IER 268 CED-3b Report

Introduction

The goal of IER 268 was to collect information from the operation of the Godiva IV super-prompt critical assembly to support multi-physics modeling efforts.

There were two types of systems deployed. One was a Photo-Doppler Velocimetry (PDV) system which used the reflection of laser light on the surface of the Godiva IV core. The other consisted of an MHD-240 detector with two other detectors (an MHD-241 and an Eljen EJ-325A) used for reference as the MHD-240 detector was moved. The collection is referred to as the MHD Detector in the narrative log.

The PDV probes and internal view of the MHD-240 detector.

There were two types of Godiva operations performed to gather data. A series of super-prompt critical bursts were performed and data collected on both systems, tied to a common trigger. Separately, a series of delayed critical operations at various power levels was performed for a combination of MHD detector distances from Godiva and the presence and absence of a shield in the line of sight between Godiva and the MHD detector. This data was collected to determine the contribution of room return during the burst measurements.

Summary

The experimental campaign occurred over multiple weeks in late September through early October, 2020. The narrative log below summarizes the activities performed by day for the two phases of the experiment. The CED-3A phase is experiment preparation and, for this experiment, the performance of a go/no-go burst to demonstrate whether the equipment could collect the desired data. The CED-3B phase is the performance of the full planned experiment.

Available data is summarized from the MHD-240 and reference detectors, first for a burst, followed by the delayed critical data. The PDV Data is then summarized for the successful data collections. A description and examples of the Godiva operational data is then provided.

Appendix A provides the preliminary Measurement Plan, dated September 2, 2020. Note the dates and details were not updated as the scheduled changed due to delivery times for equipment. Appendix B contains a compilation of the daily update emails sent to NCSP Program Management.

Integral Experiment Preparation (CED-3A)

On September 21, 2020 the final equipment arrived and was brought into the facility. Equipment for both systems was set up. A schematic is provided on the following page. The Godiva Top Hat was removed so that the PDV probes could be targeted on the surface of four of the Godiva fuel rings. A visible laser signal was used to target the probes at the fuel rings. The Class IV laser used for the measurements was not visible and was not turned on when personnel were present. (Crew: J. Goda, T. Grove)

Visible PVD Probes During Setup on Godiva Assembly

On September 22, 2020 Godiva operations were scheduled for the purpose of a go/no-go burst to determine if the desired data could be collected. At 11:31 am a sub-prompt burst with reactivity of 97.3 cents was performed. Data was not collected by the deployed systems, but it was possible that the burst was too small to see an effect.

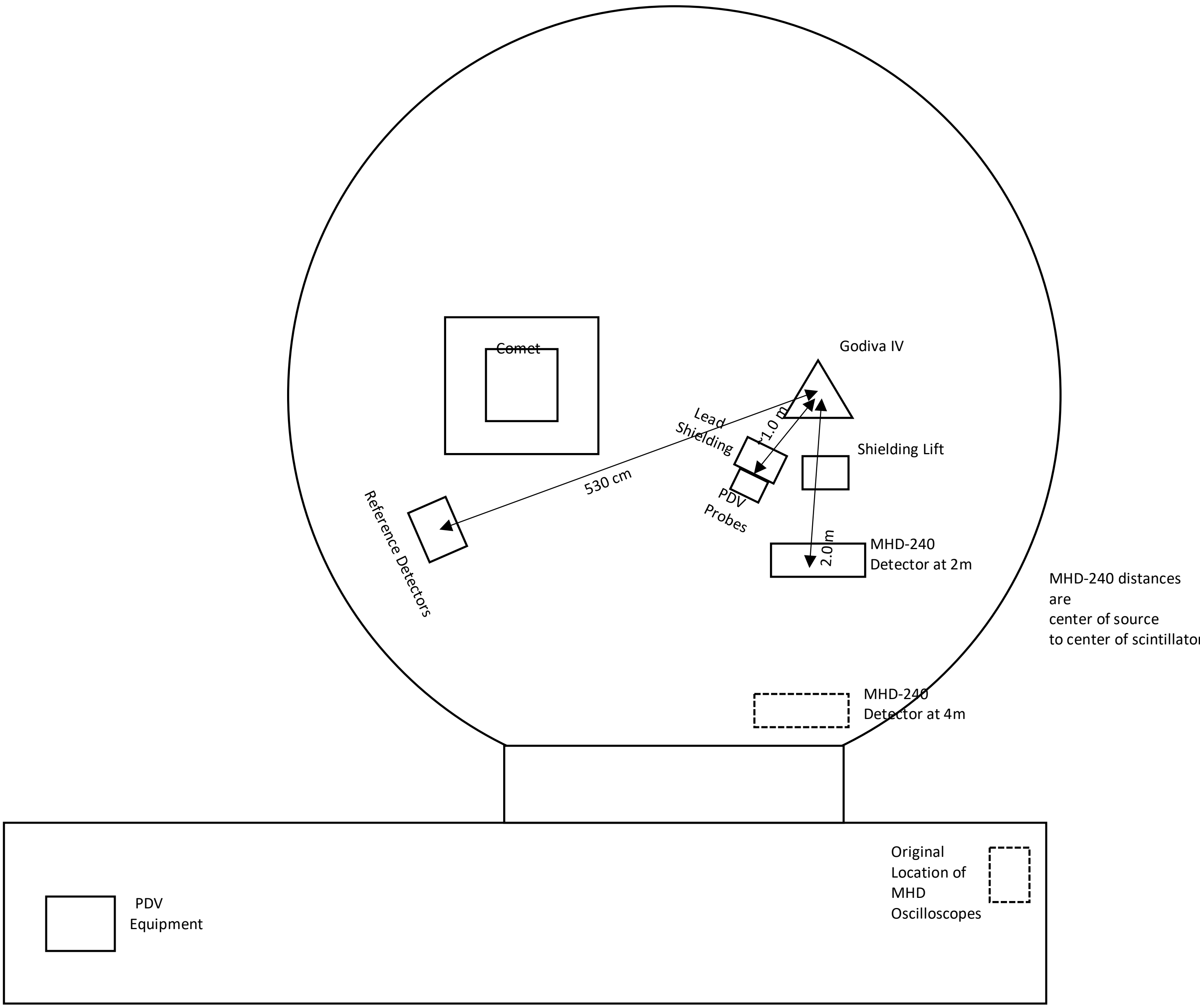
The operating crew continued with a super-prompt burst, and at 12:30 pm, burst #2047 was performed with a temperature rise of 61.7 °C. (Crew: J. Goda, T. Grove)

The measurement results from the deployed systems were mixed but promising enough to continue. The PDV Team got a faint, but distinguishable from background, signal. For the MHD Detector, the communication was lost at the time of the burst. One data collection oscilloscope blanked and another froze.

On September 23, 2020 the PDV team made adjustments to the alignment of their probes. The data collection oscilloscopes for the MHD detectors were relocated from the Godiva ante room to the control room and the signal cables were routed through junction boxes. This reconfiguration took most of the day, but prepared the teams for the full experiment weeks.

These activities concluded the CED-3A Experiment Preparation Phase and approval to proceed to CED-3b was requested.

Schematic of Equipment Setup



Equipment Setup Diagram for IER 268

Integral Experiment Execution (CED-3B) Week 1: Bursts

On October 5, 2020 the final setup of equipment was completed.

On October 6, 2020 the planned series of bursts for IER 268 began. At 11:15 am burst #2048 was performed with a temperature rise of 70.0 °C. Data from the experimental systems was not collected due to a trigger issue. It was determined that the data collection systems were triggering on the end of the trigger signal and not the beginning so only the tail of the decay following the burst was recorded. Adjustments were made to collect data at the beginning of the trigger signal. At 2:01 pm burst #2049 was performed with temperature rise of 122.8 °C. Data was collected on both the MHD-240 and PDV systems. (Crew: J. Goda, D. Hayes)

On October 7, 2020 at 10:52 am, burst #2050 was performed to repeat the nominal 70 °C burst from the previous day with a temperature rise of 71.4 °C. Data was collected by both systems. At 2:25 pm burst #2051 was performed with a temperature rise of 165.4 °C. Data was collected by the MHD-240, but one of the data collection oscilloscopes for the PDV measurement froze, presumably due to the radiation levels. It was the oscilloscope for the primary signals. The oscilloscope for the secondary (background signals) did not freeze. (Crew: J. Goda, J. Hutchinson)

On October 8, 2020 at 10:59 am, burst #2052 was performed with a temperature rise of 201.0 °C. The MHD-240 system collected data. This time the opposite PDV data collection oscilloscope froze, but since the signals had been split between the two, data was collected for two probes. (Crew: J. Goda, T. Grove, J. Hutchinson)

Integral Experiment Execution (CED-3B) Week 2: Delayed Critical

The following week (October 12 through October 15, 2020) consisted of delayed critical (DC) measurements on Godiva. Only the MHD-240 portion of the measurements was planned for the DC measurements. The PDV system was removed.

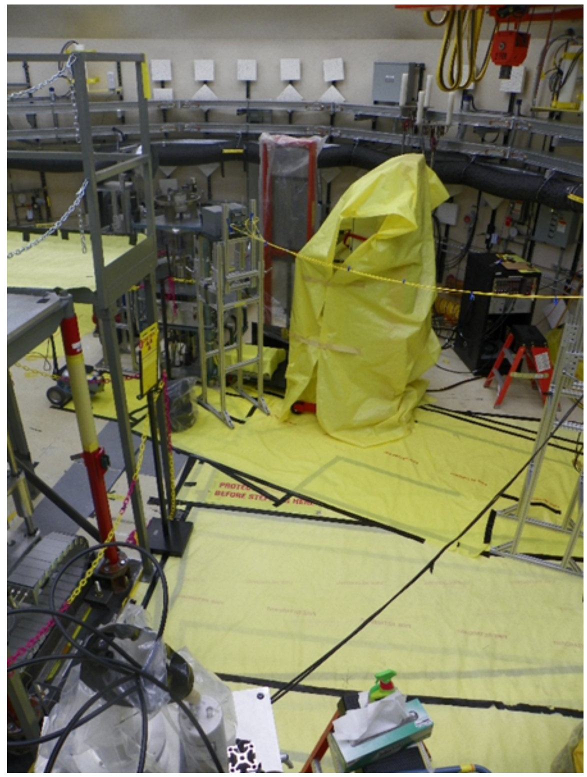
On October 12, 2020 the MHD detector was located at 4m with open line of sight to Godiva. A series of measurements were taken with Godiva at delayed critical at various power levels. (Crew: J. Goda, R. Sanchez, A. McSpaden (trainee))

On October 13, 2020 in the morning, additional measurements were taken as described on October 12. At 1:59 pm, a shield consisting of borated poly and lead was placed near Godiva, blocking the line of sight to the MHD detector. Similar measurements at various power levels were repeated. (Crew: J. Goda, R. Sanchez, A. McSpaden (trainee))

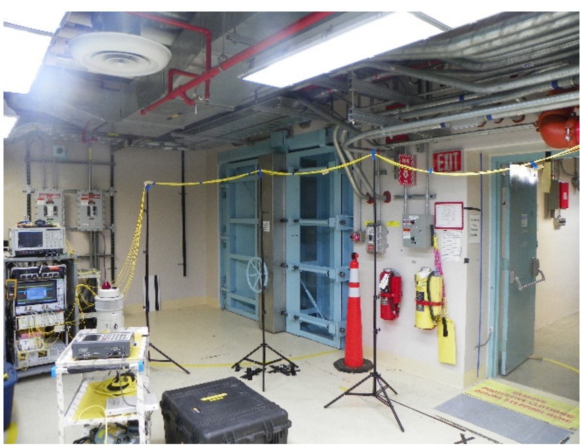
On October 14, 2020, the shield was lowered and the MHD-240 detector was moved to 2m from Godiva. Measurements were again taken at similar power levels. At 11:52 am, the shield was raised back into position and the measurements repeated. At 2:05 pm, the plastic scintillator was removed from the MHD-241 reference detector and the same measurements repeated. (Crew: J. Goda, R. Sanchez, A. McSpaden (trainee))

Photos

Reference Detectors (MHD-240 and Eljen EJ-325A)



MHD-240 covered with plastic in 2m position



PDV Laser, scopes and associated equipment

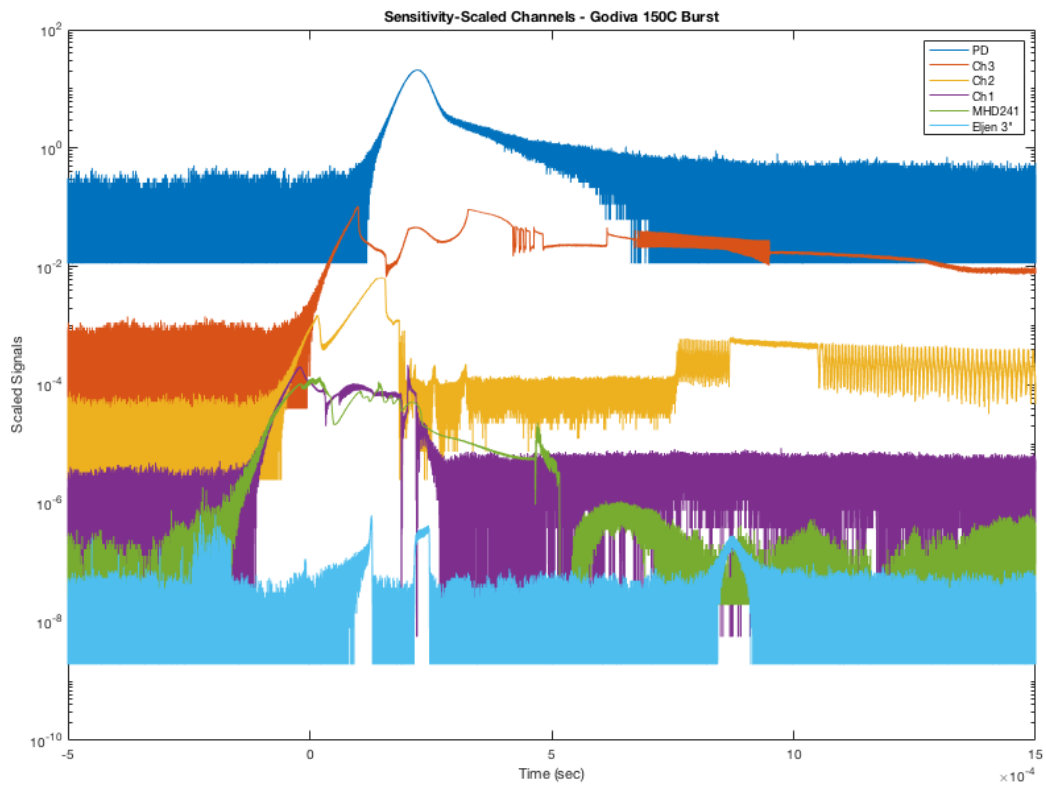
PDV Probes mounted with shielding

Available Data

MHD Detector Data for bursts

For bursts, a total of six signals were collected with the MHD system, four for the MHD-240 plus one for the MHD-241 and one for the Eljen EJ-325A. Each signal was recorded on two data collection oscilloscope channels with different scale settings.

An image showing the overlay of the data with preliminary scaling factors is shown below.



MHD Detector Data Collected During Burst

Below is the file structure for the data collected for the 123 °C burst on 10/6/2020.

C1--20201006--00002.trc	TRC File	16,611 KB	No
C2--20201006--00002.trc	TRC File	15,831 KB	No
C3--20201006--00002.trc	TRC File	17,019 KB	No
C4--20201006--00002.trc	TRC File	16,596 KB	No
C5--20201006--00002.trc	TRC File	16,375 KB	No
C6--20201006--00002.trc	TRC File	16,201 KB	No
C7--20201006--00002.trc	TRC File	16,457 KB	No
C8--20201006--00002.trc	TRC File	14,347 KB	No
C9--20201006--00002.trc	TRC File	8,293 KB	No
C10--20201006--00002.trc	TRC File	7,950 KB	No
C11--20201006--00002.trc	TRC File	8,308 KB	No
C12--20201006--00002.trc	TRC File	7,910 KB	No
ChannelOverlay-150Burst	PNG File	57 KB	No
ChannelOverlay-150Burst.fig	FIG File	56,840 KB	No
Overlay_Burst150C_20201006.m	M File	1 KB	No
ReadLeCroyBinaryWaveform.m	M File	4 KB	No

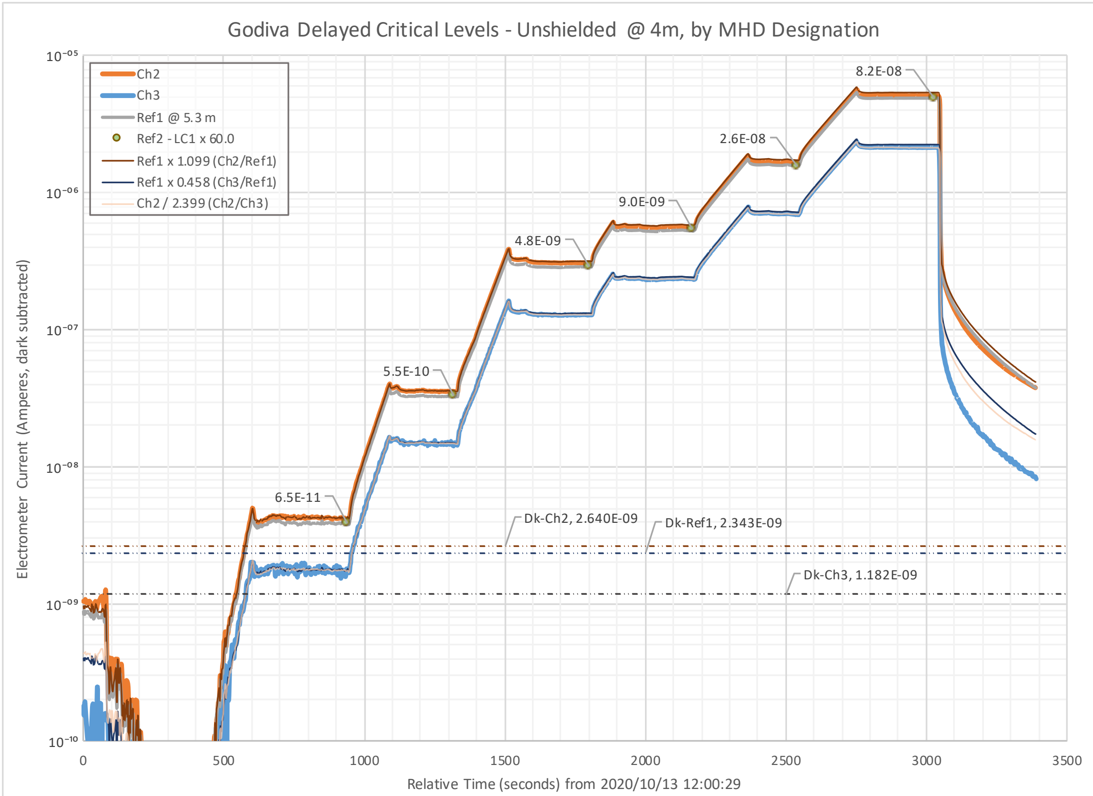
File Structure for the 123 °C burst on 10/6/2020

MHD Detector Data for Delayed Critical

The MHD Detector system data for delayed critical operations has been summarized in a preliminary report, "Preliminary Report – MHD-240 Measurements of Delayed-Critical Neutron Flux Levels from Godiva-IV with Estimates of Room-Return Contribution to Reactivity". The abstract and a representative plot are provided below.

Abstract

Precise neutron flux measurements at various delayed-critical (DC) power levels were made within the Godiva-IV source building at the National Criticality Experiments Research Center (NCERC), within the National Nuclear Security Site (NNSS) Device Assembly Facility (DAF). Measurements were conducted October 12-14, at 2-meter and 4-meter distances, shielded and unshielded, for the purpose of estimating the room-return contribution to the source reactivity, and its potential impact on burst yields. Various fixed reference monitors, calibrated and uncalibrated were also recorded simultaneously for independently tracking the source level as well as possible deviation from linearity in the main detector at higher flux levels. We present herein the experimental arrangement, acquired data, and initial analysis of our discovery. We suggest that a soft radial dependence to the room-return is evident, and that the room-return contribution must have both an outward and inward component to be self-consistent with direct irradiation following a $1/r^2$ dependence. This is physically consistent with some fraction of the inward room-return flux propagating through/around the Godiva-IV core and emerging as an outward component. We expect a more thorough report to soon follow, scaling the absolute flux with reactivity models, and momentary critical-excursion burst flux measurements with simultaneous acousto-optical measurements.



MHD Detector Data for Delayed Critical Measurements on 10/13/2020

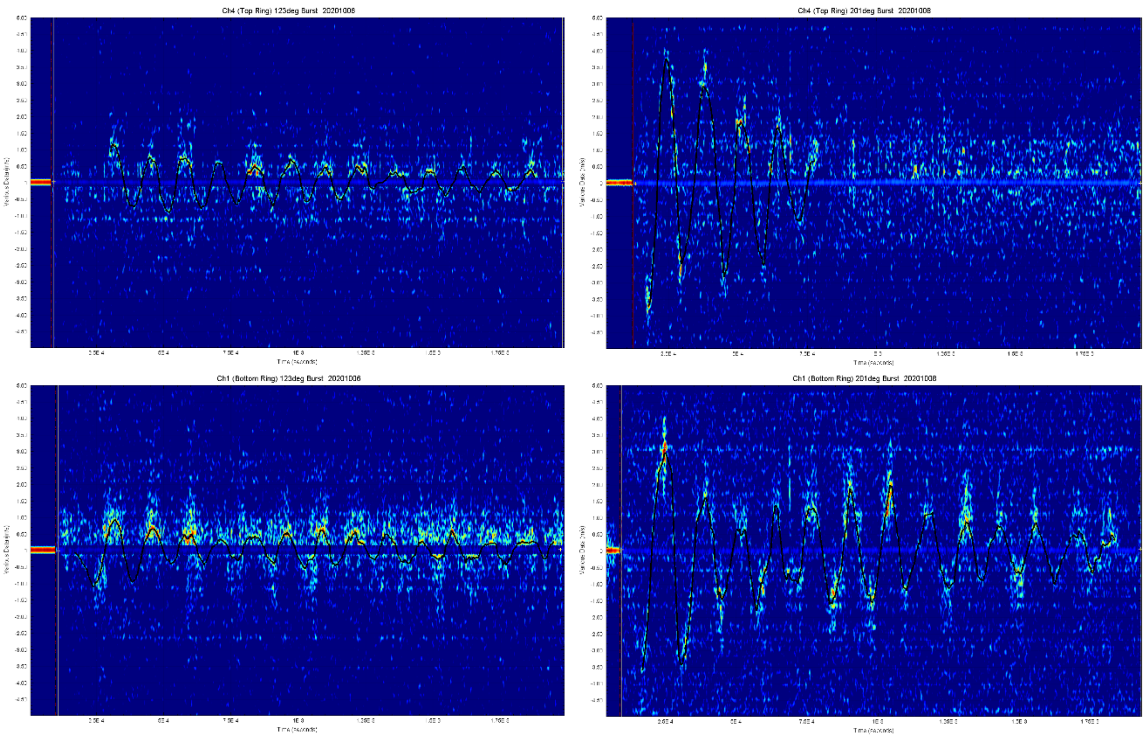
PDV Data

PDV data was collected on two bursts. The 10/6/2020 burst with a 123 °C temperature rise is denoted _004 in the PDV files. The 10/8/2020 burst with a 201 °C temperature rise is denoted _008 in the PDV data files. Although there were four probes deployed for each burst, signal was captured for only the top and bottom rings of the Godiva core. Ch1 denotes the bottom ring and Ch4 denotes the top ring.

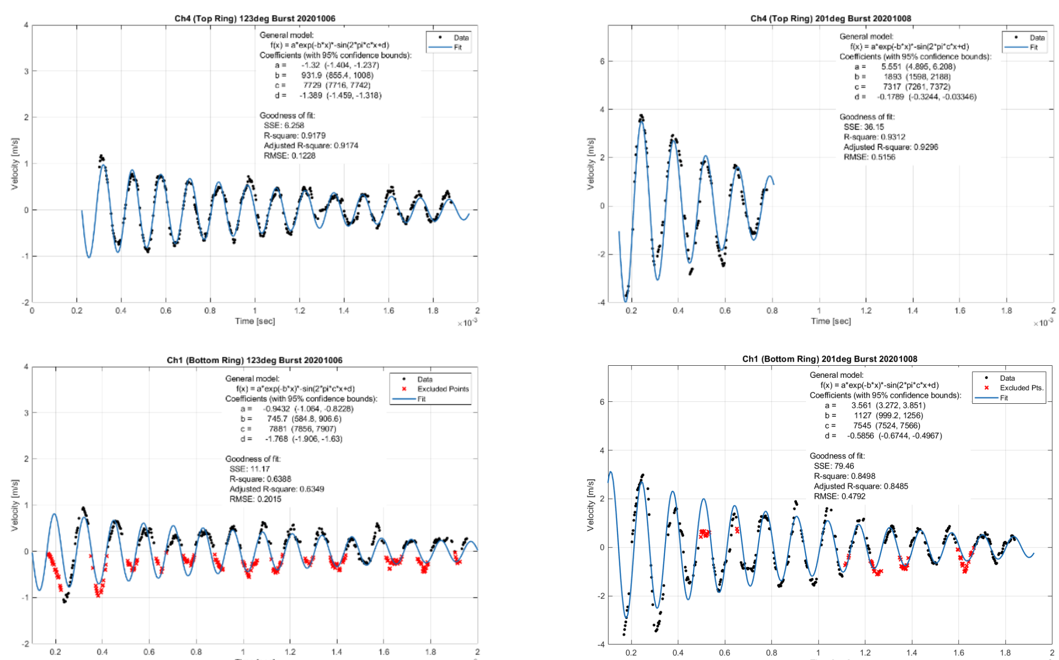
In addition to the active probes, two fiber-optic signal cables were run to the same location near Godiva. One was shielded in the same shadow as the active probes and one was not shielded. Their data is included in a file named Fiber Monitors.

Data provided includes raw digitizer files, comma separated variable files containing the velocity extractions, a Matlab script to read data, Matlab data files, Matlab figures and their corresponding images, Excel files and a Microsoft Access database file.

Shown below are plots of the velocity data versus time with a waveform overlaid to visualize the signal.



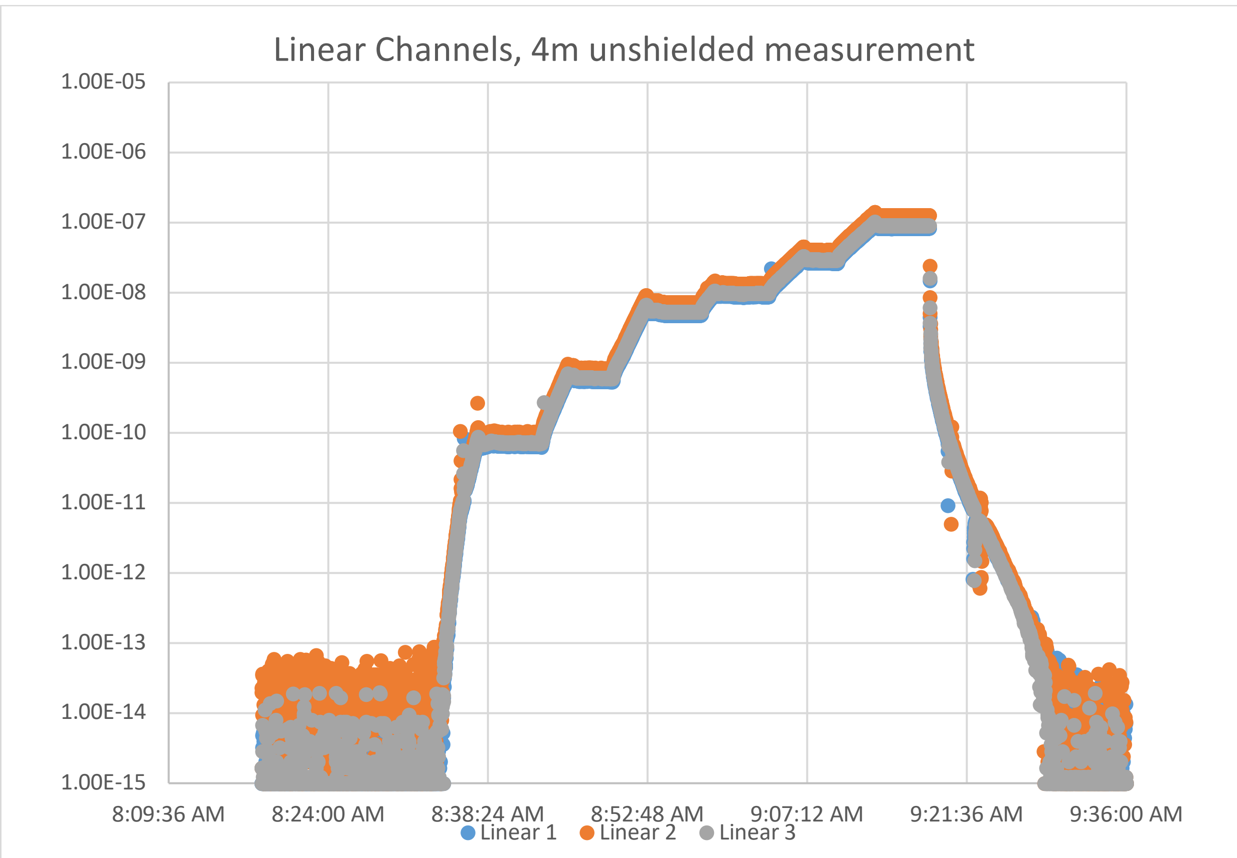
In the next set of plots, a damped sinusoid is fit to the data. All indicate frequencies in the 7-8 kHz region.



Godiva Operational Data

The available operational data can be found in the file labeled "IER 268 Data Octo 2020- LA-UR-20-28941 and consists of the following:

1. Godiva IV logbook scans for the days of the experimental campaign
2. Photos taken during the experimental campaign, including experimental setup
3. Standard NCERC detection system information, including
    a. Start-up detector responses (He-3 neutron detectors)
    b. Linear channel detector responses (compensated ion chambers for neutron detection)
4. Specialized Godiva IV burst information (only for bursts), including
    a. Photomultiplier tube detector response
    b. Photodiode detector response (two photodiodes)
5. Godiva IV temperature data (only for bursts)



Linear Channel Data During Delayed Critical Operations on 10/13/2020

Godiva Burst Information

Date	Time	Burst #	Burst Δ°C	Measured Period (us)	Measured FWHM (us)
October 6	11:15	2048	70.0	39.57	216.04
October 6	14:01	2049	122.8	15.73	84.25
October 7	10:52	2050	71.4	43.41	226.24
October 7	14:25	2051	165.4	11.87	63.68
October 8	10:59	2052	201.0	11.08	53.29

Appendix A – Measurement Plan

IER-268 CEDt-3b Measurement Plan
September 2, 2020

SCOPE

The goal is to provide total combined neutron and photon flux throughout the burst and shutdown sequence along with the measurement of initial inverse reactor period and surface motion and vibrations during and following the burst. The measurements will consist of steady state delayed critical Godiva IV power runs and bursts of several different temperatures.

For steady state measurements, the radiation flux will be acquired with an MHD240 detector with and without a radiation shield between Godiva IV and the detector. Two unshielded "monitor" detectors will also be used to provide relative power levels between the different steady state runs. The results of these measurements will allow the background room return component of the neutron and photon flux to be determined. Measurements at several different distances will allow the background to be determined as a function of distance.

Following the steady state power runs, Godiva IV bursts at different temperatures will be measured with an unshielded MHD240, in the same locations as the steady state measurements. In addition to the MHD240 detector, PDV fiber optic probes will view several locations along the outer surface of the Godiva IV fuel plates to provide surface vibration data simultaneously with the MHD240 measurements. The fiber optic probes will be located inside a lead "doghouse" to avoid direct radiation exposure, using mirrors to direct the laser light to the fuel plate surfaces. A direct optical view of the fuel plate surfaces will necessitate removal of the top hat with pre-burst and post-burst decontamination of the immediate area around Godiva IV. The radiation measurements will require burst flux histories over both short times (approx. 30 to 100 µsec) to capture the pulse and long times (up to 50 msec) to record the delayed critical plateau after the pulse to full shutdown.

PERSONNEL

LLNL: John Scorby, NCSD, IER-268 PI*
Scott Richardson, IT support
Mark May, WCI
Dan Bower, WCI
Lucas Snyder, WCI
Paul Yap-chiongco, NMO RI*
Becka Hudson, NCS Operations

NCERC: Joetta Goda, IER-268 PI, Godiva IV Crew Chief*
Godiva IV Operations crew*

MSTS: Robert Buckles (Detector Physicist), MHD240 and monitor detector lead*
Ed Daykin (Detector Physicist)
Hector Valencia (Diagnostic Engineer)*
Joe Bellow (Detector Technician)*
Derek Constantino (Detector Engineer)*
Michael Pena (Detector Physicist), PDV lead*
Ryan Emmitt (Electro-Optic Technician)*
Carlos Perez (Electro-Optic Technician)*
Anselmo Garza (Electro-Optic Technician)

* Personnel present at NCERC during set-up and/or measurements

EQUIPMENT

A detailed list of equipment has been provided to NCERC for inclusion into their work package. Principle detector and data acquisition equipment is provided below:

Radiation Measurements

- MHD240 4 head scintillation detector
- MHD241 single head scintillation detector
- Eljen EJ-325A scintillation detector
- Radiation shield (8" square by 12" deep borated poly and 4" deep coated lead)
- LeCroy HD06104A and HD06104A-MS (1 GHz 4 channel oscilloscopes); and HD08108A (1 GHz 8 channel oscilloscope)
- Keysight B2987A high resistance electrometers (three)
- Bertan/Spellman PMT-3-CN-3 and PMT-100-CP-3 high voltage power supplies

PDV Measurements

- LLNL PDV 4.5 GHz System
- IPG ELR-2-1550-SF Fiber Laser
- Agilent 8164B Lightwave Measurement System Mainframe; 81940A, 81571, and 81630B tunable laser, attenuator, and power meter modules.
- Tecktronix 6-series MS064 and TDS6124C oscilloscopes

Support Equipment

- Two Westco SPL-80-3032 hydraulic stackers

- LANL equipment stands
- DeWalt DW0825LG laser level
- Single pole stands (for PDV fibers)
- 30 lead bricks and mirrors (PDV doghouse)
- Gamma and neutron check sources

MEASUREMENT DESCRIPTION AND REQUIREMENTS

PDV Proof-Of-Principle Test

Godiva IV: Burst ΔT 70°C
Detector: PDV, MHD240. MHD241, and Eljen EJ-325A
Shield: no shield

- The measurement will use all the detectors with the Godiva IV top hat removed.
- The MHD240, MHD-241, and Eljen EJ-325A detectors will be bagged for contamination control. The PDV heads and fibers are expendable.
- The PDV probes will be housed in a lead doghouse approximately 1 m from the surface of the Godiva IV fuel plates. The laser light of each probe will be directed using mirrors onto the center of different fuel plates. An MSTS Laser Safety Officer review of the PDV configuration and interlocks will occur Wednesday September 9.
- The doghouse will be constructed to provide maximum front shielding and with a large enough area to shield the fibers which run within the radiation shadow of the doghouse to the cell doorway.
- The PDV electronics and data acquisition will be located as far down the equipment room as possible to minimize radiation.

Steady State Delayed Critical Measurements

Godiva IV: Delayed critical steady state low and high power
Detector: MHD240 at 2m, 3m, and 4m; MHD241 and Eljen EJ-325A fixed
Shield: Shielded and unshielded

- The measurements will use the MHD240 detector, two monitor detectors, under shielded and unshielded conditions. The Godiva IV top hat will remain on or off for all measurements.
- The MHD240 detector will be positioned at 2m, 3m, and 4m (center of fuel to front face of scintillator) and vertically at centerline of the fuel and extended rod positions (at delayed critical). Delayed critical will be achieved where all the rods are inserted approximately equally to minimize the overall silhouette of the fuel plates and rods.

- The shield will be positioned at 1m (center of fuel to front face) and aligned between the MHD240 and Godiva IV silhouette. The shield may but does not need to be moved as the MHD240 detector distances change.
- The monitor detectors can be positioned as desired but must remain fixed for the duration of the steady state measurements. These detectors are unshielded.
- Godiva IV will be operated in delayed critical at both high power (shielded MHD240) and low power (unshielded MHD240) configurations. The power levels will be determined during the runs by the radiation measurement lead to optimize the MHD240 and monitor detector signals.
- At each position, both shielded and unshielded configurations will be measured in a series of 3 on and off sequences, each lasting about 5 min.
- The signals of the MHD240 and monitor detectors will be measured with electrometers and logged by computer using software provided by MSTS. The computer will be located in the control room.

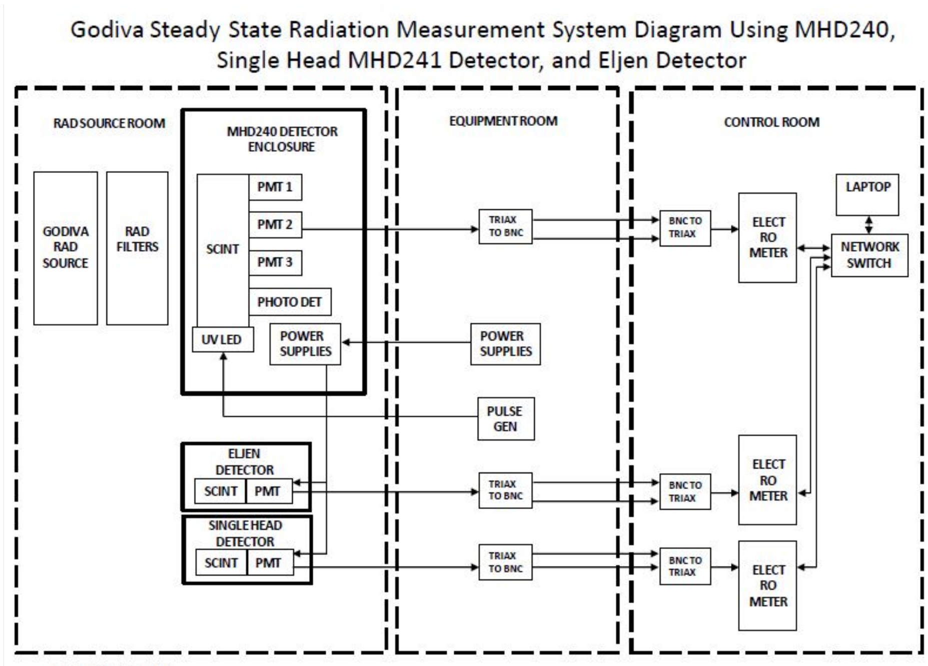
Burst Measurements

Godiva IV: Burst mode
Detector: MHD240 at 2m, 3m, and 4m; PDV fixed
Shield: No shield

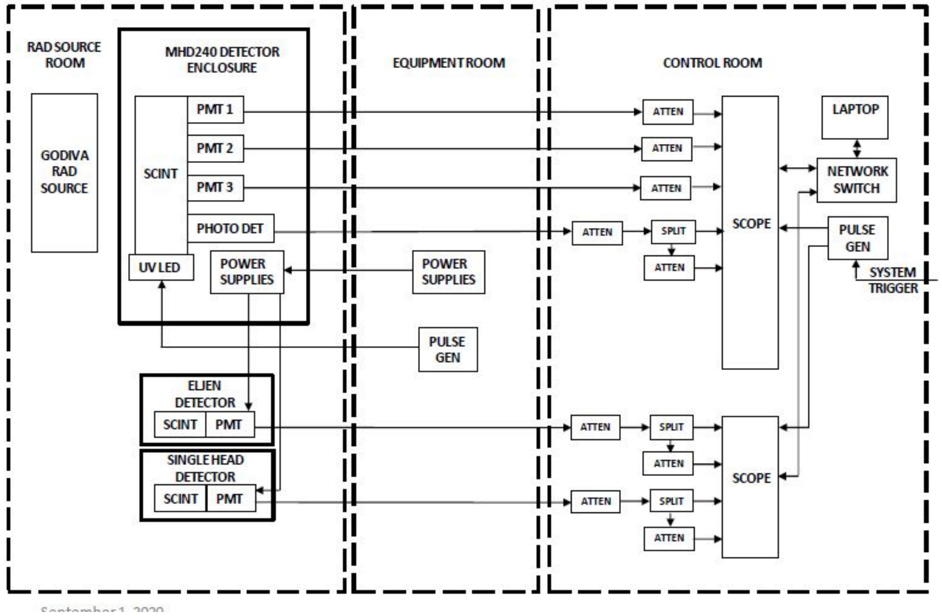
- The measurement will use the MHD240 and PDV detectors with the Godiva IV top hat removed for all measurements.
- The location of the PDV probes in the shielded doghouse will remain fixed during the measurements in the same configuration as the PDV proof-of-principle test.
- The MHD240 detector will be bagged for contamination control. The PDV heads and fibers are expendable.
- Burst size and MHD240 detector positions are per the schedule below.
- Prior to the bursts on the first and last day, and as time permits at other times, a strong check source will be placed at the detector surface centered on the scintillator face. The signal will be measured with an electrometer in the control room. The source will be removed and another measurement made. The source position must be the same for all measurements. This will be repeated twice. To use the electrometer, the cabling to the detector will need to be changed.
- After the final burst, decontamination of the Godiva IV cell will be necessary. The MHD240 detector and stand will be un-bagged and deconned as necessary and moved to the equipment room.

Data Acquisition

Schematics of the layout of the radiation detectors and data acquisition are provided for both burst and steady state measurements below. Data for the bursts will be taken from the beginning of the exponential rise of the pulse to full subcritical shutdown. This require data acquisition over two very different timeframes: short (0-100 µsec) and long (0-50 msec). PDV laser interference patterns will be measured for many vibration cycles. Each cycle is expected to be around 200 µsec so total measurement times around 20-50 msec are required. A “shot Calculator” spreadsheet was developed to estimate detector signals to assist in set up of data acquisition (see Appendix).



Godiva Burst Radiation Measurement System Diagram Using MHD240,
Single Head MHD241 Detector, and Eljen Detector



SCHEDULE

PDV Proof-Of-Principle Test

Sep 7	**Holiday**
Sep 8	**PDV Set-Up**
Sep 9	**PDV Set-Up / Laser Safety Officer review**
Sep 10	**Burst ΔT 70°C**

Steady State and Bursts

	Week 1			**Week 2**	
	AM	**PM**		**AM**	**PM**
Sep 14	**Contingency burst ΔT 70°C**		**Sep 21**	**Burst ΔT 70°C MHD240 at 2m**	**Burst ΔT 175°C MHD240 at 2m**
Sep 15	**Steady State Set-Up**	**Steady State Runs**	**Sep 22**	**Burst ΔT 100°C MHD240 at 2m**	**Burst ΔT 150°C MHD240 at 2m**
Sep 16	**Steady State Runs**	**Steady State Runs**	**Sep 23**	**Burst ΔT 70°C MHD240 at 3m**	**Burst ΔT 200°C MHD240 at 3m**
Sep 17	**Contingency**	**Contingency**	**Sep 24**	**Burst ΔT 70°C MHD240 at 4m**	**Burst ΔT 250°C MHD240 at 4m**

Note: based on equipment arrivals and approvals to enter the DAF, the order of the steady state and burst measurements may be changed.

Appendix

Shot Calculator and Setup

2020 Experiment — ADUST GREEN BOXES ONLY

MHD240	SN 16	WSMR	
Cube Size	15	cm	
Channel	C-gMeV	HV	Max Linear Volts
PMT1	4.51E-12	-2242	30
PMT2	4.53E-14	-1170	13
PMT3	4.5E-16	-1785	22
PD	2.12E-18	5000	

Test Case												
Godiva	SN16											
Shot	Temp	Distance	Head	Channel	ADC Range	V(scope)	Attn (dB)	V(Detector)	I(C/s)	C-gMeV	Flux (g-Me	ExpFlt
1979	236.9	3.15	12	PD	0.25	0.186	52.000	74.05	1.481	4.01E-18	3.69E+17	0.085
1990	229.9	3.15	12	PD	0.25	0.185	52.000	73.65	1.473	4.01E-18	3.67E+17	0.085
1991	136.9	3.15	12	PD	0.25	0.117	45.000	20.81	0.416	4.01E-18	1.04E+17	0.05

Source			
Temp	200	Flux on MHD240	2.61E+17
Fit			
Coef	2.21E+16	-4.56E+14	8.26E+12
Distance	3.15		
Cube Size	15		
Angle	0.023805		
Solid Angle	0.0017801		
Fraction of	0.0001417		
		Total Flux in sphere	1.84E+21

Distance	4	m		
Cube Size	15	cm		
Angle	0.0187478			
Solid Angle	0.0011041			
Fraction of	8.787E-05	Flux @MHI	1.62E+17	#/s
			V(FS)	
PMT1	4.51E-12	C/y-MeV	0.2	
PMT2	4.53E-14	C/y-MeV	0.2	
PMT3	4.50E-16	C/y-MeV	0.2	
PD	2.12E-18	C/y-MeV	0.25	
PD	2.12E-18	C/y-MeV	0.54	

Sensor	Full scale Attn		Measurement		Full scale Linear			Additional	Recomended Attn		Measurement
	Attn X	Attn (dB)	Sensor (V)	Sensor (#/s)				Head room			
Peak Signal (V)			Peak	Peak	Linear (V)	Attn x	Attn (dB)	Attn(dB)	Attn (dB)	V(FS)	Attn(dB)
3.65E+07	182737295.66	165			30	150.00	44	0	44	0.2	
3.67E+05	1835476.61	125			13	65.00	36	0	36	0.2	
3.65E+03	18233.21	85			22	110.00	41	0	41	0.2	
17.18	68.72	36.74				1.40	3	0	37	0.25	
17.18	31.62	30				1.40	3	0	30	0.54	

Shot setup

				Ch4					Ch3		Ch2		Ch2	
		Distance	ΔT	V(Max)	Attn (dB)	V(FS)-nom	Adjustment	V(FS)-recommend	V(FS)	Attn (dB)	V(FS)	Attn (dB)	V(FS)	Attn (dB)
21-Sep	Burst ΔT 70°C	2	70	8.06	30	0.255	2	0.51	0.2	41	0.2	36	0.2	44
21-Sep	Burst ΔT 175°C	2	175	51.31	30	1.623	2	3.25	0.2	41	0.2	36	0.2	44
22-Sep	Burst ΔT 100°C	2	100	15.53	30	0.491	2	0.98	0.2	41	0.2	36	0.2	44
22-Sep	Burst ΔT 150°C	2	150	36.67	30	1.160	2	2.32	0.2	41	0.2	36	0.2	44
23-Sep	Burst ΔT 70°C	3	70	3.58	30	0.113	2	0.23	0.2	41	0.2	36	0.2	44
23-Sep	Burst ΔT 200°C	3	200	30.54	30	0.966	2	1.93	0.2	41	0.2	36	0.2	44
24-Sep	Burst ΔT 70°C	4	70	2.02	30	0.064	2	0.13	0.2	41	0.2	36	0.2	44
24-Sep	Burst ΔT 250°C	4	250	27.9	30	0.882	2	1.76	0.2	41	0.2	36	0.2	44

Appendix B – Daily Update Emails

9/21/20

Angela, et al.,

Tuesday, the final equipment ordered by LLNL arrived and was brought into the facility. Since we were still waiting on MSTS to sign the ALMA(long story) we did the nuclear instrumentation annual surveillance which requires one crew member.

On Wednesday the MSTS PDV and director leads came into the DAF and observed while NCERC-FO placed their equipment. In the afternoon, their management signed the ALMA.

Today they[MSTS] came back with their teams and were able to connect most of the equipment. They had the laser safety officer come in the afternoon and approve their setup.

Setup will continue on Monday with the go/no-go burst finally on Tuesday. That will complete 3a. I have suggested that after folks have a little time to look at their data, we can make a brief presentation to you (or send an email summary). Then we can decide on everyone's availability to proceed.

Since I have to schedule FSS disablement in advance and I don't know how things are going to go, I have only scheduled the single day (Tues) for bursts.

[ALMA is Activity Level Management Approval and is how work is coordinated under another organizations work control at NNSS.]

9/22/20

Angela, et al.,

The bursts for IER 268 went smoothly today with mixed results for data.

The PDV Team got a faint, but distinguishable from background, signal. They consider it promising and would like to make adjustments to the alignment of their probes.

For the MHD Detector, the communication was lost at the time of the burst. One scope blanked and one froze. We had the RCT's perform a re-entry and Travis and I went in in respirators and disconnected the scopes and brought them out. When Robert looked at them briefly at the end of the day, he thought there was some data captured before the scope died. He plans to go to Plan B which is to run all the signals to the control room and locate the scopes there.

I believe everyone would be in agreement to request that we progress to CED-3b

Tomorrow we will move cabling and make adjustments to prepare for two full weeks.

If Angela approves us progressing to CED-3b, we will schedule the weeks of Oct 5 and Oct 12 for IER 268.

The teams discussed the preferred order of those two weeks. Scorby said he did not have a preference and left it to team availability. The consensus was to do the burst week first. We would use Monday for setup, then do three days of bursts.

The following week would be some reconfiguration for the DC measurements and then starting those measurements.

10/6/20

Angela, et al.,

We performed an exactly 70 deg burst at 11:15 today.

The teams did not seem to get good data. It appeared that they captured the tail of the pulse and not the actual burst. Over discussion at lunch and looking at the trigger output it was determined that the data acquisition was triggering on the end of the trigger signal and not the beginning, ~18msec late. Adjustments were made.

We then performed a 123 deg burst at 14:30 and both teams captured data. The MHD (and additional reference detectors) data appeared as expected with both PMT and PD results. The PDV signal showed a faint but distinguishable damped oscillation consistent with surface movement. The PDV team believes they can make it more clear with additional data processing. I have asked for a jpeg of the preliminary results and will share as soon as I have it.

Tomorrow we will repeat the 70 deg burst followed by a ~200 deg burst in the afternoon.

10/7/20

Angela, et al.,

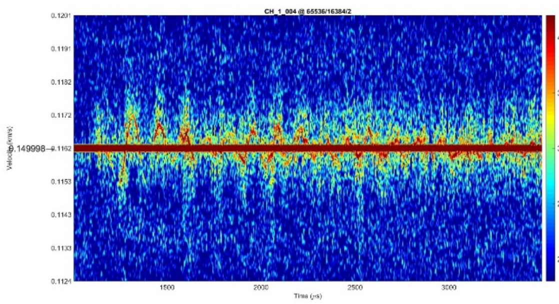
Today we performed two more bursts.

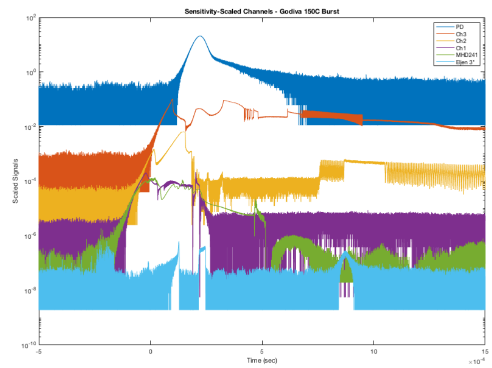
We performed a 70 deg burst at 11:00. The MHD team got what seemed like reasonable data. The PDV did not get any better data than the other 70 deg bursts; there may not be enough surface movement to measure at that level.

We performed a 165 deg burst at 14:15. The MHD got data but one signal was clipped. For PDV, the main scope died during the burst. Jesson and I returned to the building later and the scope was frozen/blank screen, but we did a hard reboot and it came back. The team mentioned swapping the signals from the scope that died to the other scope which did not die but was only collecting reference/background signals.

Rob indicates he thinks Scorby will want to proceed with the larger burst tomorrow as planned, so unless I hear otherwise, that is what we will do.

Both teams have provided an image from yesterday's 123 deg burst to share (attached).





10/8/20

Today we performed a 201 degree burst, the largest for the week.

Both teams got data!

One PDV scope died (different than the one yesterday) but fortunately they had divided up the signals between the scopes.

MHD covered a wide range for signals so none were clipped today.

We returned at the end of the day and pulled PDV cables out of the way for the FSS enable crew tomorrow.

Next week we will begin the delayed critical measurements. There are some equipment changes to make but we expect to be collecting data on Monday.

10/12/20

Today we set up Godiva for IER 268. The PDV portion finished last week, but the other detector is gathering DC measurements to determine what percentage of burst signal is room return vs direct. We changed out the coax cables for triax for more sensitive measurements. We also put the HV supply on a switched outlet so it can be controlled from the Control Room.

Alex McSpaden trained on Godiva today. While we were waiting for the measurement personnel to set up the equipment in the control room we had him do various exercises of estimating reactivity changes and finding DC in various configurations. He did an excellent job and apparently this is only the second time he has gotten to operate Godiva.

Setting up the electrometers and the data acquisition program took most of the day. So besides the training of Alex we did not really start operating to collect data until about 3:00. Most data looked good, but one detector was not responding and we went up to 10^-6 [Amps on the linear channel] so something is definitely not right. We will take a look tomorrow.

10/13/20

Today we performed DC operations for IER 268. It took a while to get all the detector systems set up as desired, but then we got data for 2 of the 4 desired configurations.

One lesson learned is that we should label the switchable outlets better in the ante room, at one point we did not have the high voltage power supply to the detectors on. I will use "Derek's Label Maker" to label them to correspond to the labels in the control room. It is rather obvious once you look at where all the outlets are, but when you only see one, it's hard to guess whether it would be left, middle or right.

The MHD team lead decided he wanted to adjust the voltage for the reference detector to reduce its sensitivity. Although he is qualified for electrical work in his area, we looked closely at the ALWD and it specifically calls out the LANL electrical worker program so we had Eloura come do the measurement as we adjusted the HV (low current).

10/14/2020

Today we completed the measurements for IER 268. We did DC operations at 5 power levels with the main detector at 2m with and without a shield in front of it. The difference was not really very large, indication I suppose that of the neutrons that are detected a lot are scattered from the walls. We should get some preliminary summary of the data next week.

Then the MHD lead wanted to remove the scintillator from the separate detector used for reference to see what the response would be. It was less than 1 percent.