Ice Trial Objectives

Ice Trial Test Matrix
Ice Trial Phase One Powerpoint Presentation

USCGC HEALY will undergo testing in a high latitude environment in order to validate the ship's ability to successfully accomplish all mission areas identified in the Operational Requirements Document (ORD). In addition to ORD validation, the cutter must also prove all testing requirements not performed by the contractor at ship delivery (due to the need for an Arctic environment for test conditions). These two aspects of testing; ORD validation and completion of contractual testing requirements, define the basis for Ice Trials, which in short, is to accomplish an operational evaluation of HEALY in the environment that the ship was designed to operate.

In order to ensure all testing requirements for Ice Trials would be met, the objectives of the Ice Trial testing program were broken down into three primary categories:

I. Cutter Icebreaking Performance
II. Hull Strength and Machinery Performance
III. Science Systems Performance

The first category, Cutter Icebreaking Performance, includes tests that will effectively evaluate the overall operational performance of HEALY during icebreaking maneuvers. Specific testing in this category will include level ice maneuvers, pressure ridge transits, and broken channel resistance. Specific objectives for the Icebreaking Performance category include the following:

1. Quantify the cutter's icebreaking capability in terms of continuous speed, ice thickness, and ice flexural strength, with an ice thickness of 4.5 feet of 100 psi ice as one boundary condition.
2. Quantify the cutter's icebreaking capability during backing and ramming in terms of ice penetration, ice thickness and ice flexural strength with an ice thickness of 8 feet of 100 psi ice as one boundary condition.
3. Quantify the level ice resistance of the cutter in terms of speed, ice thickness and ice flexural strength. Resistance data is required for near zero speed of icebreaking.
4. Evaluate the cutter's maneuvering capability in terms of speed, ice thickness and ice flexural strength.
5. Determine the pressure ridge transiting capability of HEALY for a range of sail heights and impact speeds.
6. Determine the resistance of the ship in a broken ice channel.

Each of these objectives for the first category of testing will be conducted in several variations of ice conditions depending on what is available at the time and location for testing.

The second category, Hull Strength and Machinery Performance, includes tests that will evaluate the ability of HEALY's hull and propulsion system to meet future mission requirements and determine the operational limitations for HEALY in an Arctic environment. Specific objectives for this category include the following:

1. Measure the ice impact loads on the icebelt frames in the bow, midbody and stern and use

obtained data to extrapolate ship operating limiting conditions.
2. Evaluate the propulsion control system for all configurations of machinery as a function of ice conditions and extrapolate limitations.
3. Evaluate the loads on the steering gear and rudders as a function of ice conditions and extrapolate its limits.
4. Determine HEALY's ability to produce 30,000-shaft horsepower in a bollard condition.
5. Evaluate the suitability of the installed propulsion plant in terms of step loading during ice interaction events with the propellers and shafting.

Each of the objectives for the hull and machinery testing are to be met for all ice conditions found during the Ice Trials.

The third and final category, Science Systems Performance, includes testing of all installed science equipment on HEALY. With HEALY designed specifically to be a high latitude research platform, the importance of science system operational evaluations define the main thrust for HEALY's Ice Trial program. The specific objective for this category is:

1. Evaluate the operational capability of each installed science system based on the ability to obtain useful scientific test data as would be required by embarked scientists and technicians to complete pre-determined science missions.
2. Evaluate the function of installed science systems in an Arctic environment to determine suitability of design criteria used during ship construction.

Each of the objectives listed above for the three categories was used to develop test plans to provide a basis for mission planning.

Ice Trial Test Matrix & Test Memos

The testing needed to meet the objectives for each of the three categories is listed in enclosure (1). To develop the testing, each category was assigned to a team for development and execution during Ice Trials. The first category, Cutter Icebreaking Performance, was assigned to the Icebreaking Team led by the Cold Regions Research Engineering Laboratory (CRREL) with assistance from the National Ice Center, Canadian Ice Service, and David Taylor Research Laboratories. The second category, Hull Strength and Machinery Performance was assigned to the Hull/Mechanical Team led by the Coast Guard Engineering Logistics Center (ELC) with assistance from University of Helsinki, Transport Canada, Lloyds of London, ABS, and TDC Canada. The third category, Science Systems Performance was assigned to the Science Team led by members from the Arctic Icebreaker Coordinating Committee with assistance from Navy Coastal Systems Station (NCSS).

Each of the three teams developed the test memos listed in attachment (1). For planning purposes, HEALY's Ice Trial was broken into four phases. These phases are discussed in the next chapter, **Mission Planning and Schedule**. To understand the numbering of the test memos listed, a system was used that matches the shipbuilder's. This was done for continuity and historical record keeping. This system utilized the following numbering scheme:

First Digit - Test Stage (all stage 8 for post delivery testing)
Second Digit - Equipment or systems category
Next Three Digits - SWBS

Sixth Digit - Test Location (all D for post delivery)
Seventh Digit - 5 For U.S. testing, 6 for Canadian testing
Eighth Digit - Ice Trial Phase
Ninth Digit - Sequence Number

The test memos in attachment (1) are listed in the sequence provided in enclosure (1).

Mission Planning and Schedule

The tests developed by the three groups called for a mission that met the following profile: eleven days of bottom mapping sonar and warm water science testing at the Puerto Rican Trench; six weeks for Icebreaking, hull and machinery testing; and four weeks of science systems testing. For the six-week icebreaking/hull and machinery testing, it was desired to have one port call at the three-week point where trial team members could change out. The ice conditions for the six weeks needed to vary from light level fast ice up to multi-year floes, including pressure ridges. At the end of the six week period, a majority of Ice Trial team members would change out, which would require the need for a port of sufficient draft to accommodate HEALY close to shore (preferably pierside). For the four weeks of science testing, it was desired that a port call be set once every seven days to change out trial riders. The ice conditions for the four weeks of science testing also needed to vary. This mission profile was simplified for planning purposes by breaking the ice trial testing into four phases. Phase I was defined as all warm water testing prior to arriving at the Puerto Rican Trench. Phase II was defined as the warm water science testing during the time period at the trench. Phase III was defined as the six week icebreaking and mechanical testing in the Arctic and finally, Phase IV was defined as the four week high latitude science testing.

To plan an Ice Trial mission that satisfied the above testing requirements dictated the need for an educated guess on the ship delivery date from which a post delivery schedule could be developed and subsequent mission planned. This was an iterative process that forced dual plans to be developed; one for the western Arctic around Alaska, and one for the eastern Arctic in Northeast Canada. Based on the actual delivery date of HEALY, 10 November 1999, the eastern Arctic plan proved the correct one to meet the trial requirements.

Enclosure (2) identifies the planned Ice Trial Schedule based on the 10 November 1999 delivery date. Plans call for the ship to depart the shipyard on 5 January 2000. Prior to the actual start of bottom mapping sonar testing, the ship is scheduled for several weeks of shake down training. The actual start of the bottom mapping sonar testing is 11-22 February at the Puerto Rican Trench with port visits to San Juan prior to the start and at the completion of testing to embark Phase II riders and disembark any Phase I team members. It is important to note that there will be a limited number of trial riders on board prior to the sonar testing during the cutter shake down training. These riders will be responsible for executing Phase I Ice Trial testing. The purpose of this particular phase is to calibrate the sonar system prior to testing at the trench, on a not to interfere basis with crew training. Once Phase I testing is complete, Phase II testing will occur at the Puerto Rican Trench. Phase II trial team members will disembark in San Juan after completion of Phase II testing on 22 February.

Upon completion of bottom mapping sonar and warm water science testing, HEALY will proceed to Norfolk, VA for conduct of the Helicopter Dynamic Interface Trial, scheduled for 3-16 March 2000. This trial will be conducted off shore in the Norfolk Operating Area and serves the purpose of determining the operational limits of the ship with HH-60 and HH-65 helicopters. Prior to the start of this trial, the cutter will make a port call at Norfolk on 2 March 2000. All Helicopter Dynamic Interface Trial personnel need

to embark on HEALY at this time. At the completion of this trial, HEALY will again make a port call in Norfolk for trial personnel to disembark. The second port visit to Norfolk is planned to be three days in length. **Any gear that will be used during the testing in the Arctic, that is not on board must be loaded in Norfolk.**

The next period on the post delivery schedule associated with Ice Trials is the embarkation of the Phase III personnel in Halifax, Canada on 26-29 March. During this port visit, a Rapid Core System will be installed by Canadian Ice Trial Team members. **Other than the Rapid Core System and associated equipment provided by Canada, it is expected that no additional large equipment will be loaded.** On 29 March HEALY will depart Halifax and proceed to the Davis Strait for conduct of Phase III testing. In order to maximize the number of personnel participating in the Phase III testing, this phase is broken into two three-week periods. On 25 April HEALY will proceed to Nuuk, Greenland for a short port visit. At Nuuk, the Phase III personnel change out will occur. Due to difficulties in getting to and from Nuuk, personnel who are changing out are advised to prepare accordingly. It is also noted, if permitted by the Inuit residents on Baffin Island and ice conditions allow, there exists a possibility that a small change out can occur at Clyde River or Broughton Island sometime during the testing. Once Phase III testing is complete, HEALY will proceed to a Canadian port, possibly St. Johns (or Halifax) for disembarkment of Phase III riders. Date of arrival at St. Johns (Halifax) is 21 May.

The HEALY is scheduled to stay in port for four days prior to departing for Phase IV testing. All Phase IV personnel must be on board HEALY prior to 24 May. The ship will depart on 25 May and proceed North for the start of Phase IV testing. Phase IV is divided into four one week legs with personnel change outs at the end of each leg. This was done to maximize the number of personnel that could participate while keeping costs at a minimum. The first Phase IV leg is scheduled from 27 May to 02 June. On 02 June, HEALY will again proceed to Nuuk for a short 1-day port call in order to allow for personnel change outs. The second leg will last from 03 June until 10 June from which the HEALY will proceed to Nuuk for a personnel change out on 10 June. The third leg is scheduled for 11 June till 18 June. The next personnel change out will occur again at Nuuk on 18 June. The fourth and final leg is scheduled for 19 June till 26 June. Upon completion of testing, the cutter will proceed to either St Johns or Halifax on 29 June for disembarkment of Phase IV riders and preparations for transit through the Northwest Passage, which is scheduled for 9 July through 29 July.

Travel to and from the Ship during Trials

All Ice Trial team members who will be riding HEALY during testing must be aware that travel to and from the Arctic can be extremely difficult as weather plays an important role on the ability to get to a particular location. From the schedule, Ice Trial Team members will embark at one of the following ports: Pensacola, Florida for Phase I testing; San Juan, Puerto Rico for Phase II testing; Halifax, Canada for the first part of Phase III testing; Nuuk, Greenland for the second half of phase III testing; St John's, Canada for the start of phase IV testing; and Nuuk, Greenland for each leg of Phase IV testing. There may possibly be a change out of Phase III personnel at the Phase III mid point at Clyde River, Canada or Broughton Island, Canada, prior to arriving in Nuuk. This would only occur if conditions allow and permission is obtained by representatives from the communities and the Canadian Government.

From the ports listed above, Nuuk, Clyde River and Broughton Island present the most challenges for travel. The Greenland Tourism Board provides the following information:

From Denmark, there are 5-10 weekly connections from Copenhagen to Kangerlussuaq and Narsarsuaq

in Greenland, operated by SAS and Greenlandair. From Canada, there are two weekly connections from Ottawa via Iqaluit to Kangerlussuaq, operated by First Air. From Iceland there are three weekly connections from Keflavik to Kulusuk and onwards to Kangerlussuaq and Nuuk. This is the main route from Iceland to Greenland. In the summer season there are also two weekly flights from Reykjavik to Narsarsuaq in South Greenland. Greenlandair and Air Iceland operate all routes between Iceland and Greenland. There are no passenger ship routes between Greenland and other countries.

Upon arrival in Greenland you can continue with a Greenlandair domestic flight to your destination. Or during the summer you can sail with an Arctic Umiaq Line passenger ship from the international airports in Kangerlussuaq and Narsarsuaq to the towns on the coast. But you cannot drive or go by train, as Greenland has no roads or railroads between the towns.

Please make your reservations well in advance – as soon as possible – as both air and sea routes are often fully booked. This is especially true in the summer.

For travel on Baffin Island, most flights for Ice Trial participants will begin in Canada either at Ottawa or Montreal. From these two cities, flights can be arranged to Iqaluit. Canadian Air North or First Air are the two carriers with multiple flights to Iqaluit. Once in Iqaluit, air service can be arranged to Broughton Island or Clyde River with First Air.

For information purposes, the following web sites are listed below to aid in travel preparation.

National Tourist Board of Greenland www.greenland-guide.dk
Nunavut Information www.nunatour.nt.ca
Canadian Airlines http://www.aircanada.com/en/home.html
First Air www.firstair.ca

All Ice Trial riders are to be warned that the dates listed on the schedule are based on estimated times for arrival. Due to ice and weather conditions in Baffin Bay, it is possible that the HEALY may be a day early or late in reaching a given port. Accordingly, it is advisable to arrange for a hotel. In Nuuk there are several options for places to stay. The web site listed above for Greenland provides lodging information. For travel on Baffin Island, lodging is extremely difficult. Iqaluit has several hotels available, but they are normally booked full meaning proper planning is essential. Lodging in the communities of Broughton Island and Clyde River is basically not available.

For travel into Greenland, a valid Passport will be required. For travel into Canada, a passport also is needed. For United States Citizens, a birth certificate and picture ID are acceptable in Canada. For those Ice Trial riders that will be bringing small pieces of gear on board at the embarkation ports, please be advised that you will have to go through customs. A check of customs requirements for travel to Greenland and Canada is highly recommended prior to departing.

Ice Trial Rider Listing and Information

Enclosures (3) through (11) list the Ice Trial Team members who will be riding on each phase. These enclosures also provide the compartment number where the rider will be staying during their participation.

Ice Trial participants are expected to provide their own arctic gear if they plan to do any operations on the

ice or in the weather. Gear should include: an extreme cold weather parka, extreme cold weather trousers, cold weather boots, sun glasses, cold weather undergarments, heavy socks, face mask, gloves and glove inserts. Temperatures in the Arctic during the beginning of Phase III will be below zero degrees Fahrenheit. By the end of Phase IV testing, the temperature will be near or slightly above freezing. As such, each participant is required to bring sufficient clothing to meet mission requirements based on the environment they will be working in. Survival suits will be available on HEALY.

During the trial, each rider is expected to follow all directions provided by the HEALY's Commanding Officer and crew. Safety during the Ice Trial will hold the highest priority. Those participants that will work on the ice must understand the danger of polar bears, snow blindness, frostbite and hypothermia. Personnel going on the ice will go in teams with a team leader and polar bear watch assigned. Following all directions given by the team leader while on the ice is a must.

For Ice Trial participants working on deck in the weather, considerable attention to safety must be followed. HEALY has numerous pieces of science gear on deck that utilize heavy wires and cranes. Hard hats will be made available for those participants that will need them.

Breakfast, lunch and dinner times will be provided once on board. Cleaning of staterooms is the responsibility of each Ice Trial participant. A laundry is located on board one deck below the mess room. Other pertinent information regarding the cutter's daily routine will be provided during a short indoctrination meeting to be held during each Ice Trial personnel change out.

The environment in which HEALY will be operating during Ice Trials is pristine and very fragile. It is expected that all Ice Trial participants will respect these facts, especially when working on the ice or on deck.

HEALY is home for the crew and they take great pride in their ship. As a passenger, it is requested that all Ice Trial riders conduct themselves professionally and respect the ship and the people who operate it.

Ice Trial Routine

Every evening after dinner, there will be a meeting for Ice Trial Team Leaders with the Commanding Officer. At this meeting all testing for the following day will be discussed. Test procedures are to be reviewed with special consideration toward personnel and equipment safety. During Ice Trials, the cutter's Commanding Officer has ultimate responsibility for the cutter's operation, safe navigation, and personnel safety. As such, all testing must be approved by the Commanding Officer before starting. Due to warranty considerations, the Trial Coordinator must also approve of any proposed testing prior to starting. Any deviations to the schedule determined at the evening meeting must be approved by HEALY's Commanding Officer and the Trial Coordinator. Following the evening meeting with the Commanding Officer, the Ice Trial Team Leaders are to meet with their respective Team Members to outline the next days planed trial events.

During the execution of testing, Ice Trial riders working in the Pilothouse, engineering spaces, and other working areas on the ship are to be particularly cognizant of the ship operations being conducted there and to interfere with these operations to the minimum extent possible. Requests coming from the Officer of the Deck, Engineering Watch Officer, Crane Operator, Flight Deck Officer, and others in execution of their duties are to be treated the same as direction coming from the Commanding Officer. Any routine requests outside of the normal working relationships between the crew and Ice Trial riders should be

directed through the respective Team Leader. The Team Leader will notify the Trial Coordinator and Commanding Officer. Guidance will be passed back down to the Team Leader for action.

Since ice conditions will vary throughout the Ice Trial, there is no set sequence for testing. Terry Tucker will provide ice reconnaissance with assistance from the Canadian Ice Service and National Ice Center. As each Team Leader plans on what testing is to be conducted and when, consultation with Mr. Tucker is highly recommended and deemed necessary prior to the evening meeting with HEALY's Commanding Officer.

The daily routine for the crew is identified in HEALY's Plan of the Day. This document provides all necessary information with respect to the expected activities on board throughout the trial. All Ice Trial riders should pay close attention to the Plan of the Day in order to keep abreast of what will be happening on board ship.

Ice Trial Reports

Prior to departing the ship after completion of testing, all riders in carge of various aspects of the data collection or Ice Trial evaluation are to provide a short synopsis of findings to the Trial Coordinator and Commanding Officer. This report should include the following:

1. Tests successfully completed
2. Tests not accomplished with an explanation for not completing
3. Short overview of testing results
4. Equipment deficiencies
5. Recommendations regarding equipment improvement

A detailed report of test findings is to be submitted once all data has been analyzed. This report is to be similar to the outline listed above for the quick synopsis, but much more in detail. The responsibility for final reports covering the Ice Trial will reside with Mr. Rubin Sheinberg at the Coast Guard Engineering Logistic Center (ELC). It is envisioned that a comprehensive report will be produced documenting the conduct of Ice Trials, operational performance of the cutter, and operational performance of the science equipment. All organizations participating in the Ice Trials are expected to work closely with the ELC in producing a quality report that can be used by others in the years to come. Final reports can be sent to the following address:

Commanding Officer

U.S. Coast Guard (ELC-023)
Engineering Logistics Center
Attn: Rubin Sheinberg
2401 Hawkins Point Road
Baltimore, MD 21226

For overnight delivery service, the address is:

Commanding Officer
U.S. Coast Guard (ELC-023)
Engineering Logistics Center
Attn: Rubin Sheinberg
717 East Ordnance Road, Suite 202
Baltimore, MD 21226

Personnel Contact List

Name Organization Telephone E-mail

Beukema, Tom ELC-023 410-762-6260 Tbeukema@ELCBalt.uscg.mil
Bond, James ABS 281-877-6825 Jbond@eagle.org
Brown, Terry FTL
Cleary, Chris ELC-023 410-762-6703 Cleary@ELCBalt.uscg.mil
Coccia, Ferdinand ELC-02 410-762-6233 Fcoccia@ELCBalt.uscg.mil
Conlon, Carol PMS 373 703-602-3097 Conloncl@navsea.navy.mil
Davies, Peter LRS 011-44-181-681-4040 tid@lr.org (and state name)
Deighton, Dan ELC-023 410-762-6260 Ddeighton@ELCBalt.uscg.mil
Gahs, Tom ELC-026 410-762-6291 Tgahs@ELCBalt.uscg.mil
Gaiser, Al PMS 373 703-602-3097 Gaiserao@navsea.navy.mil
Gorman, Bob Enfotec gorman@enfotec.ca
Hecker, Martin ELC-023 410-762-6706 Mhecker@ELCBalt.uscg.mil
Iyerusalimskiy, Alex STC 410-964-3211 stc.arctic@mciworldcom.net
Johnston, Michelle CHC/NRC Michelle.johnston@nrc.ca

Ice Trial Test Matrix

Trial Phase
Test Memo Responsibility Description

Phase 1

8C422D511 AICC Sonar Set-up Calibration

8C422D512 DTRC Bubble Sweep Down Pictures

Phase 2

8C424D521 NCSS/AICC Acoustic Doppler Current Profiler

8C424D522 NCSS/AICC Bottom Mapping Sonar

8C424D523 NCSS/AICC Digital Survey Fathometer

8C493D521 NCSS/AICC SDN

8C434D521 NCSS/AICC CCTV

8C591D521 NCSS/AICC Winches

8C591D522 NCSS/AICC Coring Equipment

8C591D523 NCSS/AICC CTD

8C422D521 DTRC Sonar Acoustic Test

Phase 3

8B070D531 CRREL Continuous Icebreaking in Level Ice

8B070D532 CRREL Start-up Tests

8B070D533 CRREL Turning Radius

8B070D534 CRREL Modified Captains Maneuver

8B070D535 CRREL Breaking Out of Channel

8B070D536 CRREL Broken Ice Channel Resistance

8B070D537 CRREL Backing and Ramming Thick Ice

8B070D538 CRREL Pressure Ridges

8B070D539 ELC Trafficability in Ice

8C071D531 NCSS/AICC Access

8B100D531 ELC Hull Load Test

8B100D532 ELC Rudder and Steering Gear Test

8B235D531 ELC Heavy Icebreaking Test

8B235D532 ELC Bollard Pull/Crash Stop Test

8C420D531 NCSS/AICC Meteorological/Navigation

8C573D531 NCSS/AICC Cranes

8B070D631 NRC/IMD Data Collection for Ice Properties

8B070D632 NRC/IMD Prediction of Ship Maneuvering

8B070D633 NRC/IMD Ship Motions and Global Loads

8B050D631 NRC/CHC Evaluation of Ice Regime System

8B050D632 NRC/CHC Voyage Date for Evaluation of IRSS

Phase 4

8C424D541 NCSS/AICC Acoustic Doppler Current Profiler

8C424D542 NCSS/AICC Bottom Mapping Sonar

8C493D541 NCSS/AICC SDN

8C424D544 NCSS/AICC Bathy 2000

8C465D541 NCSS/AICC ODAS/XBT

8C433D541 NCSS/AICC 45MC

8C434D541 NCSS/AICC CCTV

8C573D541 NCSS/AICC Starboard A-Frame

8C573D542 NCSS/AICC Aft A-Frame

8C589D541 NCSS/AICC Science Hoist, 6000 lbs

8C591D542 NCSS/AICC Coring Equipment

8C591D541 NCSS/AICC Winches

8C666D543 NCSS/AICC Climate Controlled Chamber

8C424D543 NCSS/AICC Digital Survey Fathometer

8C521D541 NCSS/AICC Uncontaminated Science Seawater

8C591D543 NCSS/AICC CTD

8C666D542 NCSS/AICC Thermosalinograph

8C666D541 NCSS/AICC Fluorometer

8C591D546 NCSS/AICC Meteorological Data Collection

8C591D544 NCSS/AICC Science Buoy

8C591D545 NCSS/AICC Science Towing

8C666D544 NCSS/AICC Uncontaminated Seawater Incubator

8C071D541 NCSS/AICC Access

8C573D543 NCSS/AICC Cranes

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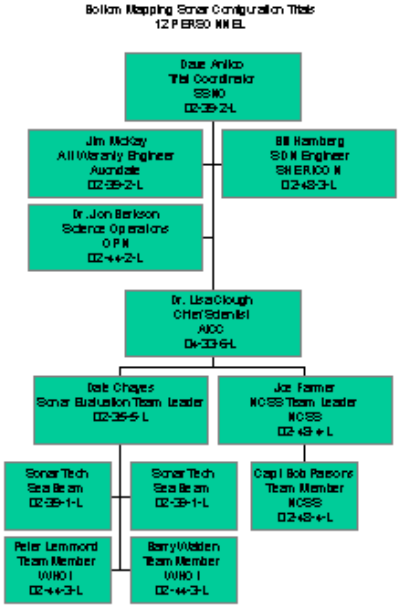
ICE TRIALS
PHASE I



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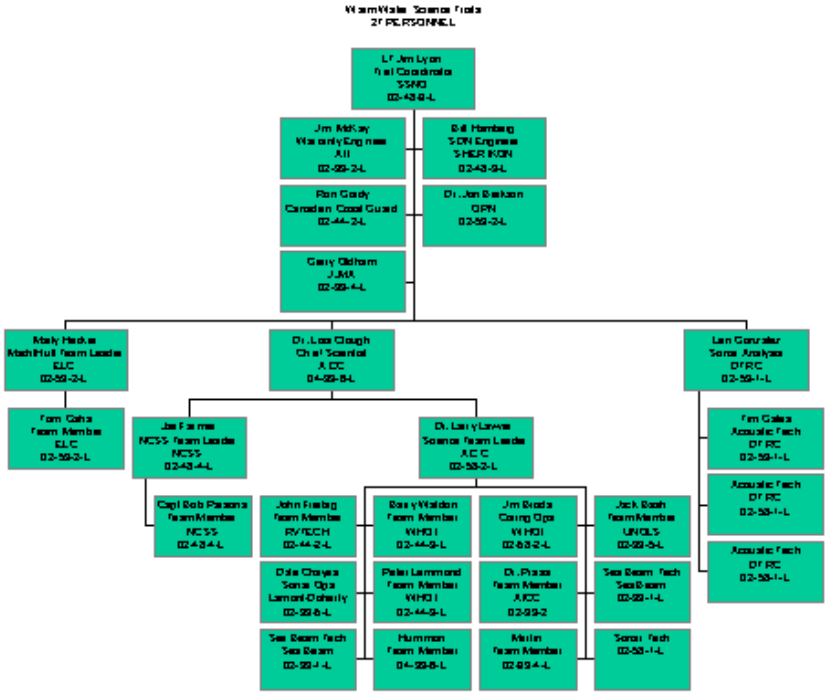

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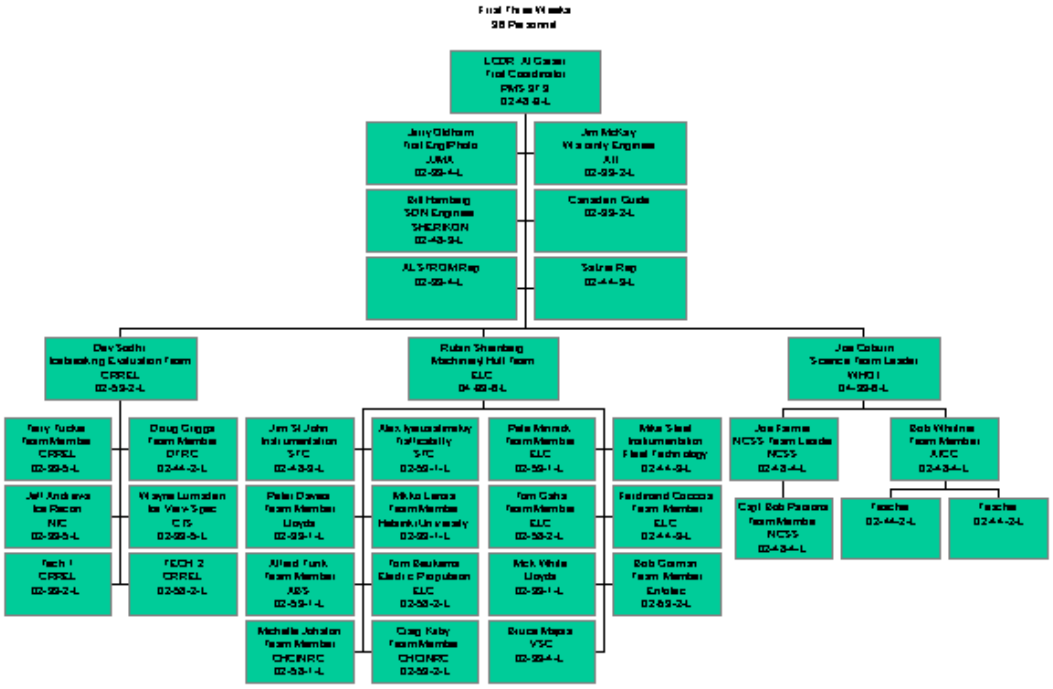

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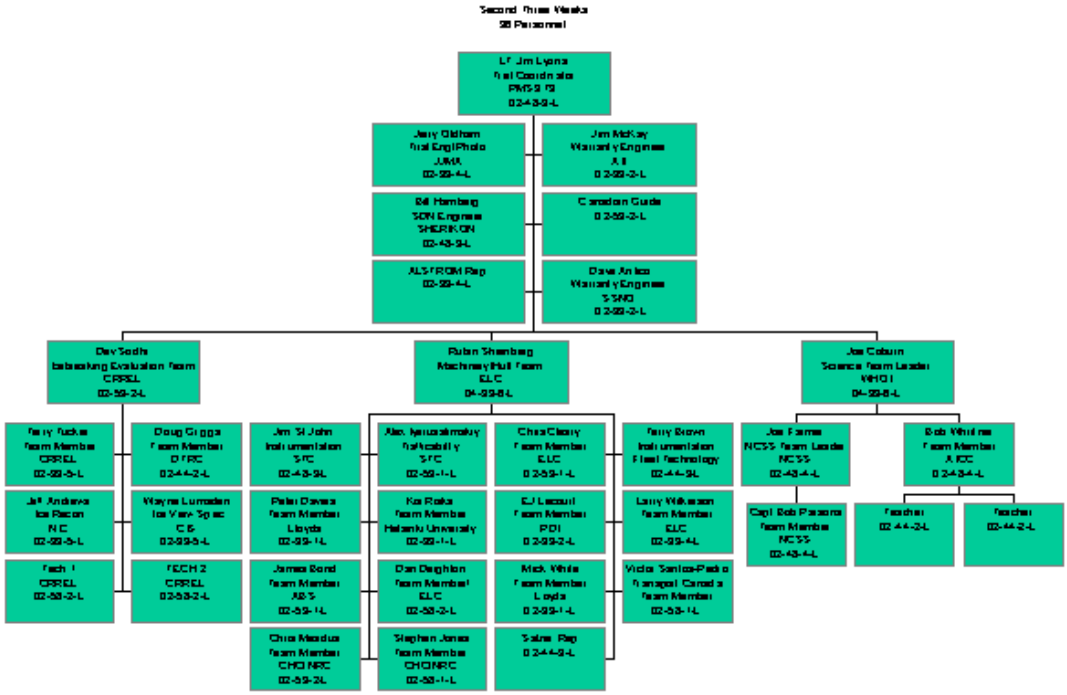

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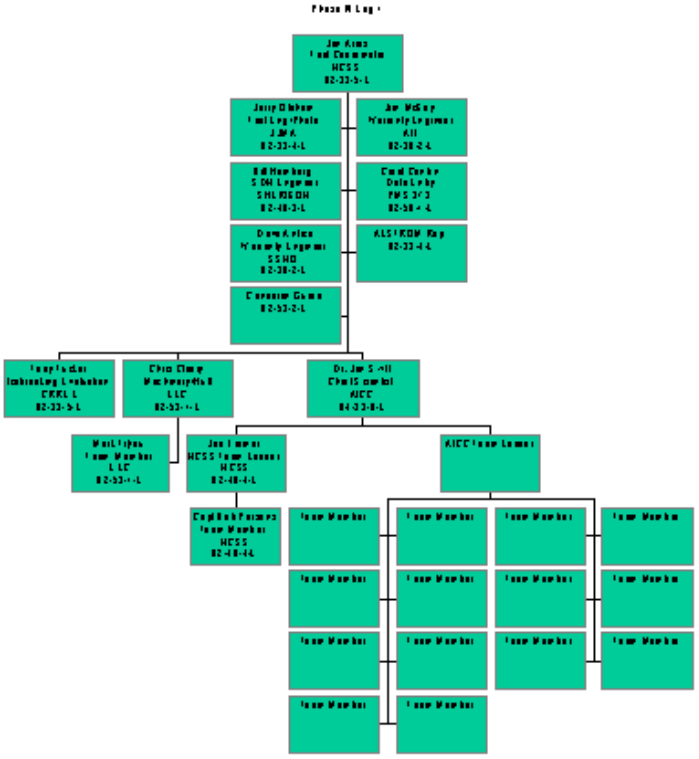

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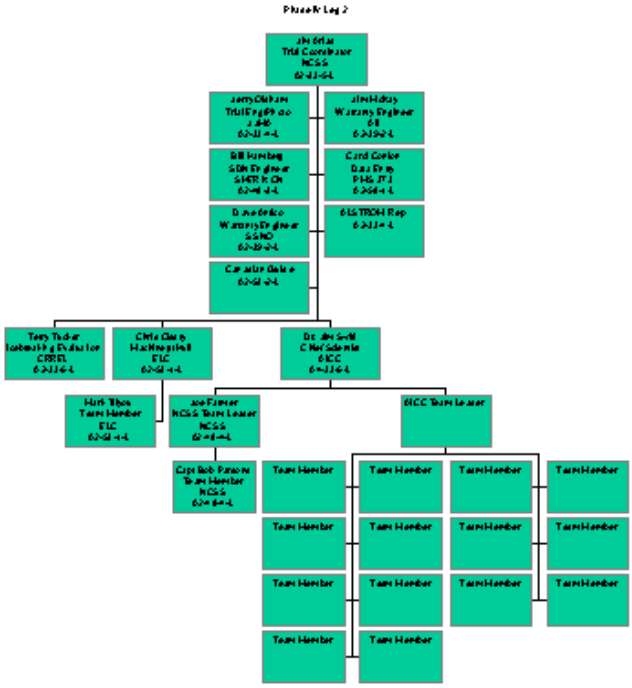

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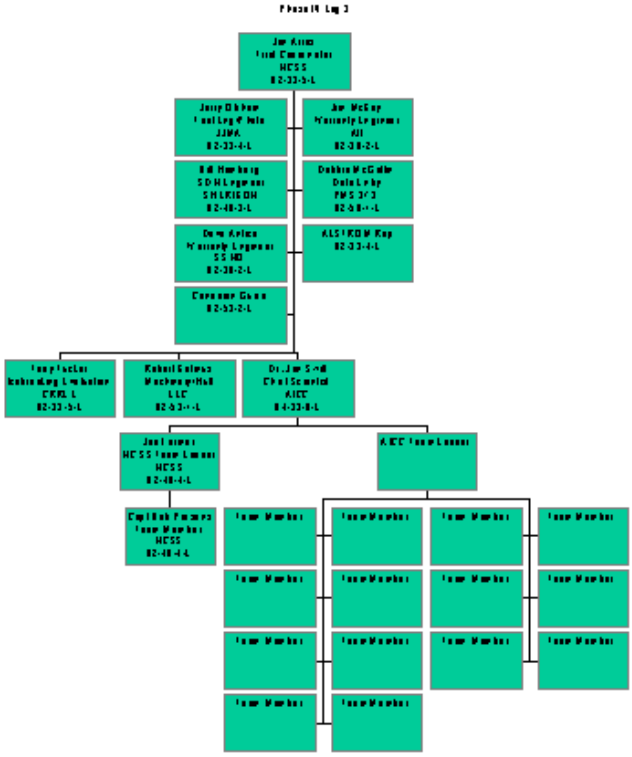

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PHASE IV