less than 0.500
ATFII shielding roof	0.500
ER roof (two feet above)	1.
Through south wall 30 cm away	0.010
Max. in Radiation Area	6.
Laser room 30 cm from concrete wall	0.016
General area skyshine from UED	0.008-0.015
Over top of side wall (south)	1.0
Through end wall	0.032
Over top of end wall (10 feet above floor)	0.8

Most of the area external to the ER and the laser area inside the ER are intended to be posted initially as Controlled Areas-TLD Required. There is expectation that after the documented radiation surveys are conducted and there is sufficient understanding of the stability of the radiation levels that the areas can be posted as Controlled Areas.

The area inside the ER with the UED could have routine radiation levels of several hundred mrem/hr at a foot. However, most of the actual area inside will have dose rates consistent with a Radiation Area. An access gate has been located at a position that is expected to have dose rates consistent with a Controlled Area. The area inside the gate can be accessed with ladders and to a lesser degree climbing so it cannot be considered impenetrable. The locked gate has a key that is mechanically attached to the key to turn on the Klystron. This meets the intent of the committee in the past. The gate must be posted as a High Radiation Area and qualified with additional notations such as “with beam on”. The actual posting and qualifications should be worked out with RCD.

(CK-UED-April 16, 2016-P. Bergh and D. Beavis-1021) Gate posting

The gate lock is a unique key with a single spare. The safety section has the spare. The Kirk key for the Klystron has a spare which is in the possession of the ACG and will be

turned over to the safety section when testing is complete. The gate provides turn knob exiting.

The committee did not want unnecessary interlocks or comfort controls on the gate. The committee chair will let BES personnel know of this determination. The gate sensor will be removed in a few days. Any documentation will have the QA level reviewed.
(CK-UED-April 16, 2016-J. Reich and D. Beavis-1022) Remove door sensor and review documentation.

The committee was satisfied with the area monitoring that was presented and the use of the chipmunk to characterize radiation levels in the UED area.

There was discussion about the long term controls for the UED. A chassis has been lent to UED from NPP for initial startup. Eventually the UED will use it own chassis and controls software. The RSC requires that the chipmunk data be sent to the MCR, to the local control room as appropriate, and finally that the data be archived with all the existing chipmunk data. The UED experiment may not be planning on this but they will need to ensure that the chipmunk will provide alarms and data to MCR. This will also be a concern for the ATFII project which is expected to have many chipmunks distributed throughout the facility. It was noted that MCR must know the conditions of operating facilities in Building 912 and potentially dispatches personnel to the area if alarms occur.

The committee was satisfied that an RCT could make radiation measurements inside the UED area under an RWP and appropriate precautions. The list of measurements was satisfactory once an item to determine the radiation with and without pulsed current is added.
(CK-UED-April 16, 2016-P. Bergh and D. Beavis-1023) Add determination of pulse radiation levels (if possible) to the radiation survey list.

It was noted on April 1, 2016 that the bottom portion of the Klystron structure/tank may not have been reviewed for possible x-ray leakage. Past surveys have shown no issue for x-rays but the design should be examine. Although the tube is a commercial unit the bottom portion may not meet the vendors design criteria.
(CK-UED-April 16, 2016-J. Sandberg and D. Beavis-1024) Review the Klystron base design for radiation protection.

CeCPoP Issues

An outline[3] of beam induced radiation measurements was provided to the committee. This is an open ARR item and will be discussed at the next meeting for CeCPoP. Members should examine the list and determine if it is sufficient.

[3] D. Beavis, April 2, 2016,"Proposed Outline of Radiation Measurements for CeCPoP"; http://www.c-ad.bnl.gov/esfd/RSC/Memos/4_02_16_CeC.pdf

A report[4] on the dose rates and fault dose due to 25 MeV beam losses was briefly discussed. The report also has the dose due to neutrons so the title is deceiving. A summary of the dose rates and fault dose from the report is copied below.

Table 1: Dose rates and fault dose from 25 MeV Electron Beam Losses of 8500 Watts

Location	Routine rate (mrem/hr)		Fault Dose (mrem)	
	photon	neutron	photon	neutron
B Alcove Gate	1	.0006	14	.001
Labyrinth gate	0.7	0.03	10	0.3
Cryogenics pipe	0.7-1.1	0.06	10-15	0.8
North cableway	0.06	0.0003	0.8	0.004
South cableway	0.2	0.0008	2.2	0.01

The routine dose rate is for 125 Watts of localized beam loss. The fault dose assumes 8500 Watts of beam loss lasting for 12 minutes. It is expected that active processes such as the machine protection and trained operators will prevent a loss of this beam power from lasting more than 12 minutes. It was noted that the machine protection system (MPS) has multiple means to detect large beam losses. After the beam fault studies this fault duration will be reconsidered and whether any additional controls need to be added.
(CK-CeCPoP-April 16, 2016-I. Pinayev and D. Beavis-1025) Review fault duration for beam losses.

There is a weakness to the cryogenic pipe penetrations that allows large dose rates above the penetration. At the end of the labyrinth structure the hot spot is approximately 8 meters above the ground. There are no existing structures to climb to reach this elevation, which are not posted as no climbing, no ladders. However, it is possible the equipment such as a man lift could be placed in the area and raises a person to this height. Extrapolated the dose rate estimated at a closer location could be as high as 3000 mrem/hr for two penetrations side-by-side. For a 12 minute beam fault this would produce a dose of 600 mrem. This is much higher than the committee desires. There are many caveats about the likelihood, if this is a credible incident, and the extrapolation. The committee recommended that additional controls be established until more understanding can be obtained. If possible and if safe for personnel a measurement of this area from the adjacent berm should be attempted or a chipmunk be placed in the area for a measurement.

The demarcation line for no elevated work and no climbing should be moved to the end of the retaining wall and enclose the laser Building (1002F) along with a limit on the beam intensity to the equivalent of 1 kW at 25 MeV. The combination should keep dose rate below 100 mrem/hr.
(CK-CeCPoP-April 16, 2016-P. Bergh and D. Beavis-1026) Move elevated work posting and limit beam power via RSC check-off list.

[4] D. Beavis, April 2, 2016,"Accessible Penetrations and the Photon Dose from 25 MeV Beam Loses"; http://www.c-ad.bnl.gov/esfd/RSC/Memos/4_02_16_25MeV.pdf

The committee would like to see the calculated peak dose rate outside the final zone that is posted for elevated work to be prohibited. It was also noted that the hot spot occurs on the other side of the IR but is limited since it is in the more backward direction of the 25 MeV beam. The peak on the south side of the IR is higher than the Building 1002B roof. **(CK-CeCPoP-April 16, 2016-D. Beavis-1027) Calculate dose rate outside area of excluded elevated work.**

CC:

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RSC Minutes File
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