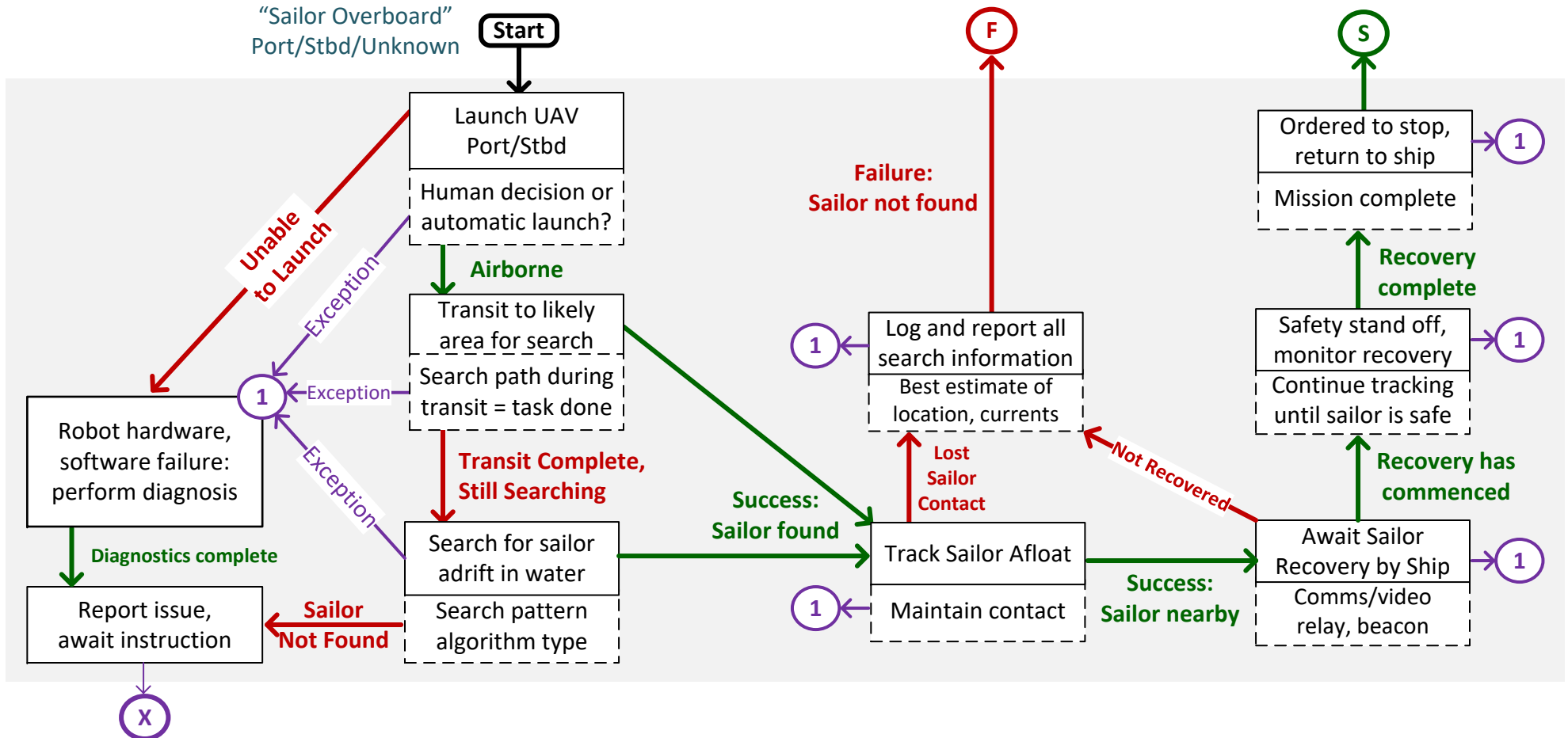


Ethical Control Mission Diagrams

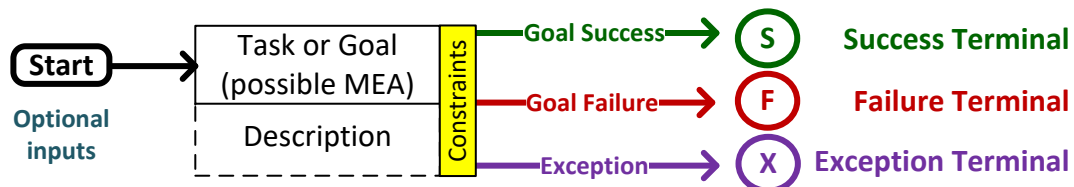
<https://gitlab.nps.edu/Savage/EthicalControl/tree/master/missions/diagrams>

Find Sailor Overboard – Mission Execution Automaton (MEA)

Single unmanned air vehicle actions to complement humans performing “SAILOR OVERBOARD” operations using **shipboard emergency procedures**.
Multiple UAVs can be employed in parallel, each following these mission orders.



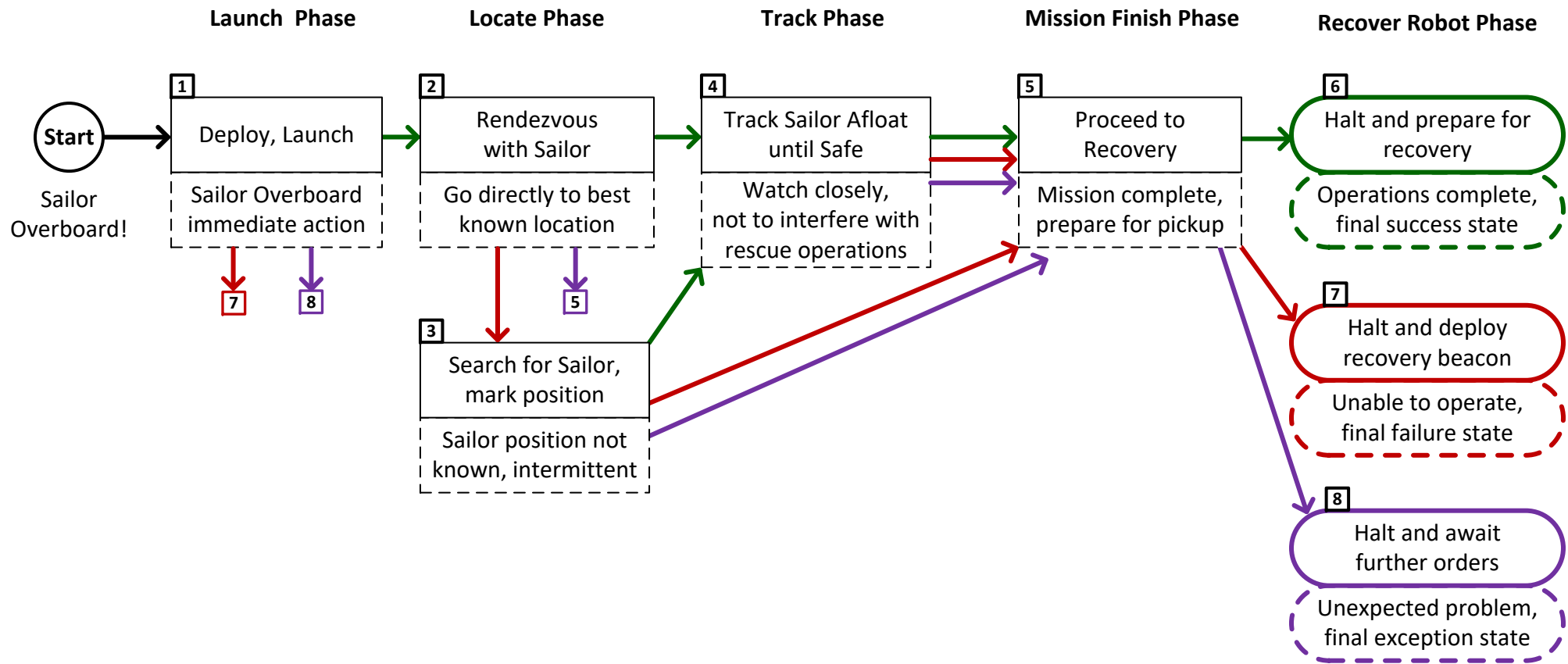
Legend



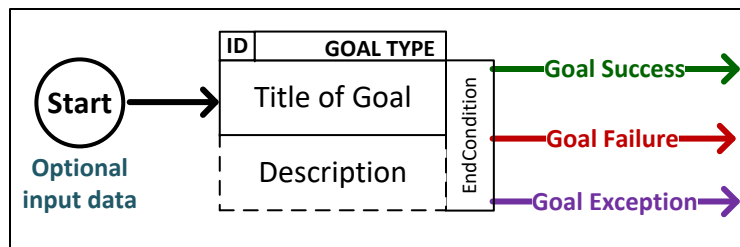
Don Brutzman and Bob McGhee
21 AUG 2019

Sailor Overboard, 8 Phases – Mission Execution Automaton (MEA)

Single unmanned air/surface vehicle actions to complement human response when performing **“SAILOR OVERBOARD”** operations, carried out in concert with **shipboard emergency procedures**. Multiple UAVs/USVs can be employed in parallel with ships/aircraft, each following mission orders.



Legend



Terminal States



Don Brutzman and Bob McGhee
Mission upgrade 19 NOV 2019



Life boat

Life-saving force: locate, track, communicate, beacon

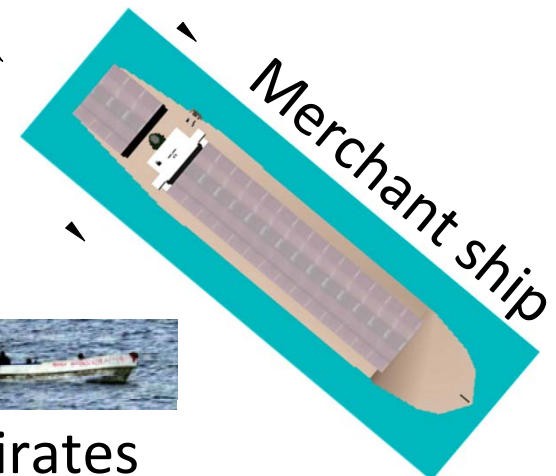
Ethical control of unmanned systems is required for both lethal and lifesaving force if remote robots communicate intermittently, operating across lengthy time and distance.

Response dilemma for U.S. Navy ship



Respond to one or both scenarios with USV/UAV assets to establish on-scene visibility and presence

Lethal force: locate, warn, defend, threaten, attack

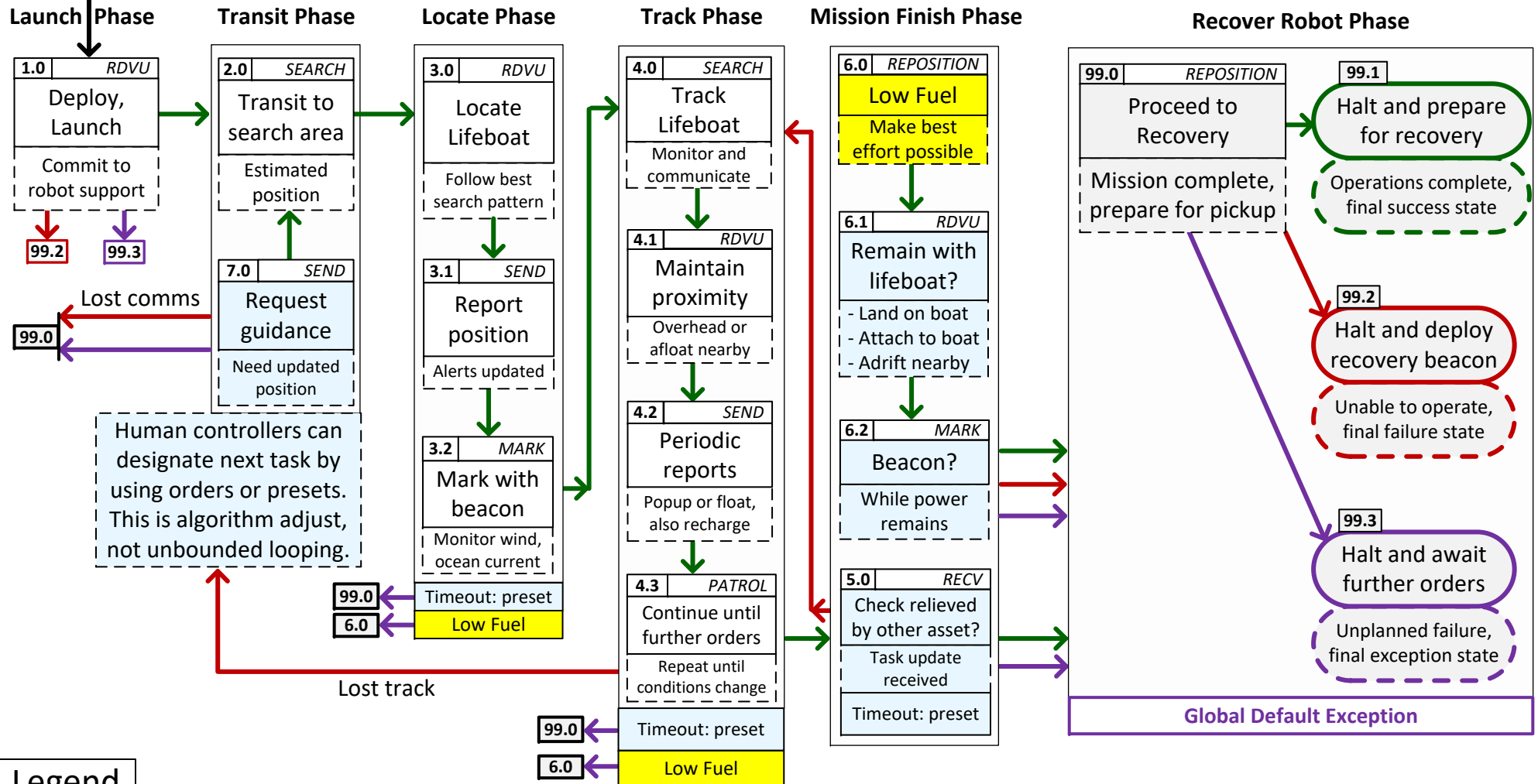


Pirates

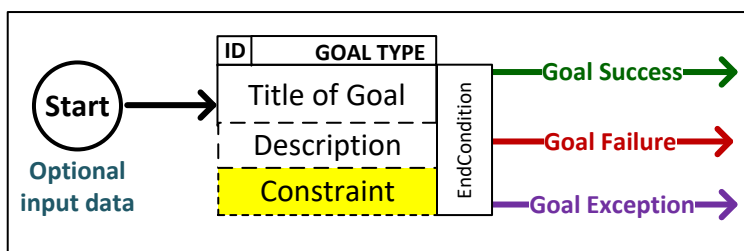
Track that lifeboat!

Lifeboat Tracking Mission

Provide remote presence for locating, tracking, communications and beaconing.

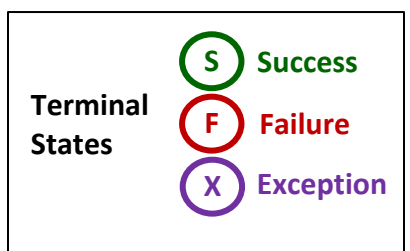
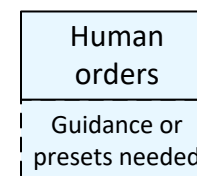


Legend



Default Condition Transitions

- Goal Success condition must be defined for non-terminal Goals
- If no Failure condition defined, then Failure matches Success
- If no Exception defined, then Exception condition matches Global Exception or else Failure



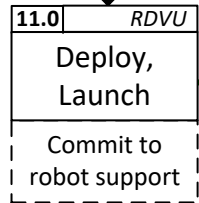
Defend the Merchant!

Pirates Seizing Merchant Mission: Approach Phases

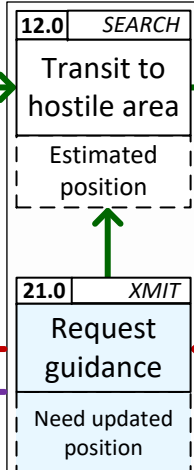
Overtake pirate small-boat gang attempting to capture threatened merchant ship

10 Start

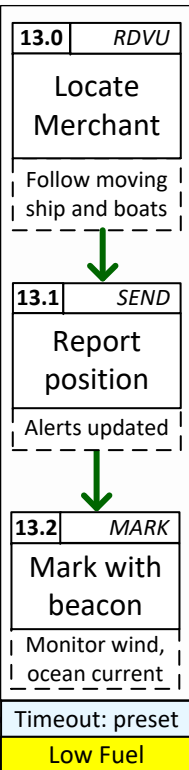
Launch Phase



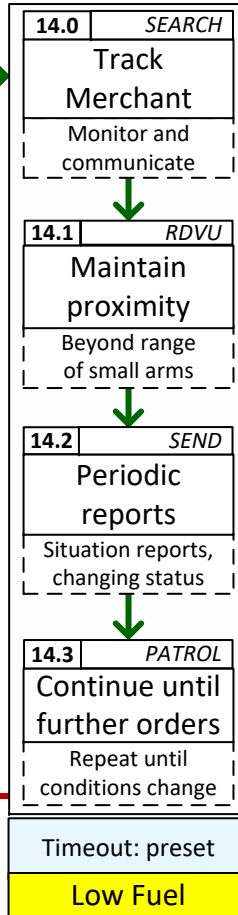
Transit Phase



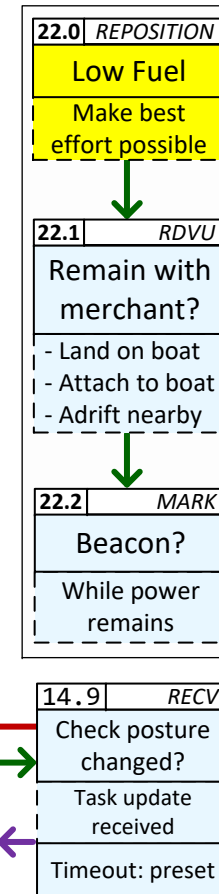
Locate Phase



Track Phase



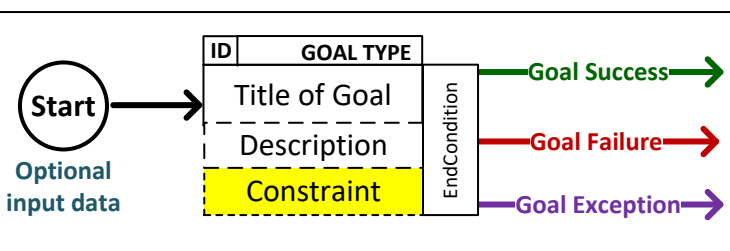
Mission Finish Phase



30 Warn

Proceed to Warning Phase

Legend



Default Condition Transitions

- Goal Success condition must be defined for non-terminal Goals
- If no Failure condition defined, then Failure matches Success
- If no Exception defined, then Exception condition matches Global Exception or else Failure

Human orders

Guidance or presets needed

Use of Lethal Force

Phase Names or Terminal States

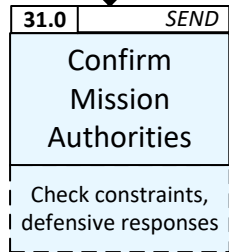


Warn
Pirates!

Pirates Seizing Merchant Mission: Escalation Phases

Warn pirate small-boat gang to stand down and move away, otherwise lethal force imminent

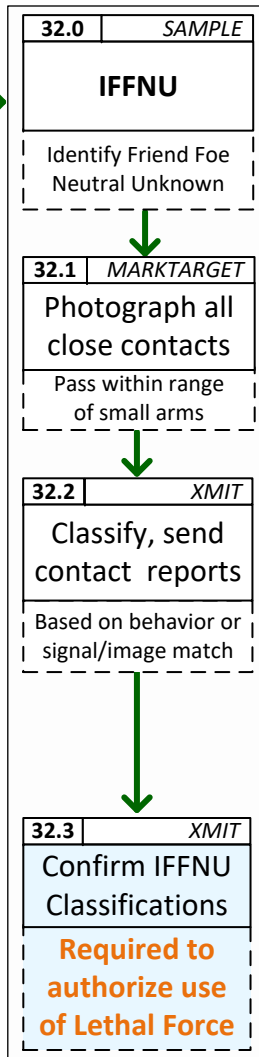
Confirm Phase



Does MarkTarget also require a Search loop?

Does Classify computation require a separate standoff task?

Classify Phase

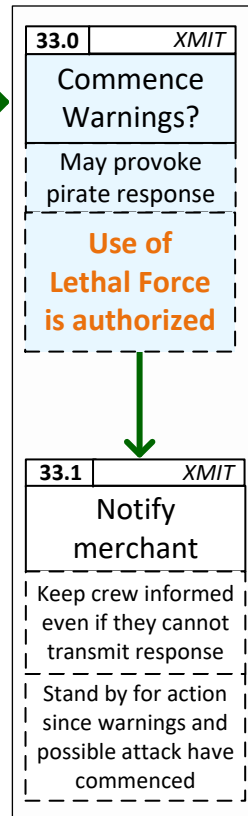


Timeout: preset

Low Fuel

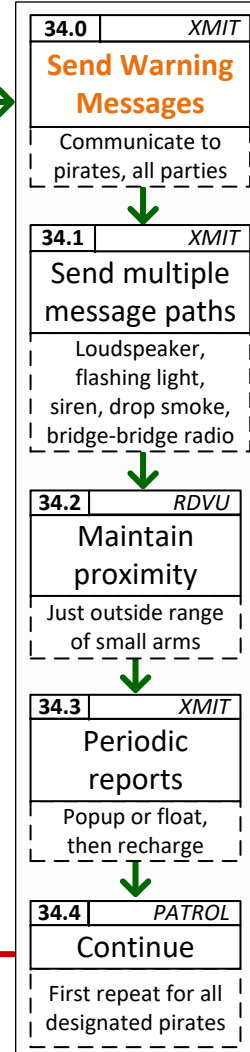
Relief available?

Engagement Phase



Track Merchant, Approach Phase

Warning Phase

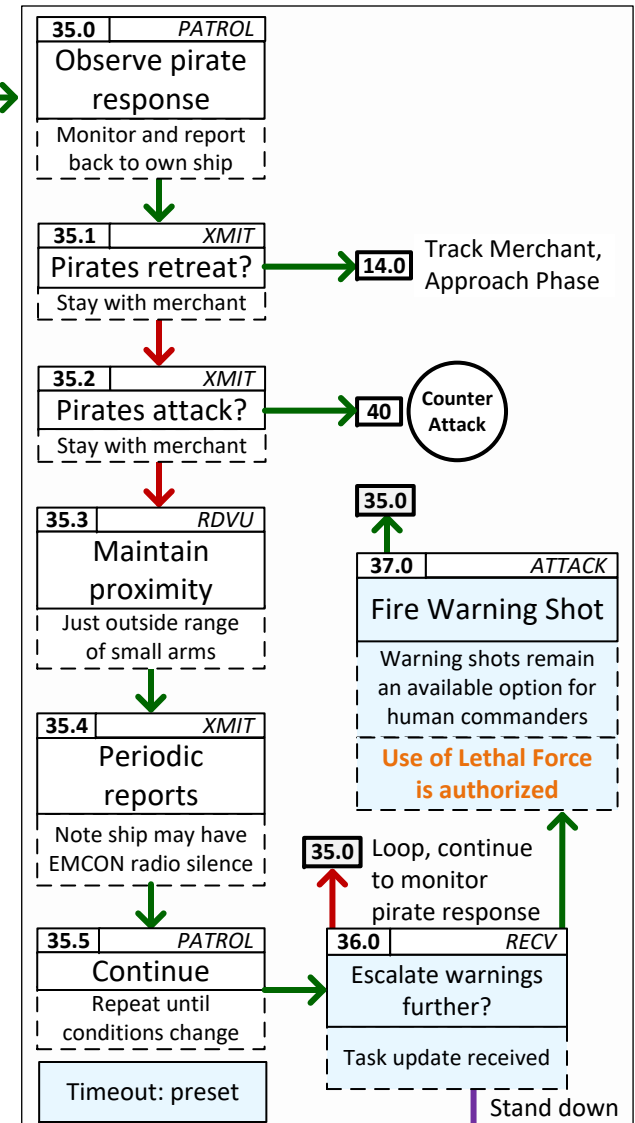


Timeout: preset

Low Fuel

Relief available?

Hostilities Imminent Phase



Track Merchant, Approach Phase

Counter Attack

Track Merchant, Approach Phase

Low Fuel

Relief available?

Low Fuel

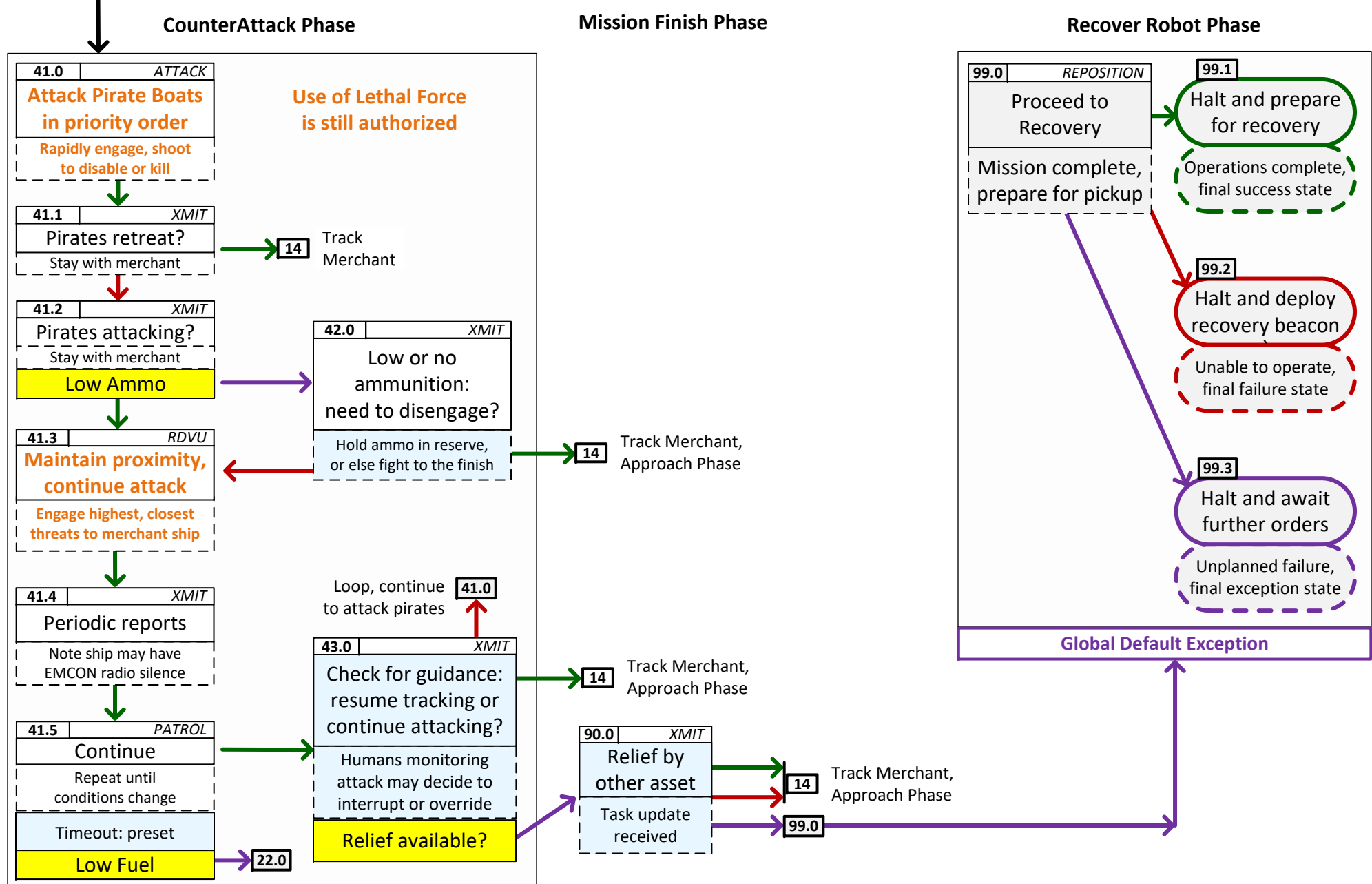
Relief available?

Low Fuel

Relief available?

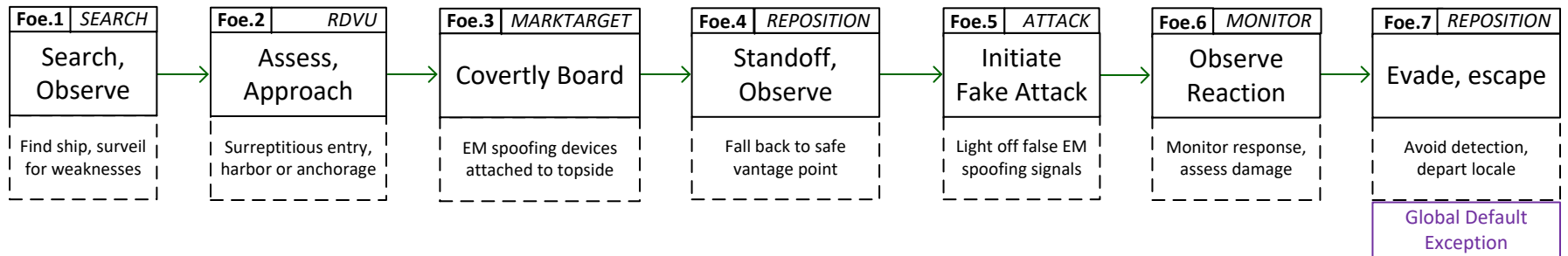
Pirates Seizing Merchant Mission: CounterAttack Phase

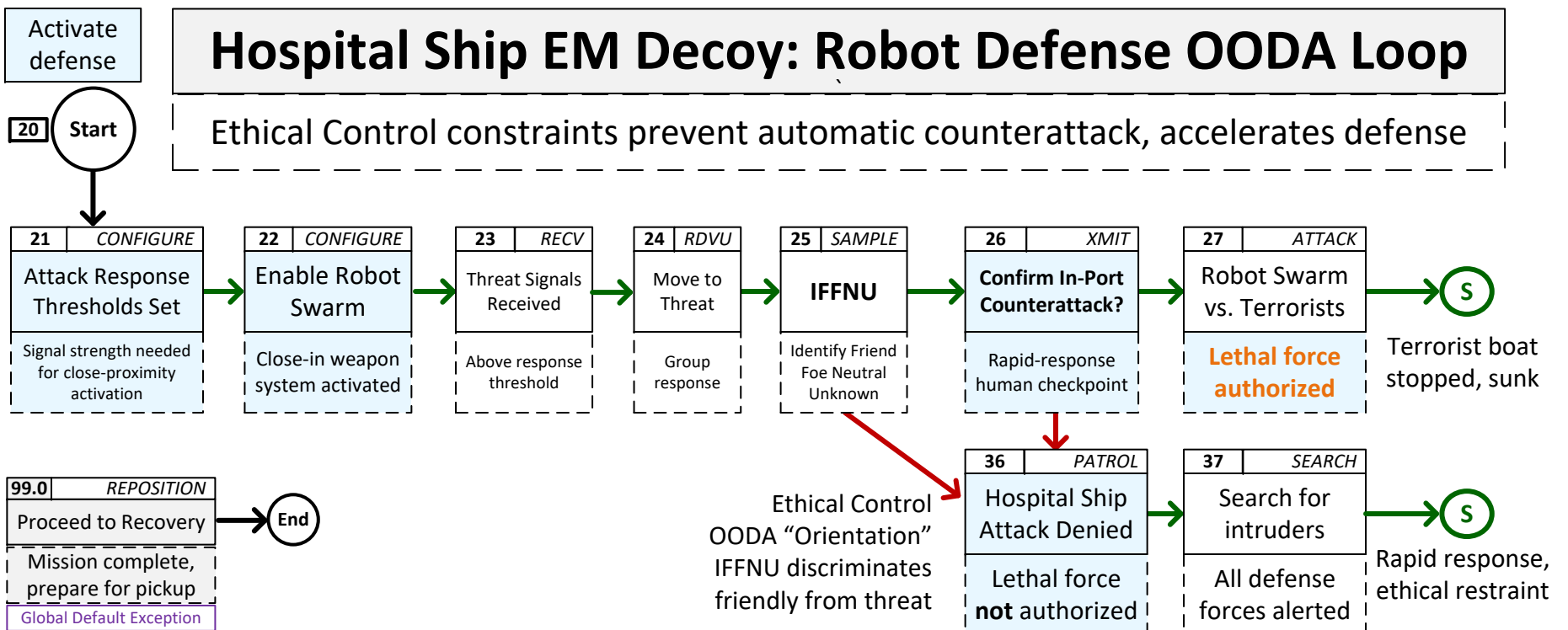
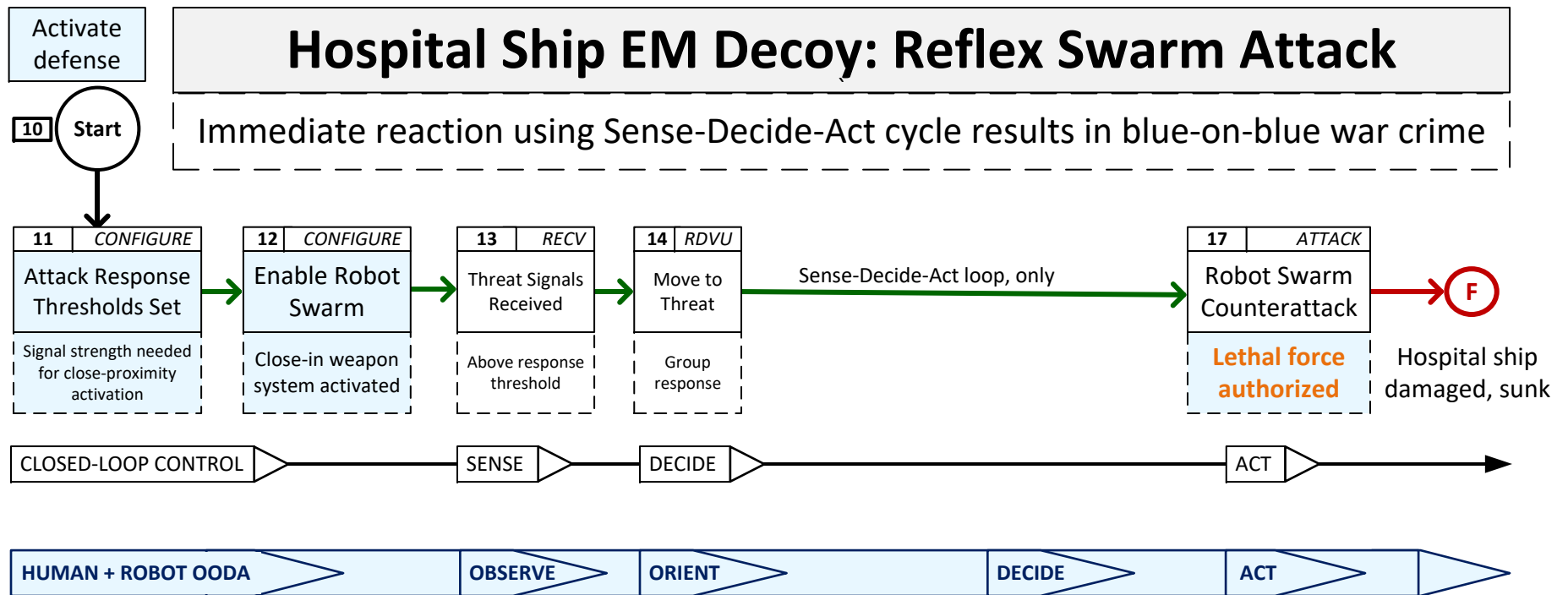
CounterAttack to force pirate small-boat gang withdrawal from threatened merchant ship
--



Hospital Ship EM Decoy: Opponent Actions

Plant “false flag” electromagnetic (EM) decoy devices to provoke blue-on-blue robot swarm attack. Although this mission is likely to be manned by human opponents, AVCL representations still work.





Response dilemma for U.S. Navy ship



Life boat

Life-saving force: locate, track, communicate, beacon

Ethical control of unmanned systems is required for both lethal and lifesaving force if remote robots communicate intermittently, operating across lengthy time and distance.

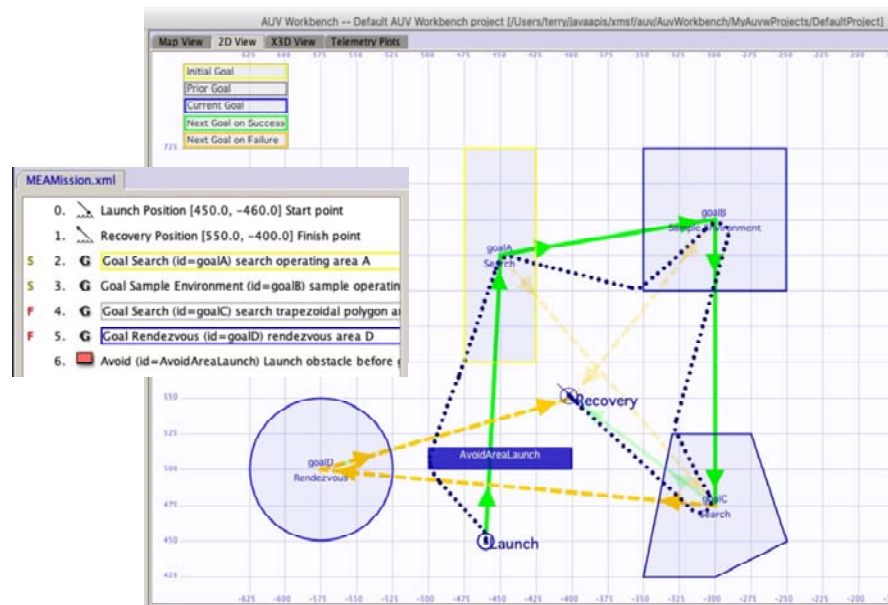
Lethal force: locate, warn, defend, threaten, attack



Merchant ship

Pirates

Respond to one or both scenarios with USV/UAV assets to establish on-scene visibility and presence



Mission Execution Ontology (MEO) evolving

