SRS Digital Photography Upgrade

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SAVANNAH RIVER NATIONAL LABORATORY
We Put Science To Work

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Agenda

- Visual Inspection History
- Digital Program Need
- Proposed Digital Upgrade
- Direct Photography (DP) Solution
- Wide Angle Photography (WAP) Solution
- Current Status
- Program Continuation
- Questions and Contacts

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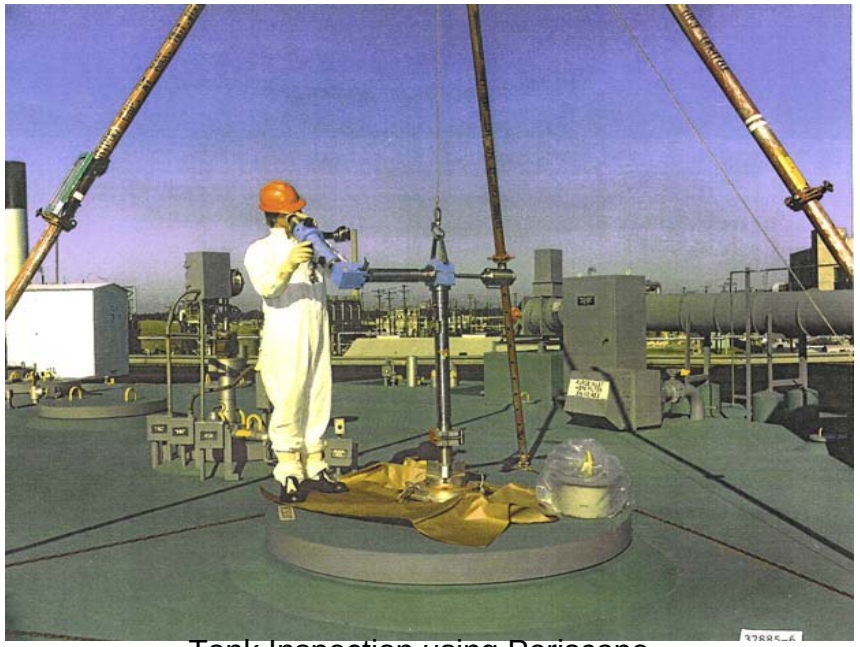
History of Visual Inspections for SRS Tanks

- Visual inspection programs initiated in the 1960s relied on the best available technology at the time.
  - shining flashlights into the risers and looking into the risers through binoculars using mirrors.
  - Technological improvements deployed as they became available
- The 1970s saw improvements to the deployment methods
  - 35 mm cameras were used in tank annulus to acquire a photographic record of the tank walls.
  - Remote inspection tool enabled ultrasonic wall thickness measurements
- "Skate UT Program" continued until the mid-1980s.
  - Incorporated video inspections and improved 35 mm cameras and lenses.
- In the mid-1990s, a commercially available ultrasonic testing (UT) system was used to acquire volumetric wall information on six underground tanks.



Tank Inspection using Periscope

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SRS Inspection Program Moves to the 21st Century

- 100,000 still photos and thousands of hours of video
  - Storage space and record retention requirements
  - Deterioration
  - Archiving and retrieval
  - Continued availability of film and film processing
  - Manual screening

→ SRS inspection frequency and dated technologies with declining resources demanded improved efficiency.

→ SRNL 2005 proposal to begin program to transition to digital technology

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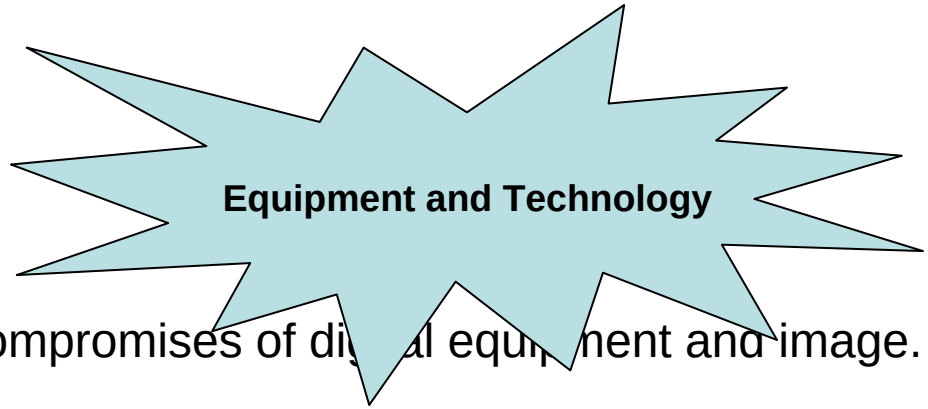
SRNL Proposed Digital Photography Program

- Conceptual Phase - Design digital photography program (equipment) to systematically address looming issues with film technology
  - Storage space hardcopy vs. electronic
  - Availability of film processing equipment / resources
  - Repeatability
  - Screening
  - Cost/Quality*



* Quality concerns stemming from compromises of digital equipment and image.

SRNL Digital Photography Solution

CONSIDERATIONS

- Replace Contax camera body
- Zeiss Hologon T 16mm lens
- Use existing deployment mast
- Provide real-time image feedback

APPROACH

- 5-8 Mega pixel to retain image quality
- 12mm telecentric lens to compensate for smaller imager format
- Head redesign (larger camera body, modular flash bars)
- Add portable viewer and transmission

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Digital Photography to Address DP and WAP

- Direct Photography
  - Visual spot inspection of welds, seams, etc.
  - Collective review and analysis of condition at inspection site (salt nodule changes, etc.)

- Wide Angle Photography
  - Annular bottom views (floor space)

- Common Elements
  - Results are manually reviewed
  - Equipment constraints
    - Selection of high quality lens for desired view drives selection of camera
    - 5” clearance challenges
    - Robustness (rigs subject to impacts and contamination)
    - Maximize rapid prototyping / manufacturing
    - Remote control and image transmission

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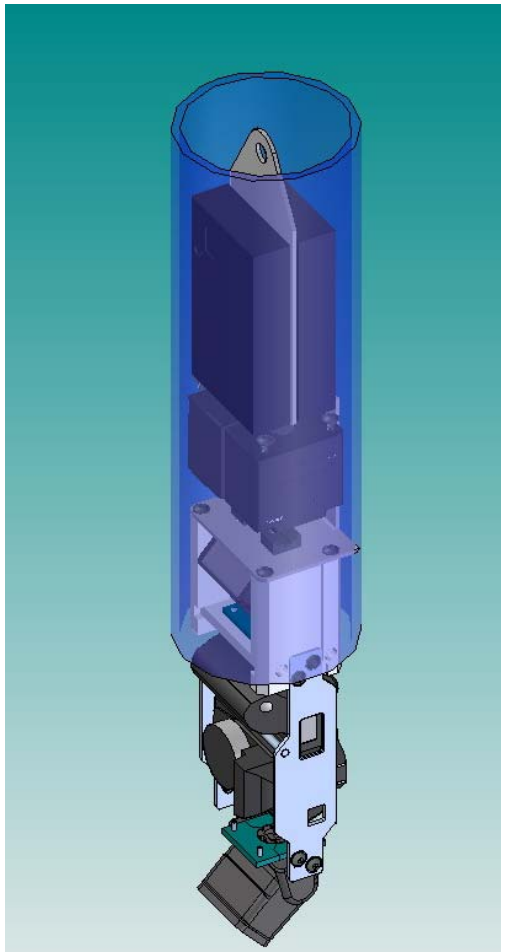
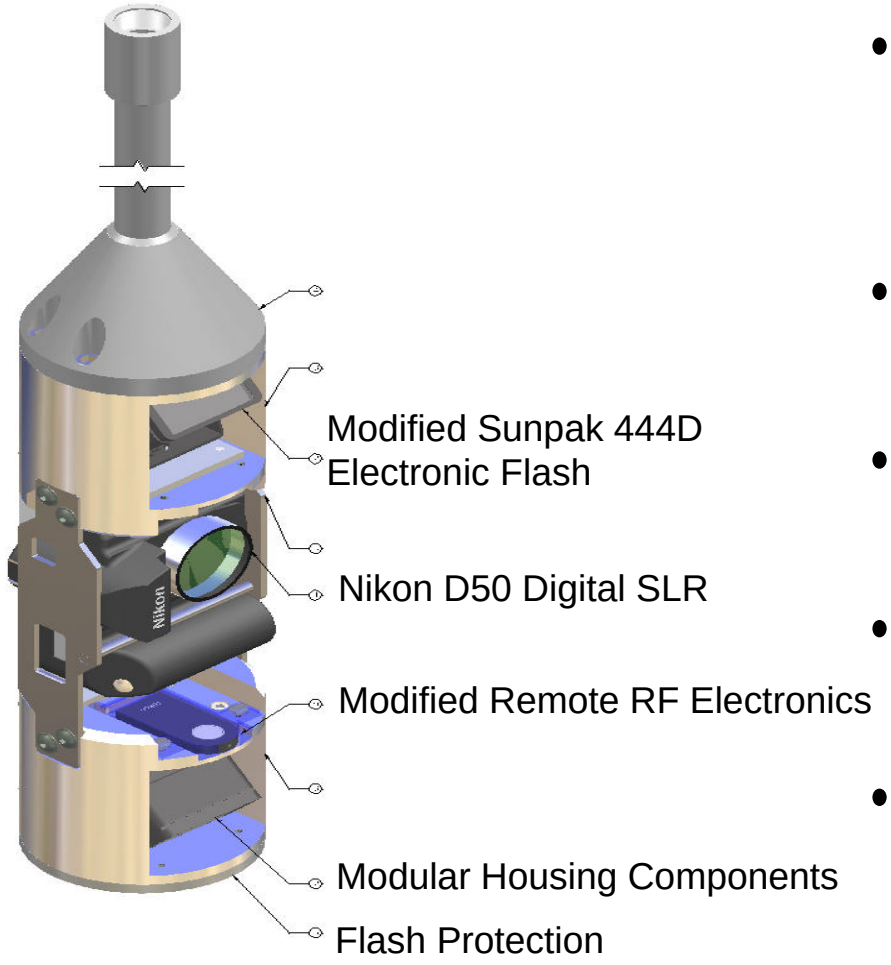
1st Generation Direct Photography (DP) Rig

- 1st Generation design mounted camera and dual flash (above and below)
- Battery and electronics housed above camera / flash assembly
- Reduced weight significantly
- Field tested in 2007
  - Flash assembly susceptible to damage
  - Battery replacement required removal of the assembly



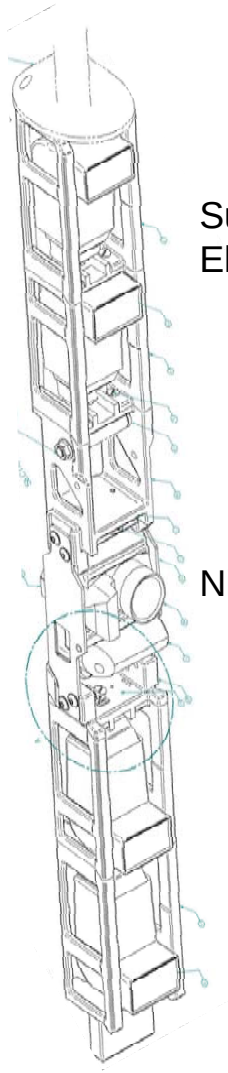
Model of 1st Generation DP System shown in 5” Pipe

2nd and 3rd Generation of Direct Photography (DP) Rig



- 2nd generation improved design with flash protection and modular mountings
- Batteries and controls remoted to tank surface
- 3rd generation integrated controls into single chassis
- Added commercial DVD and instant feedback
- Both generations successfully field tested in 2007

Wide Angle Photography (WAP) Solution



- Addressed different lighting needs
  - Multiple iterations of number, position and angle
- Mechanically cable drive to horizontal position
- Full modularity in design (allows interchangeability for maintenance by component), significant improvement over previous design

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FY07 Development and Deployment Status

- Successful demonstration of DP and WAP in multiple deployments FY07
- Over 10 SRNL supported deployment reviews performed in 2007
- Full transition from film to digital camera equipment technology planned for 2008

Model of 3rd Generation DP Rig

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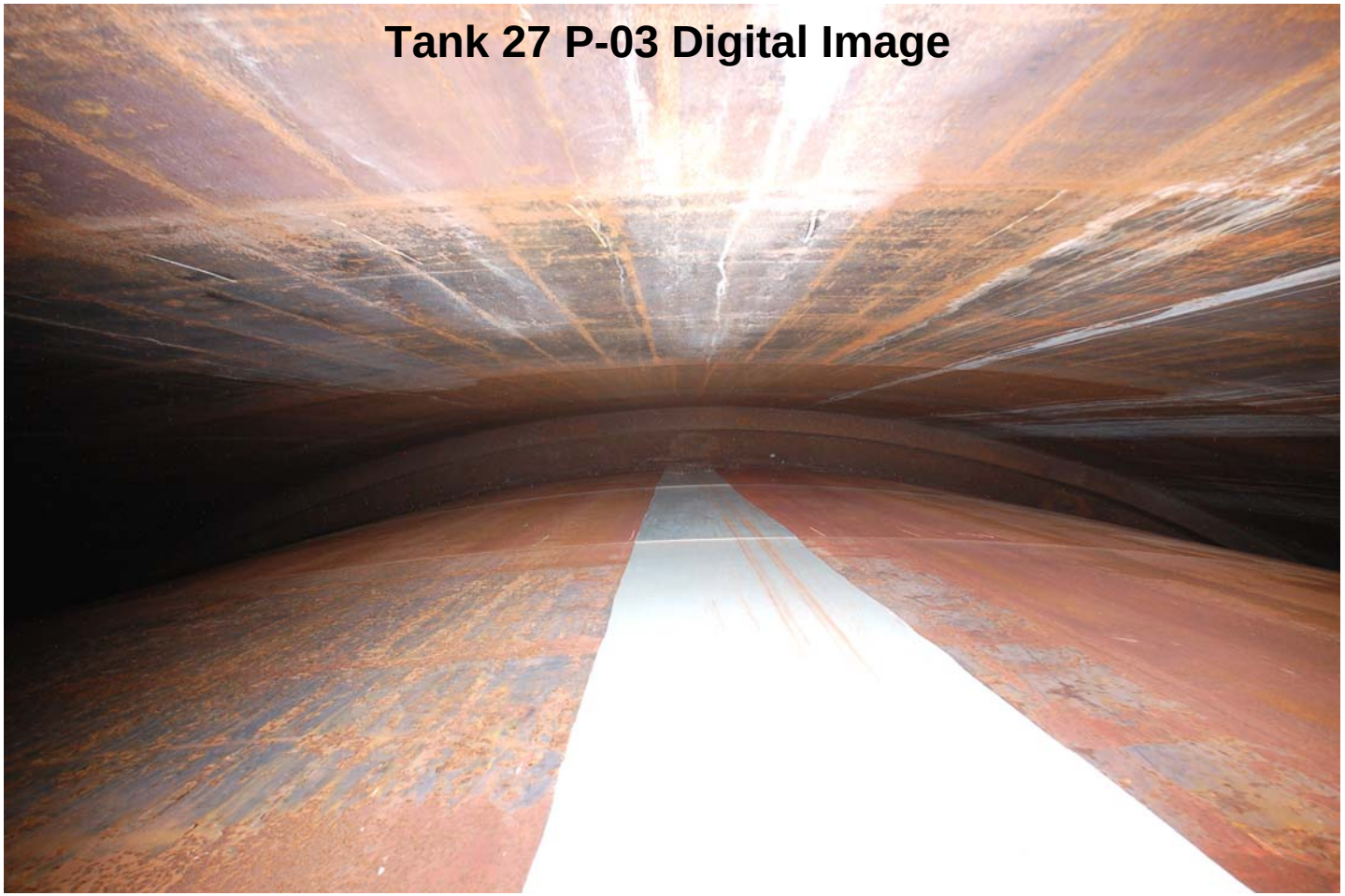
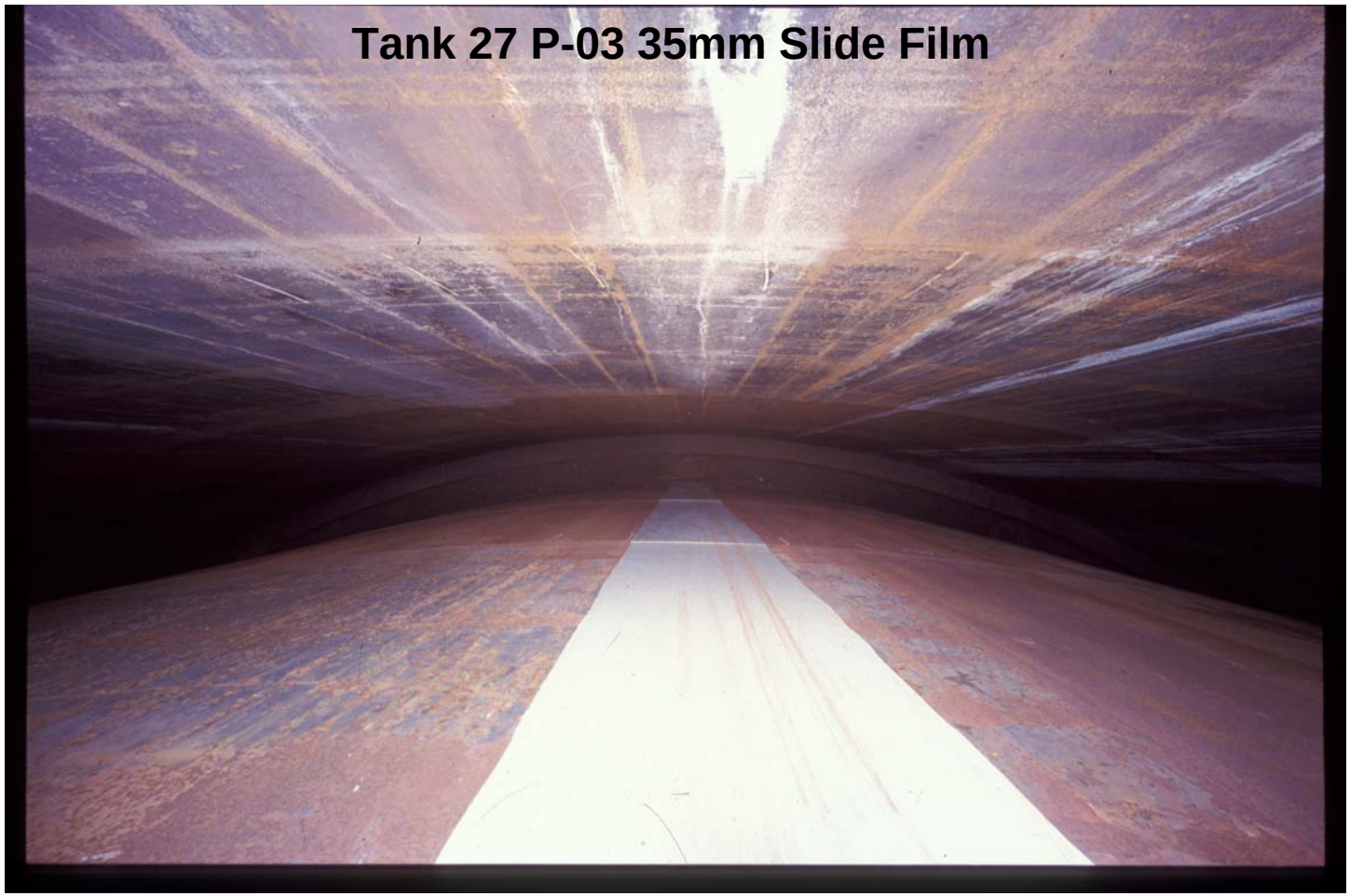
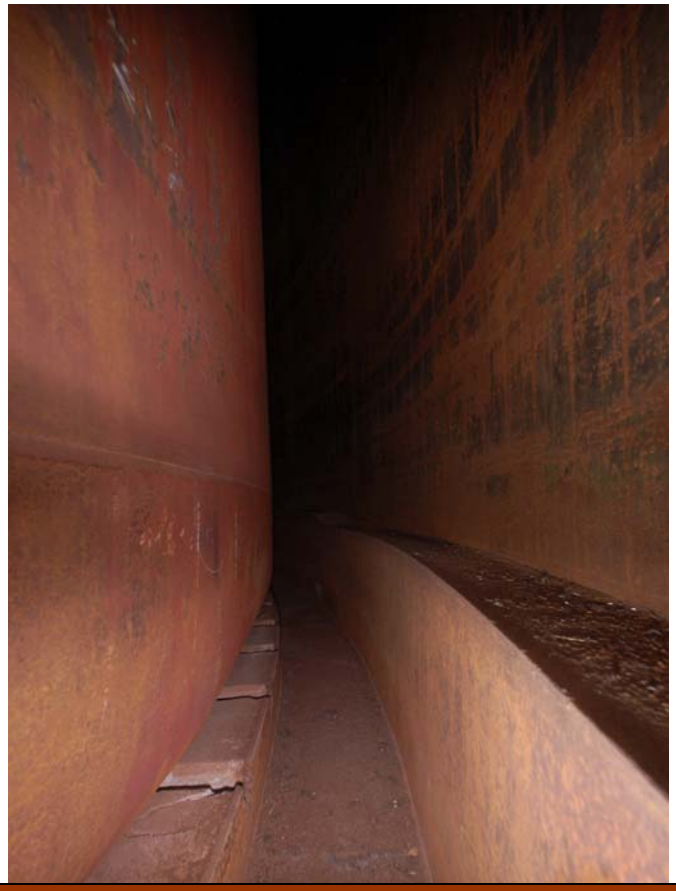
Digital Results



Compared to Film



Side by Side Comparison



Tank 27 P-11

2003 35 MM Slide Film **2007 Digital Image**

Contributors to Success

- Rapid Prototyping
  - Eden and Titan Rapid Prototype Machines used extensively for reviews
    - Eden 330 cured resin parts used for delicate flash mounts in final product
    - Working scale models deployed for evaluation in the field
    - Reduced iterative turn around time to < 48 hrs
- Solid Edge freeware to view and convert to CNC machine language
- Operator reviews during iteration of designs
- No paper reviews (3D model and rapid prototypes)
- Continuity in expertise and knowledge (customer, engineering design, machinist)

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Digital Photography Program Follow On

- Proof and maturity of the digital photography equipment and technology would enable a program designed for;
  - image recognition (maturity of existing technologies)
  - improved delivery (deployment)
  - future retrievability of image formats
  - legacy photograph conversion
  - contamination controls / recovery

Digital Photography Status

- Successfully deployed and demonstrated both Direct Photography and Wide Angle Photography in FY07
- Perform funded maintenance activities to deployment rigs in FY08
- LW Inspection and Monitoring group to implement Digital Photography exclusively for routine annulus inspections in FY08
- SRNL performing review and evaluation of programmatic elements and follow on in FY08

SRNL Digital Photography Contacts

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