

# Deployment of Remote Systems in U.S. Department of Energy Decontamination and Decommissioning Projects

Mark W Noakes and Dennis C Haley  
EM50 Robotics Crosscut, D&D Robotics  
Oak Ridge National Laboratory

Robert Vagnetti

D&DFA

Energetics, Inc.

for

Spectrum 2000

Sept. 24-28, 2000

# Summary of Five Technologies Deployed

- Dual Arm Work Platform—Argonne National Laboratory CP-5 Research Reactor. (1996-1998)
- Canyon Disposition Initiative Remote Characterization System—Hanford U-plant. (1998)
- Remote Underwater Characterization System—INEEL Test Reactor Area. (1998)
- Modified Brokk with Remote Console—INEEL Security Training Facility. (2000)
- Compact Remote Operator Console—INEEL Security Training Facility. (2000)

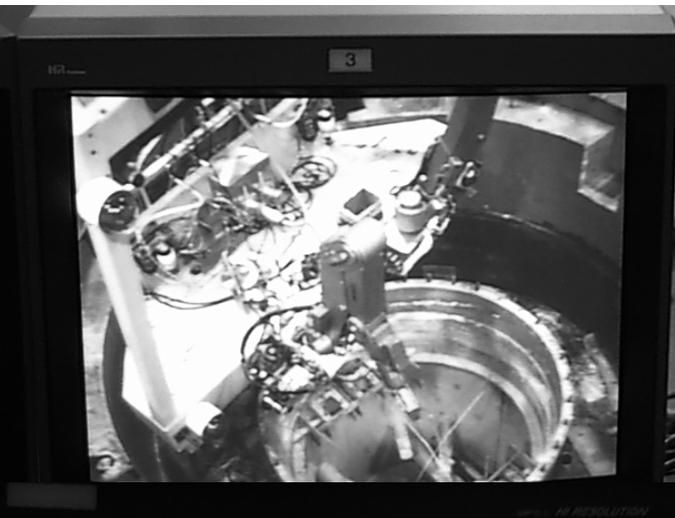
# Dual Arm Work Platform Deployed for Reactor Dismantlement at CP-5



Material Removed: 62,000 lb of graphite brick; 2,000 lb of steel; 1700 lb of aluminum; 1400 lb of lead; 620 lb of boral

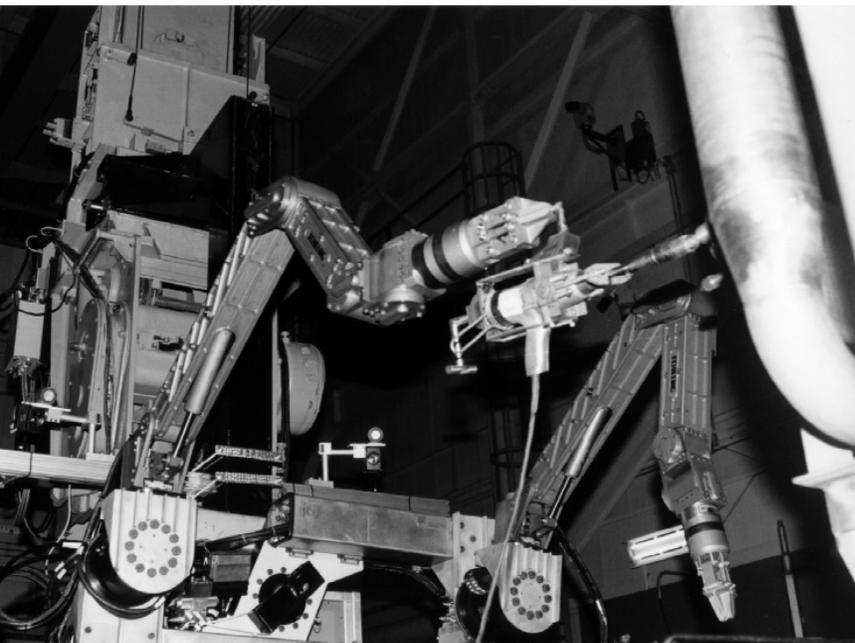
Significant operator/operations, tooling, and facility issues

## CP-5 Tasks and Tooling



Required minimal tool mods  
Required no unfamiliar tools  
Required no torch cutting  
Alignment and reactive force

# Other Dual Arm Configurations



## Significant Lessons Learned

- \$1.5 M hardware is too expensive for almost everyone.
- Reuse is a key but reuse is very difficult and usually means reconfig and adaptability.
- Cheap is important.
- Facility burden must be minimal.
- Operator skill is generally low and non-computer.
- Tools are frequently hacked.
- Gradual technology intro works best.

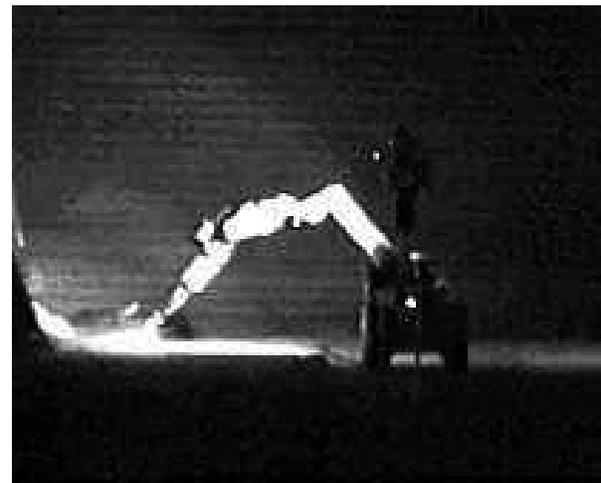
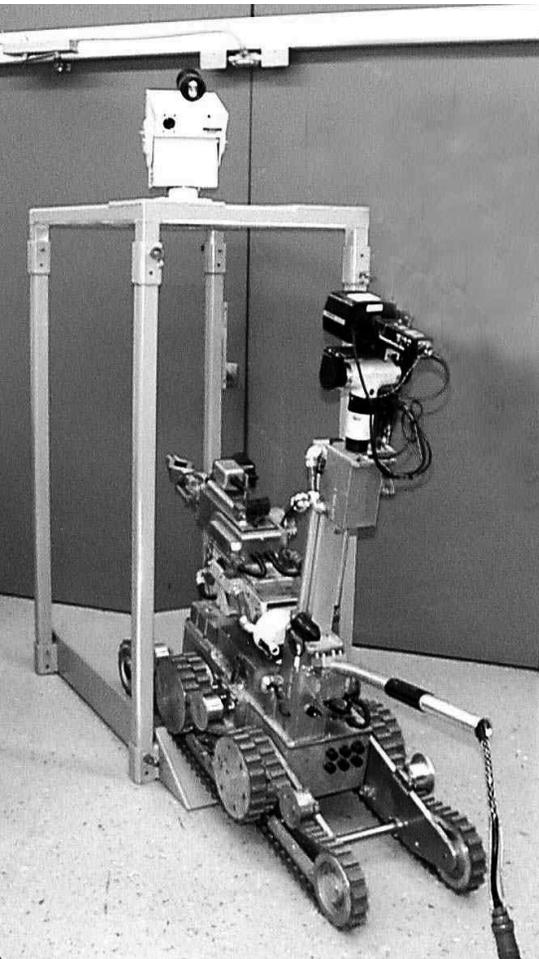
# Andros Deployment for Sampling and Characterization

- Adopted a philosophy of starting small and meeting needs directly to build confidence and support. —> ok, what else can you do for me?
- Task was to inspect railroad and ventilation tunnels as part of the overall task to evaluate the suitability of using the five processing cells in the Hanford U-plant for low level waste disposal.
- Approach was to take a commercial Andros Mark VI and add facility and system support necessary to complete the inspection.

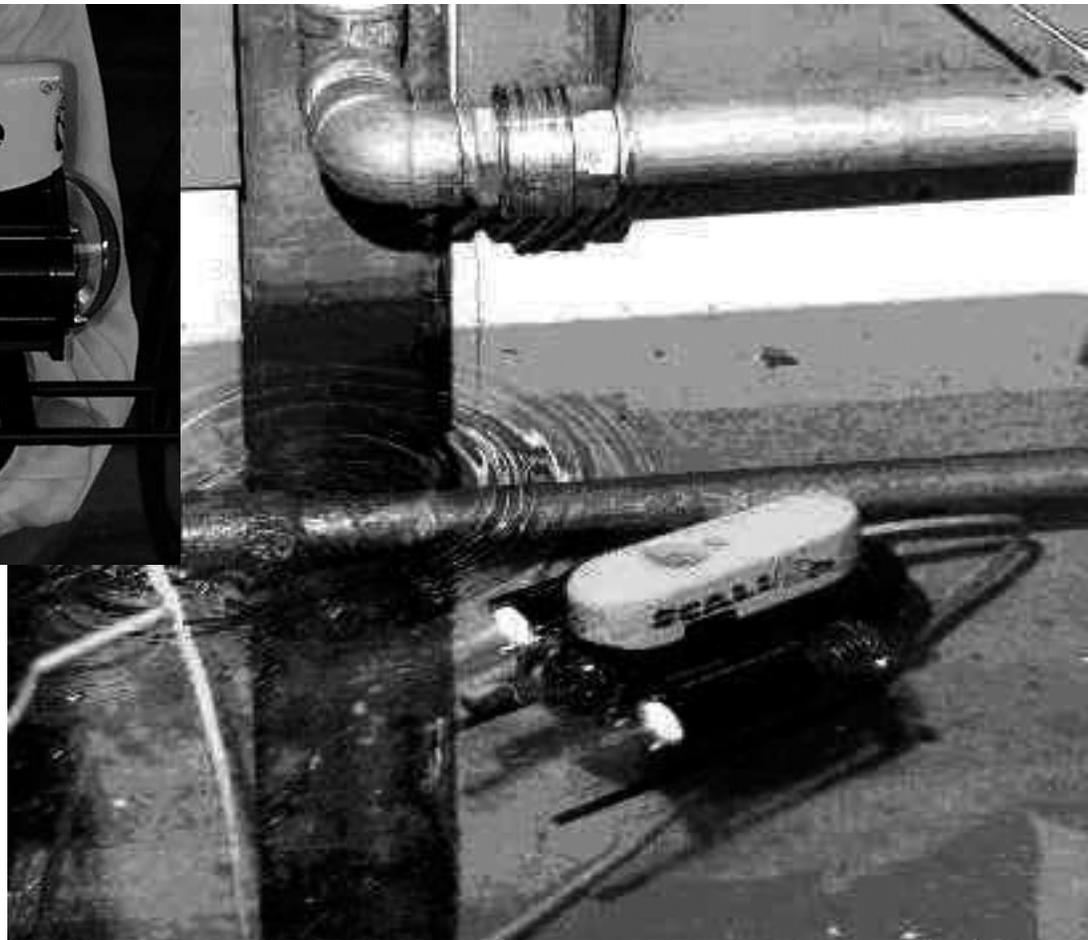
# Andros Deployment for Sampling and Characterization

- Hardware added:
  - Cameras and lights
  - Smear sample station
  - Deployment station
- Tasks:
  - Collecting video footage while traversing the entire tunnel length
  - Collecting gross gamma readings
  - Collecting smear samples

# Andros Deployment for Sampling and Characterization



# Remote Underwater Characterization System



Ultimate in cheap (<\$20K) and in keeping the customer happy

# Remote Underwater Characterization System

- Need was to inspect old reactor fuel pools (Bldg TRA-660, INEEL)
- Started with commercial equipment and worked with the vendor, Inukten
- Modified by Rbx:
  - Support inspection and radiation mapping
  - Auto-depth control
  - Vehicle orientation and depth monitoring
  - Video and gamma documenting
- Inukten incorporated many of the changes in their product.
- RUCS was so well received by operations that they asked to keep it.

# Low Cost Demolition System with Remote Console

Low cost systems that work and are accepted by the end users.



Reaction forces slide vehicle +/- 5 ft and can even tip it over.

# Low Cost Demolition System with Remote Console

- Make use of equipment familiar to D&D operations.
- The Brokk meets numerous demolition needs.
- The Modified Brokk was remotized with a bolt-on kit provided by Rbx.
  - Cameras and positioning
  - Potential tool control
  - Facility camera pod
- Demonstrated at INEEL Security Training Facility.
- D&D operations asked to keep the unit to complete their tasks and then to use it for hot deployment.
- Intended for reactor vessel dismantlement at TRA-660.

# Compact Remote Console



- Control chair
- Video systems
- Control placement

# Summary

- Big and expensive is also intimidating.
- Management and user acceptance is critical to equipment success.
- Small incremental technology improvements build operations confidence and understanding.
- Smaller successes build the opportunity for the implementation of larger scale systems if/when they are needed.