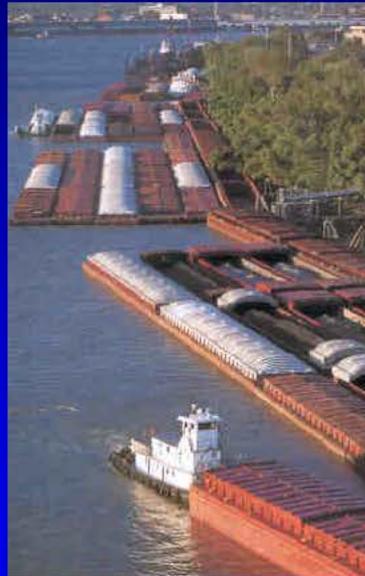


ERDC Navigation Research

Inland Navigation CoP Workshop
September 19-20, 2007
Louisville, KY



Presenters: Jim Clausner, John
Hite
Technical Programs Office, CHL



Research and Development

Navigation Research Programs

- Navigation Systems (NavSys)
- Dredging Operations and Environmental (DOER)
- Dredging Operational Technical Support (DOTS)
- Inland Electronic Navigation Charts (IENC)
- Monitoring Completed Navigation Projects (MCNP)
- Coastal Inlets Research Program (CIRP)
- Regional Sediment Management (RSM)



Navigation Systems

“An Integrated Program”



- ERDC Labs
 - Cold Regions Research Engineering Lab
 - Construction Engineering Research Lab
 - Coastal and Hydraulics Lab
 - Geotechnical and Structures Lab
 - Information Technology Lab
 - Topographic Engineering Lab
- Institute for Water Resources
- Efforts integrated with other Research Programs
- **Industry Input/Cooperation**



Navigation Systems “Current R&D Program”

- Deep Draft Channels and Harbor Design
 - Vessel Effects, Deep Channel Design
- Coastal Structure Design
- Hydrodynamic Design of Inland Structures
- Inland Infrastructure
 - Inspection
 - Condition Assessment
 - Inventory Management System
 - Predicative Maintenance
 - Rehabilitation
 - Safety
 - Vessel Impacts
 - Outdraft



Navigation Systems Focus Areas

- **Deep Draft Navigation**
- **Inland Navigation**
 - **Hydrodynamics**
 - **Infrastructure**



Deep Draft Work Units, Vessel Effects

Work Units

- **Improved Ship Simulations**
- **Improved STS Vessel/Current Interaction**
- **High Fidelity Vessel Effects**



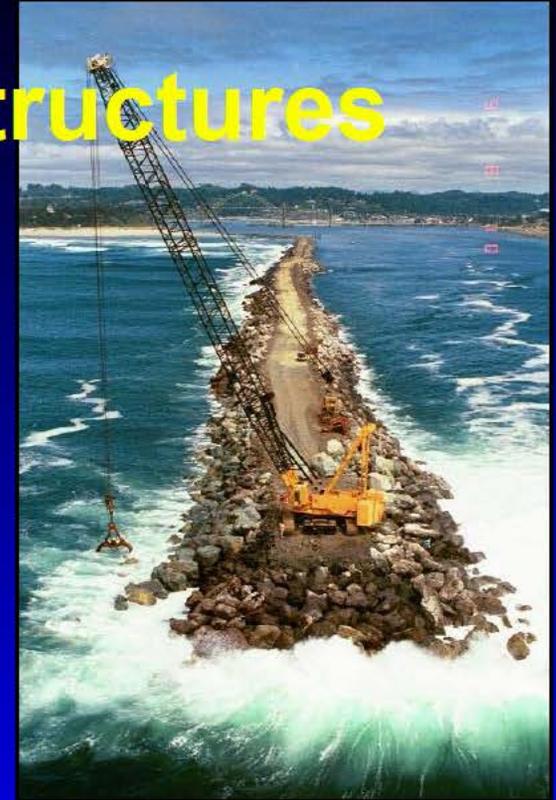
Added Capabilities

- Improved tools for STS, Ship Squat, Vert. Motions
- Hydrodynamic influences of vessel on flow field real-time basis
- Model for vessel generated waves and other complex fluid flow



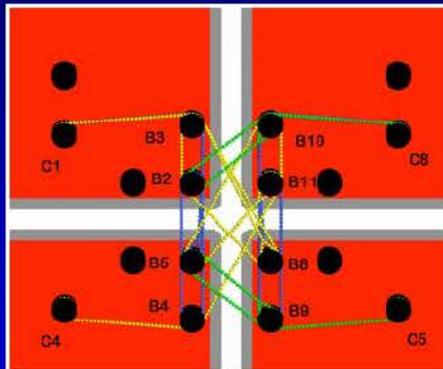
Risk Analysis of Coastal Structures

- **PI:** Jeffrey Melby, PhD
- **Team:** Steve Hughes, Prof. Kobayashi, Prof. Kriebel, IWR
- **Capability**
 - Have CEM, CEDAS, SMS, and generalized @Risk
 - Lacking applied risk analysis methods/tools, physics-based design, modern computer models and examples
- **Products:**
 - Physics-based design methods, Damage models
 - Reliability methods/partial safety coefficients
 - Risk methods/programs
 - Case studies/examples, spreadsheet applications
 - Web Page for all Corps structures
- **Benefits:**
 - Improved design/analysis tools
 - Reduced costs for breakwater, jetty design/rehab
 - Better planning/scheduling



Inland Navigation Research Areas

- **Hydrodynamics**
- **Infrastructure**

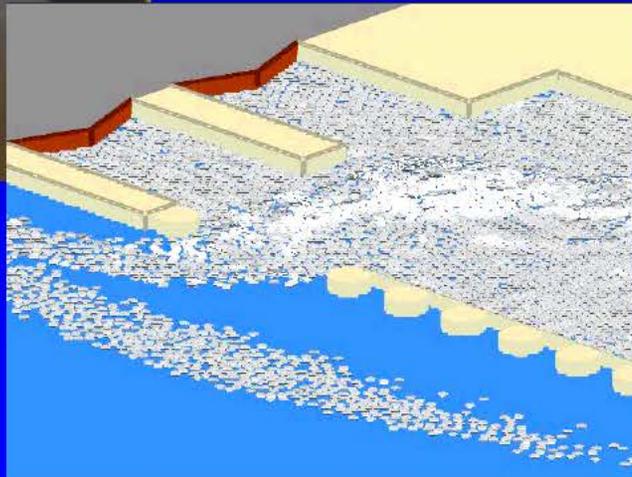
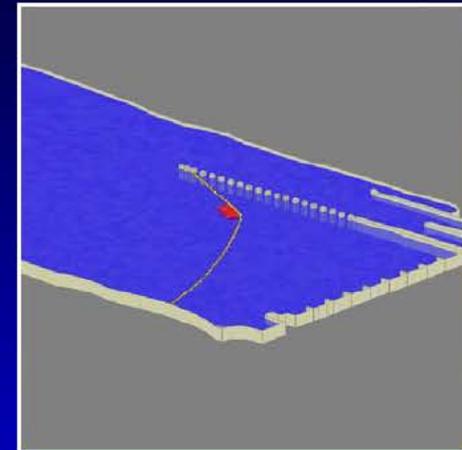


Focus Area Leader: John Hite



Hydrodynamic Design of Inland Structures

- **Capability Being Developed**
 - Model ice and debris at locks.
 - Integration of structural and hydraulic modeling (Ice & debris, tows, guard walls, gates, barge impacts)

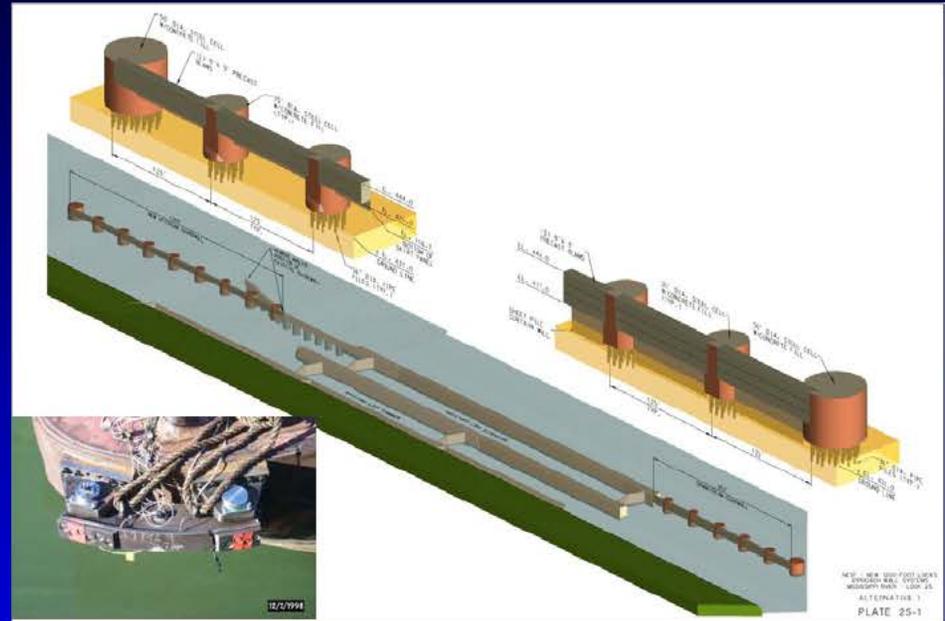


- **Benefits: Simulation Tool**
 - Unique ability to model fluid/structure interactions.
 - Placement of emergency lock bulkheads and dam gates. (hydraulic forces during placement).
 - Placement of float-in lock components.



Vessel/Barge Impact

- **Capability Being Developed**
 - Engineering methodologies for the complete impact-induced deformation based interaction between the structure and it's foundation will be based on 1) energy balance procedure and 2) structural dynamics (time varying force applied to the structure)



- **Benefits:**
 - Cost savings by determining realistic values for impact loads for utilization in the design guidance for flexible impact walls
 - Updated design guidance for impacts with rigid walls

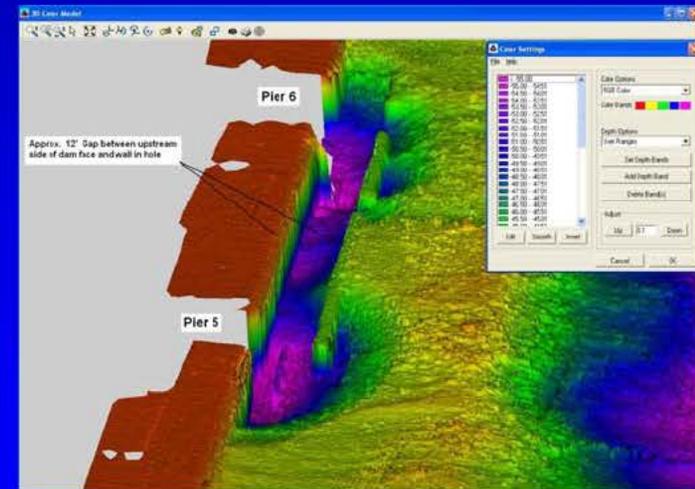
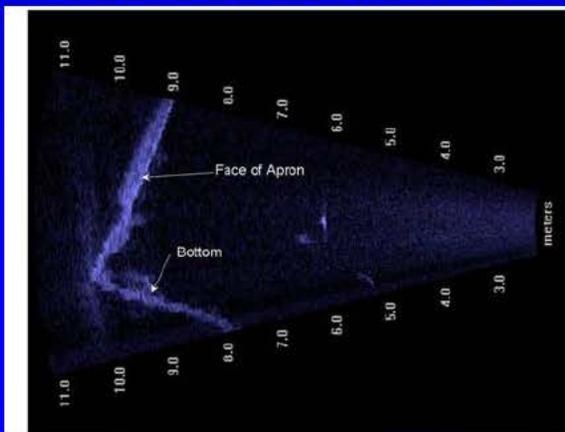


Detection of Scour

- **Capability Being Developed:**
 - Underwater inspection of scour protection
- **Benefits**
 - Process to assess repair needs
 - Better prediction of maintenance/rehab costs
 - Reduced chance of failure



Underwater Imaging



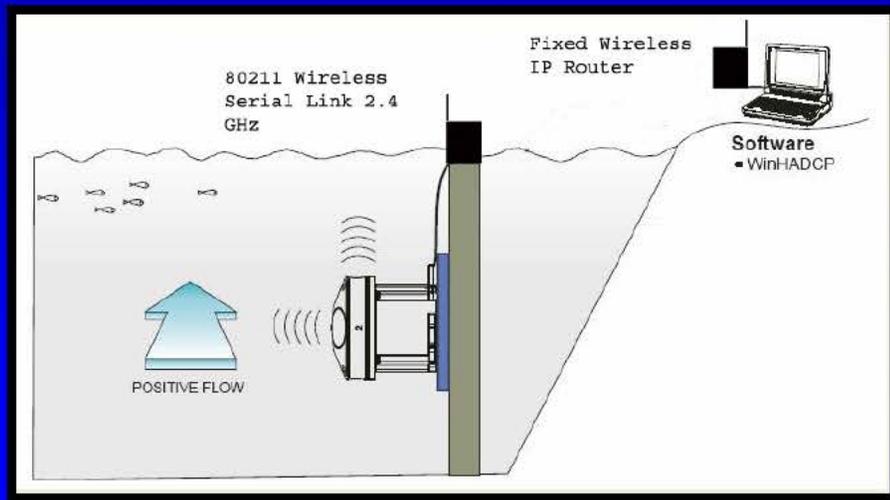
Acoustical Camera Demonstration

Tracking Total Station for Position



Real Time Current Velocity System

- **Capability Being Developed**
 - Real Time Outdraft Measurement that is transmitted to Tows approaching a Corps Lock and Dam



- **Benefits: Improved Safety on Inland Waterways**
 - Real Time Data provided for the Mariner to make better decisions
 - Utilizing AIS Network
 - Ability to Direct Marine Traffic and Transmit Lock Schedules to a Que



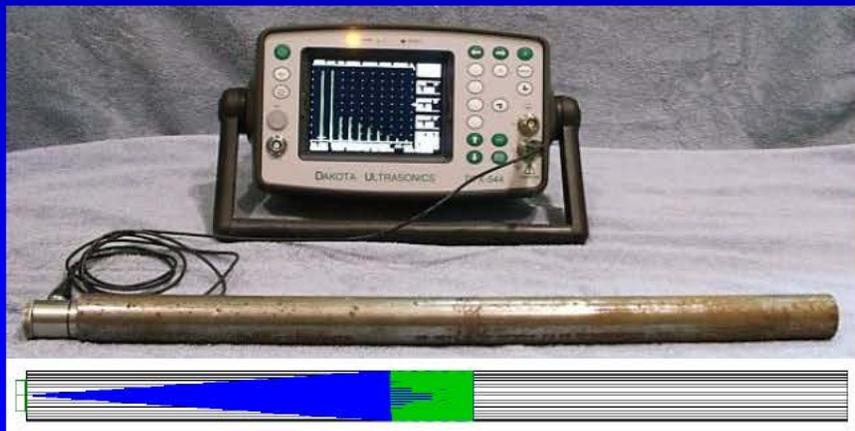
Steel Cracks and Welding

- **Capability Being Developed**
 - Criteria for performing fitness for service assessments
 - Analytical techniques for numerical fracture mechanics analysis
 - Analytical models to assess the pre-stress requirements of miter gate diagonals
- **Benefits**
 - Consistent and systematic guidance for performing a fitness for service assessment
 - Detailed fracture analysis
 - Reassessment of miter gate diagonal design criteria



NonDestructive Condition Monitoring for Tensioned Steel Members

- **Capability Being Developed**
 - NonDestructive test technique for quantitatively measuring tension and corrosion of steel members



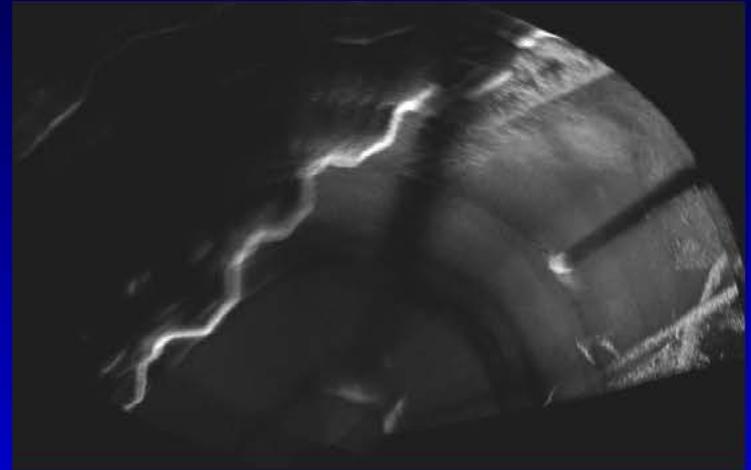
- **Benefits:**
 - Rapidly measures tension
 - Works with only limited access to part
 - Provides evaluation of fitness for service
 - Improved infrastructure reliability
 - Decreased maintenance costs



Inspection and Condition Assessment of Steel Hydraulic Structures

• Capability being developed

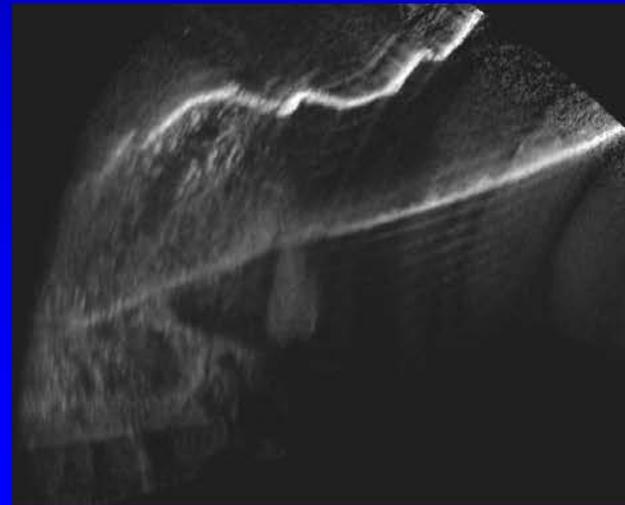
- procedure for the inspection of gates using an acoustical camera
- Development of a satisfactory deployment system and methods to enhance the images for the acoustical camera



• Benefits

- Improved quality of inspections
- Reduced cost of inspections
- Reducing personnel risk
- Real time permanent record

Mosaiced acoustical images of sheet piles at Mel Price Dam, Mississippi River



Robotic Inspection of Corps Structures

- **Capability Being Developed**
 - Widespread use of Remotely Operated Vehicles (ROVs) to inspect Corps structures



- **Benefits**
 - Lower inspection costs
 - Higher inspection rates
 - Less unplanned outages
 - Better asset management
 - Improved public safety



Innovative Lock Repair Techniques

- **Capability Being Developed**

- Repair of frost damaged concrete
- Managing alkali-aggregate reaction



cycles of
freezing &
thawing



- **Benefits**

- Tools for interim repair
- Tools for Asset Management

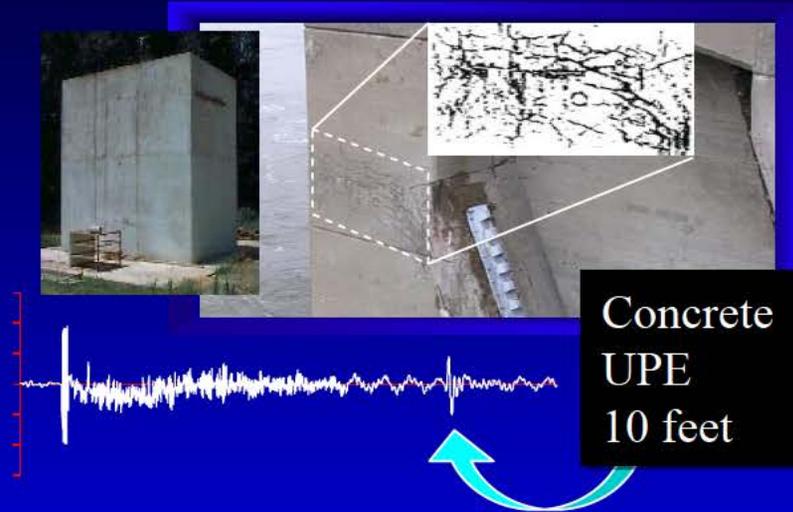
ASR



Condition Assessment and Monitoring of Concrete Structures

- **Capabilities Being Developed**

- Enhanced ability to detect and quantify deterioration using new and improved tools to support inspection and assessment of mass concrete structures



- **Benefits:**

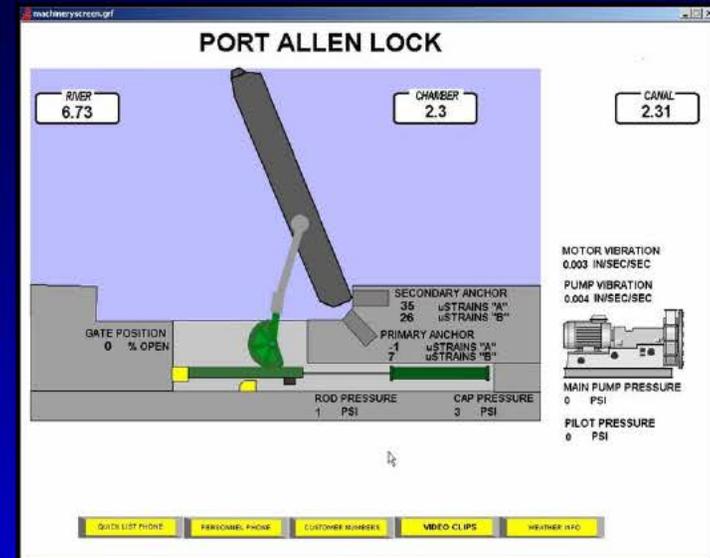
- Increased ability to develop long-term plans for maintenance and repair to facilitate the effective use of available resources and help insure continued operation of the navigation system.



Asset Management Condition Monitoring for CW Infrastructure

- **Capability/Products:**

- Condition monitoring baseline data for:
 - Structural components
 - Lock operating machinery
- Guidelines for Predictive Maintenance



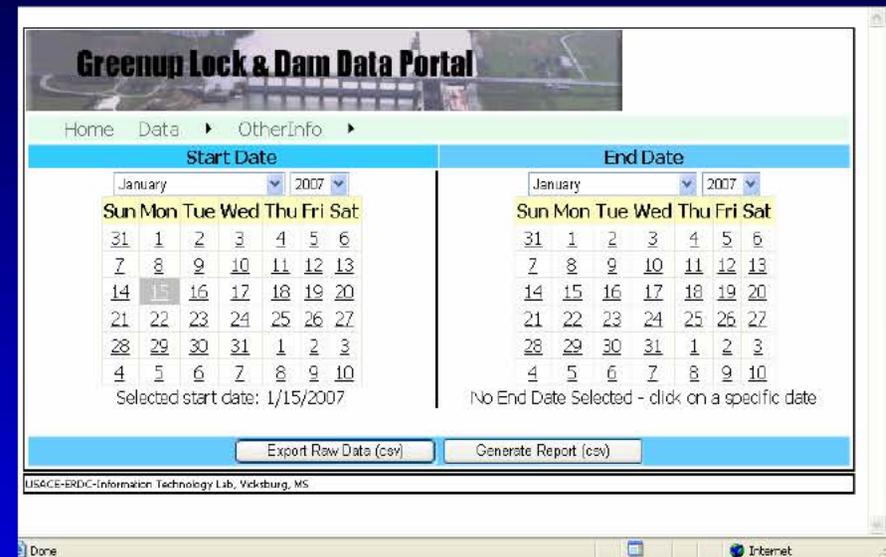
- **Benefits:**

- Real-time indication of electrical, mechanical and structural condition
- Reduces fracture critical component failure
- Reduces maintenance cost and personnel requirements
- Improves safety and reliability of lock gate, dam gate and pumping station operations



Real-Time Data Management for Structural Monitoring – A Demonstration Project

- **Capability Being Developed**
 - A robust, adaptable data management architecture and user interface that will allow the structural engineer instant access to real-time sensor data for condition assessment



- **Benefits: Improved condition monitoring for**
 - Miter gates
 - Tainter gates
 - Trunion anchors
 - Dams and Levees





**US Army Corps
of Engineers.**

Results of Outdraft





US Army Corps
of Engineers.

Lock Distance Measurement System

- Capability Being Developed
 - Every Vessel Receives Real Time Distance
 - Distance Can be Transmitted by AIS
 - Displayed on IENC's Providing ± 3 ft Accuracy



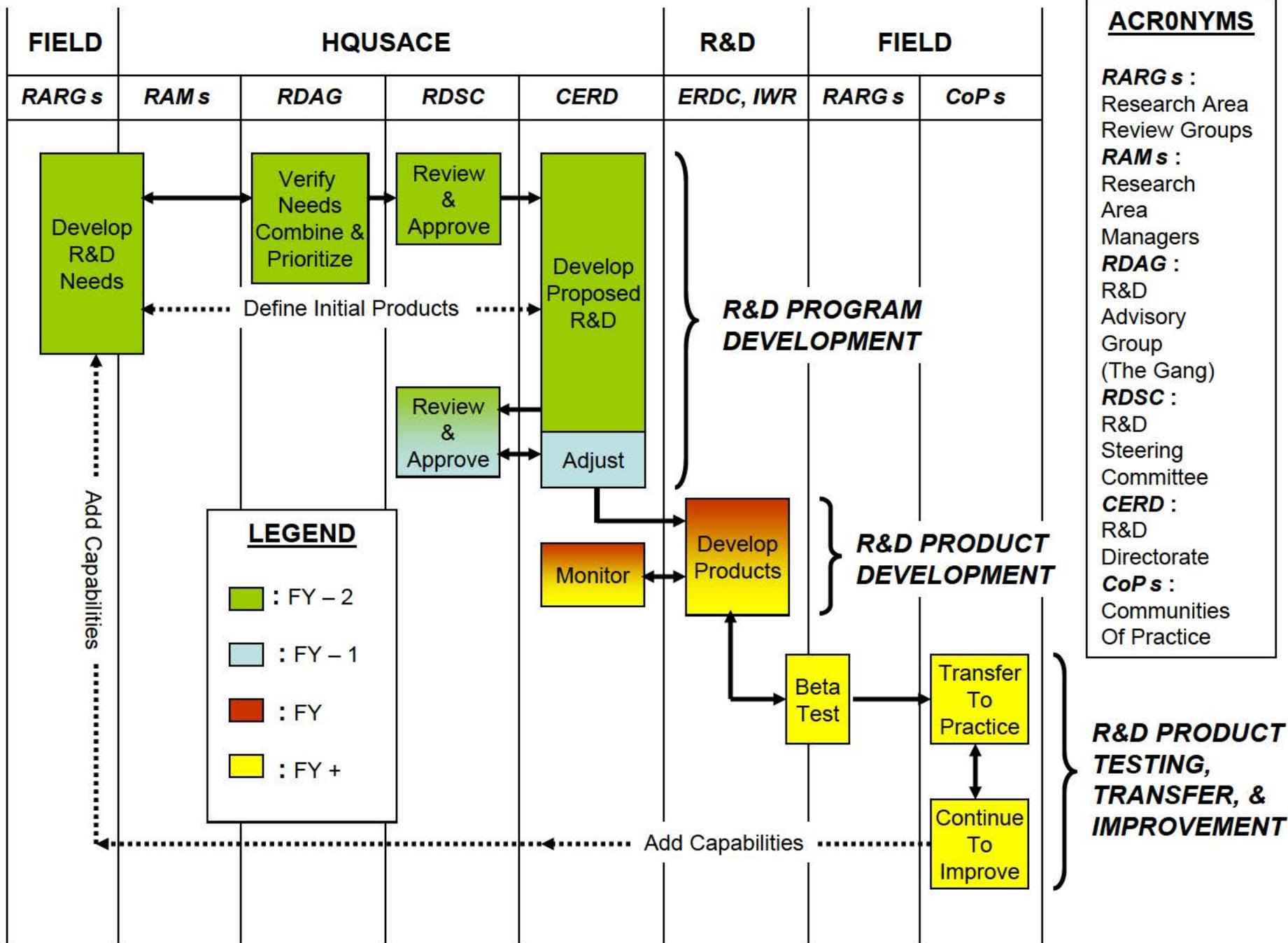


US Army Corps
of Engineers.

Navigation Safety Initiatives The Way Ahead (cont'd)

- AIS demonstration projects:
 - Louisville, KY – McAlpine Lock – USCG/Corps
 - Galveston, TX – Galveston Causeway Bridge – USCG/NOAA/Corps – with nav industry purchasing and maintaining the equipment





Questions

- <http://chl.erd.c.usace.army.mil/CHL.asp?p=s&a=Programs;4>

