Army Lockheed YO-3A in Vietnam

A Technical Observer's Perspective

Adapted from a Presentation
Delivered 2004
by

Karl Forsstrom
Technical Operator (TO)
Long Than North 3/71 – 8/71

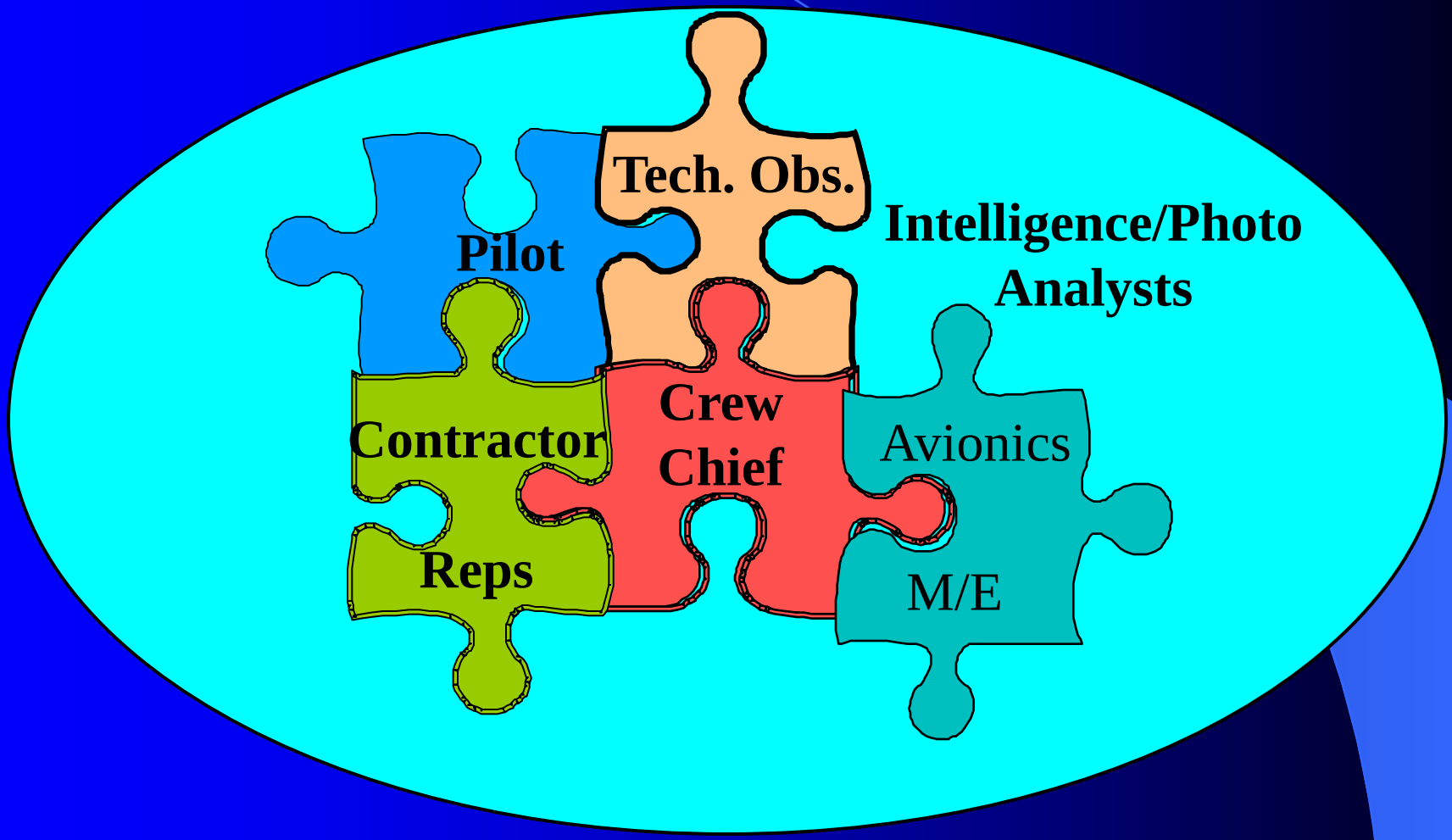
The YO-3A Missions

- **Perform After-curfew Night Surveillance of Rivers and Roads in Suspected Enemy Controlled Areas of South Vietnam**
  - **Report "Unusual" Activities to Ground Troops**
  - **Collect Data for Post-mission Intelligence Analysis**
- **Act as Real-time Forward Air Controller (FAC)**
  - **Direct Artillery at Identified & Cleared Targets**
  - **Direct Air Strikes at Identified Targets**

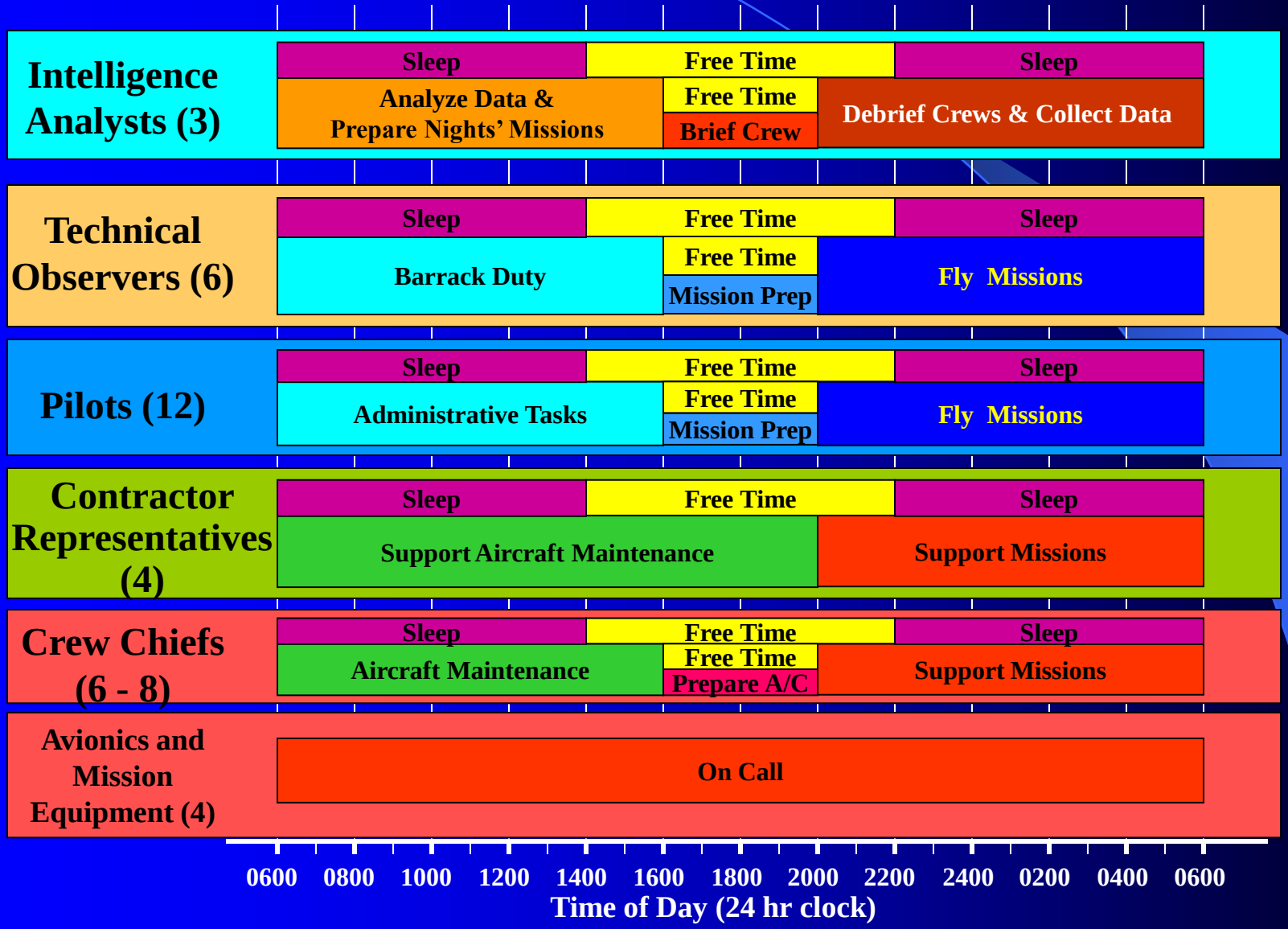
Presentation Outline

- YO-3A Mission Personnel
  - Emphasis on Technical Observer (TO)
- YO-3A Mission Technology
  - Detection^2

YO-3A Personae Dramatis



A Day in a Life of a YO-3A Company



Free Time & Mission Time

YO-3A Technical Observer (TO)

- Initially Trained as Airborne Sensor Specialist (MOS 17L) for Army OV-1 Mohawk Surveillance Aircraft
  - Aerial Navigation
  - Communication & Forward Air Controller
  - Sensor (Radar, IR, Photo) Operations

OV-1B Mohawk

Typical Missions

- River Reconnaissance
- Road Reconnaissance
- Coastal Reconnaissance
- Designated Area Search
- 4 – 5 Missions per Night per Operating Base
  - Early Evening: 2000 – 2300 hrs
  - Night: 2300 – 0200 hrs
  - Pre-Dawn: 0200 – 0500 hrs
  - Mission Duration: 2 – 3 Hours

Mission Example

Pre-flight Briefing

- **Intelligence Analyst Outlines Search Area and Potential Targets based on Previous Night's Data and/or Information from Core Intelligence (J2)**
- **Pilot Receives Weather Updates, Radio Frequencies and Navigation Waypoints**
- **TO Marks/Reviews Mission Maps and Is Issued Crypto Sheet-of-the-Day**

TO's Responsibilities

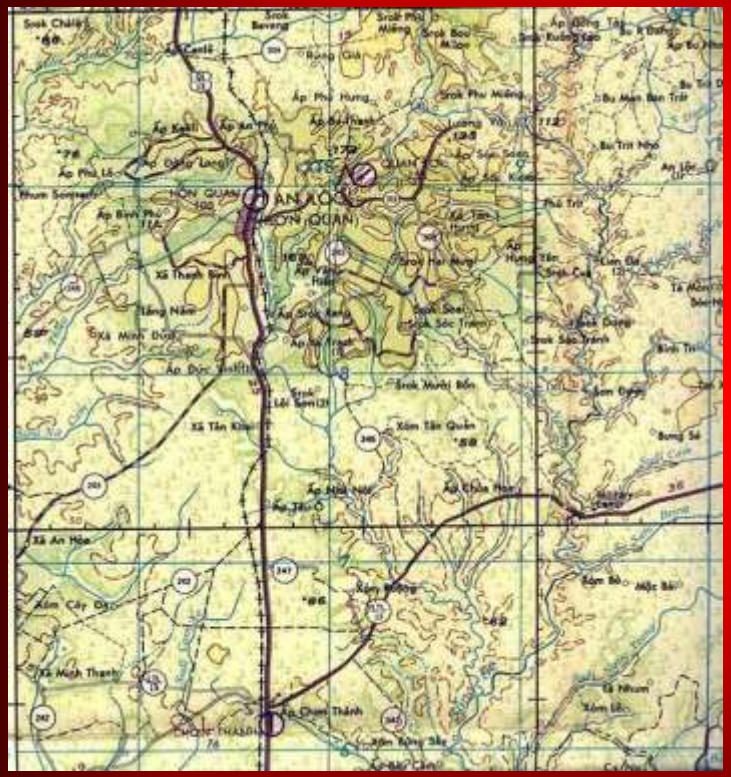
- **Pre-takeoff**
  - Verify NVAP Functionality with On-ground Check (Look at Hanger Across Runway)
- **In-flight**
  - Assist Pilot with Navigation
  - Coordinate Radio Communication with Ground Troops (Artillery) and Air Traffic Control
  - Operate Mission Equipment (Night Viewing Aerial Periscope - NVAP)
  - Call in Potential Targets to Ground Troops
  - Direct Artillery or Air Strikes on Targets
- **Post-flight**
  - Debrief Mission to Intelligence Analysts
  - Turn in Crypto Sheets

Sensor Fusion à la YO-3A

- **Visual (Seeing)**
  - **Right Eye in NVAP Ocular – Bright Greenish Image**
  - **Left Eye on Mission Map – Dull Red Light from Cockpit Spotlight**
- **Vestibular (Inner Ear – Balance)**
  - **Conflict between Gyro Stabilized NVAP and Rocking YO-3A (i.e., Pilot Trying to Navigate by Looking Out Side of Canopy)**
- **Tactile (Touch)**
  - **Right Hand on Joystick**
  - **Left Hand Trying to Fold Unwieldy Mission Map**
- **Aural (Hearing)**
  - **Constant Chatter between Pilot, TO and Ground**
- **Sensor Overload For Some Resulting in Vertigo and Air Sickness**

The View from the Front Seat

Cabin Night Light



Left Eye

Right Eye

One TO's Observations

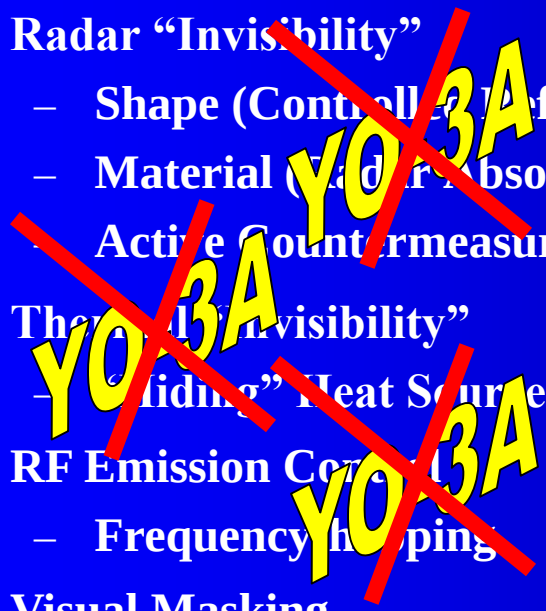
- Who's In Charge of the Mission?
  - Pilot Is Only the Sensor-platform Driver
  - TO Makes Value Judgments on Target's Importance
- Aerial Origami
  - Art of Folding Maps in Tight Quarters
- Flying from the Front Seat of a YO-3A
  - Most Pilots Insisted that the TOs Learn to Fly in Case of Emergencies
  - Short, Telescoping Control Stick
  - No Trim Control
- Confusing Air Force and Navy Personnel
  - "What Kind of Insignia Is that Pilot in the Front Seat of that Strange WWII Fighter Wearing?"
  - "Looks Like a Really Fast Plane."

YO-3A Mission Technologies

- Avoiding Detection
  - Stealth before Stealth Was a Popular Term
  - 10 Years Before Have Blue (Prototype Version of F-117 “Stealth Fighter”)
- Enabling Detection
  - Night Vision Sensors
  - Years before “We Own the Night” became the Army’s Mantra

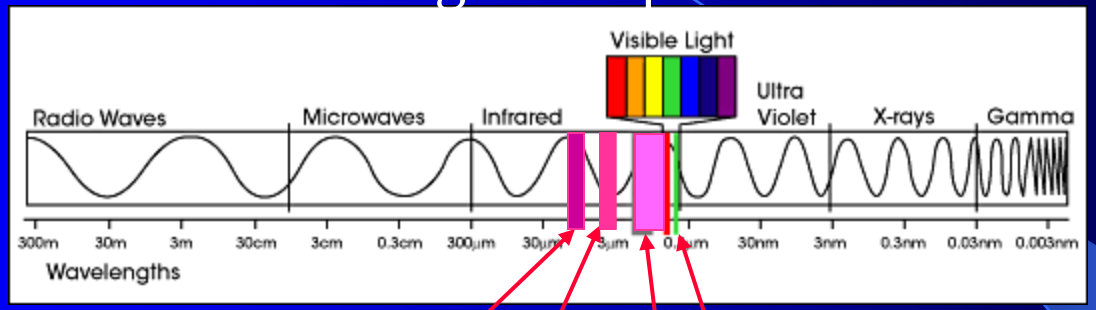
Elements of Stealth

- Radar "Invisibility"
  - Shape (Controlled Reflectivity – Known Radar Spikes)
  - Material (Radar Absorbing Material – RAM)
  - Active Countermeasures (Jamming, Ghosting, Phase-cancellation)
- Thermal "Invisibility"
  - "Hiding" Heat Sources
- RF Emission Control
  - Frequency Hopping
- Visual Masking
  - Shape
  - Camouflage Paint Patterns
- Acoustic Reduction
  - Engine Shielding
  - Belt-drive Reduction System
  - Modified Muffler
  - Custom-made Wooden Propeller



Night Viewing Technology

Electromagnetic Spectrum



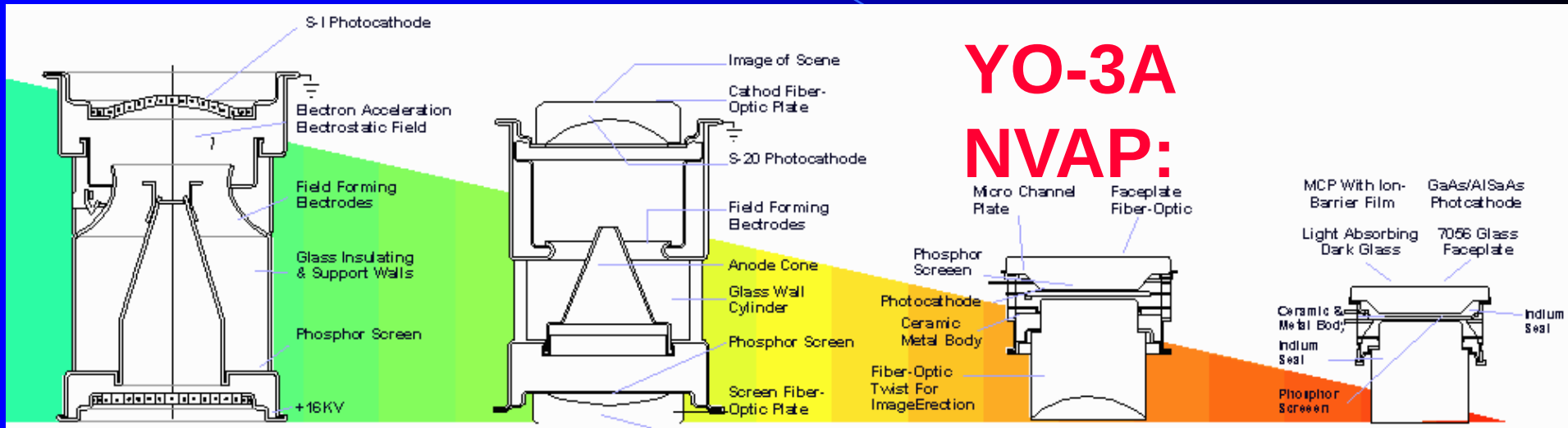
Far IR 10 μm (thermal) FLIR

Near IR 4 μm (thermal) FLIR

Visible Light 0.4 – 0.7 μm (reflective) Photographic, Conventional TV

Near IR 0.7 – 2 μm (reflective) NVAP

Image Intensification Technology



Gen 0 1940 - 1960 | **'60 – '68 Gen I** | **'69 – '80 Gen II** | **'80 -2000 Gen III**

Gen 0 - Typically uses an S-1 photocathode with peak response in the blue-green region (with a photosensitivity of 60μA/lm), electrostatic inversion, and electron accel-eration to achieve gain. Consequently, Gen 0 tubes are characterized by the presence of geometric distortion and the need for active infared illumination.

Gen I - Typically uses an S-20 photocathode (with a photo-sensitivity of 180-200μA/lm), electrostatic inversion, and electron acceleration to achieve gain. Because of higher photo-sensitivity, Gen I was the first truly passive image intensifier. Gen I is characterized by geometric distortion, perform-ance at low light levels and blooming.

Gen II - Usually an S-25 (extended red) photo-cathode (with a photosensitivity of 240+μA/lm) and a micro-channel to achieve gain. Can be found with either electro-static or fiber optic-inversion. Gen II tubes provide satis-factory performance at low light levels and exhibit low distortion.

Gen III - Uses gallium-arsenide for the photocathode and a micro-channel plate for gain. The microchannel plate is also coated with an ion barrier film to increase tube life. Produces more than 800μA/lm in the 450 to 950 nanometer (near infared) region of the spectrum. Gen II Provides very good to excellent low-light-level performance, long tube life. Recent mil-spec tubes have no perceptible distortion.

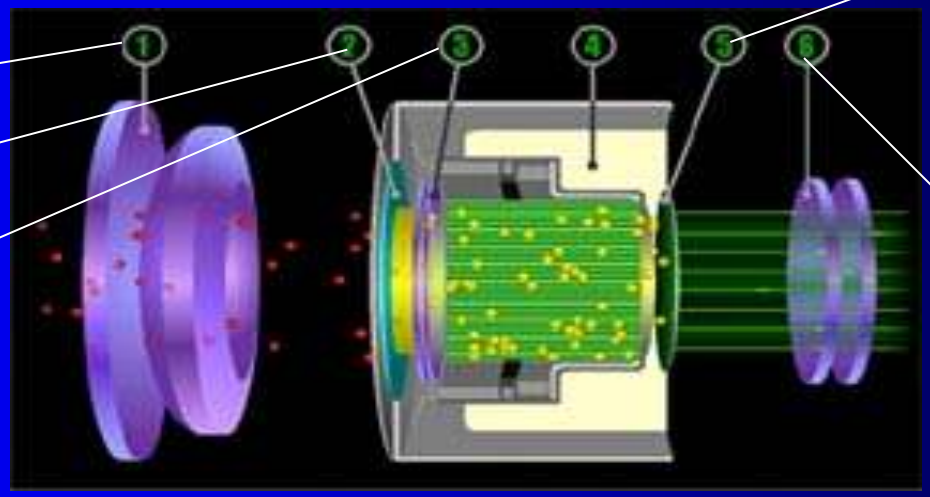
100 X Gain | 1000 X Gain | 10,000 X Gain | 40,000 X Gain

Night Viewing Aerial Periscope (NVAP)

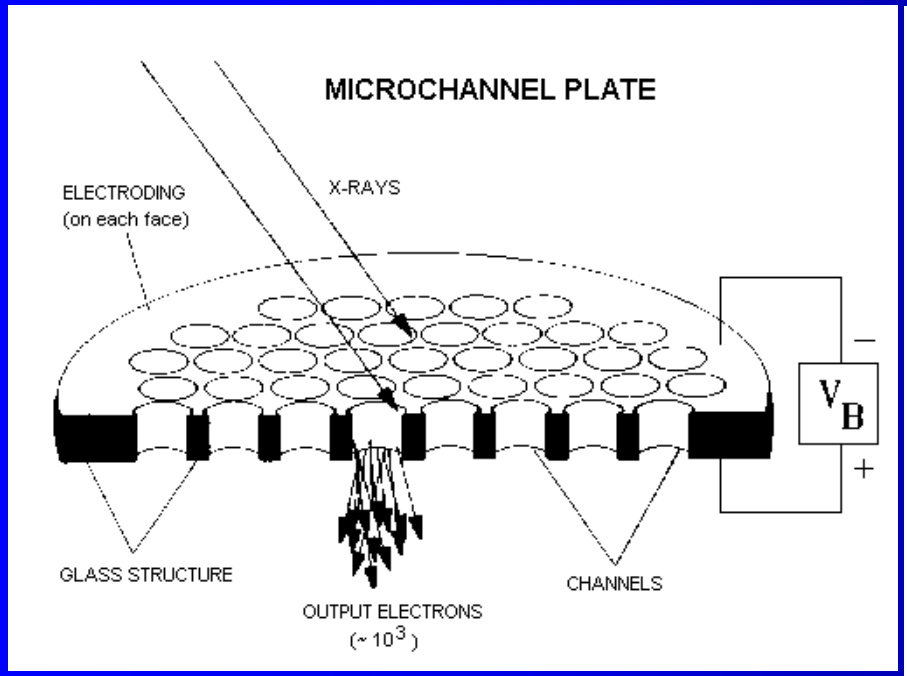
- Light Intensification System (e.g., Starlight-scope) Sensitive in Optical and Near Infrared Portion of Electro-Magnetic Spectrum (Early Generation II)
  - Not a Forward Looking Infrared (FLIR) System with Cryogenically Cooled Sensor
  - Infrared Beacon Assist for Dark Nights
- Technical Observer Controlled NVAP Line-of-Sight (Azimuth and Elevation) via Joystick
  - Joystick Also Slaved Infrared Illuminator's Line-of-Sight to Match NVAP's Line-of-Sight
- NVAP Optics Gyro Stabilized
- Mono-Ocular Eyepiece to Focus Grainy, Greenish Monochrome Image from Fibre Optics Bundle

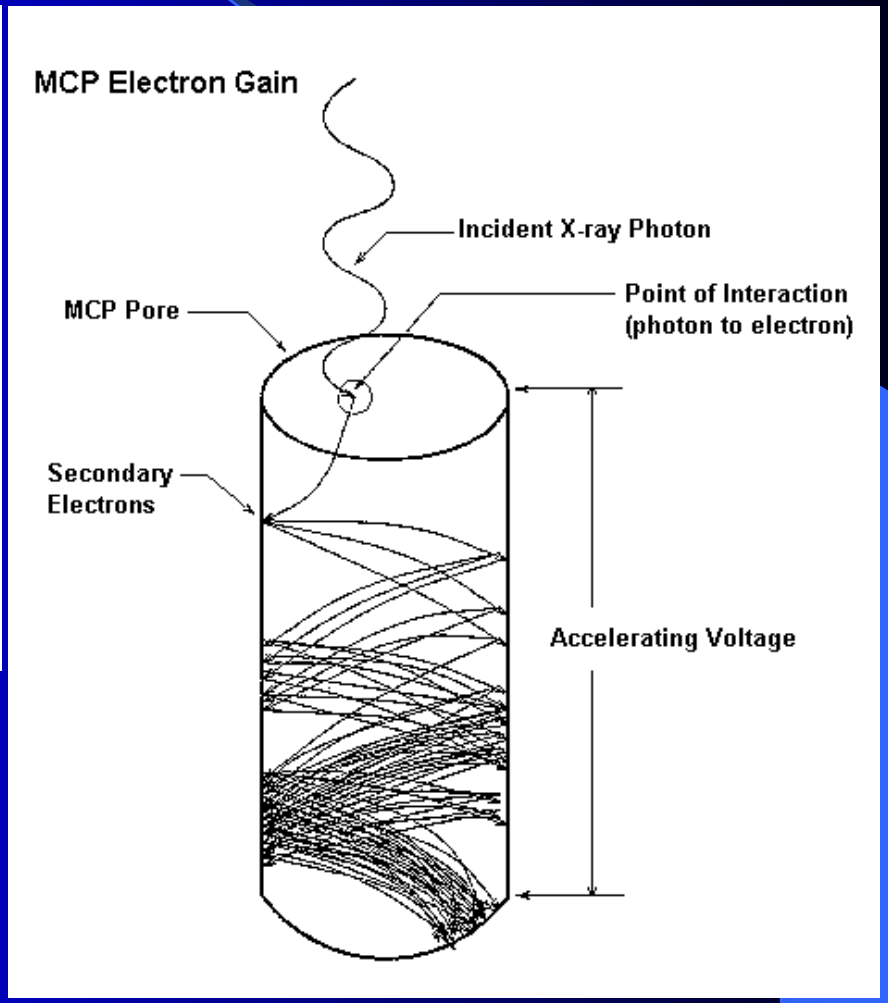
Generation II Night Vision Device

- Micro-channel Plate (MCP) Works As An Electron Amplifier and Is Placed Directly Behind the Photocathode.
  - Several Million Microscopic Hollow Glass Channels Fused Into a Disk
  - Each Channel, Approximately 0.0125 mm In Diameter, Is Coated With a Special Semiconductor Which Easily Liberates Electrons
  - A Single Electron Entering a Channel Initiates an Avalanche Process of Secondary Emission, Under Influence of an Applied Voltage, Freeing Hundreds of Electrons
  - These Electrons, Effectively Collimated by The Channel, Increase the Resolution of the Device
- Details As Fine As 0.025 mm Can Be Realized



Micro-channel Plate (MCP)





Conclusions

- YO-3A Was a Unique and Successful Experiment Combining:
  - A Motivated Army Team with Embedded Civilian Contractor Support
  - A Visually and Acoustically Stealthy Aircraft
  - State-of-the-Art Night Vision Equipment