



# IER 605: Godiva IV Criticality Accident Alarm System (CAAS) Testing for AWE

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DOE Nuclear Criticality Safety Program (NCSP) Technical Program Review (TPR)

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Managed by Triad National Security, LLC for the U.S. Department of Energy's NNSA.



## Overview

- AWE requested to test their mini-Criticality Incident Detection System (CIDS) using Godiva IV
- AWE previously tested their CIDS detectors with Godiva IV in 2017 in conjunction with Y-12 CAAS detector testing.
- AWE plans to further test the **IS821 Detector Head Assembly (DHA)** and define post incident dose reporting ability
- IS821 DHA goes into → IS859 mini-Criticality Incident Detection System (CIDS)
  - IS859 mini-CIDS: goal is to rapidly detect a criticality incident
  - Consists of a system rack and up to four IS821 DHA
  - 3 DHAs shall provide 2 of 3 voting (for redundancy and false-alarm reduction)
- IS859 mini-CIDS was developed to have same architecture as the IS820 CIDS but with reduced IS824 channel modules & IS821 DHAs

# Tentative Schedule

Planned for Q3 or Q4

- Monday: AWE equipment set-up etc.
- Tuesday: Sub-prompt burst(s), 70 °C prompt burst
- Wednesday: Sub-prompt burst(s), 150 °C prompt burst
- Thursday: Sub-prompt burst(s), 250 °C prompt burst, equipment disassembly and packing, etc.

# Participants

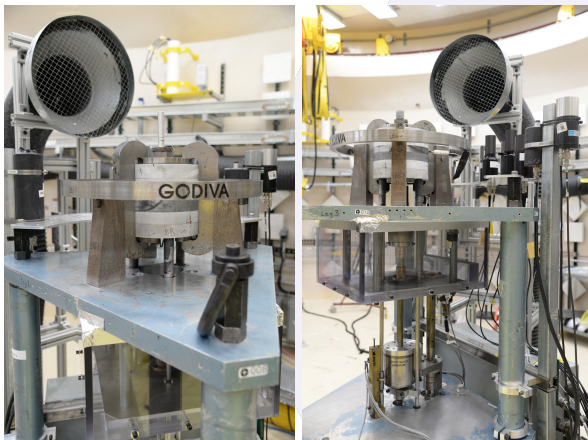
- (Primary objectives) AWE mini-CIDS & GMS595 testing - 4 participants confirmed, 3 reserves
- (Supporting objectives)
  - AWE - another organization interested in testing electronic personnel dosimeters
  - Mirion Technologies - interest in fielding smaller subset of equipment related to Y-12 CAAS systems for UPF.
  - PNNL - interest in fielding PNADs or additional NAD equipment
- (Bonus supporting objectives) LANL, LLNL passive diagnostics

## Godiva IV - a quick review for most of you

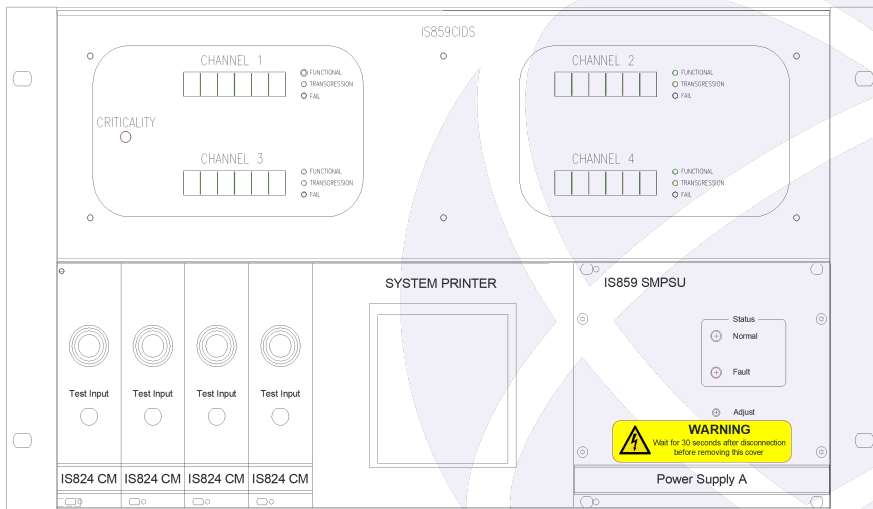
- Godiva IV is a fast burst reactor at the National Criticality Experiments Research Center in the Device Assembly Facility at the Nevada National Security Site, often used for dosimetry & detector testing
- Godiva IV is comprised of several fuel rings of highly-enriched uranium alloyed with 1.5% molybdenum for strength
- The reactor can deliver large doses and dose rates for both  $n$  and  $\gamma$
- Super-prompt critical bursts release radiation output on the order of  $1 \times 10^{16}$  fissions per burst with a burst FWHM approximately 50-70 microseconds
- Godiva IV provides a controlled test environment similar to a fast metal criticality accident

## Our Dearest Lady (Top Hat Removed)

\*Photos taken during Godiva IV Benchmark Measurements (IER 555) FY 23



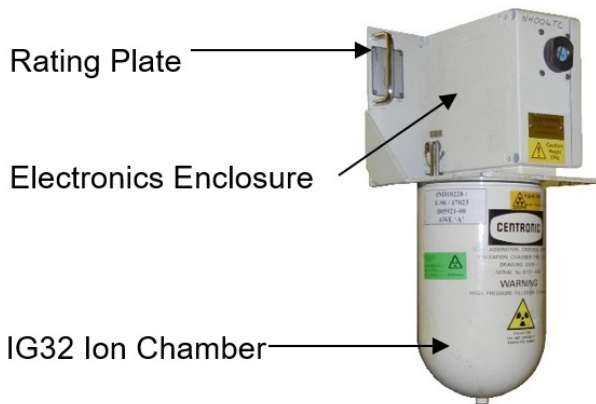
# IS859 mini-CIDS System Rack



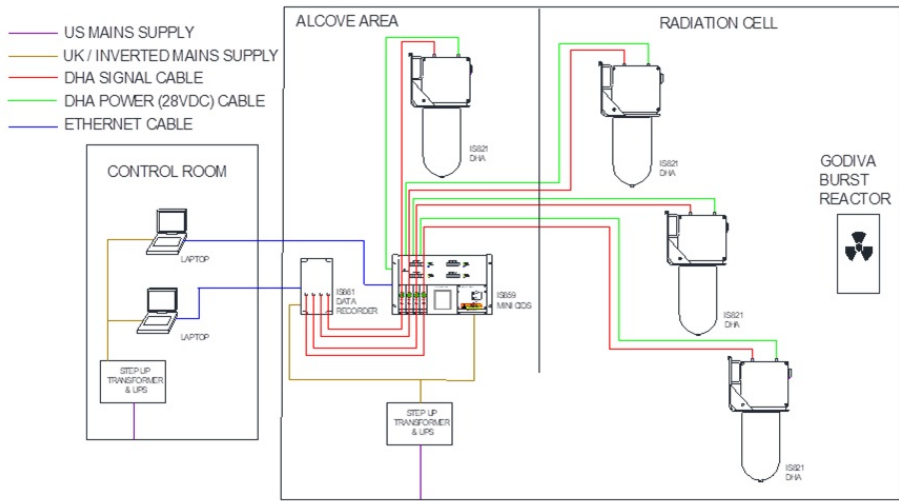


## IS821 Detector Head Assembly (DHA)

Centronics IG32 Parallel Plate Ion Chamber ( $\gamma$ )

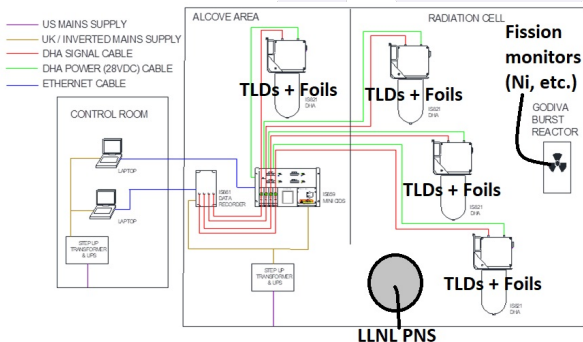


# mini-CIDS Test Configuration in the Godiva IV Cell



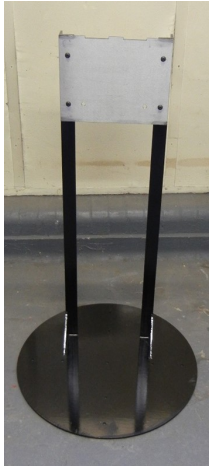
## Additional LANL, LLNL passive diagnostics

- LANL will field ( $n + \gamma$ ) and ( $\gamma$ ) sensitive LiF thermoluminescent dosimeters (TLDs) at each DHA location to obtain  $n$  and  $\gamma$  dose component
- LANL will also field nickel, gold, and iron foils at each DHA location
- LLNL will field passive neutron spectrometer and PNADs



## IS821 Detector Head Assembly (DHA) with Mounting Stand

DHAs desired to be 1 m off of ground - custom mounting stands being sent with other equipment, additional raise/lower lifts (below) available on demand @ NCERC



## GMS595 Scintillation Detector x6

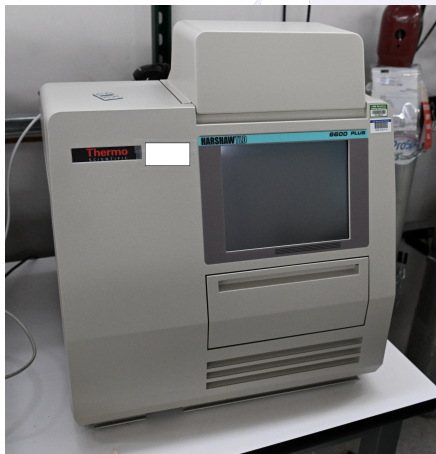
Will be fielded alongside mini-CIDS

Developed by AWE in collaboration with JCS Handheld wide-range gamma dose rate monitor



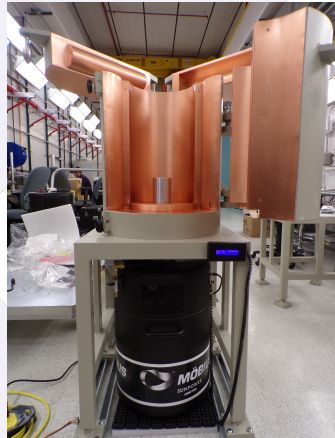
## NCERC Radiation Metrology Lab/Count Room

Thermo Scientific Harshaw TLD reader - using TLD-6/700s for this exercise, calibrated for Godiva IV burst operations



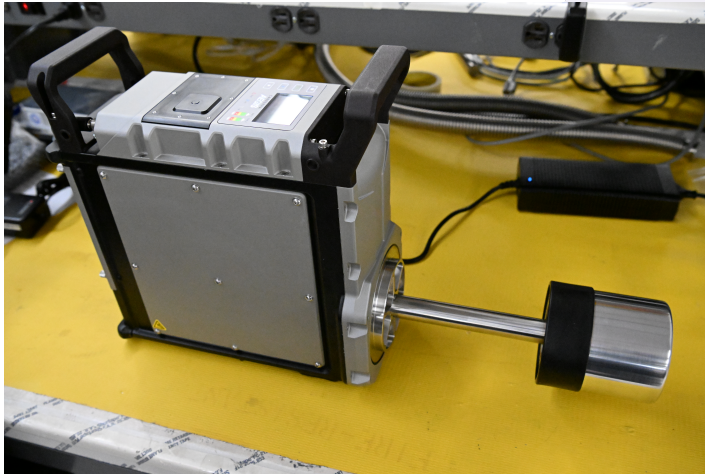
## NCERC Radiation Metrology Lab/Count Room

Automated sample changer, Kolga shields (2x) to remove background for low activity samples with HPGe & LN2 Mobius coolers



## NCERC Radiation Metrology Lab/Count Room

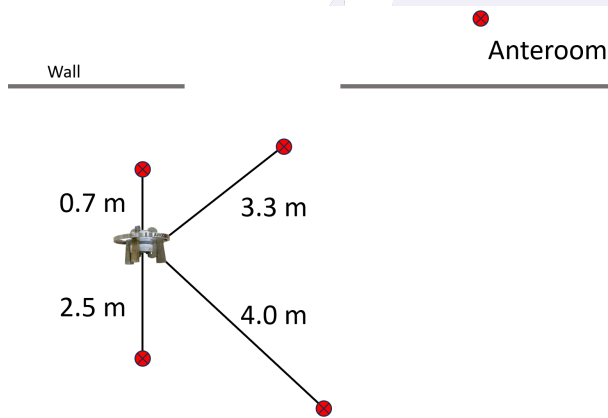
★New★ Mirion Technologies portable “Aegis” BeGe detector





## Recent Godiva IV Dosimetry Data

Recent 250 °C Godiva IV burst fielding TLDs, Au & Au(Cd), approximately  $4 \times 10^{16}$  fissions. Red circles designate locations of dosimetry.



## Recent Godiva IV Dosimetry Data

Recent 250°C Godiva IV burst fielding TLDs, Au & Au(Cd), approximately  $4 \times 10^{16}$  fissions

Position	TLD-600 response (mR)	TLD-700 gamma dose (mR)	Dose from thermal neutrons (R)	Thermal neutron fluence (cm <sup>-2</sup> )	R / 1E10 thermal neutrons
0.7 m	1.25E+07	1.54E+06	1.22E+04	2.80E+10	4.35E+03
2.5 m	1.10E+07	5.80E+04	1.08E+04	2.65E+10	4.07E+03
3.3 m	9.45E+06	4.27E+04	9.27E+03	2.34E+10	3.97E+03
4.0 m	1.00E+07	3.03E+04	9.82E+03	2.38E+10	4.12E+03
Anteroom	2.37E+05	1.09E+03	2.33E+02	7.79E+08	2.99E+03

## Acknowledgements

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