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Overview of Advances in Remote Technology

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Contents

- Current and Historical Applications of Remote Technologies
- Ongoing EPRI evaluations:
  - Location Tracking
  - Robotics
- Summary and Path Forward

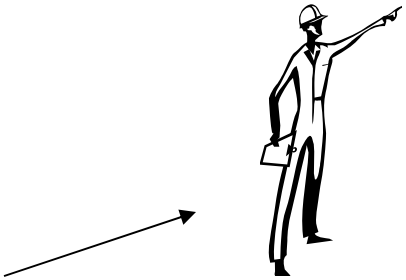
What is Remote Monitoring Technology?

- Remote Monitoring Technology = RMT
- RMT has been implemented in varying degrees throughout the nuclear industry and encompasses the following technologies:
  - ✓Area Monitoring
  - ✓Telemetry (dose/dose rate)
  - ✓Video
  - ✓Communications
  - ❑Robotics
  - ❑Location Tracking
  - ❑Biometric Monitoring

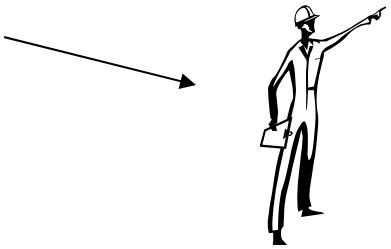
Historical Use: RP Job Coverage Using RMT

- RP organizational change
  - RMT Central RP Technician
  - RP Field Technician supporting the use of RMT
  - RMT System Administrators
  - Full coverage vs. intermittent coverage

Central RP Tech

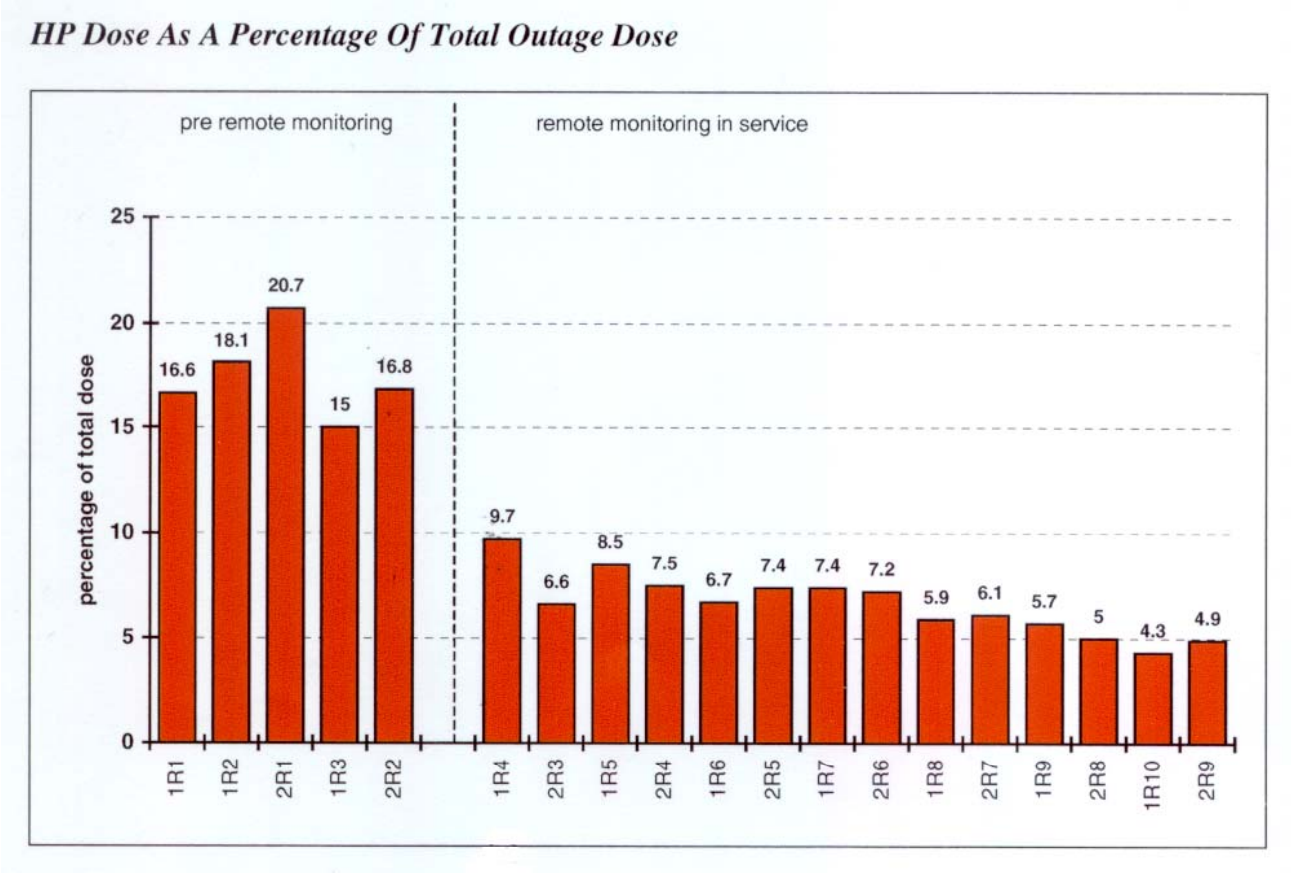


Field Tech



Field Tech

Historical HP Benefits



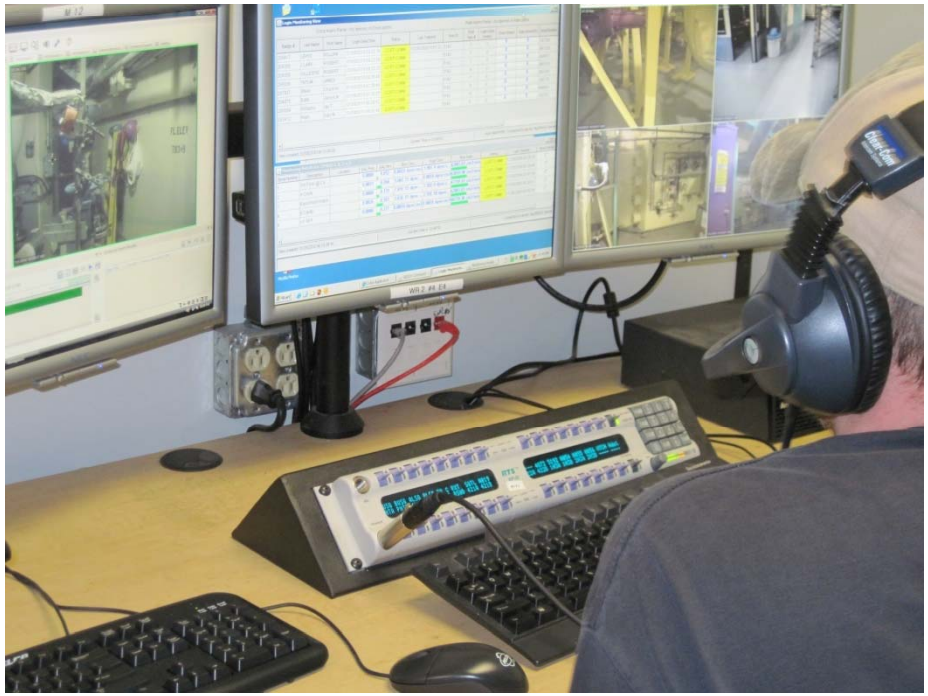
- RMT contributed to lowering HP dose by half

Example Benefits: Oconee Steam Generator Project

- ✓**Real-time Radiological Monitoring**
  - Telemetry for all **personnel** performing Steam Generator Platform entries
  - Monitoring of possible **radiological sources**: ventilation downdraft tables, used probe buckets, vacuum filters
  - Reactor building **airborne** radiological data
- ✓**Surveillance by Camera**
  - Eliminate personnel trips into reactor building for surveillance
- ✓**Monitor Power Remotely**
  - By camera and by built in IP Based power switches (tells you status of power, amps, and allows for remote start/stop)
- ✓**Temperature Monitors**
  - SG shell temperatures, SG tubesheet temperatures
  - Wet bulb for stay time calculations (heat stress)

Also Integrating equipment into SG Mock-up Facility for Training!!

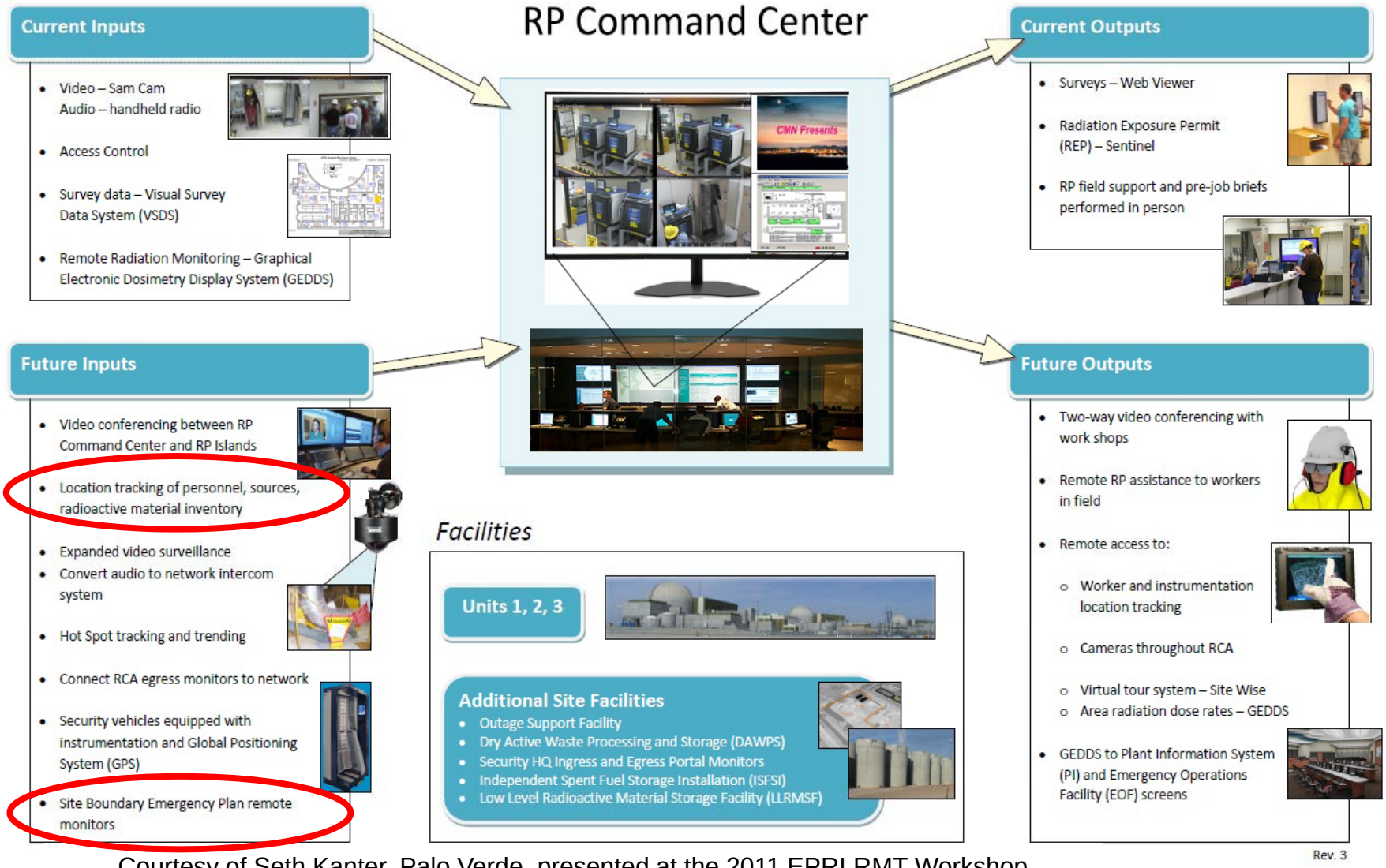
Remote Monitoring Center for Oconee SG Project



Courtesy of Edmond Allen, Oconee, presented at the 2011 EPRI RMT Workshop

Helped Achieve Lowest Outage Dose for Unit 1!!

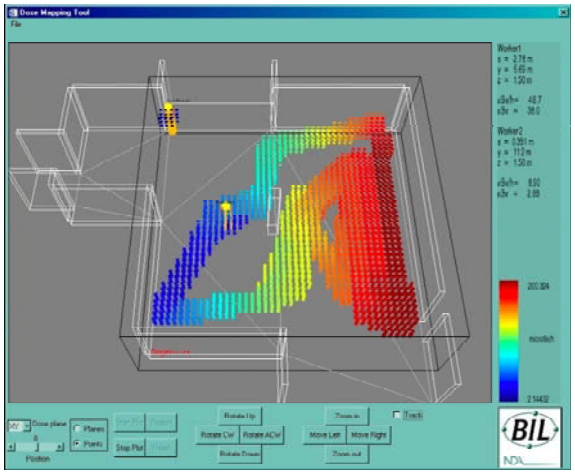
RP Command Center Vision



Courtesy of Seth Kanter, Palo Verde, presented at the 2011 EPRI RMT Workshop

Up and Coming Technologies

- Location Tracking
- More Robotics for Specific Applications
- Discuss Ongoing EPRI Projects



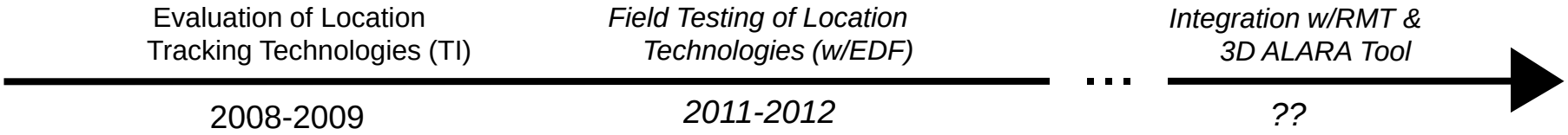
- <u>Previous EPRI R&D Efforts on Location Tracking:</u>

1. *Evaluation of Location Tracking Systems for Remote Monitoring of Radiation Protection* . EPRI, Palo Alto, CA: 2010, 1021182.

2. *Field Testing of Location Tracking Technologies for Radiation Management: Interim Report.* EPRI, Palo Alto, CA:2011, 1023018.

3. Results of Field Testing to be published in 1Q 2013.

Field Testing of Location Tracking Technologies (w/EDF)



Objective:

- Investigate and field test location tracking systems to improve safety, rapid response, asset location, and increase workflow efficiency.

Description:

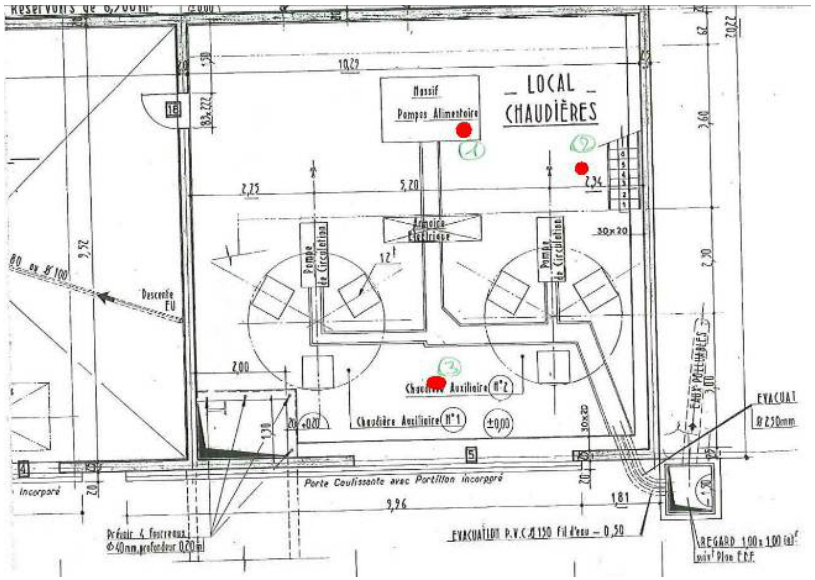
- Leverage R&D efforts with EDF to test commercially available systems in a more industrial environment (e.g detailed mock-up facility or inside power plant)
  - Ease of deployment
  - Tracking performance

Testing Ground :
Auxiliary Boiler Room, NPP Tricastin

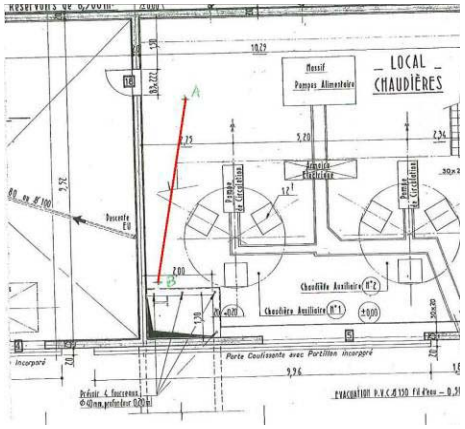
- Functional Requirements:
  - ❑ Real time positioning and transmission of:
    - Person's location & orientation
    - Equipment location & orientation
  - ❑ Data access and export by 3rd party software
  - ❑ Full coverage of testing ground
  - ❑ Rapid deployment and tear down
  - ❑ Electromagnetic compatibility

Two Test Protocols

- Static Test
  - Left for 5 minutes at each spot
  - Determine accuracy and drift

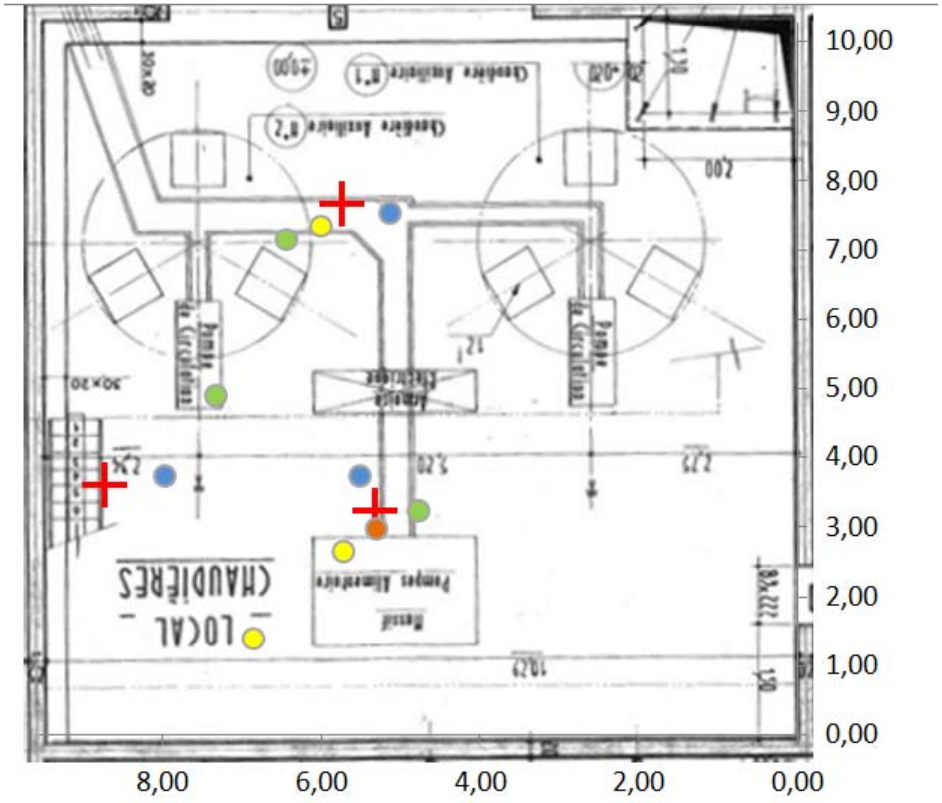


- Dynamic Test
  - Used robot to deploy geolocalization tag in defined path
  - Assess statistical error btw measured vs real during movement



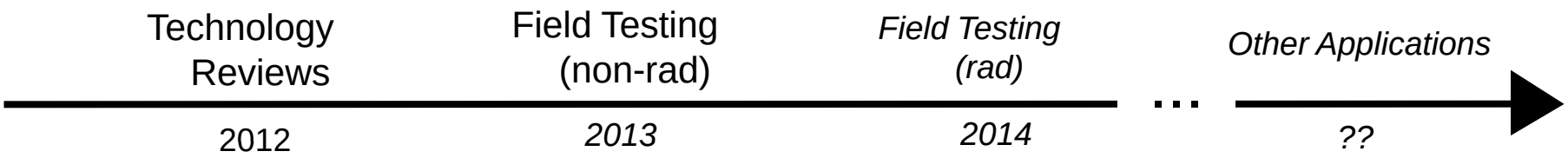
Preliminary Results

- 4 geolocalization technologies tested:
  - ✓Zigbee
  - ✓Wi-Fi
  - ✓Inertial and Magnetometers
  - ✓Bluetooth
- Test results are being evaluated
  - Appears that an accuracy of 1.5 m is possible.



Display of Preliminary Results for Static Tests

Evaluation of Robotic Technologies for Cavity Decontamination (w/EDF)



Objective:

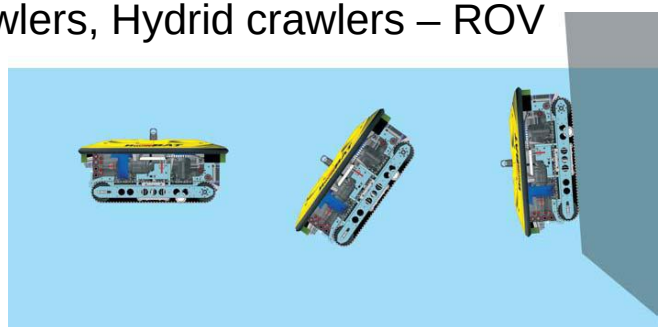
- Identify and evaluate best robotic options for performing cavity decontamination tasks.
  - Reduce exposure, outage time
  - Improve effectiveness of application

Description:

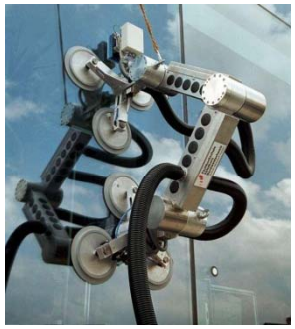
- Leverage R&D efforts with EDF to test commercially available robots in a non-radiological environment:
  - Capabilities
  - Modifications (specific NPP tasks, plant configurations, etc)

Robotic Needs for Cavity Decontamination

- **2 required types of robots:**
  - **Type 1:** Robots for under-water decontamination and in-air decontamination and drying of the floor
    - Crawlers, Hydrid crawlers – ROV

  - **Type 2:** Robots for in-air decontamination and drying of walls
    - Robots able to climb a wall with suction cups
    - Robot able to run on a wall with its vacuum system


Tasks for 2013-2014

- 2012
  - ✓ Review of available options (included in refueling report: 1025309)
- 2013
  - ❑ Based on review of current robots, select 2 robots (1 of each type)
  - ❑ Define needed improvements for these robots and perform some initial modifications (design demonstrator).
  - ❑ Evaluate demonstrator at CETIC
- 2014
  - ❑ Modify demonstrator with nuclear requirements
  - ❑ Evaluate demonstrator in the field (e.g. PWR in France)

Summary

- Remote technologies have assisted industry in achieving dose reductions
- Emerging technologies in location tracking and robotics should be add to our tool box in the future
- Location tracking results to be published in 1Q 2013
- Initiating robotics testing this year- contact Phung Tran (ptran@epri.com), if you are interested in participating in project

Acknowledgments

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