“When things go horribly wrong...”

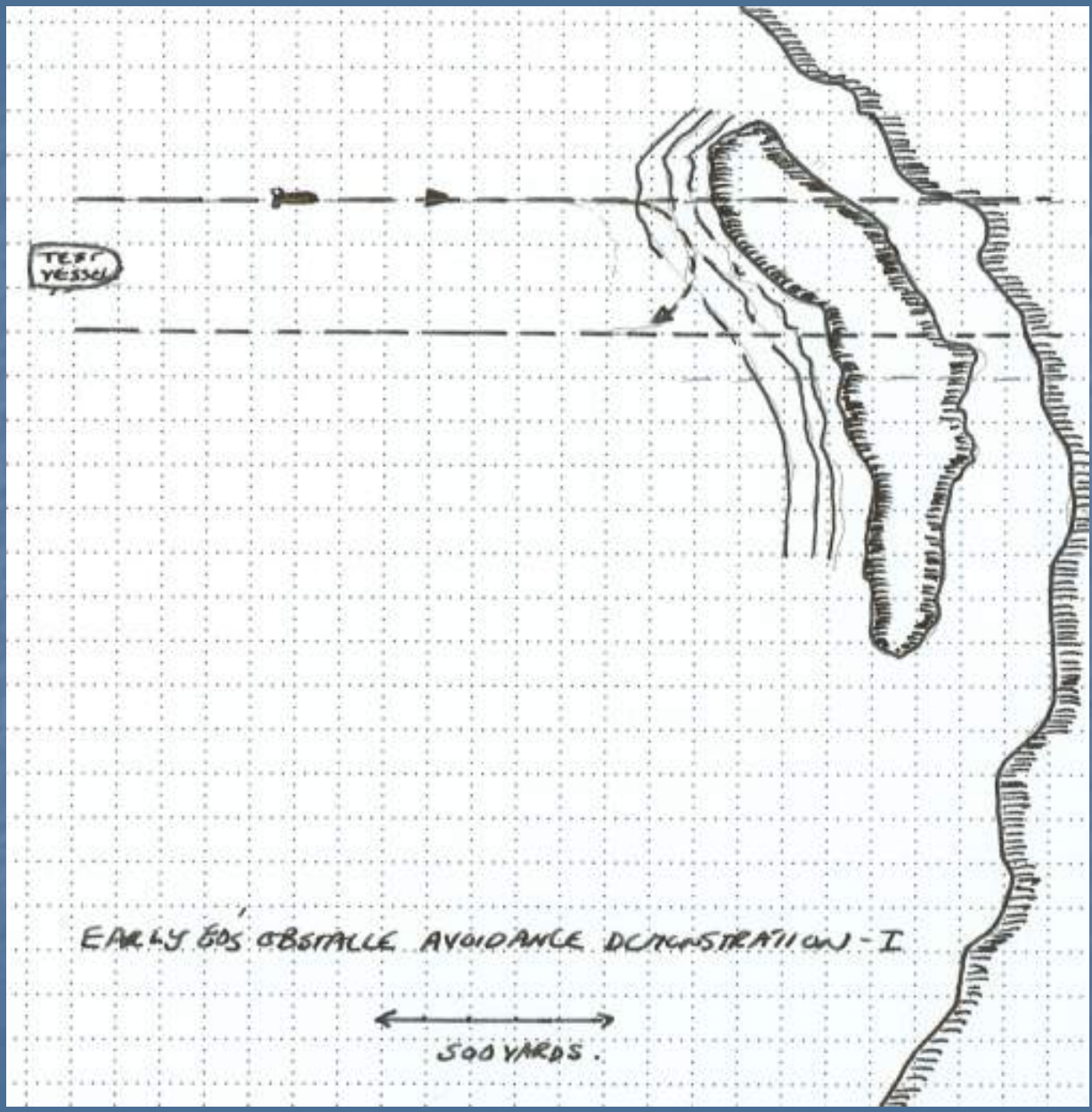
“What to do when things appear to go horribly wrong...”

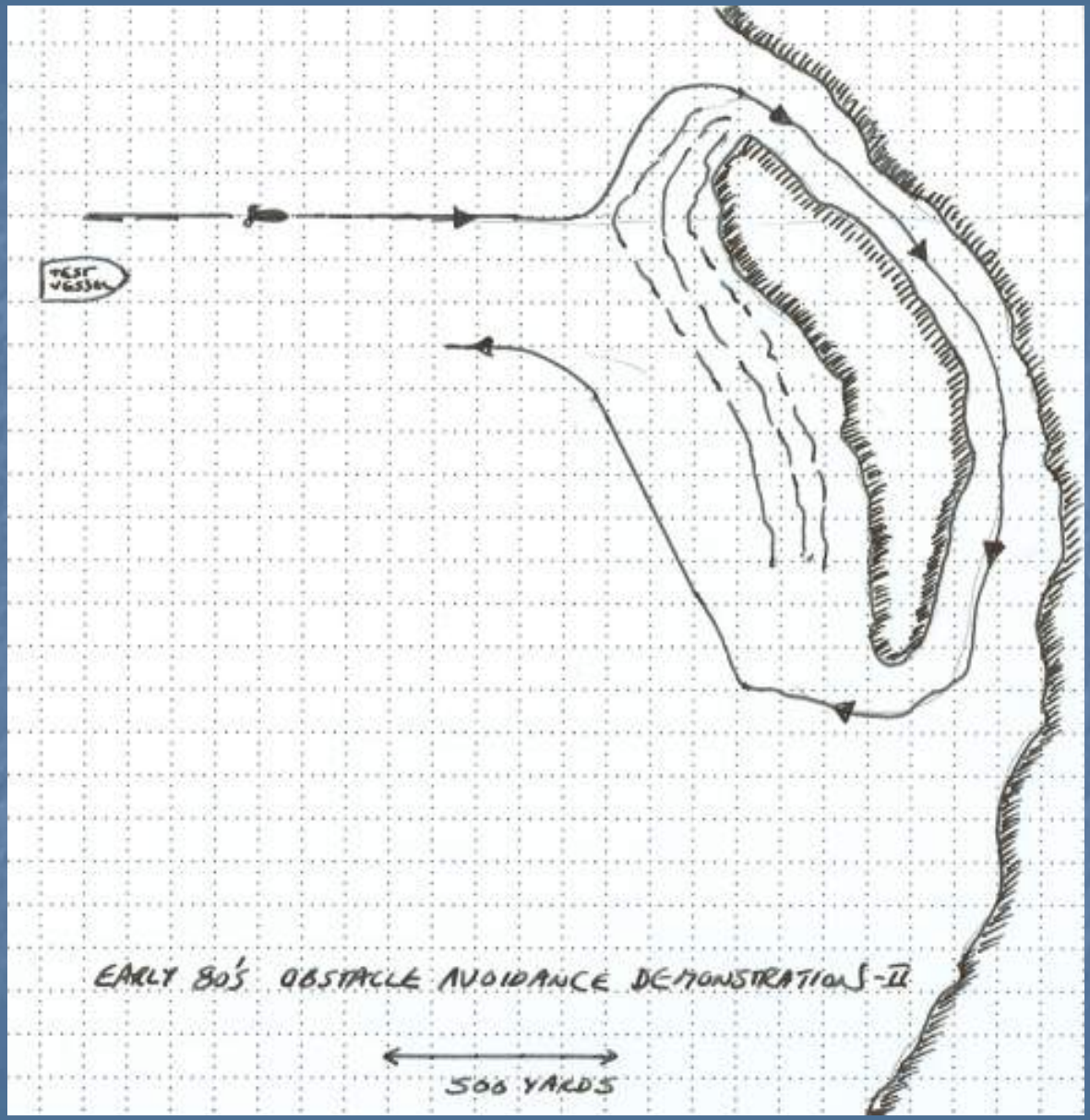
# “When things go horribly wrong...”

- Presume to mean the loss of the vehicle under the ice.
- This loss can take the form of
  - Vehicle not showing up or checking in as required
- In this case .....

# “when you think you’ve lost your vehicle...”

- Make no assumptions
- Take nothing for granted


TEST VESSEL
EARLY 60's OBSTACLE AVOIDANCE DEMONSTRATION - I
500 YARDS.


TEST VESSEL
EARLY 80'S OBSTACLE AVOIDANCE DEMONSTRATIONS-II
500 YARDS

“when you think you’ve lost your vehicle...

- Do not under any circumstances share your concern with the insurance man
- Do make every attempt to find it

# “When things go horribly wrong...”

- Loss can also be real
  - Vehicle known to be on the bottom (or under the ice) and stopped
  - Vehicle known to have sunk in water depths exceeding its limit
- In these cases, you will benefit from careful pre-planning

# “Losing your vehicle in the arctic ...”

- An event which is going to happen
  - AUVs have and will continue to be lost in open water for reasons that we may not be capable of controlling
    - Design flaws
    - Equipment malfunctions
    - Operations in dangerous environments
    - Human error
  - Conditions in the Arctic are not significantly different than anywhere else
- Accepting the inevitablity of AUV losses,  steps must be taken prior to deployment that
  - minimize the occurrence
  - Minimize the impact on current and near term operations.

# Preparing for the inevitable ...

- Minimize the probability
  - Reliability engineering
  - **Design and build for the insurer**
  - **Testing and training**
  - redundancy and backup
  - What is permitted in the vehicle and what is not ....
  - Ops – avoid  the awesome, riskier bthings to the end etc
- Think about when to talk to the insurance man ...
- Prepare for a salvage (sue and labor)
  - search tools (helicopter, balloon etc)
  - Portable hole making equipment
  - reconnection (portable operator console, telemetry, ROV)

# Preparing for the inevitable ...

- Minimize the impact on current and near term operations.
  - Emergency location, recovery, restart equipment
  - Insurance
  - Spare vehicle (on– ice)
- Question – what to do with the “hot” spare...

# Breakout Topics

- Should there be minimum requirements (or an Arctic check-off list) for under-ice ops – if so, what are they, and how do we establish them?

- is there new technology which could help to prevent a loss – if so, what is it, and what's the risk of it not working?

- Is it better to put the money into reliability engineering and training, or into insurance and redundancy?

- Insurance in the form of money or a spare vehicle is a requirement for ongoing arctic ops. Are we doing a good enough job in educating our funding sponsors about the risks ? If not, what more could we do?

# Breakout Topics

- Should there be minimum requirements (or an Arctic check-off list) for Arctic ops – if so, what are they, and how do we establish them?
  - Weather forecasts (if available) and impact on ops
  - Best available ice forecasts
  - Don't ignore -search out local knowledge (weather, boita)
  - ECOR - Best Practices document
  - Safe search practices (grad students below decks)
  - Local HSE regulations (arctic)
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# Breakout Topics

- is there new technology which could help to prevent a loss – if so, what is it, and what's the risk of it not working?
  - 400 KHz radio detectors (low risk)
  - fuzzy logic fault management too fuzzy
    - structured approach aids in fault reconstruction
  - New Fault Management systems - review previously recorded data, prove new algorithms, then consider protyping in the AUV
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# Breakout Topics

- Is it better to put the money into reliability engineering and training, or into insurance and redundancy?
  - Redundancy and reliability are part of the overall system design
    - Redundancy can be complex
    - Difficult to avoid reliability engineering
    - can't trust manufacturers data
    - AUV industry should collect its own and share it
    - AUV industry needs to manage its supply chain
  - Insurance - panel still out...
- Are we doing a good enough job in educating our funding sponsors about the risks ? If not, what more could we do?
  - Efforts have been made, but we need to improve