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46TH RANGE GROUP

# *Gulf Range Drone Control System (GRDCS): Past, Present, and Future*

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Specialized Engineering Flight Chief
46 RANG/VTSO
Eglin AFB, FL

**October 9, 2008**

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# Outline

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- **Past**
  - Brief History
  - Historical Milestones
  - Historical Drones
- **Present**
  - Current Drones
  - Capability
  - Development Team
  - Ranges
  - Utah Test and Training Range
  - GMCS/WMCS
  - Recent Additions
- **Future**
  - In Development
  - Future Drones
  - Potential Projects

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# GRDCS

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- Gulf
- Range
- Drone
- Control
- System


*Operationally Oriented; Customer Focused*

# Past – Brief History

- **Developed in Early 1980's to Support AMRAAM**
- **"In-House" Technical Expertise to Develop System**
  - 96th Communications Group (96 CG) – Computer and Software Resources, Drone Integration
  - 46th Test Wing (46 TW) – Datalink System, Consoles, Tower, Infrastructure
- **Derived from Existing Systems**
  - White Sands Missile Range (WSMR) Drone Formation Control System (DFCS)
  - Eglin Central Control Facility (CCF) Real Time System

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# GRDCS
# Historical Milestones

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1980
Tyndall Operational
Need Identifed

1987
MQM-107 SSAT

1988
QF-106

1992
First GMCS Van

1993
BQM-34A (-47)

1996
QF-4

1999
MQM-107E

2002
BQM-34A (-53)

2006
BQM-167A

2007
Deployed to UTTR

1980
Ground Target
Control
Operational
1982

QF-100
VAX 11-780
DL Format
1986

QF-100 GPS Testing
1991

IBM RISC/6000
1994

QF-4 GPS Testing
2000

IBM 7044-170
RISC/6000
2005

2008

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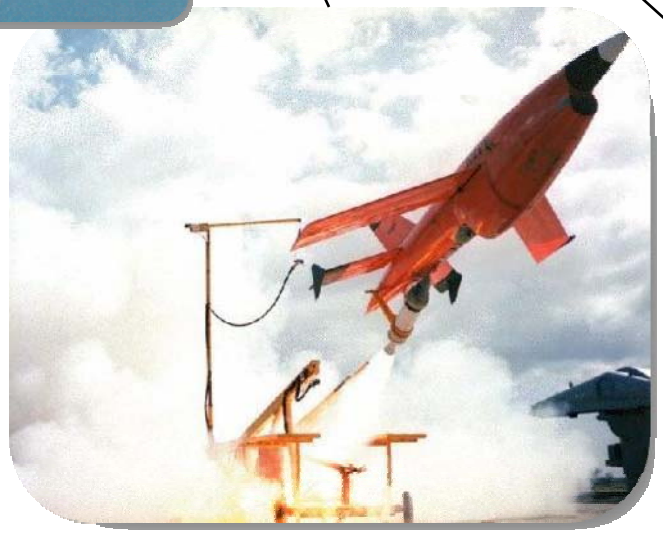
# Past – Historical Drones

- **Full Scale**
  - QF-100
  - QF-106

# Past – Historical Drones

- **Sub-Scale**
  - MQM-107 D/E
  - BQM-34 A/P



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# Present – Current Drones

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- **Full Scale**
  - QF-4
- **Sub-Scale**
  - BQM-167 A

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# Present - Capability

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- **Simultaneously Track and Control any Combination of 6 Drones**
  - **Flight Paths**
  - **Formations**
    - Dynamically changeable
    - Collision escapes and avoidance
  - **Maneuvers**
    - 25+ pre-programmed
    - Linked in sequence
  - **Escapes**
    - Aircraft orbit offshore at 20K MSL
    - Auto flight termination on datalink loss
- **Track**
- 4 shooters
- 4 high fliers (relays)
- 2 other aircraft
- **Track and Terminate 4 Missiles**
- **Fly Drones Manually or Automatically**
- **Over the Horizon and Line of Sight Tracking**

# Present – Capability (Continued)

- **GRDCS Mission Simulator**
  - Full 6DOF Simulation of All Supported Targets
  - Utilized for
    - Mission practice and preparation
    - Software testing and validation
    - Controller training
- **Government**
  - Developed
  - Owned

# Present – Development Team

- **46th Range Group**
  - Team Based at Eglin
  - Validate Autopilot Software
  - Integrate New Drones
  - Mission Support
  - GRDCS System Improvement Requests
  - Data Analysis
  - Create Test Plans
  - Develop Models

# Software/Systems Engineering Process Improvement Highlights

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Software Technology Support Center

CERTIFICATE OF ACHIEVEMENT

This recognizes that the

96th Communications Group
Eglin AFB, Florida

has successfully achieved a
Software Engineering Institute, Capability Maturity Model rating of

LEVEL 5

on this day, 10 October 2003, by the following assessment team:

| | | | |
|---|---|---|---|
| STSC Lead Assessor | Rushby Craig | 96 CG Team Member | Jeremy Mings |
| STSC Team Member | Mike Ballard | 96 CG Team Member | Susan Tweedy |
| 96 CG Team Member | Kathy Reid | 96 CG Team Member | Tobias Cahoon |
| 96 CG Team Member | Steve Tuckey | 46 SK Team Member | Deborah Bailey |
| 96 CG Team Member | Charlie Churilo | Alpha Data Corporation Team Member | Tim Deckert |

1997 — SEPG and ESC established

1999 — CMM Level 2 achieved

2000 — PSO and TWGs established

2002 — Defect Prevention & TCM Processes established

2002 — Quick Look – Level 3 well established, high probability of Level 5

2003 — CMM Level 5 achieved

2004 — OSP Streamlined using AFSO21 principles, Support Tools enhanced

2005 — Benchmark Appraisal to establish CMMI transition plan

2006 — Effort expanded to Systems Engineering

2007 — Continuing Journey: Maintaining CMM L5 Transitioning to CMMI

2008 — SCAMPI A CMMI Level 3 Appraisal Goal: Action Plan for 2009

2009 — SCAMPI A CMMI Level 5 Appraisal Goal: Maturity Level 3

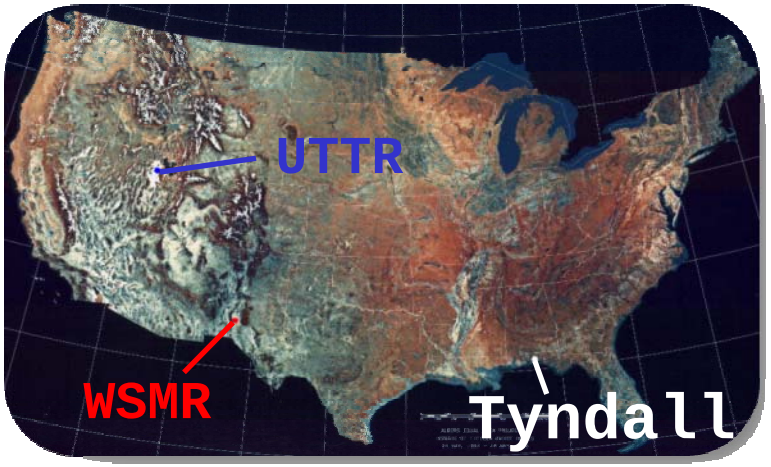
2010 — 2012… SCAMPI A CMMI Level 5 Appraisal Goal: Maturity Level 5

**Return on Investment Demonstrated**

- **Higher Productivity (46% increase)**
- **Improved Quality (13% less corrective work)**
- **Better Estimation (56% improvement in achieving or exceeding organizational goals)**

# Present - Ranges

- **Tyndall and Eglin**
  - Main mission operations (53rd WEG)
  - GRDCS Software Development (46th TW)
  - New target acquisition (691st ARSS)
- **Holloman AFB / WSMR, NM (WMCS)**
  - Support full scale target operations (53rd DET)
- **Utah Test and Training Range (UTTR)**
  - Support combined Combat Archer and Combat Hammer evaluation (53rd WEG)



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# GRDCS:

## Utah Test and Training Range (UTTR)

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- Successfully Tested GRDCS Mobility
- UTTR Fall 2007
- Completed QF-4 Range Sweep Data Collection
- Capable of Flying BQM-167A Target
- BQM-167A Flight Scheduled for November 2008

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# Present – GMCS and WMCS

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- **GRDCS Mobile Control System (GMCS)**
- **WSMR Mobile Control System (WMCS)**
- **Used for "Wounded" Drone Recovery**
  - Chase pilot visually ascertains damage
  - Controller performs controllability check
  - Mission commander determines if recovery should be attempted
  - Flown to short approach by GRDCS
  - Hand-off to GMCS for final recovery
- **Available as Backup Control if Main Control Facility Goes Down**

# Present – Recent Additions

- **Linux based I/O Control System**
  - Linux GRDCS IO (LGIO)
    - Replaces AIX I/O Computers
    - Supports ISc Interface
  - C-Band Radar Interface
    - Bi-Phase Serial Data
    - Flight Termination System Data
  - Designed for Interoperability
- **Future Features**
  - Joint Advanced Missile Instrumentation (JAMI) Interface
  - Non-Developmental Item—Airborne Instrumentation Unit (NDI-AIU) Interface
  - Search Radar Interface
  - Range Instrumentation Grid (RIG) Data
  - Output Translated Slaving Data

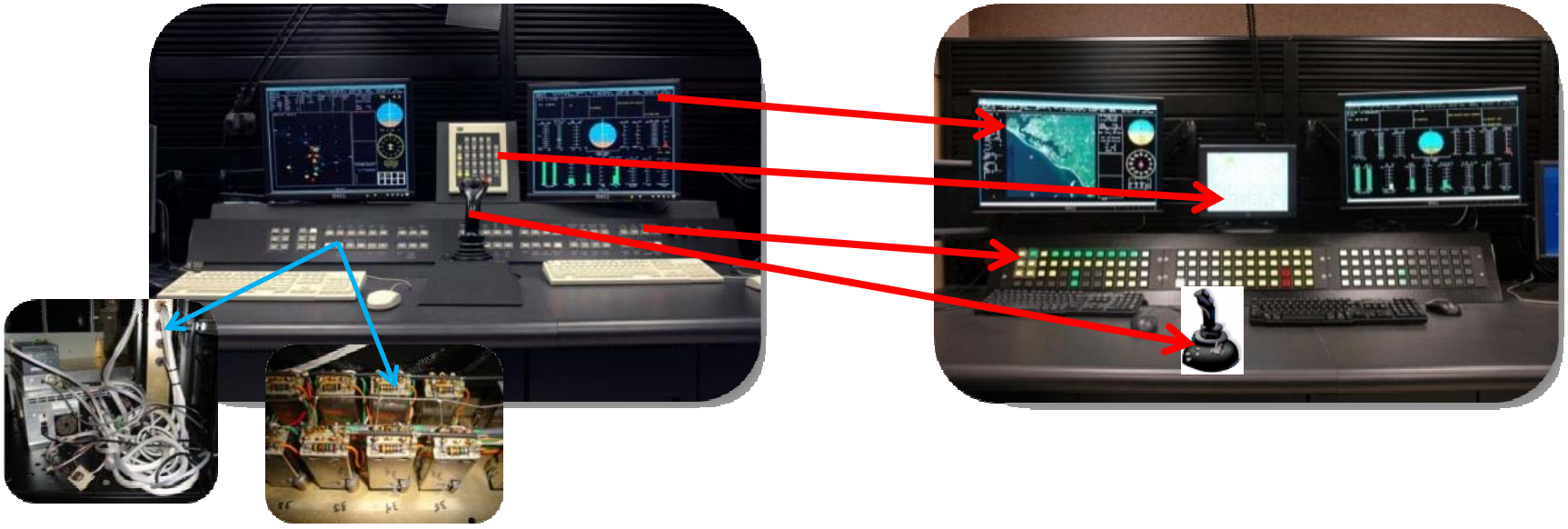
# Future – In Development
# ProLog Replacement

## Old

- Standard Monitors
- IBM Proprietary Pushbutton Input
- Individually Wired Pushbuttons with Overlay
- Specialized Controller Joystick

## New

- Widescreen Monitors
- COTS Touch Screen
- Integrated Connection Programmable LCD Pushbuttons with Standard Serial Interface
- USB Joystick



# Future – In Development
# Display Update

## Old

- IBM Proprietary GraPHigs
- IBM Proprietary Hardware
- IBM Proprietary OS
- Wireframe Only

## New

- Modern Open Standard OpenGL
- COTS PCs
- Linux Based OS
- Modern Display Technology

# Future – In Development

- **Convert Servers to Linux**
  - Migrate Control Processors to Linux
  - Provides Support for Multiple Programming Languages
- **Decoupled Simulation**
  - GRDCS Core Processes Run Independently of Simulator Processes
  - Modular Interface
- **GRDCS Mission Management**
  - Enhance System Startup and Configuration to Point/Click Interface
- **Enhanced Logging**
  - Record More Data
- **Real-time Matlab® Analysis Capability**

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# Future - QF-16 Integration

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# Future – Potential Projects

- **Replay Capability**
- **Additional Datalink Interfaces for Interoperablity**
  - UHF
  - Link-16
- **Flight Path Management**
  - Enhance Flight Path to be Based on Time and Location
  - Possible Touch Screen User Input
- **Terrain Avoidance**
  - Use DTED Maps to Provide Notification of Terrain Abnormalities
- **GPS Based Navigation**
- **3D Visualization**
  - Provide Different Views
  - Used with Replay for Personnel Training

# Conclusion

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# GRDCS Engineering Contact Information


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