

**system design and  
management**

# **Value Analysis of the US Coast Guard Search & Rescue Communication System Using a CAST Application**



**Sid Osgood, USCG  
SDM '13**

# Presentation Overview

- **USCG Search & Rescue Overview**
- **Thesis Research Questions**
- **Case Background**
- **CAST Application**
- **Findings/Discussion**



# US Coast Guard Search & Rescue Mission

- Minimize loss of life, injury, and property loss and damage in the maritime environment;
- Minimize crew risk during SAR missions;
- Optimize use of resources in conducting SAR;
- Maintain a world leadership position in maritime SAR.

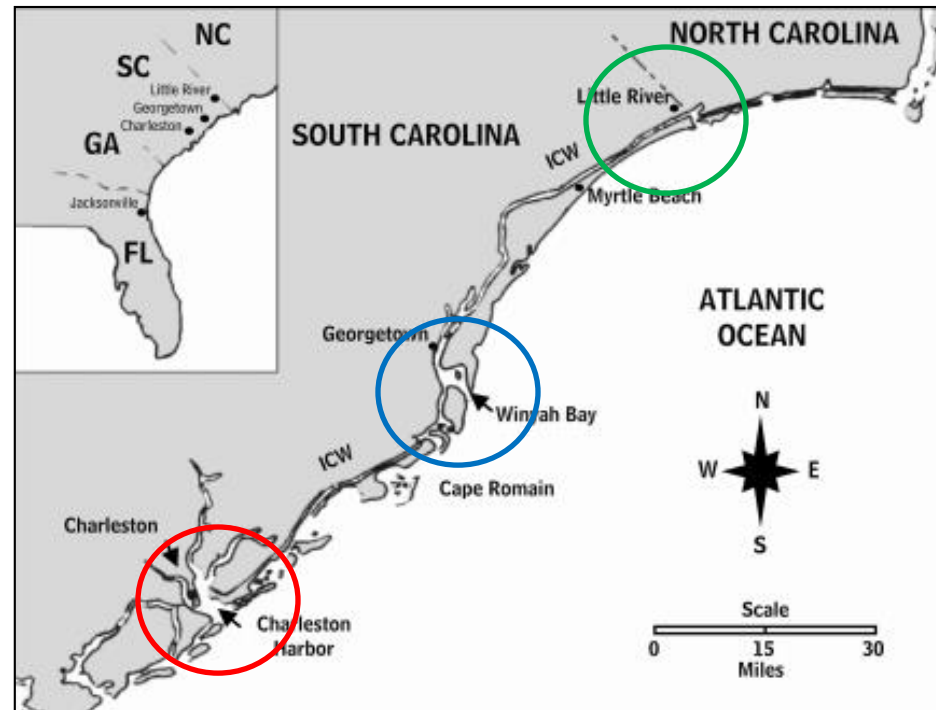


# Thesis Research Questions

- Can STAMP/CAST be useful in developing search and rescue communication system improvements?
  - Specifically in comparison to the recommendations developed in reference to this accident
- Have the system and policy improvements implemented by the Coast Guard resolved the recommendations outlined by the CAST analysis, or do gaps still exist?



# The Sailing Vessel *Morning Dew*



# A Tragedy Unfolds



# A Tragedy Unfolds



# A Tragedy Unfolds...Human Error?

*“This tragedy was avoidable. It was not an angry sea or cruel weather that impeded the Coast Guard's ability to rescue the S/V Morning Dew's passengers. It was human error, the impetuous termination of a search and rescue mission approximately thirty minutes before sunrise. This court's decision is not premised on hindsight, rather it is based on the circumstances facing the Coast Guard at 6:27 a.m. on December 29, 1997.” -Judge David C. Norton, U.S. District Court, District of South Carolina*

**Los Angeles Times** | ARTICLE COLLECTIONS

[← Back to Original Article](#)

COLUMN ONE

## When a 'Mayday' Isn't Heard

*A wrong turn on a winter trip down the Intracoastal Waterway cost five lives on the S/V Morning Dew in Charleston, South Carolina. At issue is what the Coast Guard didn't do in the accident.*

February 17, 2001 | MIKE CLARY | TIMES STAFF WRITER

CHARLESTON, S.C. — Two months after her husband, two young sons and nephew were killed in a boat accident, a woman in Charleston, S.C., testified in court that she had a tape-recording of a three-second radio transmission from the boat that was never heard by the Coast Guard.

"May . . . Mayday, U.S. Coast Guard, come in," cried a tiny, frightened voice that came from a radio in the cockpit of the boat just a mile from shore.

In the silence that followed, Libby pictured the pounding waves, the cold rain and the boat bobbing in the water just a mile from shore.

She had always thought Daniel and the others who lost their lives aboard the sailboat would be rescued. But she knew the reach of any help, bobbing in the cold Atlantic for hours until the dark waters of the night closed in.





# Hazards and System Safety Constraints and Requirements Identification

## HAZARD:

The Coast Guard does not respond to a mariner who is in distress

## SAFETY DESIGN CONSTRAINT:

The Coast Guard must respond to a mariner who is in distress

## SYSTEM SAFETY REQUIREMENTS:

The USCG shall have the ability to receive/hear distress notifications

The USCG shall have the ability to understand/interpret distress notifications

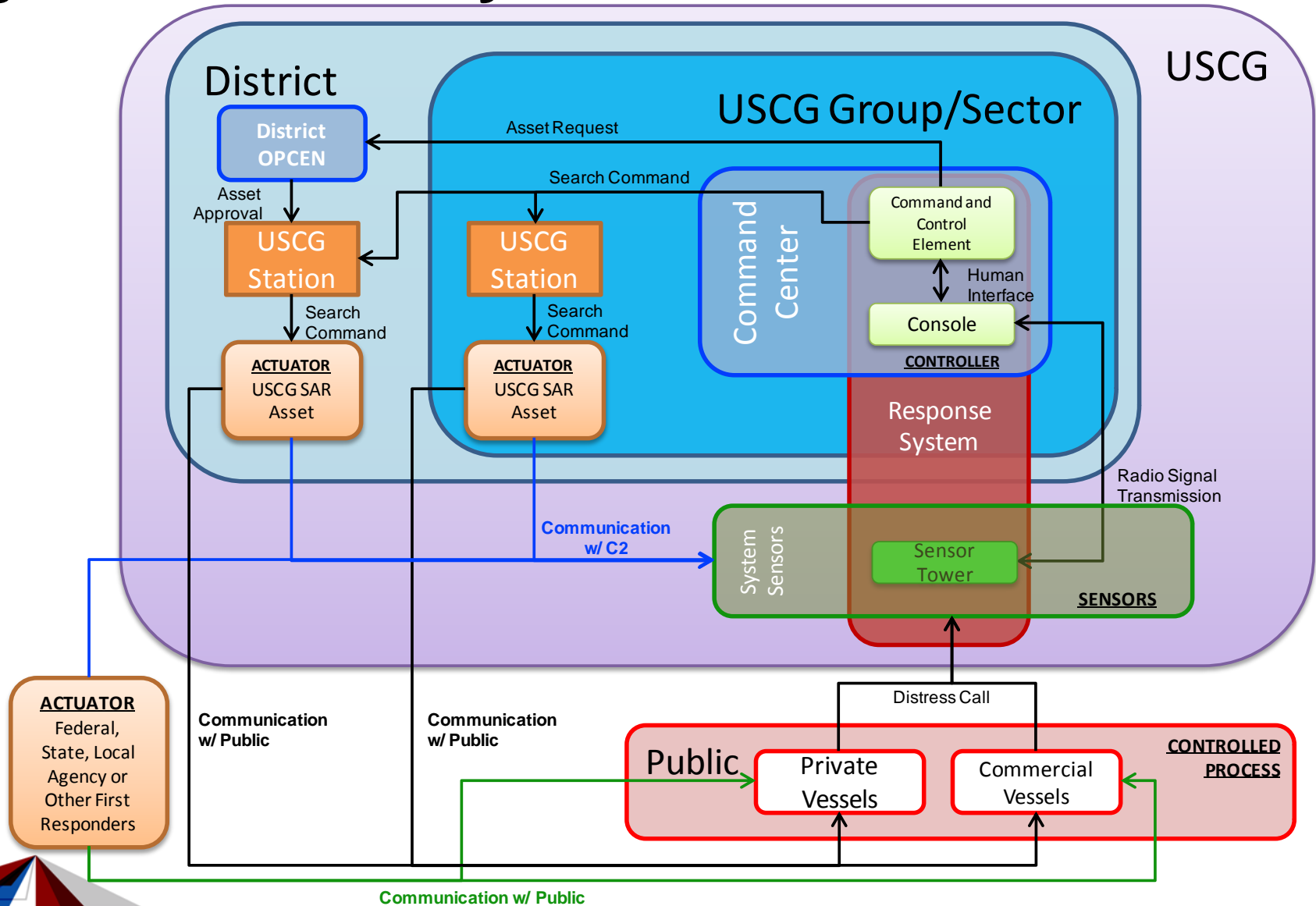
The USCG shall have the ability to respond to distress notifications

The USCG shall have the capability to communicate and coordinate with other first responders

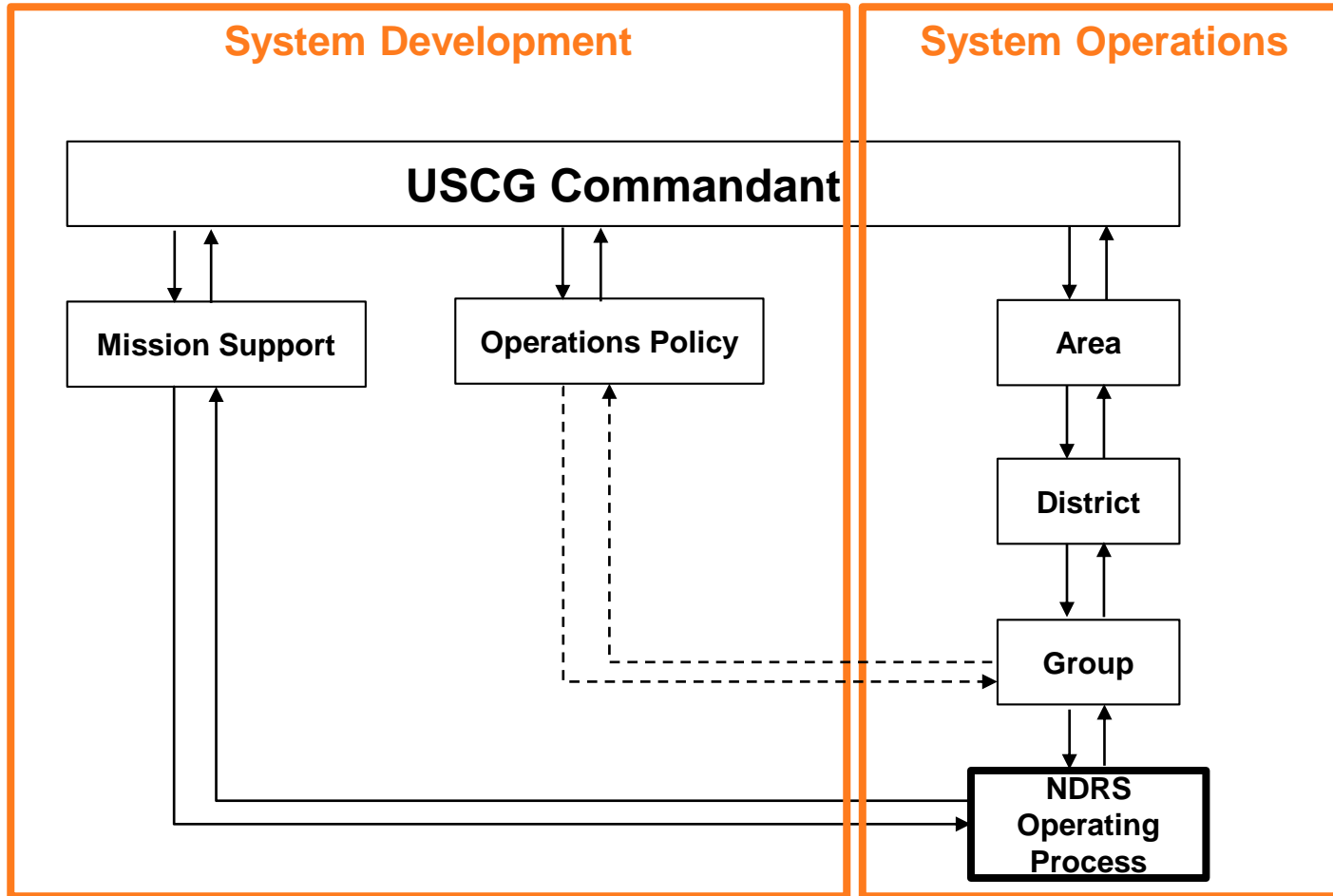
1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations



# System Boundary



# Hierarchical System Control Structure

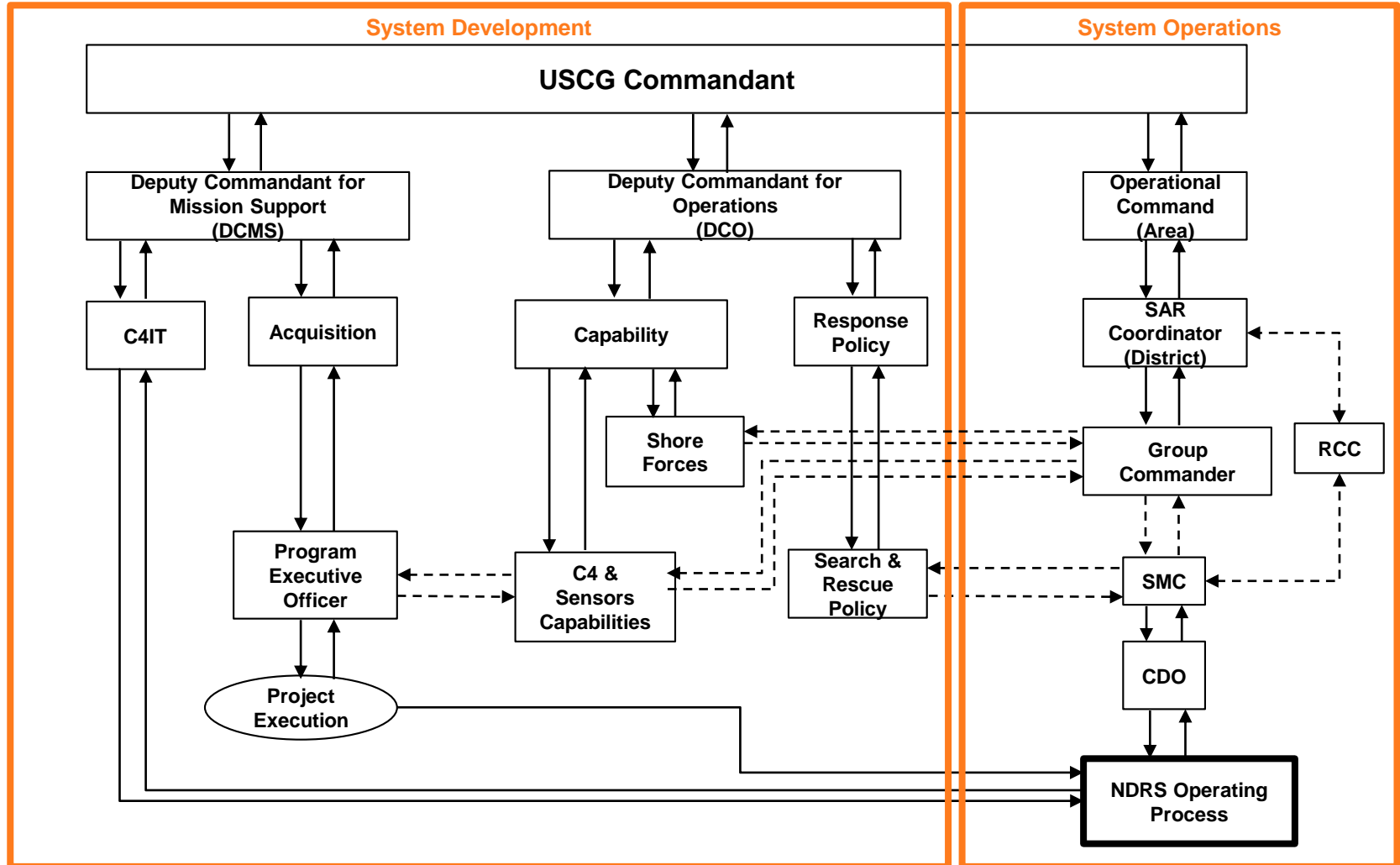


1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

Notes:

- 1) Solid connector lines indicate formal hierarchical relationships
- 2) Dashed connector lines indicate ad-hoc or informal relationships

# Hierarchical System Control Structure



Acronyms:

**C4IT** – Command, Control, Communications, Computers & Information Technology

**CDO** – Command Duty Officer

**NDRS** – National Distress Response System

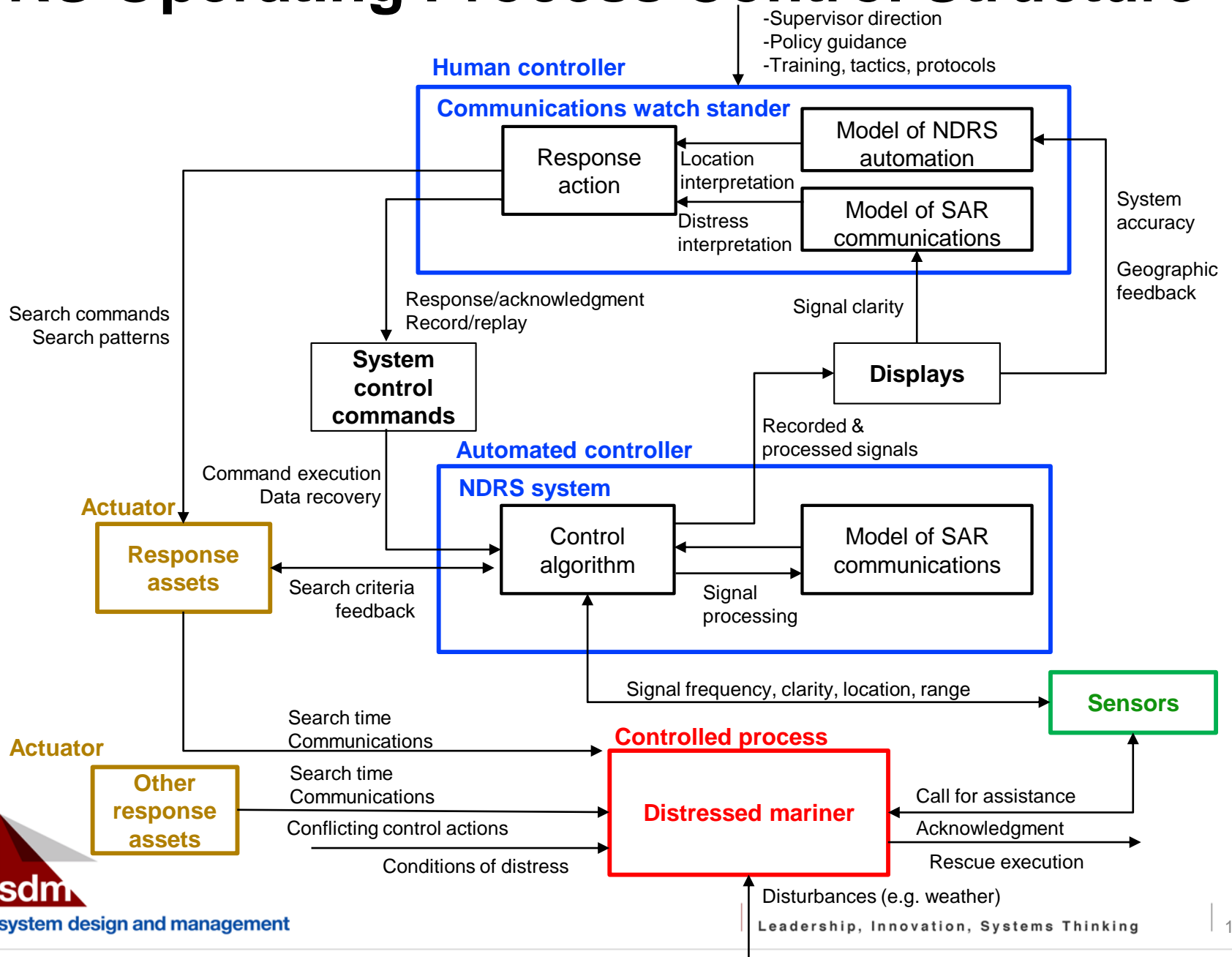
**RCC** – Rescue Coordination Center

**SAR** – Search and Rescue

**SMC** – Search and Rescue Mission Coordinator



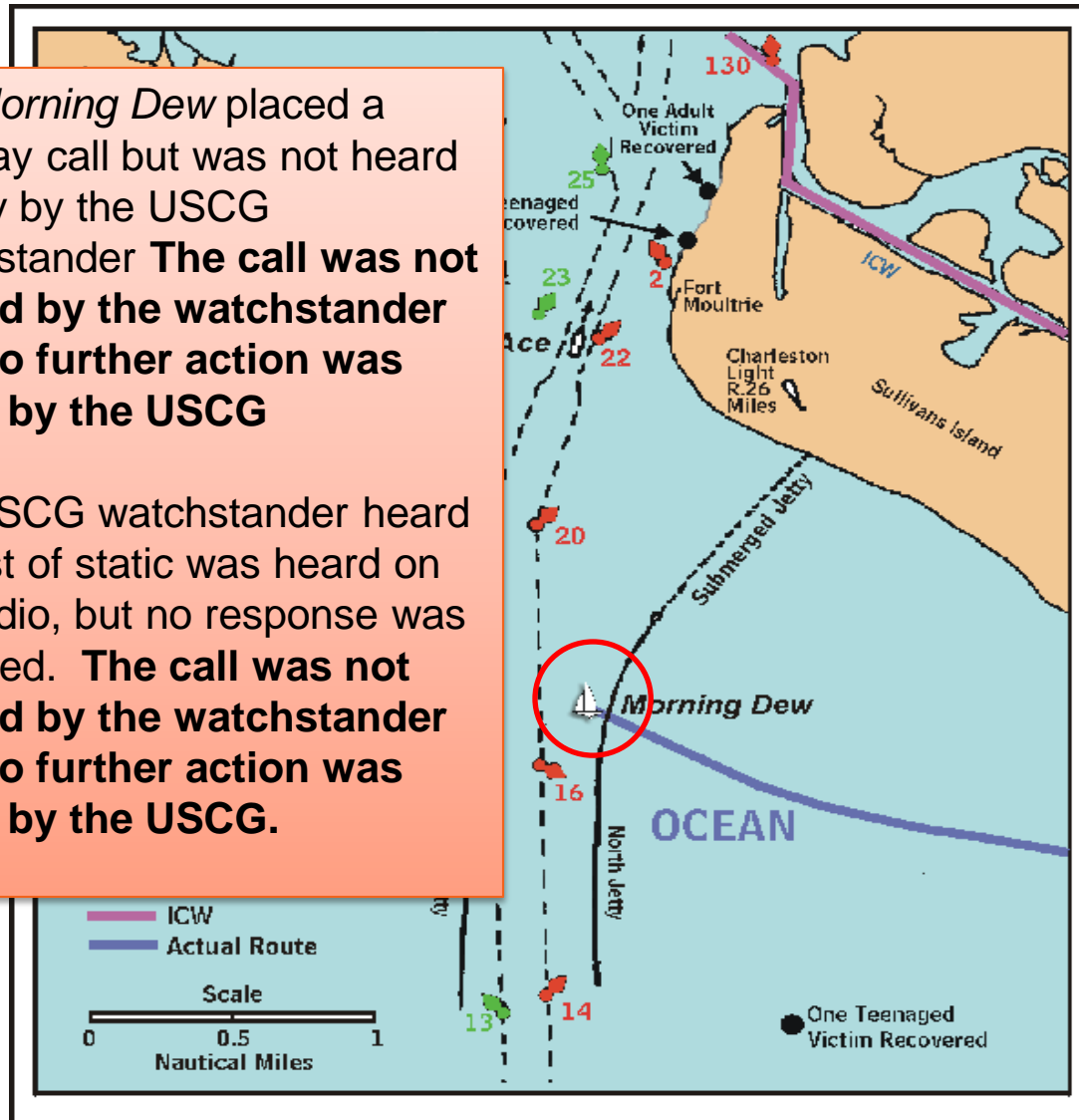
# NDRS Operating Process Control Structure



# Proximal events

**0217**—The *Morning Dew* placed a Mayday call but was not heard clearly by the USCG watchstander. **The call was not logged by the watchstander and no further action was taken by the USCG**

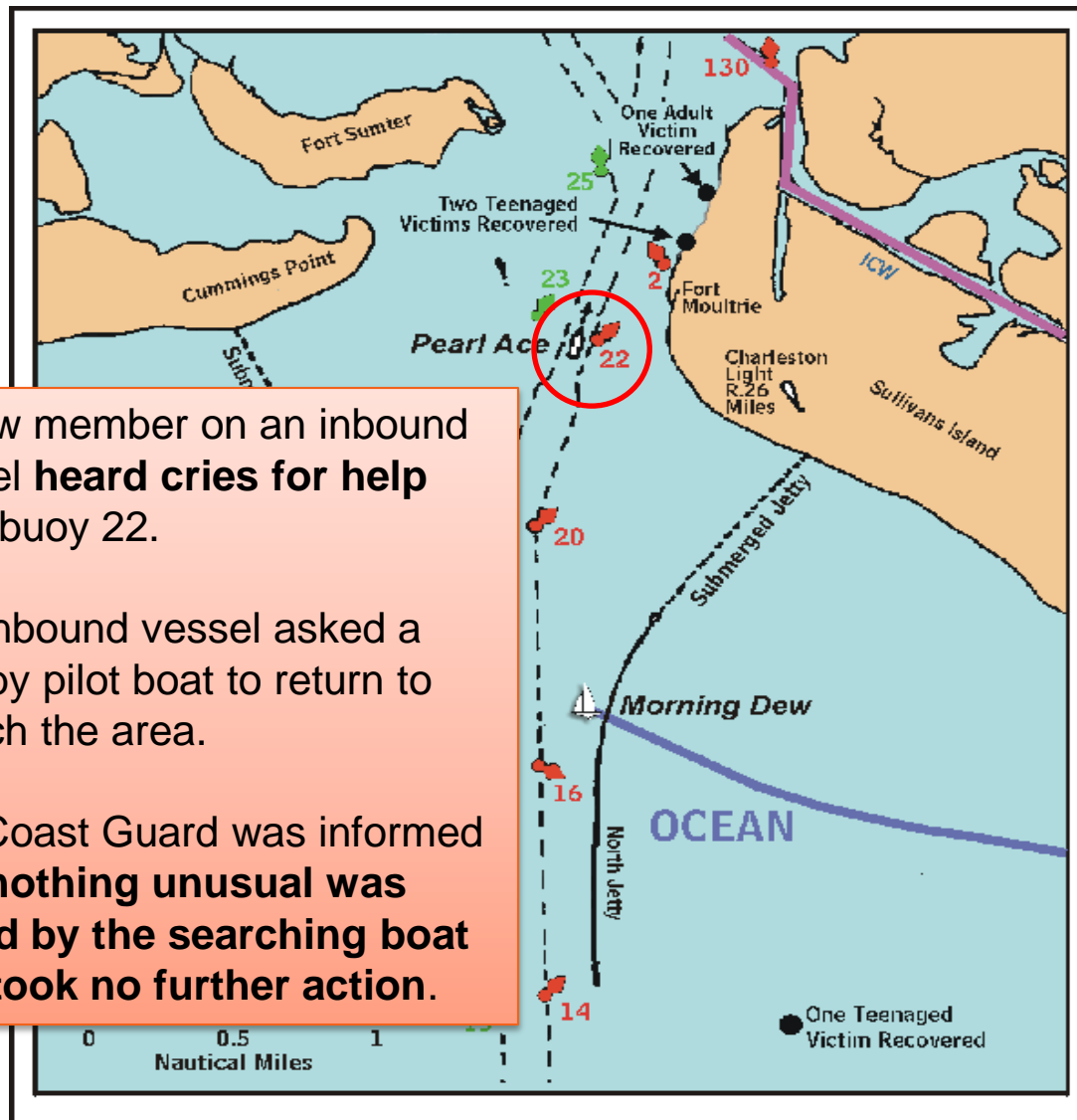
**0221**—The USCG watchstander heard a burst of static was heard on the radio, but no response was received. **The call was not logged by the watchstander and no further action was taken by the USCG.**



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations



# Proximal events



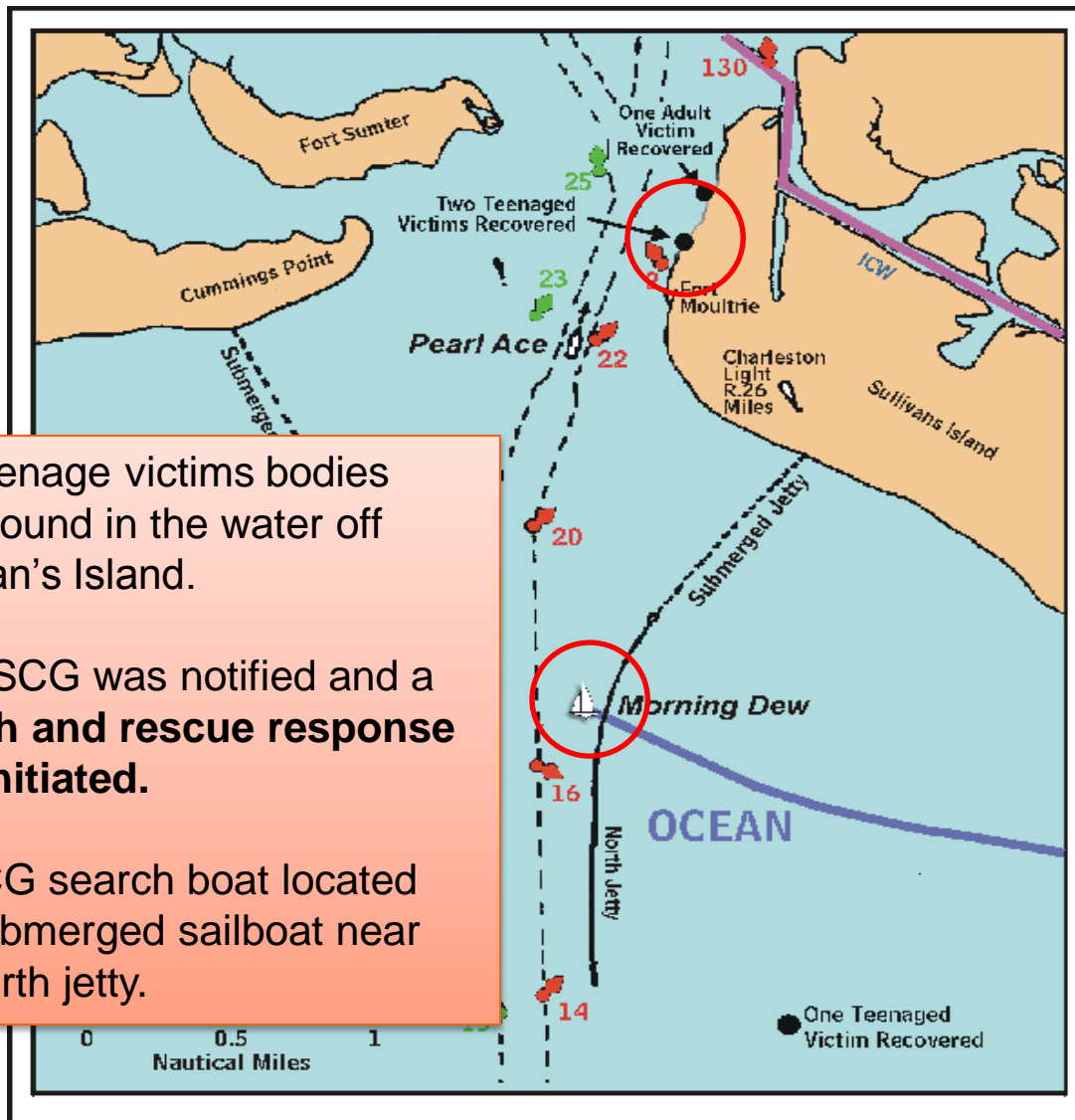
**0620**—A crew member on an inbound vessel **heard cries for help** near buoy 22.

**0625**—The inbound vessel asked a nearby pilot boat to return to search the area.

**0648**—The Coast Guard was informed that **nothing unusual was found by the searching boat and took no further action.**

1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

# Proximal events



1110—Two teenage victims bodies were found in the water off Sullivan’s Island.

1122—The USCG was notified and a **search and rescue response was initiated.**

1217—A USCG search boat located the submerged sailboat near the north jetty.

1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations



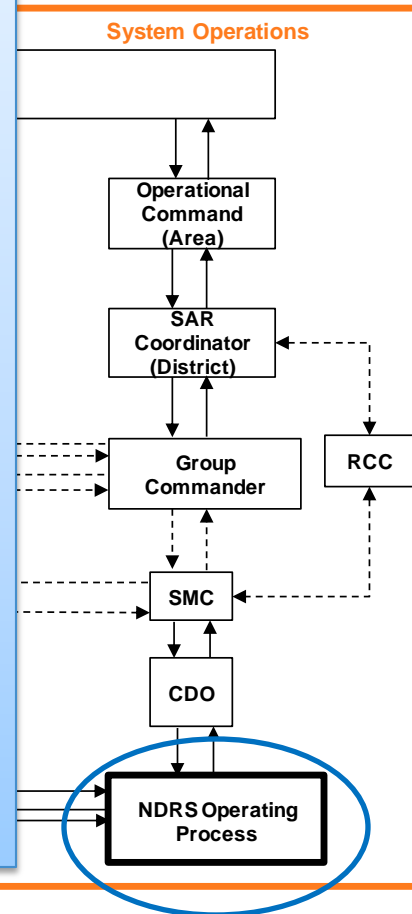
# Analyze the physical system level

## Safety Requirements and Constraints Violated:

- USCG must respond to a mariner who is in distress.
- USCG shall have the ability to receive/hear distress notifications.
- USCG shall have the ability to understand/interpret distress notifications.
- USCG shall have the ability to respond to distress notifications.

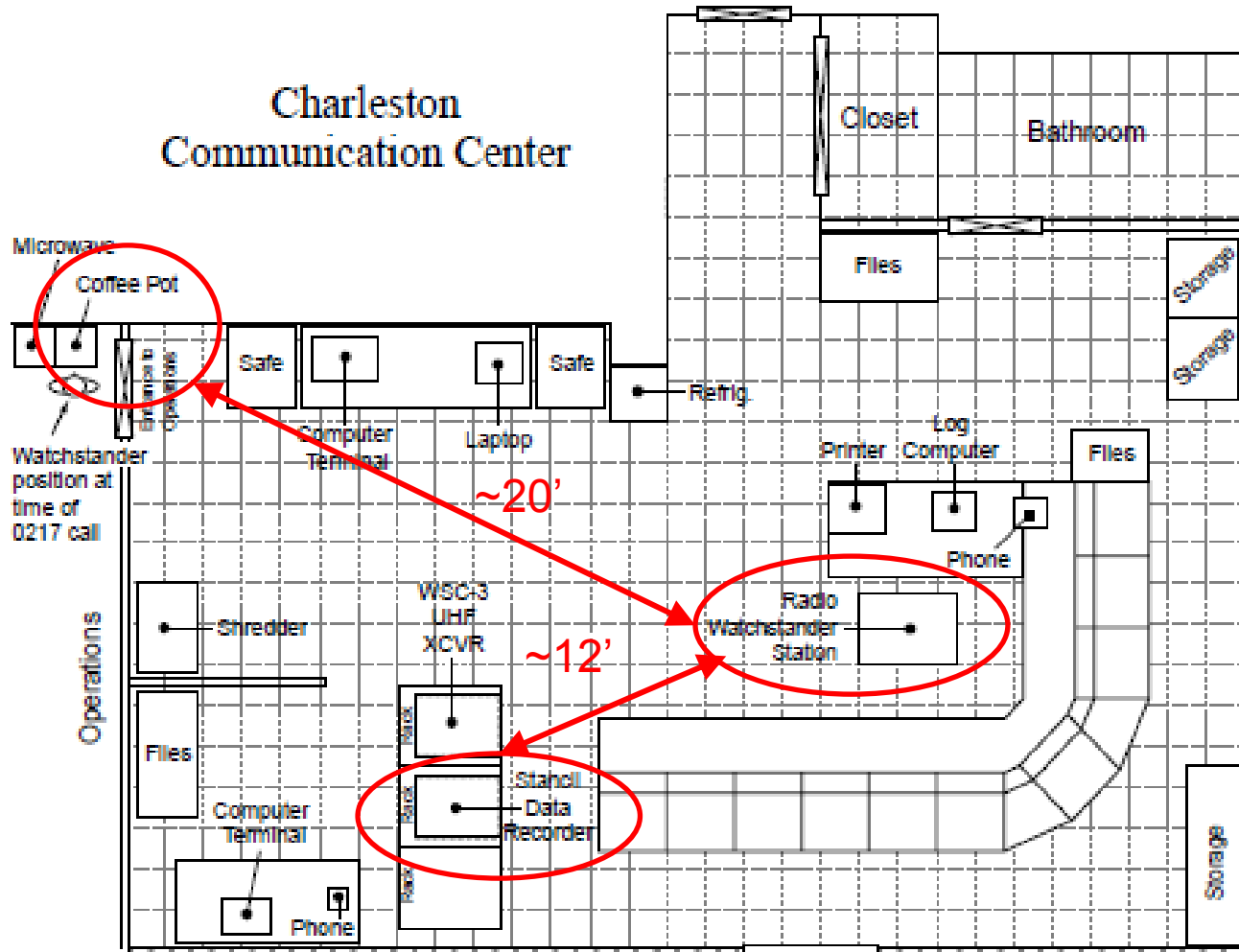
## Emergency and Safety Equipment (Controls)— Partial List:

- VHF Radio Tower Sensors
- VHF Radio Transmitter/Receiver Console
- Telephone
- Data Recorder
- Communications watchstander



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

# Analyze the physical system level



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

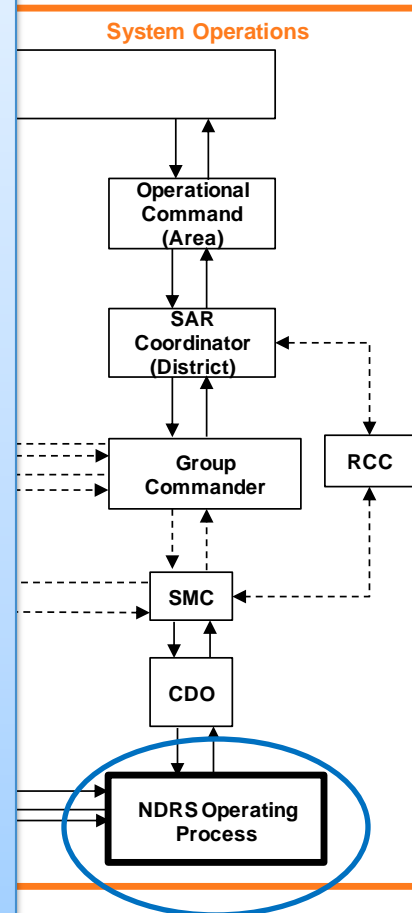
# Analyze the physical system level

## Failures and Inadequate Controls:

- Inadequate strength of the radio signal to hear the distress call.
- Inadequate clarity of the distress call.
- Inability of the communications system to pinpoint the location of the distress call.
- Insufficient training/procedures for actions when a call cannot be understood or a response is not received.
- Insufficient human factors considered in the layout design and staffing of the command center (e.g. bathrooms, coffee pots, data recorder, etc.)

## Physical Contextual Factors:

- The watchstander was the only person in the command center awake at the time of the call.
- The distress call was received while the watchstander was standing at the coffee pot ~20 feet away from the radio console.
- The data recording system was located ~12 feet away from the radio console.



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

# Command Duty Officer (CDO)

## System Development

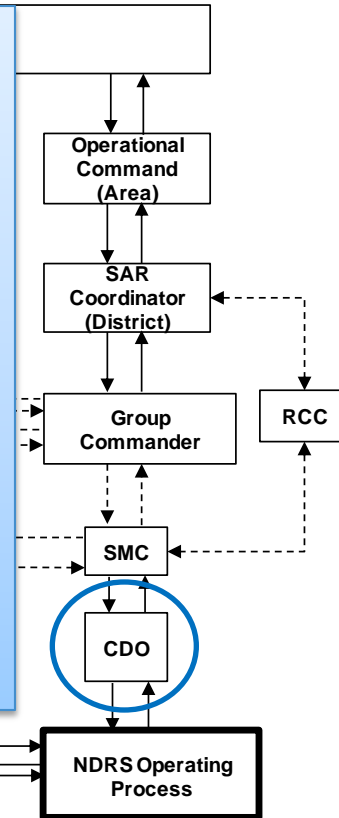
### Safety Related Responsibilities:

- Oversee the Command Center during a watch period.
- Supervise and assist communications watchstander.

### Context:

- CDO was asleep during the initial call from the Morning Dew at 0217.
- Due to personnel shortages, the USCG had adopted 24-hour shifts for CDO's.

## System Operations



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

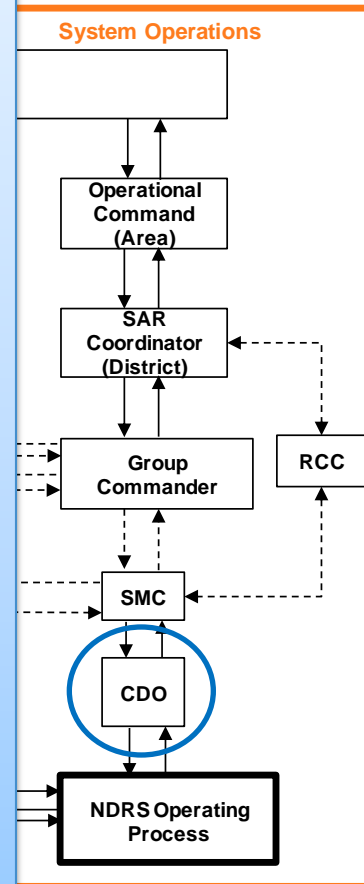
# Command Duty Officer (CDO)

## Unsafe Decisions and Control Actions:

- Inadequate synthesis of sea state, weather conditions, water temperature, ambient light after notifications of distress.
- Failure to inform higher levels of authority after a distress notification.

## Process Model Flaws:

- Inaccurate risk assessment in accepting vessel of opportunities failure to find anything was sufficient to take no further action.
- Assumed the watchstander would awaken the CDO if help was needed.



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

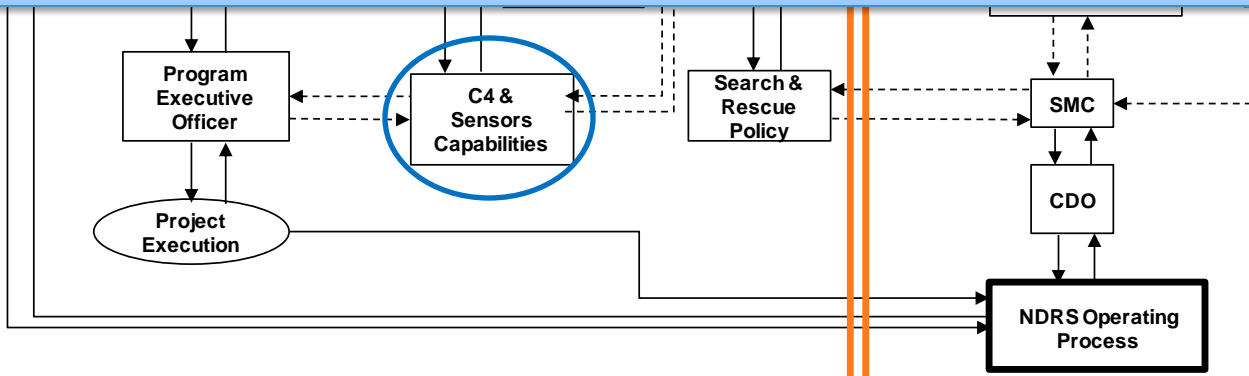
# Office of C4 and Sensors Capabilities

## Safety Related Responsibilities:

- Generate requirements, set priorities, and negotiate fulfillment of user C4 and Sensor needs.

## Context:

- Efforts to modernize the system capabilities with the latest state of the market equipment had been ongoing for nearly 20 years without a successful project initiation.



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

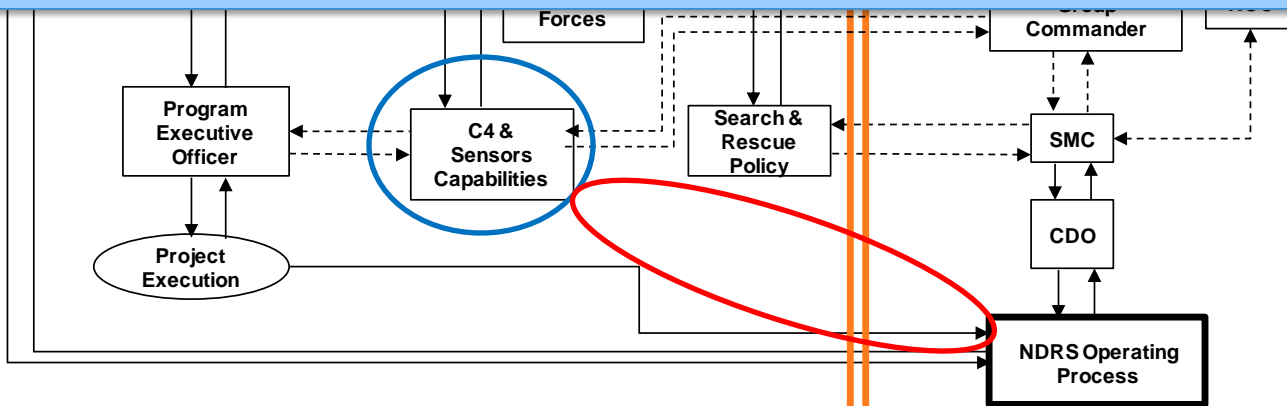
# Office of C4 and Sensors Capabilities

## Unsafe Decisions and Control Actions:

- Insufficient initiation and sponsorship of National Distress Response System modernization efforts.
- Insufficient analysis of human factors related to radio watchstanding.

## Process Model Flaws:

- Insufficient feedback mechanisms to capture and synthesize command center user capability needs.



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

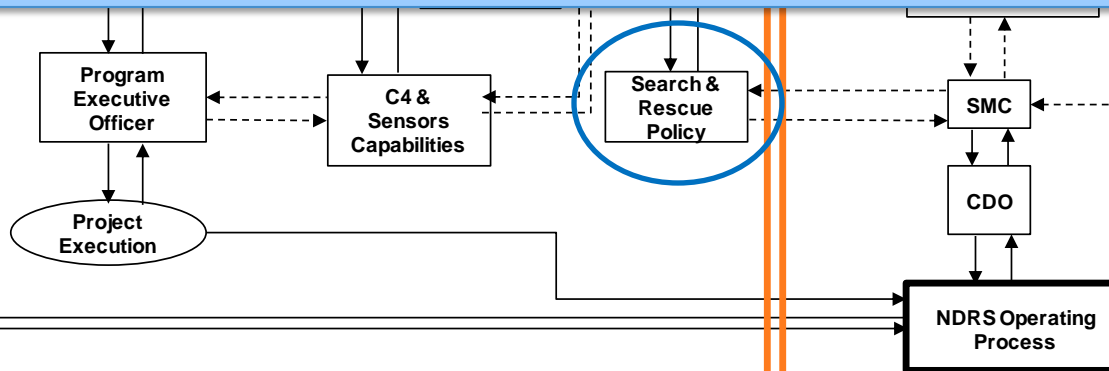
# Office of Search and Rescue Policy

## Safety Related Responsibilities:

- Develop Search and Rescue (SAR) program training, tactics and policy.

## Context:

- Realignment of the hierarchical structure and personnel reductions in all Coast Guard Headquarters offices commenced in 1995 as a part of the Streamlining initiative.



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations



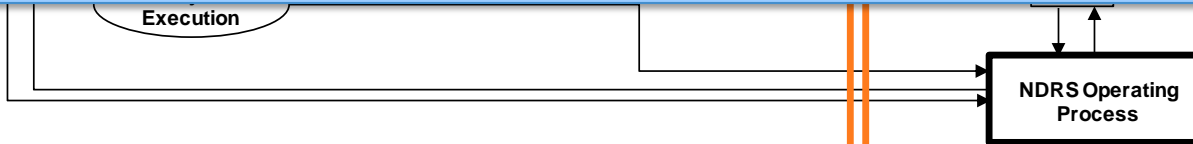
# Office of Search and Rescue Policy

## Unsafe Decisions and Control Actions:

- Insufficient policy to direct command centers on SAR procedures or actions to take when a receiving radio calls that cannot be understood or when callouts are not responded to.
- Insufficient policy allowing a single watchstander to be alert in a command center performing the SAR mission at night.

## Process Model Flaws:

- Inaccurate assessment of the potential consequences resulting from a single alert watchstander during evening watches in the command center.



1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

# Coordination & communication

- Single alert watchstander
- Watch relief information sharing
- Coordination with CG Search and Rescue leaders
- Coordination with other first responders (i.e. the Pilot vessel and other local agencies)
- Feedback loops between policy makers and system users

1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

# Dynamics and changes over time

- Acceptance/Complacency having only one alert watchstander at night
  - Personnel shortages at the unit
  - Budget saving initiatives to “save money and increase efficiency” not clearly linked to potential impacts to core missions
- Capability gaps known and documented but not acted upon
  - Existing capability dated back to the 1970’s
  - Mission Needs statement drafted in 1995

1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

# Summary Recommendations

- Operating Process Recommendations
  - Increase communications system coverage
  - Upgrade communications system technology to include position location capability
  - Increase communication system interoperability
  - Improve watchstander ergonomics
- System Development Recommendations
  - Fund and implement system improvements
  - Review system human factors
  - Improve feedback loops between policy developers and system users
- System Operations Recommendations
  - Review watchstanding qualifications
  - Review training procedures

1	System and hazard definition
2	System level safety requirements
3	Draw control structure
4	Proximal events
5	Analyze the physical system
6	Moving up the levels of the control structure
7	Coordination and communication
8	Dynamics and change over time
9	Generate recommendations

# Recommendation Comparison

Recommendation	CAST	NTSB	USCG Policy/System
Ensure full NDRS radio coverage within system boundary	✓		✓
Provide continuous monitoring of VHF CH-16	✓		✓
Provide continuous NDRS operational availability	✓		✓
Provide increased radio signal clarity	✓		✓
Provide capability to receive non-radio distress notifications	✓		
Provide rapid and seamless record/replay/enhance capability	✓	✓	✓
Provide distress call location finding capability	✓	✓	✓
Improve command center watch-stander ergonomics	✓	✓	✓
Provide remote sensor status indicator capability	✓		✓
Provide inter-agency interoperability capability	✓		✓
Fund and implement NDRS system upgrades	✓	✓	✓
Fund and implement maintenance program based on operational availability requirement	✓		✓
Provide remote sensor fault detection/notification capability	✓		✓
Conduct a human factors review of command center watch-stander responsibilities	✓	✓	✓
Review command center staffing standards	✓	✓	✓
Review policy on handling of unclear or non-responsive calls	✓	✓	✓
Review policy on required radio log entries	✓	✓	✓
Implement policy for use of Incident Command System in SAR operations	✓	✓	✓
Review watch-stander qualification requirements with an emphasis on decision-making capabilities	✓	✓	✓

# Recommendation Comparison

Recommendation	CAST	NTSB	USCG Policy/System
Improve feedback loops between training developers & end users	✓		
Improve feedback loops between capability developers & end users	✓		
Develop a command center user forum	✓		✓
Improve coordination between various system development offices	✓		
Assess & address impacts from Streamlining Initiative on system development processes	✓		
Review watchstander qualifications & experience when developing watch schedules	✓		
Review policies & procedures for training new watchstanders	✓	✓	✓
Review policies & procedures for staffing command center watch positions	✓	✓	✓
Review procedures for relieving command center watches	✓	✓	✓
Enhance/reinforce watchstander training an emphasis on decision making capabilities	✓	✓	✓
Develop & execute periodic training exercises/evaluations	✓	✓	✓
Develop agreements with local response agencies	✓	✓	✓
Develop & execute ICS training with local response agencies	✓	✓	✓
Establish procedures for testing watchstanders for alcohol and drugs after an incident occurs		✓	✓

# Delivering Value - Actual Case

## December 2011:

On the evening of December 06 the **Sector Los Angeles/Long Beach** command center heard an adult male hail "Mayday" on a VHF-FM marine radio, but were not given the location of the boaters in distress.

The Rescue 21 system generated three lines of bearing from the radio towers that picked up the distress transmission, providing an exact Lat/Long position. This enabled the search and rescue controllers to triangulate the origin of the call. Using the information provide by the Rescue 21 system, the Sector was able to guide a MH-65 Dolphin helicopter and several boats directly to the distress scene.

The command center also received an electronic notification from an emergency personal locator beacon 15 minutes into the launch, which further corroborated the initial position. Using the registered contact information the Sector contacted the boater's wife. She was able to provide them with a description of the men, boat, route, and destination.

On scene, the helicopter located four men floating in the water and rescue three. A 45-foot RBM arrived and rescued the fourth boater. All four boaters were transported back to safety where they were evaluated by EMTs and found in good health.

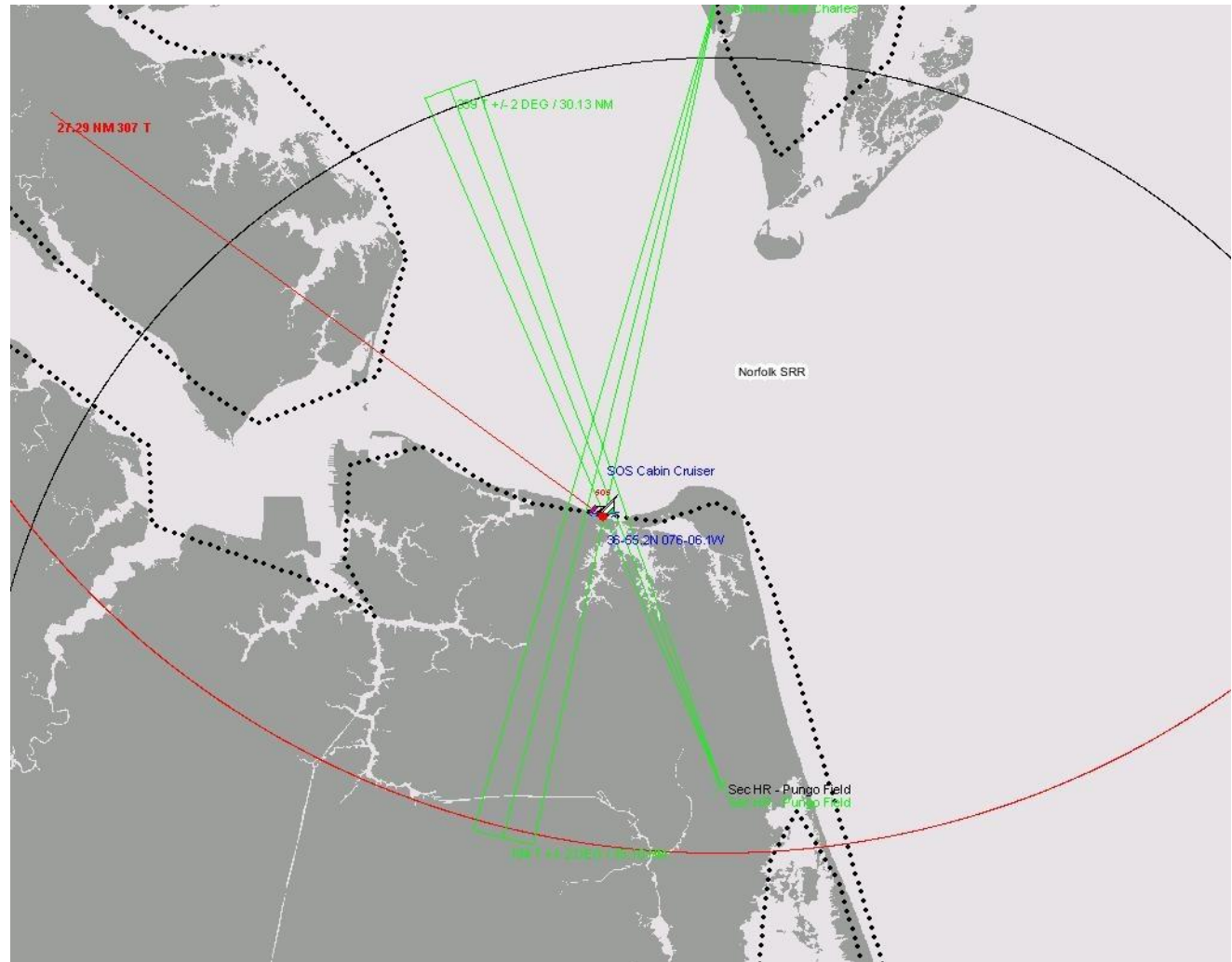


**"This was one of those cases where, without Rescue 21, we would not have known where to look; with Rescue 21, we had all we needed from the first call." LTJG Sean Arumae, Command Duty Officer, Sector Los Angeles/Long Beach**

# Delivering Value - Actual Case

**Jan 14, 2009:**

Sector Hampton Roads and local first responders rescued 4 people in the water from a capsized 18-foot boat off of Lynnhaven Inlet. Rescue 21 LOBs from RFFs Pungo Field and Cape Charles were used to assist with the case.





# Questions?

