

# NUCLEAR CAMERAS FOR VISUAL INSPECTIONS INCREASE OPERATIONAL SAFETY

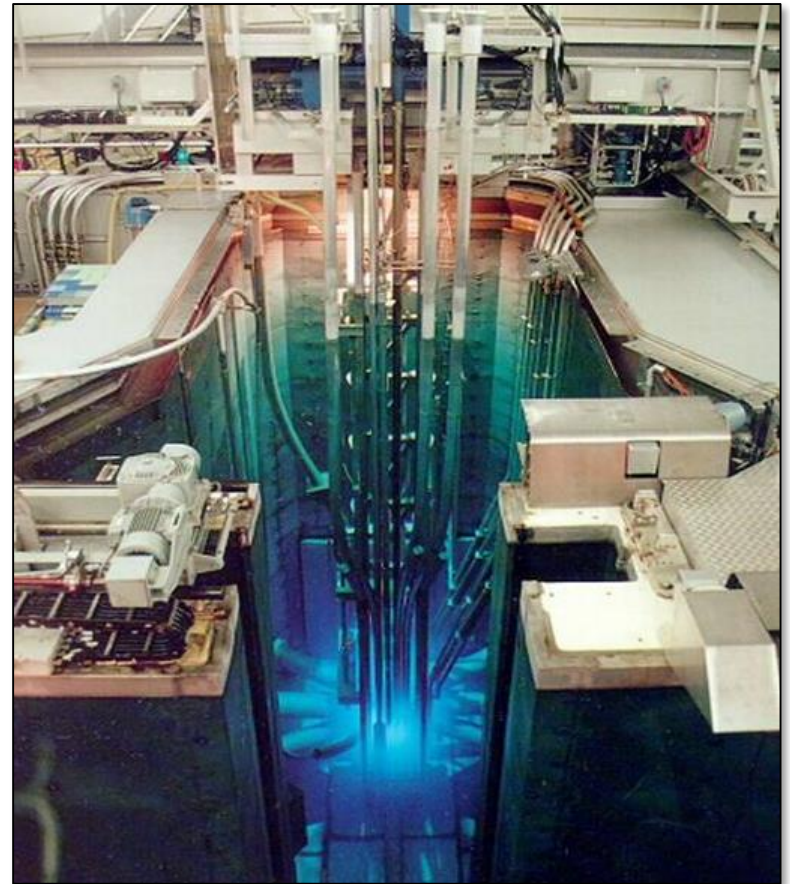
*Presented by*

*Aaron Huber, Diakont*

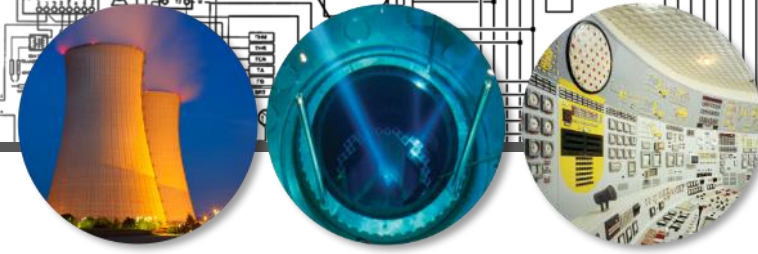
# Agenda



- Background
- Defect Detection
- Fuel Inspection
- Periodic Inspection Programs
- Surface Defects & Identification
- Specialized Cameras



# Diakont – A Trusted Partner

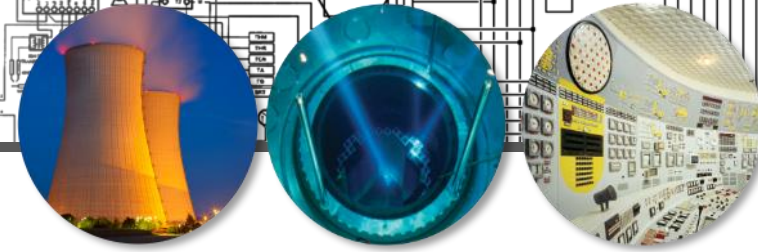


## Company Info

- 25 years in operation
- Global staff of over 1,300 employees
- Facilities in US, Italy, and Russia
- ISO 9001:2008 certified
- Radiation tolerant cameras deployed at research reactor facilities worldwide
- Awarded for *Innovation* in Robotics



# Core Competencies



## Rad-Tolerant Video Systems



## Digital I&C Systems



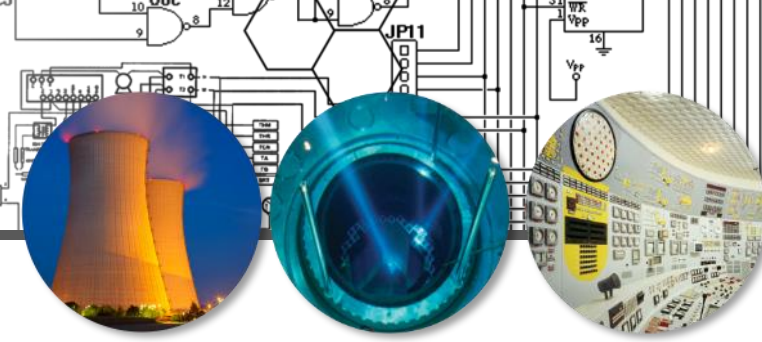
## Robotics & Manipulators



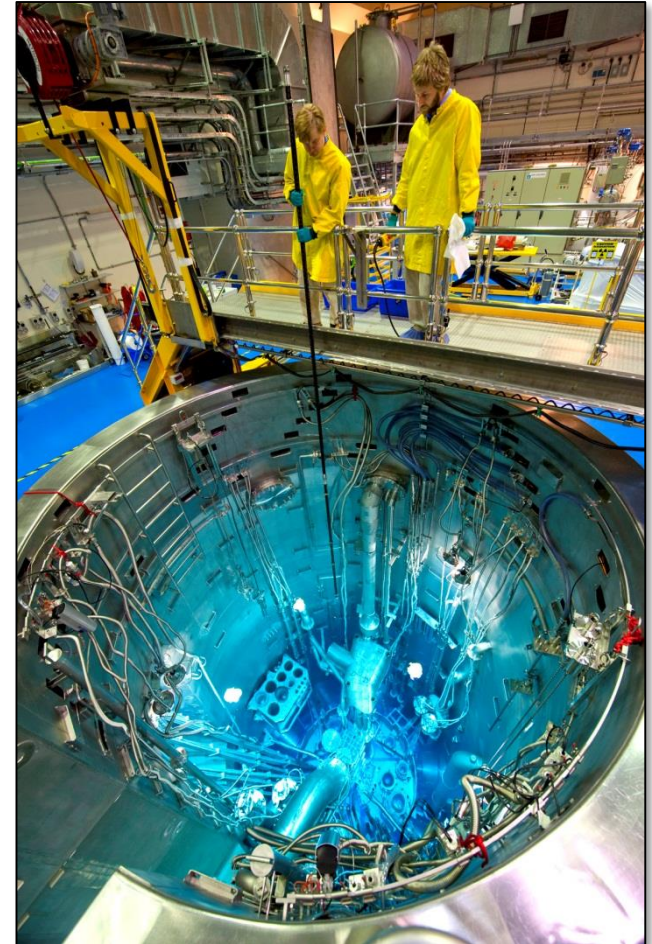
## Underwater Decon



# Defect Detection

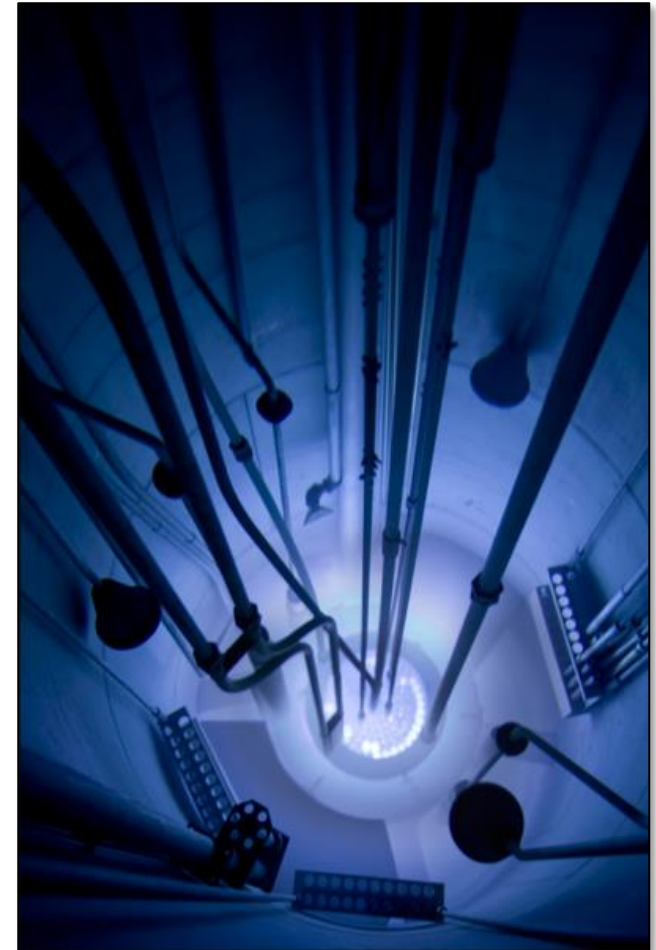
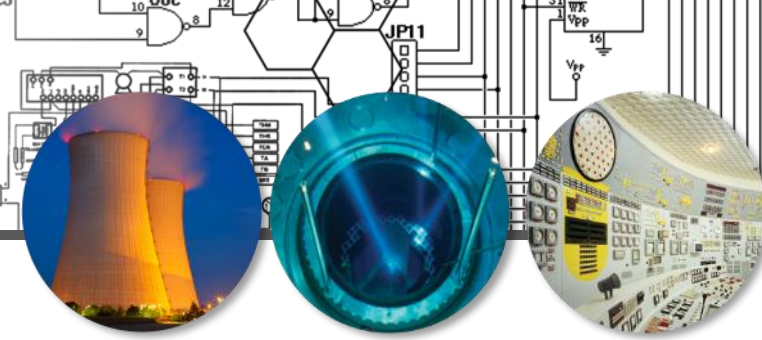


- Defects or component failures can lead to serious issues
  - Reactor downtime
  - Impacted safety
  - Increased costs
  - Increased regulatory scrutiny
  - Increased stakeholder concern



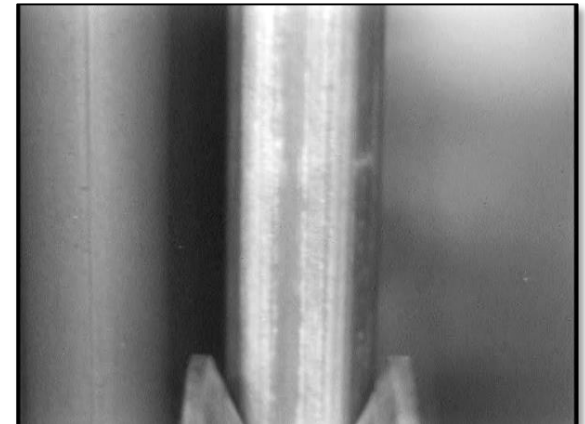
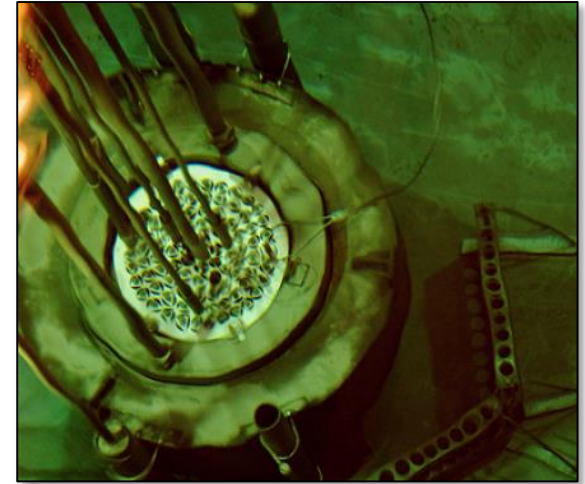
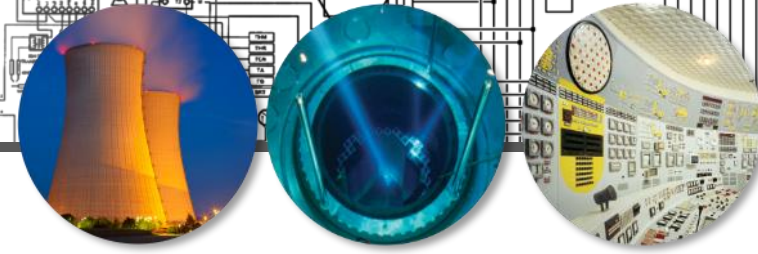
# Fuel Inspection

- Fuel serial numbers
- Fuel cladding
- Overlooked defects could cause contaminant leakage into the primary reactor coolant system

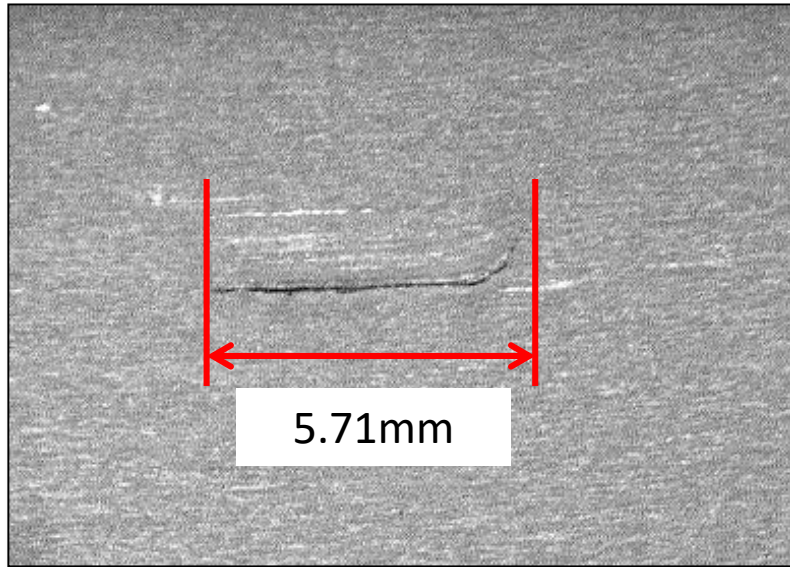


# Periodic Inspection Programs

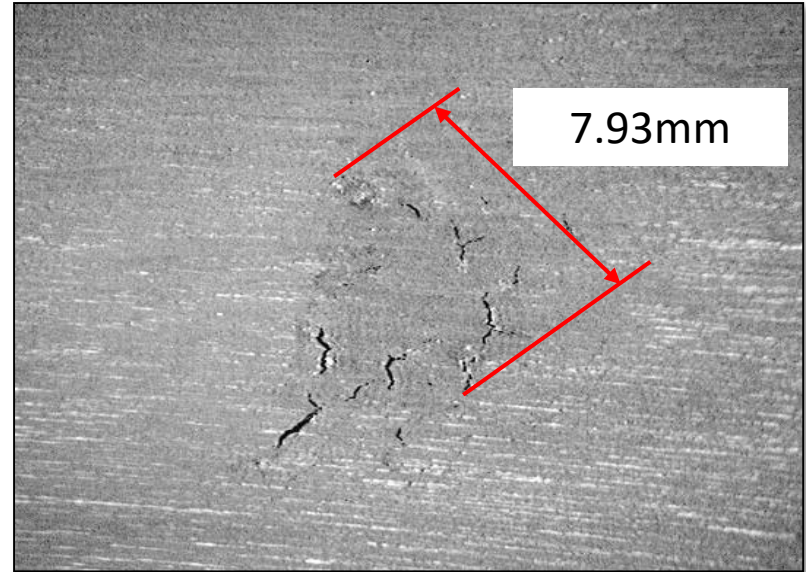
- Periodic inspection programs are imperative to maintain safe operations
- Ultrasonic and Eddy Current do not reveal surface defects
- Visual inspection technologies are considered the best method for this inspection



# Surface Defects



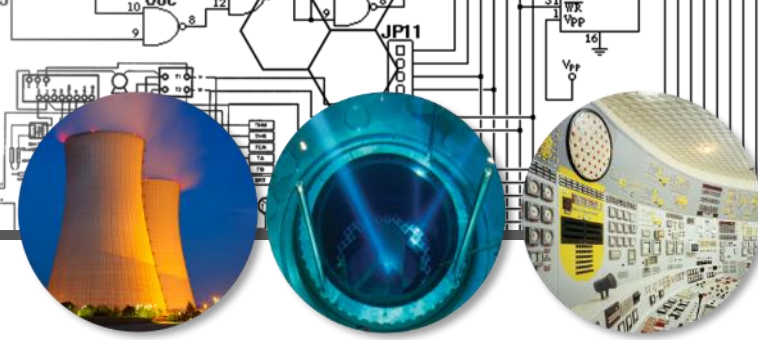
**Line Crack Found in  
Reactor Cladding**



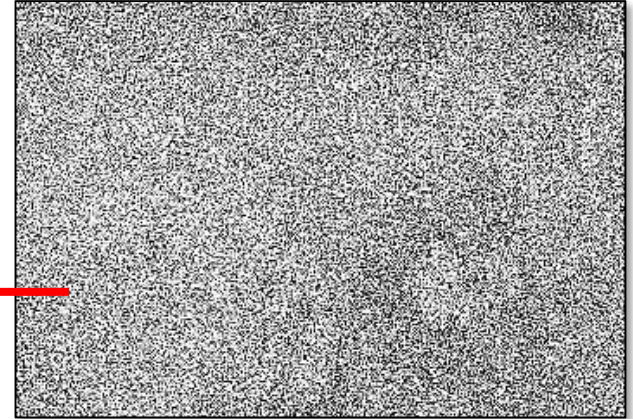
**Spider Crack Found in  
Reactor Cladding**



# High Radiation Environment



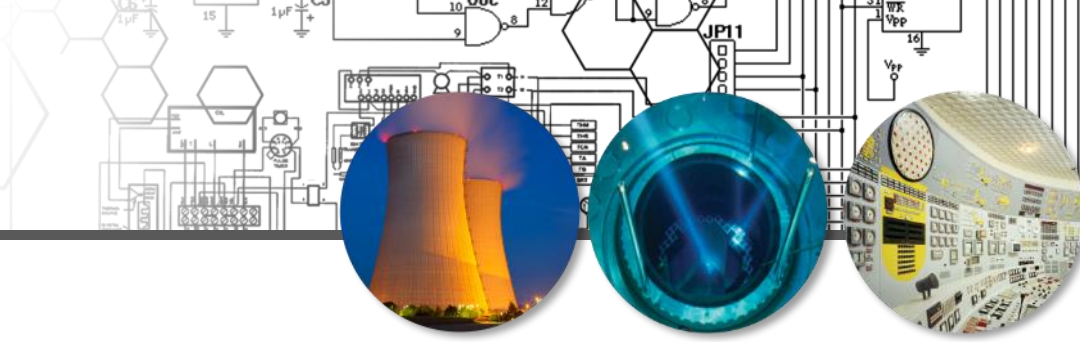
- Defects viewed in high radiation environment with a standard CCD camera
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- Defects viewed in high radiation environment with a D40 camera system
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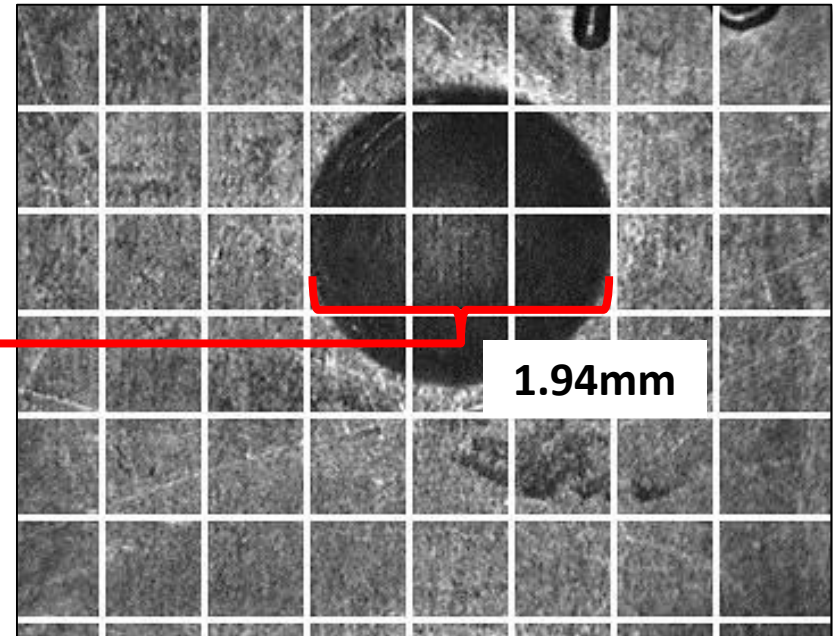


# Defect Identification

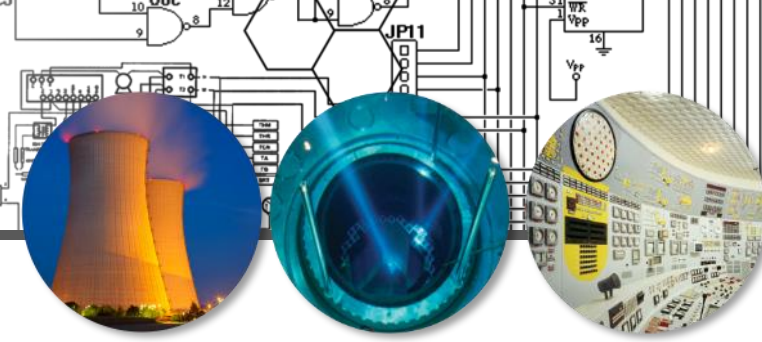


- Defect detection can require more than just high quality imaging
- Sizing technology may be required to detect the length and width

Measurement grid  
provides accurate sizing



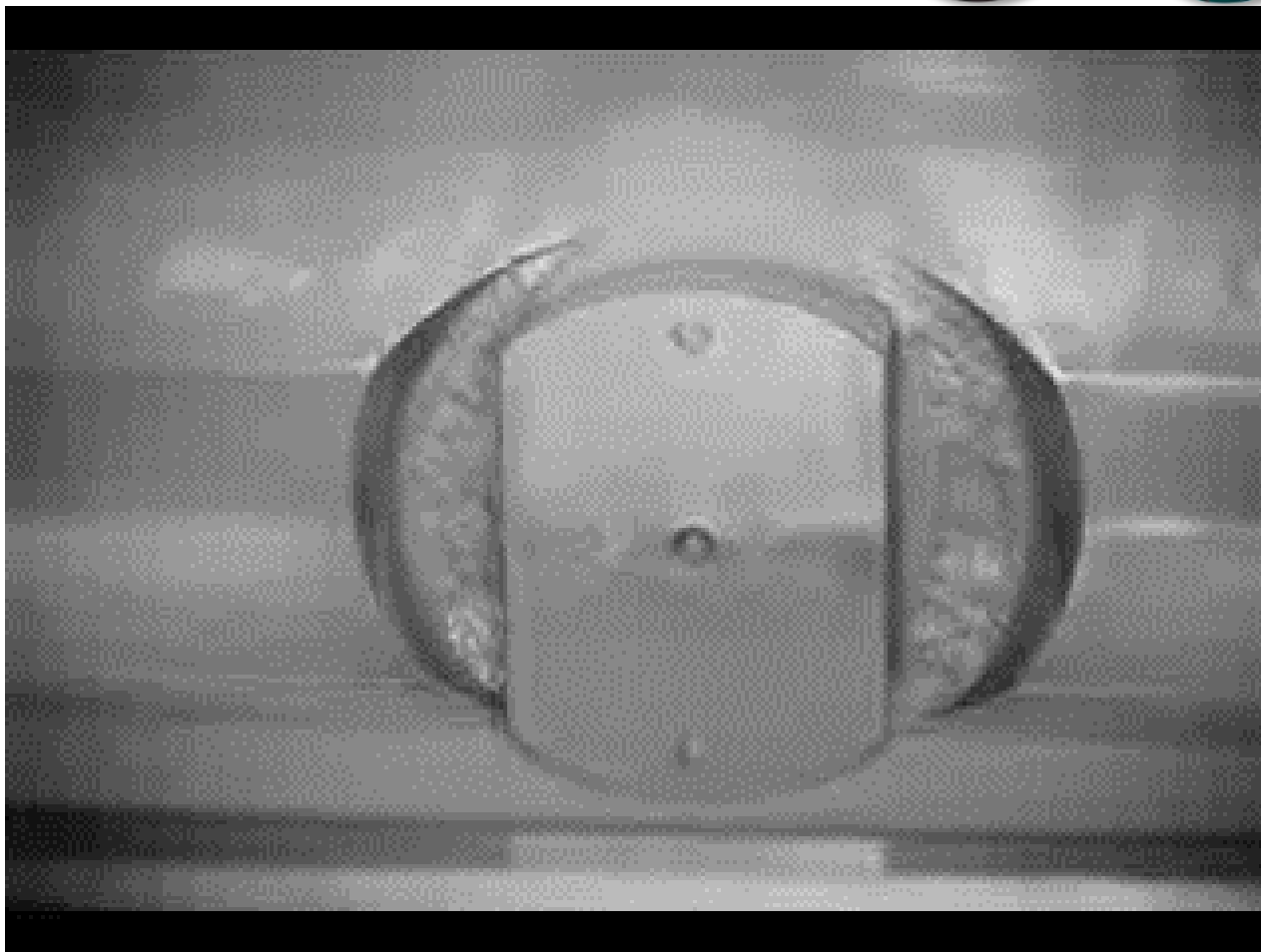
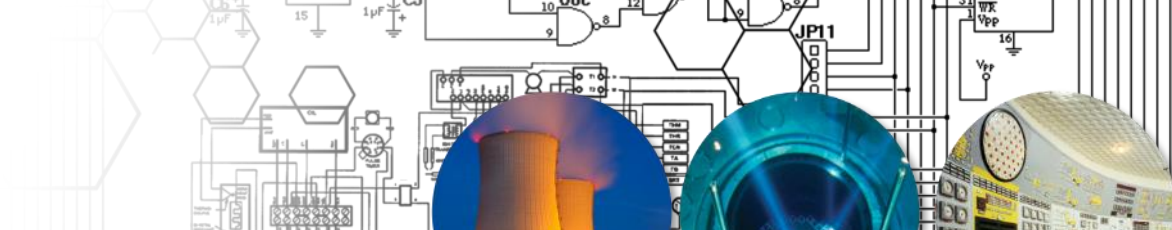
# D40 Camera System



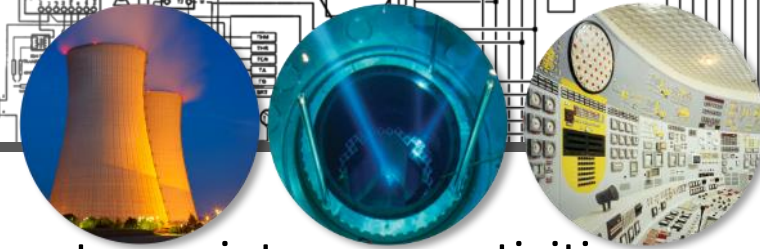
- Ultra high rad-tolerant split-head design
  - Only non-browning optics and minimal electronics are located inside the camera - camera components are housed in the topside Camera
- Easy refurbishment using factory tuned tube replacement
- 1000+ systems deployed worldwide

Radiation Tolerance	2x10 <sup>8</sup> Rads (10 <sup>6</sup> Rads/hr)
Image	Black & white
Format	600+ H-TVL
Lighting	Integrated LED
Zoom	2x analog (10:1 option)
Environment	IP 68, 131' submersible





# MicroCam

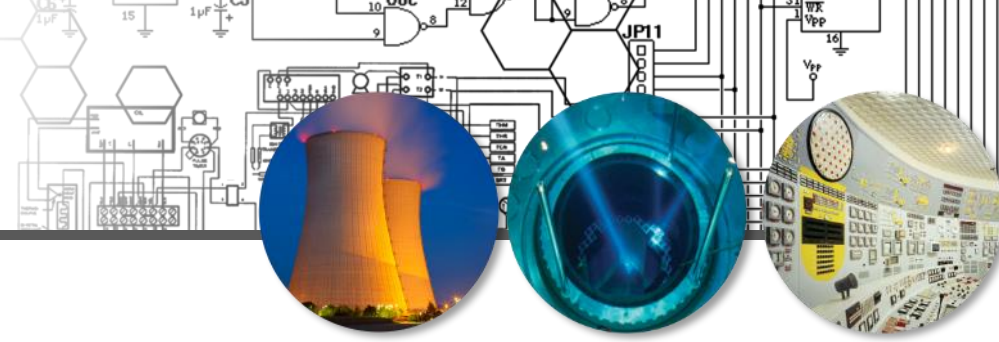


- Low cost color video camera for monitoring reactor maintenance activities
- Integrated LED lighting
- Exceptional image quality in low light
- Compact form factor: 1.125" diameter
- Plugs directly into monitor (no control unit required)

Radiation Tolerance	50,000 Rads (100,000 Rads/hr)
Image	Color
Format	420 H-TVL
Lighting	Integrated LED
Sensitivity	0.025 lux (50 IRE) F1.2 3200°K
Environment	IP 68, 200' submersible



# Proton Camera System



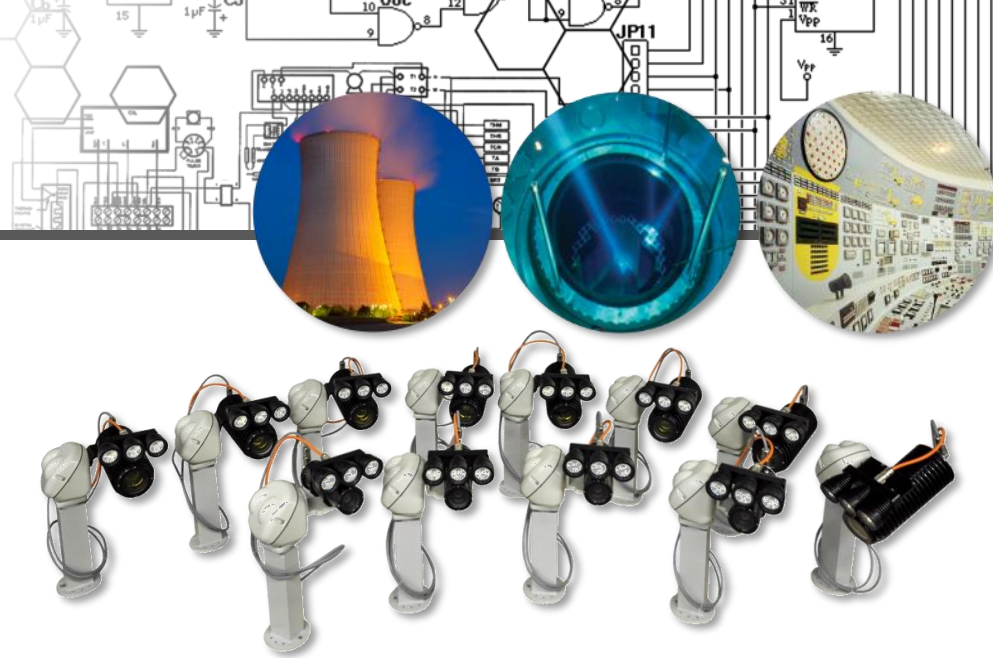
- High definition, color, PTZ camera
- Utilized system for monitoring critical activities in the reactor, refueling, and spent fuel pools

Radiation Tolerance	$10^8$ Rads ( $10^3$ Rads/hr)
Image	HD Color
Format	1080i / 720p
Lighting	Integrated LED
Zoom	10:1 Optical; 4x digital
Environment	IP 68, 131' submersible



# CCTV Camera System

- Permanently-installed, networked systems for containment and drywell online monitoring
  - Equipment failure mitigation
  - Critical data during emergencies
  - Supervision of powered entries
  - Also used during outages
- CCTV systems are standard plant equipment in Europe and Asia



# Contact Diakont



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