Onyx Special Services, Inc.
Standard Operations & Procedures

Start of Day

1. Weather Assessment
    a. Onyx Project Superintendent references NOAA Weather forecast, USCG observations and MAFOR for current weather conditions and trends.
    b. Favorable weather conditions will allow for wave heights of 3 foot or less dependant upon prevailing wind direction.
    c. An objective decision will be made by the Onyx Project Superintendent (with input from the Client Representative and Durocher Barge Captain) concerning barge movement. This decision will take into consideration factors such as window of opportunity, location and amount of work to be accomplished, as well as whether conditions are degrading or improving.
2. Ship traffic concerns
    a. Durocher Barge Captain communicates with USCG concerning any traffic issues that could impede work safety.
    b. Durocher Barge Captain will maintain watch for traffic concerns while under tow as well as when anchored and deal with them as needed.
3. Breathing and Treatment Gas Stores
    a. Onyx Project Superintendent will insure that suitable stores of breathing and treatment gas are in place prior to barge movement.
4. Equipment Startup
    a. While decision to sail is underway, deck crew begins equipment startup procedures
    b. Navigation equipment is started including Hypack, GPS and gyro compass.
    c. Note: Gyro compass requires 30 minutes of spin-up time prior to barge movement.
    d. Generators, compressors, cranes and all motorized equipment are warmed up and checked for serviceability.
5. Decision to Sail
    a. Onyx Project Superintendent (with input from the Client Representative and Durocher Barge Captain) weighs all information above and decides whether or not to sail.
6. Notice to Concerned Parties
    a. Enbridge representative calls control center and provides notification of impending work
    b. Durocher Barge Captain communicates with USCG about our position. Notice to Mariners issued.

Positioning Over Repair

1. Determination of Span Location to be repaired will be made by Enbridge representative.
2. Barge is to be navigated into anchor positions which have previously been plotted into the Hypack / DGPS navigation system.
3. Barge is positioned over the repair location as identified on the Hypack / DGPS navigation system, with the Port side tool launching location of the barge directly over the repair area.

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4. Barge movement is observed for at least 10 minutes to insure the position can be held within a 5 foot radius as affected by prevailing surface wind/wave conditions.
5. Observation ROV is launched and placed at the span location.
    a. Reference ROV daily operating procedure for system checklist.
    b. Span location is surveyed to determine exact anchor location guided by conditions such as span height.
    c. ROV operator places gauge pole next to pipeline at repair location so as to determine the height of the span and to mark the repair location for the diver.
6. Diver's bell is launched and lowered to a depth equivalent to 10 feet above the pipeline invert.
7. Bell position is monitored via the ROV and Hypack / DGPS navigation system for at least 10 minutes to insure the position can be held within a 5 foot radius as affected by prevailing subsurface current conditions.
8. Determination of GO / NO-GO for anchor placement is made by the Onyx Project Foreman with input from Enbridge field representative and Durocher Marine Foreman. Onyx Project Foreman will have final authority to abort the procedure if conditions appear unsafe in his estimation.

Helical Screw Anchor Placement

1. Anchor assembly is assembled on deck and placed into drilling tool.
    a. Screw leads are fastened to the required extensions (as determined by the repair and soil conditions) with galvanized bolts and nuts tightened securely.
    b. Anchors are threaded into the support beam, with the beams shaft receiver resting on the first extension joint.
    c. Anchor assembly is loaded into setting tool and drive Kelly pinned.
    d. Hanger strap, bolts, spacer and tools are loaded onto their respective carriers on the setting tool.
2. Anchor assembly / tool is lowered into the water
    a. Assembly is placed in such a manner as it does not descend directly over the pipeline, and so the crane may simply swing it into position over the pipeline when near the bottom.
    b. Descent is to be monitored via the ROV
    c. Descent will be stopped when the tips of the screw leads are 5 feet above the pipeline.
    d. No movement of the assembly toward the pipeline will be permitted unless the crane operator is in direct contact (either via radio or through the person on deck designated by the Onyx Project foreman)
3. Diver Enters the water
    a. Descent procedures as applicable to depth and breathing gas. Reference USN tables or approved replacement.
    b. Diver reaches bottom and locates work area.
4. Drilling tool is moved into position over the pipeline
    a. No movement of the assembly toward the pipeline will be permitted unless the crane operator is in direct contact (either via radio or through the person on deck designated by the Onyx Project foreman)
    b. Movements of the drilling tool are accomplished exclusively through the use of boom swing and main hoist. Should these movements not be sufficient to accurately place the drill tool, repositioning of the barge will need to occur.
    c. Prior to final movement over the pipe, the diver will obtain the HDPE pipe shield from the setting tool, and place it around the pipe to aid in prevention of pipe / coating damage.

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d. The diver will utilize a tagline to assist in placement of the tool.
e. Tool is lowered over the pipeline ensuring that "tuning forks" have engaged the pipe on both sides of the tool.
f. Descent is stopped as screw leads make contact with firm soil.

5. Drill motors are engaged.
   a. Diver requests "drill hot" to topside supervisor.
   b. Independent drill controls must be held in the "ON" position.
   c. Any team member may call for "cold" on the drill motors if they spot a potentially hazardous situation.
6. Diver (with aid of the ROV) guides the crane operator to "chase" the screw anchor with the tool.
   a. Screw leads should be held plumb as they are imbedded.
   b. Very limited tension on the crane should be held in an effort to maximize down force.
   c. Movements of the drilling tool are too accomplished exclusively through the use of boom swing and main hoist. Should these movements not be sufficient to accurately place the drill tool, repositioning of the barge will need to occur.
7. Diver chains up the "tuning forks" periodically as the anchors imbed. This insures a more rapid recovery of the tool from the pipeline should an emergency removal be required.
8. Individual drill motors are optimized to insure proper placement of the screws.
9. Topside crew monitors drill motor pressure and notifies dive control when the appropriate pressure has been met.
10. Diver notifies dive control when support beam is touching the pipe guard.
11. Drills are disengaged
12. Drill tool is prepped for removal
    a. Diver removes 3-fingered pins
    b. Tuning forks are chained tight
    c. Diver insures crane is centered on load
    d. Note: This procedure will be completed should the drilling procedure not be completed in one dive; to allow for emergency removal of the tool should barge positioning become unstable.
13. Diver directs the crane to lift the setting tool and set it down 15 to 20 feet east of the pipe. Movement should be coordinated so no additional suspension over the pipeline is required.
    a. Movements of the drilling tool are accomplished exclusively through the use of boom swing and main hoist. Should these movements not be sufficient to accurately place the drill tool, repositioning of the barge will need to occur.

Pipeline Support Assembly Completion

1. Diver recovers tools from drilling tool
2. Support beam bolted to anchor pipes
   a. Using lifting bar assembly, diver lifts support beam into position.
   b. Line up bolt holes on each anchor using spud wrench.
   c. Insert and tighten 3 bolts for each anchor (6 total)
   d. Remove lift bar assembly and replace on setting tool.
   e. Remove HDPE pipe shield and replace on setting tool.
3. Install support strap.
   a. Hang strap with soft line under pipe.
   b. Place pipe spacer between pipe and support beam.

c. Place 4 support bolts through support beam and into pipe strap, using load distribution plates on top of support beam.
d. Place nuts on the bottom of each support bolt by hand, insuring that no cross-threading exists.
e. Tighten bolts in a criss cross pattern with a hydraulic impact wrench until the pipeline is fully seated in the support strap and the spacer is tight.
    i. Note: Do not over tighten bolts

4. Final cleanup of work site.
    a. Remove any residual tape and line from pipeline and support assembly (secure to setting tool)
    b. Place tools and gauge rod back onto setting tool.
    c. Direct crane to recover the setting tool to the surface.
        i. Note: lift should be accomplished as far away as possible form the pipeline.
    d. Recover diver to the surface.
        i. Reference applicable dive tables and procedure
    e. ROV completes final inspection of assembly
    f. Recover ROV to the surface
    g. Barge is prepped for move to next location.

Onyx Special Services, Inc.
Hydrographic Standard Operations & Procedures

PHANTOM HD2 & RELATED EQUIPMENT

Equipment Overview:

Onyx employs the Phantom HD2 Remote Operated Vehicle (ROV) as our primary work class inspection vehicle. Manufactured by Deep Ocean Engineering (DOE), it is a free-swimming vehicle tethered to a surface support vessel and/or transportable control center. It is equipped with a remote pan/tilt/zoom video camera with auto focus controls, as well as 1000 watts of total lighting. The ROV gets its power from 5 thrusters (2 forward, 2 horizontal opposing, and 1 vertical), which enable the ROV to achieve lateral speeds and/or maneuver in currents of greater than 2 knots. The standard umbilical is 1,000-feet long, but an additional section can be added to give the vehicle a range of up to 2,000' from the control center. The vehicle can also be outfitted with a number of different instruments; including sector scanning sonar, acoustic underwater positioning beacons, auxiliary camera, and two function manipulator.



Sector scanning sonar (when mounted vertically) enables ROV operators to see objects out of the visual range of the video camera and/or in low visibility environments. When mounted in the horizontal position, these sonars can be used to identify internal pipeline conditions--such as out-of roundness, sediment buildup, and deformations. Onyx uses an Imagenex 881a sector scanning sonar in conjunction with our ROV operations when needed.

For underwater positioning information, Onyx operates the Linkquest TrackLink 1500+ system. The system uses a transducer mounted to the ROV to transmit its location to a transceiver mounted just below the surface of the water. The system will include Trimble DGPS/RTK units for positioning (RTK 5700 for this project with AG132 DGPS as a backup), TSS Standard Gyro for accurate vessel heading, and a TSS MRU (DMS-25 or better) for heave, pitch and roll compensation. All component data streams will be integrated into HyPack for real-time corrections and display.

System Performance:

The Phantom HD2 derives its power from a 220v (5kW minimum) AC supply, usually a portable generator dedicated to the unit. This supply feeds into a power inverter for conditioning before being feed to the control center hardware. The surface control center hardware converts the conditioned power source into a variety of DC voltages, from 12 to 48 volts, which are sent to the components in the ROV via the umbilical. Once supplied to the umbilical, all power being transmitted to the ROV and its instruments is completely enclosed—thus creating an intrinsically safe environment from the umbilical to the sub-surface components. The control center, however, is not intrinsically safe and care must be taken in selecting its location when working around suspected hazardous environments. The sealed ROV housing is protected

from damage by a 1 ½" diameter stainless steel crash frame which also serves as a support for mounting auxiliary equipment.



Video from the on-board camera is sent to the surface and recorded in standard VHS formats (SP & EP). The video unit can be programmed to display other information on-screen along with the raw video footage--such as depth, heading, position, date/time, and titling information.

Our sector scanning sonar has a selectable scanning angle from 10° to 360°, and a radial range of 4.5 to 180 feet. Images are captured in BMP format, but can easily be converted to JPG, TIF, and/or scaled into AutoCAD for measurement. The unit is controlled through its specific software operated on a standard laptop computer.

Project Setup:

Prior to beginning the days survey activities, the control center location must be selected. Because the control center and its components are not intrinsically safe, care must be taken in the selection of this location. In suspected hazardous environments, the operators shall monitor possible sites with an appropriate field air-sampling meter prior to selection. Care shall be taken to identify any possible sources of hazardous vapors and the wind patterns associated with the final site selection. Once the site is selected, the control center will be setup. The generator or power supply shall be located as far as possible from the control center to minimize noise and the potential for exhaust fumes in the area. Whenever possible, the generator or power supply shall be grounded to an appropriate source to prevent static arching. In instances where the ROV will enter a hazardous environment, a decontamination area including plastic ground liners and a ROV washing containment area will be set up as close to the entry/exit point as possible. If entry point is a manway, hatch, or other vertical shaft, a tripod and pulley system capable of supporting 200 lbs will be setup over the entry/recovery point.

The power inverter and other components of the control center are environmentally sensitive to wind and water, thus care will be take to locate them within a sheltered area. Setup of the control center includes all cable hookups (including the umbilical to the control unit) with the exception of the umbilical to the ROV and the power supply to the inverter. At this time, any laptops used for sonar and/or positioning equipment will also be connected into the system. Once the control center is setup, the ROV will be configured for the project's activities. Configuration of the ROV for this project will include mounting of the sector scanning sonar, positioning transponder, auxiliary camera and lighting, and the manipulator within the crash frame of the vehicle. The auxiliary camera/light will be mounted in a forward-facing direction (this camera is normally mounted in a rear-facing position) low in the crash frame. Mounting the auxiliary camera/light in this fashion will allow the best possible field of vision for determining the start/end points of the various pipeline events.

For the purposes of this project, the control center will be located within the cabin of the survey vessel. The generator will be the only component of the system located outside of the cabin, on the back deck with the exhaust facing outboard. Once the control center is setup, it will remain in-place until the surveys are

complete. Onyx personnel will develop an anchoring strategy for surveying the pipelines once on-site. Given the level of accuracy required, the lake bottom terrain, and the limitations of acoustic positioning equipment; anchoring positions will be set no more than 600' apart (300' radius under the boat). The only exception to this anchoring strategy will be positions within the shipping channel, whereas the anchor positions will be 1000' apart and set on either side of the channel.

Daily Procedure:

High winds/surf, lightening, and fog are the most common weather related hazards faced by marine personnel. Knowledge of expected weather patterns for the duration of the day's work activities is an absolute must. Onyx personnel are required to obtain weather information from two different sources (at a minimum) prior to beginning their daily activities on the water. In addition, hourly monitoring of the Marine Weather Information Band on-board the vessel is required to track any changes that many affect their continued activities. All weather related stoppages will be discussed with the client and project contacts—but, for safety reasons related to our experience and expertise in the marine field, *ONYX RETAINS THE RIGHT TO MAKE THE FINAL DECISSION ON WHETHER OR NOT WORK WILL BE CONDUCTED AND/OR CONTINUED.*

Upon determining that suitable weather is predicted, the RTK base station will be setup and calibrated. At the same time, the location for the first anchoring point for that day will be displayed on the HyPack navigation screen for the vessel captain. HyPack will also be used to display the pipeline positions, depth contours, vessel position, and the ROV position (once deployed). Onyx will also fill out a copy of our standard Survey Log that details the site conditions, calibration results, water datum, project geodesy, and surveyors' names at a minimum. Along the way from the dock to the work site, wave heights and wind speed/direction will be monitored and confirmed as suitable for the day's activities. Once at the anchoring position, the vessel will be moored on two anchor lines, with the vessel's final position centered over the pipeline to be surveyed. The deck hands will then prepare the ROV and davit for launching.

With the sonar, transponder, cameras/lighting, and manipulator attached and operating; the ROV's main housing will the tested by applying a vacuum and monitoring a gage to ensure a proper seal is attained. If a leak is found, the ROV will not be powered up and/or launched until all of its seals are checked and re-seated. Upon completing a successful vacuum test, the umbilical will be connected to the ROV and secured in place. At this point, the generator and/or power supply will be activated and connected to the control system.

The following system checks will be performed prior to commencement of work:

1) Power Supply – Indicator lights and main unit gage will be check for the appropriate output.
2) Video Transmission – Video clarity and on-screen programming will be configured and confirmed on the control display screen. In addition, pan/tilt/zoom functions controlled from the joystick control unit will also be confirmed as functional on this display.
3) Video Recording Equipment – A 10 second sample video will be recorded on the surface and played back to ensure video operation. The sample will be recorded over upon successful completion.
4) Thruster Tests – All five thrusters will be monitored for axial, lateral, and vertical operation from the joystick control unit.
5) Sonar Calibration – If used, the sonar it be powered on and calibrated to zero heading (vertical mount) or the 12 o'clock (horizontal mount) position.
6) Manipulator Tests – Test the functions available for the electric manipulator.

With the system checks completed, the ROV will be deployed using the davit into the water. The ROV will be piloted down to the pipeline and centered under the vessel. Once in place, the acoustic positioning and the MRU equipment will be tested and confirmed that it is operating correctly. Then the video recorder

will be started and the ROV's initial position will be recorded on the daily Video Log that records tape positions, ROV positions, and notes detailing significant events along the pipeline. The ROV will then proceed northbound along the pipeline for a distance of 350' (and/or half way to the next anchor position), then turn the vehicle and fly back southbound (beyond the start point) an equal distance (termed a "survey run"). Whenever possible, the ROV pilot will fly the vehicle along the east side of the pipeline going northbound and on the west side when returning southbound. At regular intervals, the pilot will fly the vehicle over the top of the pipeline to check its position.

During the inspection, significant events (start/end of spans, deformations, damage, debris, etc.) will be recorded on the Video Log. At each event seen the ROV cameras will be positioned determine the best probable start point for the event. Once the start/end point is determined (the Enbridge representative will be consulted on all start/end points), the ROV will be re-positioned over the point and the event location will be recorded on the Video Log. An attempt will be made at each span located to ascertain the average and maximum height of the span and record this information in the Video Log. At the completion of the survey run, the ROV will be recovered and the videotape will be stopped. The anchors will also be recovered and the crew will make a decision (based on predicted weather conditions and hours of operation) whether to continue on to another anchor location.

Upon completion of the day's activities, the ROV will be recovered and equipment will be shutdown. All videotapes, logs, and other survey related information will be completed and copied. The day's activities will be summarized in a progress report (submitted to Enbridge) and marked on a map posted in the vessel.

RTK VESSEL POSITIONING SYSTEM

Equipment Overview:

To achieve reliable accuracy within ± 2-3 centimeters in the horizontal and vertical planes requires the use of a Real-time Kinematic (RTK) positioning system. The system combines DGPS satellite positioning with a land-based beacon set at a known location or benchmark. The land-based beacon is in constant communication with a mobile beacon (on the boat) via a radio link. The system is able to interpolate the mobile beacon's position by calculating a "solution" derived from the positions given by a number of satellites, the differential signal, the land-based beacon position, and the distance measured between the two beacons via their radio link.

The DGPS and RTK systems used for the 2004 portion of the project is the Trimble 5700 base unit in conjunction with a Trimble 5700 Rover Unit. The 5700 base unit is controlled with the Trimble TSC1 data logger which also serves as the benchmark point coordinate data input/storage device. The 5700 system uses the Trimble Trimmark II base radio transmitter, with a mobile unit has an internal Trimble receiving radio.



System Performance:

Because the link between the base unit and the mobile beacon must be maintained, there exists the possibility that "dead zones" will exist in the survey area (zones within the survey area where radio signal is lost). The HyPack navigation software will also be configured to activate a visual alarm to alert the operators when unacceptable accuracy conditions or dead zones are present. The three modes of RTK survey are: fix (accuracy ± 2 to 3 cm), float (accuracy ± 1 meter), and autonomous (accuracy ± 30 meters). HyPack will be configured to display the mode of RTK survey accuracy in real-time and alarm when no

data is present. Moving the base unit may eliminate dead zones; however, if this does not remedy the situation, the client representative will be consulted and the area will be noted.

Daily Procedure:

Prior to beginning the days survey activities, the RTK base station will be setup over a pre-existing benchmark provided by the client (north end of crossing). Once setup, the base station benchmark position point will be entered (the position point is a preset point containing the vertical/horizontal position of the benchmark) into the TSC1 unit. Next, the operator will power on the base station (via the TSC1) and confirm that both are functioning properly (refer to the operations manuals for the TSC1 5700 units).



Onyx will perform two verification checks on the system once the base station is set and operating correctly. The first verification will involve the operator powering on the Trimble mobile unit, placing the mobile antenna over the base station benchmark, and checking/recording the output position. The output position from the mobile unit should match the benchmark position within 1 thousand of a second when functioning properly in RTK fix mode. The positioning/setup information for this verification will be recorded on the daily survey log.

The second verification on the system is to relocate the mobile unit to another adjacent benchmark and verify the mobile output in the same manor as was outlined for the base station position. As before, the mobile antenna will be held over the benchmark and its position output will be compared to the known position of the benchmark. This second verification will also be recorded on the daily survey log. At the end of the survey day, the second verification procedure will be repeated at the same benchmark used in the beginning of that day.

Onyx will have standard DGPS positioning available at all times on the vessel. Throughout the survey day, random checks can be made between the two positioning outputs to confirm their performance. If at any point in the survey the operator or client representative observes a difference of greater than 1 meter between the two systems, the survey will be halted and both systems will be checked for possible errors.

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ENBRIDGE

Adam J Erickson

06/25/2004 09:46 AM

To: Mark S Sitek/LPL@LPL, John R Sobojinski/LPL@LPL, Mark F Newman/LPL@LPL, Mark J Willoughby/LPL@LPL

cc:

Subject: Method of Execution & Outages-Straits of Mackinac-DRAFT-PLEASE REVIEW AND COMMENT

File Database: File:

Would you like the recipient to view the FILING info? ○ Yes ● No

For this year's round of inspection and repair on the Straits of Mackinac, we have defined the general schedule for the inspections and repairs.

1.Leg A (I am not yet sure which leg will be inspected first, so I will call each leg Leg A, and Leg B respectively) will be shut down, and locked in with NGL.

2. ROV inspection of Leg A will begin on July 19, provided NGL is locked in that leg

3. The Repair barge will be available to commence repairs on July 20th

4. The inspection will continue on Leg A. As locations for installation of anchors are identified, they will be placed as soon as the repair barge can place them (working daylight hours only).

5. If the ROV inspection finishes before the all anchors are installed, it will proceed with replacing batteries on current meters and/or placing tilt sensors pending direction weather these are to be installed or not. If the repair barge finishes before the ROV, it will either go on standby, or one of a couple other options: A. Place additional supports on the longest spans identified, likely under 140', as the full barge crew will be paid for the time regardless. B. Place a test anchor and try to remove it to confirm its loading capacity

6. Upon completion of the ROV survey, and installation of all necessary anchors on Leg A, it will be reactivated.

7. Upon reactivation of Line A, Leg B will be shutdown and locked in with NGL

6. After Leg B is shutdown/locked in with NGL, the ROV will begin the survey on Leg B.

7. Upon identification of need for anchors, they will be placed by the barge crew until all are completed.

8. If necessary, the ROV will complete any current meter battery changeouts/tilt sensor installations.

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Checkon value closing Characteristics

What is minimum clearance for pipe installation