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# Infrared Imaging Camera Final Report CRADA No. TC02061.0

E. V. Roos, S. Nebeker

September 12, 2017

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# Infrared Imaging Camera

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## Final Report

CRADA No. TC02061.0

Date Technical Work Ended: October 30, 2007

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Date: December 21, 2007

Revision: 1

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### A. Parties

This project was a relationship between Lawrence Livermore National Laboratory (LLNL) and Cordin Company, in conjunction with the Russian Federation Nuclear Center All-Russian Scientific Institute of Experimental Physics (RFNC-VNIIEF) in Sarov, Russia.

Lawrence Livermore National Security, LLC  
Lawrence Livermore National Laboratory  
7000 East Avenue  
Livermore, CA 94550  
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Tel: (925) 423-2175  
Fax: (925) 422-2382

Cordin Company  
2230 South 3270 West  
Salt Lake City, UT 84119-1194  
Sidney Nebeker  
Tel: (801) 972-5272  
Fax: (801) 972-8270

### B. Project Scope

This was a collaborative effort between the University of California, Lawrence Livermore National Laboratory (LLNL) and Cordin Company (Cordin) to enhance the U.S. ability to develop a commercial infrared camera capable of capturing high-resolution images in a 100 nanoseconds (ns) time frame.

The Department of Energy (DOE), under an Initiative for Proliferation Prevention (IPP) project, funded the Russian Federation Nuclear Center All-Russian Scientific Institute of Experimental Physics (RFNC-VNIIEF) in Sarov. VNIIEF was funded to develop a prototype commercial infrared (IR) framing camera and to deliver a prototype IR camera to LLNL. LLNL and Cordin were partners with VNIIEF on this project. A prototype IR camera was delivered by VNIIEF to LLNL in December 2006. In June of 2007, LLNL and Cordin evaluated the camera and the test results revealed that the camera exceeded presently available commercial IR cameras. Cordin

believes that the camera can be sold on the international market. The camera is currently being used as a scientific tool within Russian nuclear centers.

This project was originally designated as a two year project. The project was not started on time due to changes in the IPP project funding conditions; the project funding was re-directed through the International Science and Technology Center (ISTC), which delayed the project start by over one year. The project was not completed on schedule due to changes within the Russian government export regulations. These changes were directed by Export Control regulations on the export of high technology items that can be used to develop military weapons. The IR camera was on the list that export controls required. The ISTC and Russian government, after negotiations, allowed the delivery of the camera to LLNL. There were no significant technical or business changes to the original project.

### C. Technical Accomplishments

VNIIEF developed a state-of-the-art commercial high-speed infrared framing camera, which exceeds all presently available commercial high-speed IR cameras. The development of a commercial infrared camera was based on the existing Russian KIT-2F camera. This unique Russian camera, called KIT-3M is capable of capturing high-resolution infrared images. The camera can capture 9 images each at 500ns time frame. The performance parameters of the IR camera developed, under the IPP project, are listed below along with an image of the camera

#### KIT-3M Performance Parameters

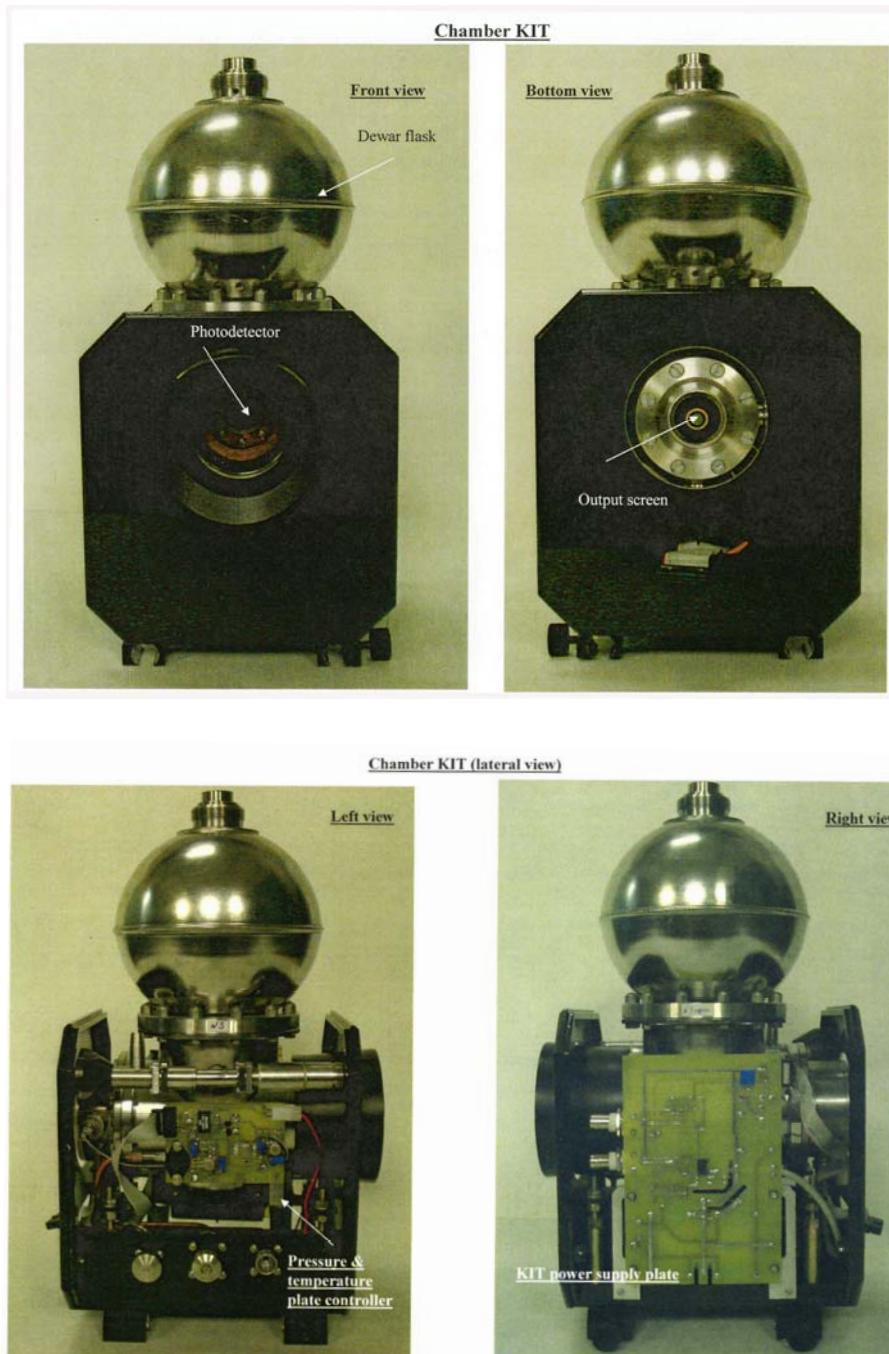
Input active area	Ø 20 mm
Spectral range	1 to 10 $\mu$ m
Temperature detection threshold	300°C
Energy detection threshold ( $\lambda = 3\mu$ m)	1.0E-8 J/cm <sup>2</sup>
Dynamic range of recording	400
Number of frames	1,4,9
Frame duration	0.5 to 20 $\mu$ s
Framing frequency	50 to 500 kHz
Spatial resolution	100 lp/frame

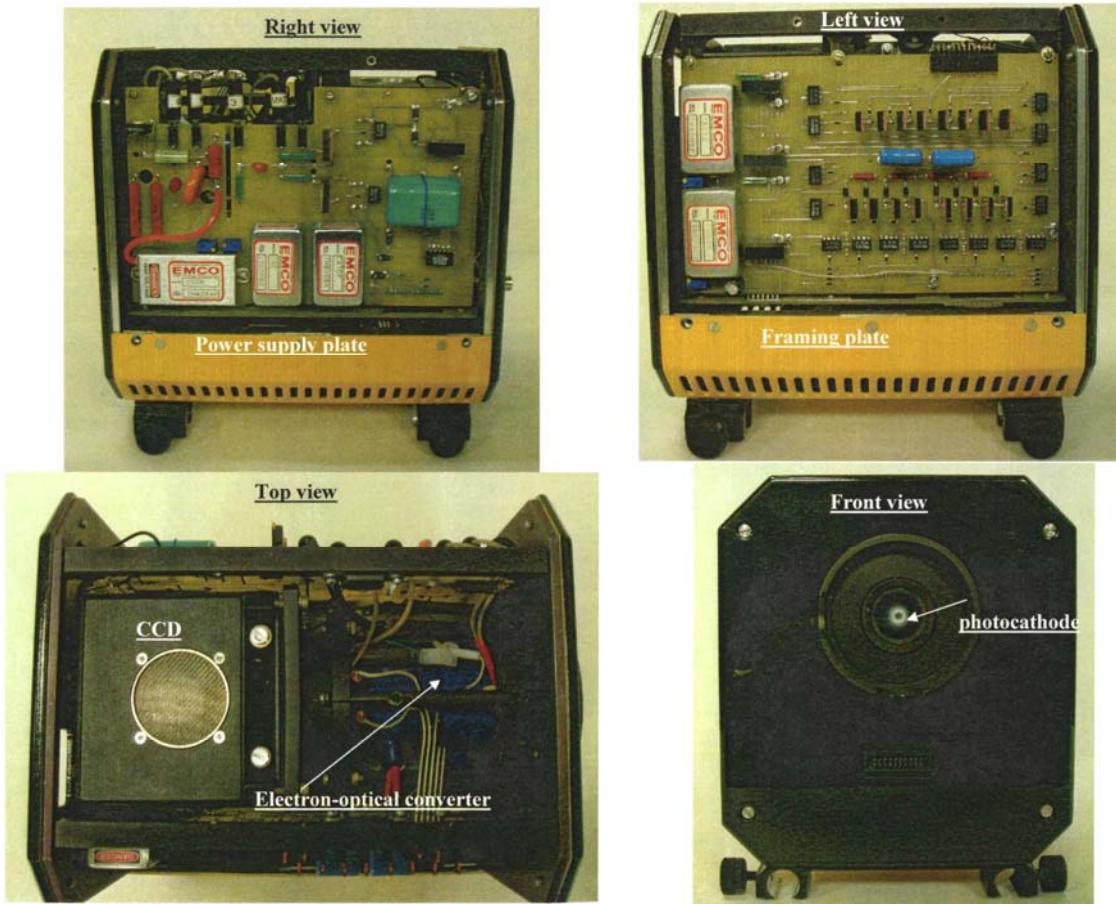


The design, development and evaluation of the commercial camera was performed by the RFNC-VNIIEF. The Ioffe Physico-Technical Institute under contract from VNIIEF developed the image converter tube, the heart of the camera. Ioffe Institute, a member of the Russian Academy of Science, which is located in Saint Petersburg, Russia. Cordin Corporation contributed with their technical expertise in high-speed cameras and their knowledge in customer needs and requirements. LLNL was responsible for managing and monitoring a highly complex scientific project. Deficiencies in the camera's performance were corrected, and the camera was re-engineered to reduce cost and improve reliability.

LLNL and Cordin met in Salt Lake City, UT to evaluate the newly delivered IR camera in June 2007. Personnel from VNIIEF were present at the meeting to assist in the camera evaluation and

training in the operation and maintenance of the camera. The evaluation of the camera validated state-of-the-art commercial camera performance that can compete in the international IR camera market place. The technical performance of the camera was excellent. The camera was engineered to meet the performance needs. What was most pleasant to see was the first class manufacturing of the camera. Photo of the two main modules are shown below. The first four photos are of the IR photo detector module and the second set of four photos is of the image recorder.





The only unresolved issues are the selling price that the Russians will sell the camera to Cordin and the other issue is the Russian Export Control requirements. The selling price to Cordin is an issue that Cordin needs to resolve with VNIIIEF and the Russian government. The camera was shipped to LLNL with an export control approval; this was with a great deal of work by VNIIIEF and ISTC. The question is, can the camera be sold to others? LLNL has no further plans or activities.

#### D. Expected Economic Impact

Cordin believes that sales of approximately \$1,000,000 per year can be expected if the export control issues can be resolved and the camera can be delivered to Salt Lake City at a reasonable price - around \$75,000 per unit. There needs to be considerable work to demonstrate the reliability of the camera.

##### D.1 Specific Benefits

## **D.1 Specific Benefits**

### Benefits to DOE

This CRADA is consistent with and furthers DOE's goals for proliferation prevention. Production of the camera will divert those personnel from research and development on weapons of mass destruction. LLNL and Cordin Company personnel, working alongside with the Russian scientists and engineers will gain a greater understanding of the capabilities of this technology and will be better able to identify areas where it can be advantageous to U.S. industry.

### Benefits to Industry

The high-speed IR camera developed over the past 10 years at VNIIIEF has strong commercial applications and can be converted into marketable products and a source of income for VNIIIEF personnel.

## **E. Partner Contribution**

Cordin's activity is in the marketing, sales and servicing of the camera. This includes the requirements of the camera, both technical and business issues and the selling of the camera. Cordin was involved in testing and evaluating the camera. Cordin hosted a meeting in Salt Lake City with VNIIIEF and LLNL to discuss the camera's performance and marketing plan.

## **F. Documents/Reference List**

### Reports

None.

### Copyright Activity

None.

### Subject Inventions

None.

### Background Intellectual Property

There was no Background Intellectual Property disclosed for this project.

## G. Acknowledgement

Industrial Participant's signature of the final report indicates the following:

- 1) The Participant has reviewed the final report and concurs with the statements made therein.
- 2) The Participant agrees that any modifications or changes from the initial proposal were discussed and agreed to during the term of the project.
- 3) The Participant certifies that all reports either completed or in process are listed and all subject inventions and the associated intellectual property protection measures generated by his/her respective company and attributable to the project have been disclosed and included in Section E or are included on a list attached to this report.
- 4) The Participant certifies that if tangible personal property was exchanged during the agreement, all has either been returned to the initial custodian or transferred permanently.
- 5) The Participant certifies that proprietary information has been returned or destroyed by LLNL.



Sidney Nebeker, President  
Cordin Company

5 Feb 2008

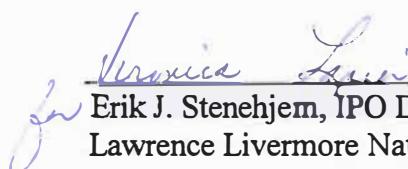
Date



Edward V. Roos, LLNL Principal Investigator  
Lawrence Livermore National Laboratory

Feb 15, 2008

Date



Erik J. Stenehjem, IPO Director  
Lawrence Livermore National Laboratory

Feb. 20, 2008

Date

Attachment I – Final Abstract

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# Infrared Imaging Camera

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## Final Abstract (Attachment I)

CRADA No. TC02061.0

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### B. Purpose and Description

This was a collaborative effort between the University of California, Lawrence Livermore National Laboratory (LLNL) and Cordin Company (Cordin) to enhance the U.S. ability to develop a commercial infrared camera capable of capturing high-resolution images in a 100 nanoseconds (ns) time frame.

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#### **C. Benefit to Industry**

The high-speed IR camera developed over the past 10 years at VNIIIEF has strong commercial applications and can be converted into marketable products and a source of income for VNIIIEF personnel.

#### **D. Benefit to DOE/LLNL**

This CRADA is consistent with and furthers DOE's goals for proliferation prevention. Production of the camera will divert those personnel from research and development on weapons of mass destruction. LLNL and Cordin Company personnel, working alongside with the Russian scientists and engineers will gain a greater understanding of the capabilities of this technology and will be better able to identify areas where it can be advantageous to U.S. industry.

#### **E. Project Dates**

October 30, 2003 to October 30, 2007