Expedition 402T

08 April – 04 June 2024

Napoli, Italy – Amsterdam, Netherlands

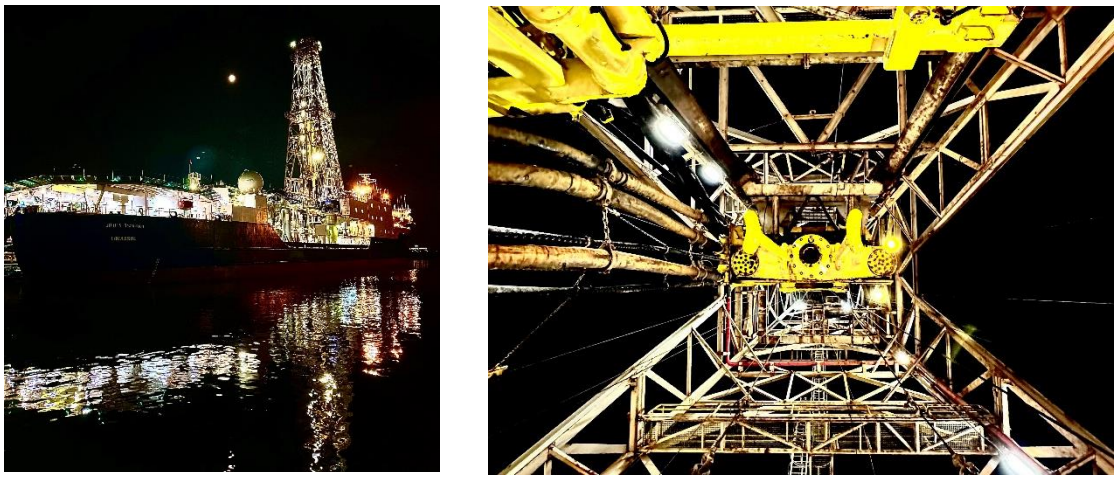

Figure 1. JOIDES Resolution at Night and its Freshly Painted Draw Works

Expedition Engineering Report

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JRSO Engineering Support

Contents

Figures

iRIS Rig Instrumentation System

a) Hardware

No hardware changes were made during this leg.

b) Software Coding Development

During this expedition, some changes to the iRIS code were made remotely from JRSO. The types of changes made, in general, were:

- Continued to decouple the original version's "Driller Worksheet" to decrease latency and improve overall performance.
- Large improvements in the simplification of the Driller's User Interface (DUI), reducing the required interactions of the driller to a minimal amount of "button clicks" to prepare, start, and operate the Driller's Interface while allowing full data collection.
- The "Kitchen Sink Report" web reporting module is functional, but in future versions, this will be simplified to a network-stored flat file (see below)
- Move the code from a virtual machine (VM) in the MCS data to directly onto the cRIO controller. This was done to improve failure recovery, and to allow for faster processing.

c) Reporting Module

The reporting module was tested and found to successfully pull data from specific time periods. The dataset, however, is quite large currently, and is planned to allow the requestor to select specific channels and time boundaries to greatly shrink the report size. However, as a project criterium, the "Kitchen Sink" report meets the original charter requirement to report data equivalent to the current RigWatch system in a more simplified manner.

The next version of the reporting module will simply output a single, twenty-four (24) hour's range of data before closing the file and starting a new file. This file will be in a comma separated value (CSV) filetype, that will be compatible with the vast majority of data analysis systems, further simplifying the data reporting aspect of the iRIS system and eliminating all requirements for licensing of database access software.

The ease of generating an iRIS data report is as follows:

1. Run the java script "iRIS Kitchen Sink Report" from the Operations Superintendent desktop computer
2. Enter the date and time range that the user is interested in in the pop-up dialog

Figure 2. iRIS Report Module

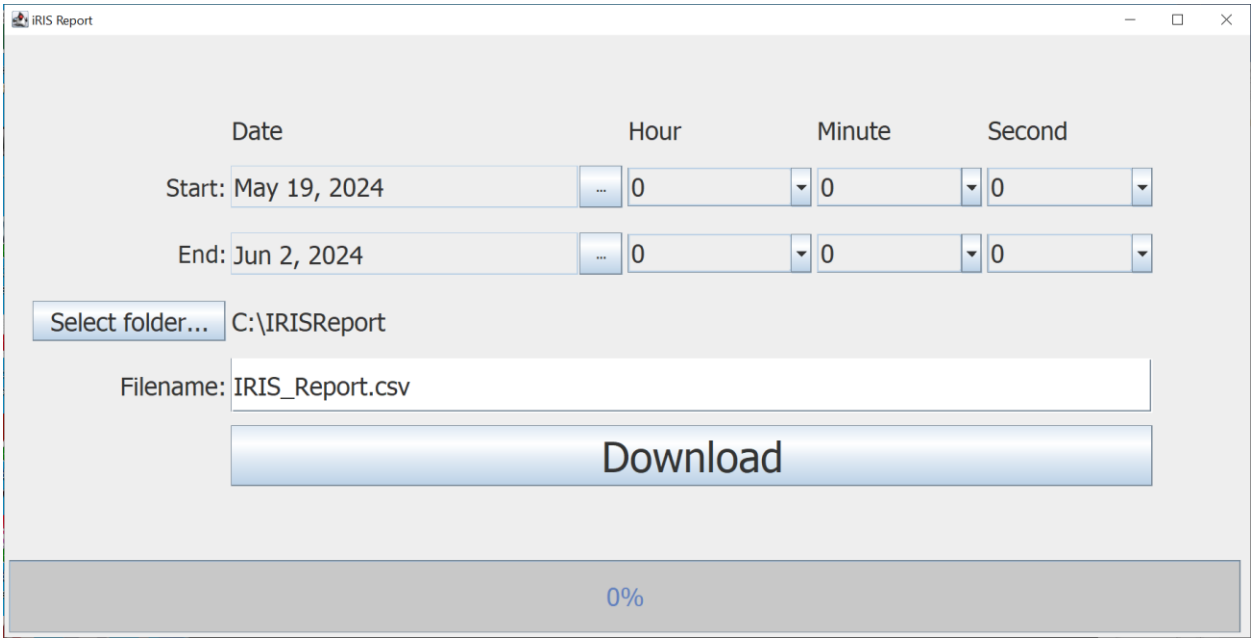


Figure 3. iRIS Kitchen Sink Report Input

3. Generate the report.

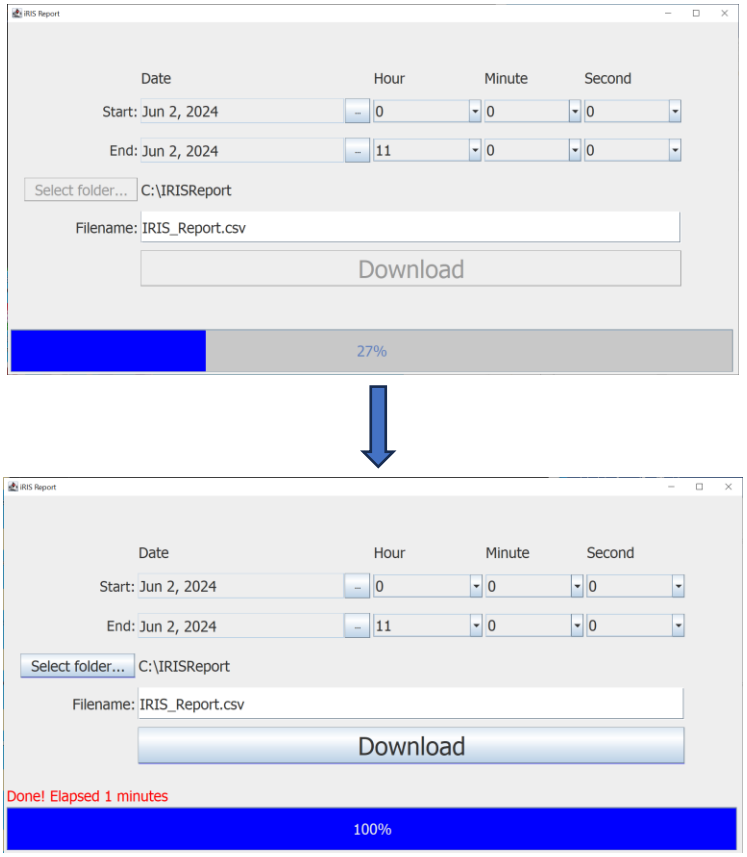


Figure 4. Running an iRIS Report

Go to the selected folder where the file is stored and open with a data analysis package, such as Microsoft™ Excel™.

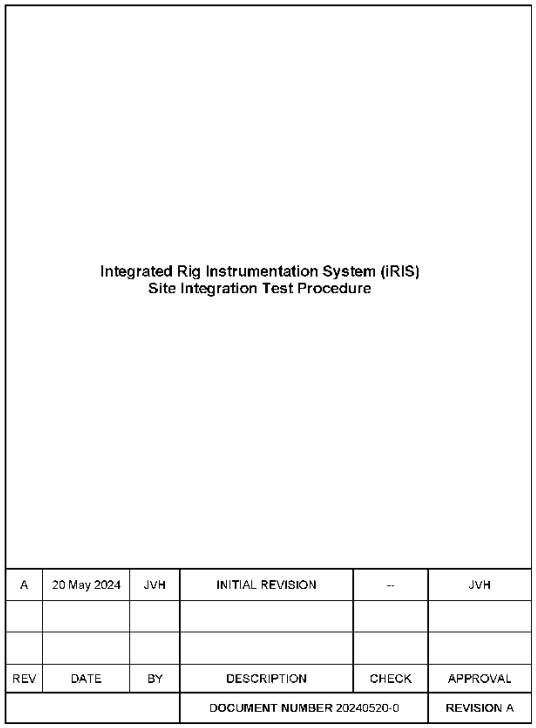
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
1	Date/Time	Lat	Lon	Block position	DEPTH_BIT	Water Depth	Water Depth (PDR)	Bit Depth (mbsf)	Hole Depth (mbsf)	Hole Depth (mbrf)	Core Line Depth	Core Line Tension	Hookload (Active)	WOB (kibs)	Standpipe Pressure	Torque (amps)	RPM	Heave	Roll	Pitch	VIT Depth	Mud Pump
2	6/2/2024 0:00	52.404697	4.884073	0.709	-0.04	1000	0	0	0	1000	0	5.978608	128.343	0	15	-70.17	-0.3	0	0	0.4	-38.2	0
3	6/2/2024 0:00	52.404697	4.884073	0.722	-0.04	1000	0	0	0	1000	0	6.03273	128.343	0	33	-68.842	-0.6	0	0.1	0.4	-38.2	0
4	6/2/2024 0:00	52.404697	4.884073	0.712	-0.04	1000	0	0	0	1000	0	5.984184	126.111	0	28.4	-71.264	0	0	0	0.4	-38.2	0
5	6/2/2024 0:00	52.404697	4.884072	0.692	-0.04	1000	0	0	0	1000	0	5.974344	126.971	0	17.1	-70.327	0.1	-0.1	0	0.5	-38.2	0
6	6/2/2024 0:00	52.404697	4.884072	0.705	-0.04	1000	0	0	0	1000	0	5.951711	129.397	0	21.6	-72.306	-1.3	0	0	0.3	-38.2	0
7	6/2/2024 0:00	52.404698	4.884072	0.712	-0.04	1000	0	0	0	1000	0	6.003209	127.165	0	43.4	-66.888	-1.4	0	0.1	0.3	-38.2	0

Figure 5. Generated "Kitchen Sink" Report

d) Testing of the improved iRIS system

It was anticipated that a full site integration test (SIT) would be performed while in port to test the major functions

The code changes outlined above, however, were hampered due to very slow network connections between the JR and the JRSO, in conjunction with network collisions with multiple devices trying to connect with the cRIO. Billy Miller (Engineering Support) alleviated many of these issues, but the solution took too much time and the initial test was not able to be conducted as planned prior to the end of the expedition. A copy of the test procedure has been left with Expedition 403 Ops to try to get a test of the system completed if the debugging can be completed. The test procedure is included as Appendix A at the end of this report.


Integrated Rig Instrumentation System (iRIS)
Site Integration Test Procedure

REV	DATE	BY	DESCRIPTION	CHECK	APPROVAL
A	20 May 2024	JVH	INITIAL REVISION	--	JVH
			DOCUMENT NUMBER 20240520-0		REVISION A

1. VIT Sonar Troubleshooting

Sea1's Electrical Technicians informed us that the VIT sonar was not functioning correctly.

An initial test showed that unit 300172 was not communicating with the Seanet Pro software on the computer in the DP room. Initial troubleshooting began with verifying all Seanet Pro settings along with the PC's communications (COM) settings. All PC and Seanet Pro settings were correct, and all cables were fully re-seated and secured in their proper slots.

As unit 300172 was not working despite proper settings, it was switched out with the secondary unit, 300173, to try and establish whether communications via the fiber optic cable might be impaired. Unit

300173 started communicating with Seanet PRO immediately upon being powered up, confirming that unit 300172 has an internal issue as no settings in Seanet PRO or the DP computer were changed.

As unit 300173 was communicating, it also appeared to have a movement-related issue, as it was presented with a jerking/stuttering motion as it scanned, issue as instead of a smooth, even sweep. Seanet PRO was further indicating the sonar could not center itself (self-calibrate with an internal magnet). See Figure 6 below

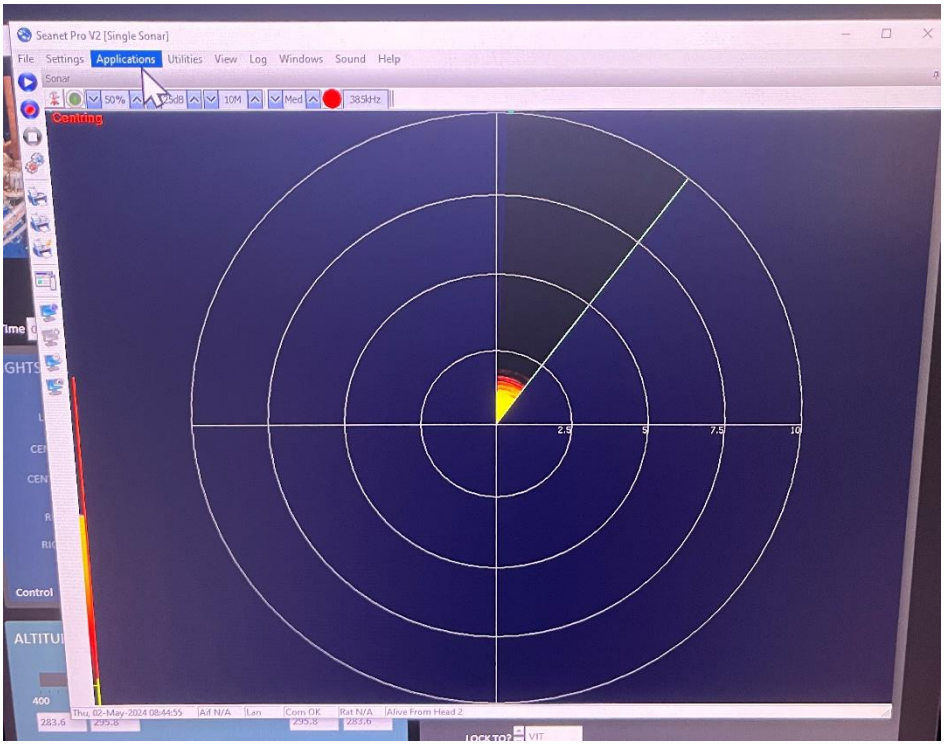


Figure 6. Sonar software indicating error in self-centering startup routine

Initial calls to the manufacturer's technical support, Tritech Int. (Tritech) , provided some additional troubleshooting paths to pursue. The units have two (2) indicator LEDs, one green and the other red, that should indicate certain things via blinking and/or turning on. The green LED should blink when communication and power are turned on. The red LED should light up and remain on once the unit "centers" (transducer head rotating and self-calibrating off a magnet that is in the transducer housing).

Unit 300172's green led never turned on or blinked and there was never any indication that it was receiving power properly (unsurprisingly, the red LED also did not turn on). Unit 300173's green LED did properly turn on and blink, however the red LED never turned on, indicating that the transducer head was not properly centering, something that is supposed to happen relatively quickly (normally in 3 to 5 seconds).

Tritech also suggested pulling the electronics packages and inspecting them to see if anything was obviously wrong such as dip switch or jumper settings being incorrect, which could affect the communication settings in the unit. They also suggested swapping the electronics packages between the two units to see if the transducer head in 300172 was functional. Even with the working electronics package from 300173 in the housing of transducer 300172, the unit would not center.

Both electronic units were restored back to their original housing. An additional troubleshooting suggestion from SubSea was to check if the transducer heads were properly seated on their press-fit shaft. As we have the unit installed head down, which is nonstandard, the head can slip down/loose from its press fit seating on the shaft, especially if jarred or bumped. Attempting to reseat the transducer head via pushing on the center of the head, as advised, did result in ~2-3mm of movement, which is about what Subsea suggested it might move if it reseated, however 300173 still failed to center when turned on, suggesting that either it still isn't fully press fit into place or that there are other issues with the transducer head.

A request to verify repair lead times for Tritech Int. in the United Kingdom got a response of 3-5 weeks. This does not fit the timetable available to have the units back on the JR before departure of Expedition 403.

A check of AMS showed that one unit had been previously repaired by SubSea Technologies (SubSea) in Katy TX. An inquiry was made about their lead times on unit repairs with them. SubSea gave an estimate of a 1 to 2-week turnaround for repairs which would allow the units to arrive back on the JR in sufficient time to install and test them before Exp 403 commences.

Further trouble shooting of the transducer heads would have involved opening the oil filled pressure housing and both Subsea and Tritech were strongly against doing so as that would increase the likelihood of issues if reassembled or refilled with oil incorrectly.

Both units were sent priority overnight to Subsea in Katy TX for analysis and repairs and arrived Friday, May 17th, 2024.

Subsea's diagnostics of unit 300172 found the following issues: stepper motor worn, transducer shaft bent, a bad power supply, and a blown fuse. Diagnostics of unit 300173 found the following issues: stepper motor worn, and a bent transducer shaft.

Both units will also receive new labels, due to current labels being worn/torn, new transducer oil, and new blue boots (transducer covers) as black boots are no longer made by Tritech. Repairs are expected to be completed sometime on May 30th and arrangements have been made for them to be picked up and taken straight to air freight.

2. Appendix

a) iRIS Site Integration Test (SIT) Procedure

Integrated Rig Instrumentation System (iRIS)
Site Integration Test Procedure

0	20 May 2024	JVH	INITIAL REVISION	--	JVH
0	02 June 2024	JVH	INITIAL RELEASE	JK	JVH
REV	DATE	BY	DESCRIPTION	CHECK	APPROVAL
			DOCUMENT NUMBER 20240520-0		**REVISION** 0

1 INTRODUCTION

The Engineering support section of the International Ocean Discovery Program (IODP) – *JOIDES Resolution* (JR) Science Operator (JRSO) has been tasked with design, development, integration, and deployment of a new Rig Instrumentation System (RIS) to supplant the currently deployed RigWatch RIS in use on the *R/V JOIDES Resolution* (JR). The primary purpose of the RigWatch system is to provide visual drilling indicators and to collect a variety of drilling criteria for later study by scientific and other disciplines. However, the RigWatch system suffered from several shortcomings, which provided the motivation to provide a newer, leaner RIS and improve the following characteristics.

i) Improved data collection and distribution method

The RigWatch system, while relatively easy to operate, has a complex procedure to isolate, extract, and deliver historical information. The RigWatch data file format is proprietary and must be converted to a more universal format to be used by those that request historical data, which includes scientists of varying disciplines.

ii) Make the application more universally installable

The RigWatch system as installed on the JR, is only compatible with PC-based computer systems, and not currently available for other systems (including iOS™- based computers, or stand-alone computers that are in use on the JR during normal scientific expeditions. There also is no way for real-time collection of drilling/coring parameters from the RigWatch system.

2 SAFETY

It is the intent of all stakeholders that all assembly and testing is performed with the highest level of safety possible. During these operations, everyone involved is encouraged to stop any process if a potentially unsafe condition is perceived or detected. This includes, but is not limited to, unauthorized personnel in the work area, dangerous practices being performed, or faulty equipment observed. Below is a list of minimum requirements during operation.

1. Job Safety Analyses (JSA's) are to be written and signed by all personnel performing work as required. Also, all toolbox discussion must be conducted by all test-related personnel prior to performing any operations.
2. Minimize any non-essential equipment from the test site to minimize clutter and introducing safety hazards.
3. Prevent unauthorized personnel access to the test area or zone.
   If possible, isolate equipment from personnel performing the work.

3 PROCEDURE OVERVIEW

The following procedure outlines the basic steps required to make the rig tools ready for use and to prepare the drill rig for several transition operations to allow the iRIS system to react to the simulated operations and record the relevant data for later retrieval and analysis.

a) Required Equipment

- Rig Tools as required
- Any other required tools for the job
- One (1) twenty-foot knobby sub prepared for lifting and lowering by the draw works. The is the simulated "drill string"

4 TEST PROCEDURE

iRIS AND RigWatch PREP

NOTE: iRIS and RigWatch should be confirmed running and collecting data prior to beginning the test phase.

Num	Task Description	
1	Hold test familiarization review with relevant participants to ensure all parties understand the test processes and intended results.	☐
A. Test Setup Configuration		
1	**Make sure the iRIS system is running and Driller UI is running in the drill shack. Verify, if possible, the software version that is installed and running**	☐
2	**Verify iRIS Ops Interface is running in Ops Office**	☐
3	**Verify iRIS General User Interface is running in Ops Office**	☐
4	Make sure RigWatch is running in the drill shack and a remote is running in Ops office. **Verify RigWatch is recording data to dummy hole**	☐
iRIS Software Version is _____		
Current Local Time is (for database correlation): _____		
Current Test Date is: _____		
1	**Verify iRIS Driller's User Interface is connected and initialized with the following settings:** **a. Verify "cRIO Online" indicator is green** ☐ **b. Verify "cRIO Connected" is green** ☐ **c. Verify "Collector Online" indicator is green** ☐ **d. Verify "Pipe Counter" reset to zero (0)** ☐ **e. Verify "TOP DRIVE" is set to "OUT"** ☐ f. **Verify "SLIPS" are set to "OUT" and are in "AUTO" mode** ☐	
B. Rig Setup Configuration		
1	Rig to be in the initial test configuration: a. Top Drive in the "Installed" position ☐ b. Crews to make up twenty-foot (20') knobby to top drive ☐	
C. Pipe 'Trip In' – 'Trip Out' and 'DRILLING MODE' Test		
1	With the iRIS Slips in "AUTO" Mode, driller picks up the simulated drill string until the blocks take the full weight. Stop and hold the blocks. **Verify iRIS "SLIPS" indicator changes from "SLIPS IN" to "SLIPS OUT" mode**	☐
2	With top drive in and knobby made up, raise the blocks to derrick crown and note block position in iRIS and RigWatch to verify displayed block positions are within ± 5% of each other. Set brake and hold for enough time to stabilize indicator. Release brake and lower	☐

	blocks to minimum allowable height, set brakes and hold for enough time to stabilize display. Record iRIS and RigWatch height in maximum and minimum positions. **Repeat series 2x and record maximum and minimum positions in the table below.**	

Run	iRIS max | min position (m)		RigWatch max | min position (m)	
1				
2				
3				

1	Begin to rotate the top drive. **Verify "TD AMPS" increases in value** **Verify "TD RPM" increases in value**	☐
2	Stop rotating the top drive	☐
3	Set the drill string into the slips and remove hook load weight. **Verify the iRIS "SLIPS" indicator automatically toggles from "OUT" to "IN"**	☐
4	**Verify the iRIS Drillers Interface goes from "DRILLING" mode to "TRIP" mode**	☐
5	With the drill string still in the slips, Driller toggles "SLIPS" from "AUTO" to "MANUAL" mode.	☐
6	Raise the drill string until full weight is on the blocks. Hold the weight	☐
7	Driller manually corrects the "BIT DEPTH" to zero (0)	☐
8	Begin to slowly lower the drill string to simulate a bit on bottom is beginning to "drill"	☐
9	**Verify the "BIT DEPTH" begins to increase, indicating drilling mode**	☐
10	**Verify "HOLE DEPTH" begins to increase**	☐
11	Driller stops lowering and holds the drill string in place	☐
12	Driller toggles the SLIPS from "OUT" to "IN"	☐
13	Driller begins to slowly raise the drill string simulating inserting a new joint of pipe into the drill string	☐
14	Simulate new pipe joint installed by blocking pipe counter photocell on pipe stabber **Verify "PIPE COUNTER" increases by one (1) on iRIS Driller Interface and RigWatch**	☐
15	**Verify the "BIT DEPTH" and "HOLE DEPTH" do not change**	☐
16	Driller stops raising drill string, sets the SLIPS from "IN" to "OUT"	☐
17	Driller slowly lowers the drill string to simulate setting bit on bottom and resume drilling	☐
18	**Verify the "BIT DEPTH" begins to increase, indicating resuming drilling mode**	☐
19	Driller lowers drill string and sets into slips	☐

20	Secure all rig equipment from testing	☐
21	**-----END OF TEST SECTION ------**	

D. Tracer Pump Test

1	Notify IODP Lab Officer to assign lab personnel to begin monitoring tracer pump with a IODP radio in hand. Tracer pumps runs on a set (i.e., not proportional) pump rate. **Verify lab staff is ready for testing in mud pump room**	☐
2	**Verify "TRACER PUMP" indicator on Driller's UI is showing green**	☐
3	Driller toggles "TRACER PUMP" from "OFF" to "ON". Notify staff member of toggle event	☐
4	**Verify TRACER PUMP turns on**	☐
5	Driller toggles "TRACER PUMP" from "ON" to "OFF". Notify staff member of toggle event	☐
6	**Verify TRACER PUMP turns off**	☐
7	**-----END OF TEST SECTION ------**	

E. Coreline Retrieval Test

1	Coreline Winch Operator begins to slowly raise coreline to maximum height and hold. Lower coreline slowly back down to minimum height and hold. Repeat 2X and record coreline depth in table below.	☐
2	**Verify depth measurements are within ±5% between iRIS and RigWatch** **Verify graphing component on iRIS matches height changes** **Verify Ops office Rig Floor Monitor Overlay follows Coreline movements**	
3	**-----END OF TEST SECTION ------**	

Coreline	iRIS max | min position (m)		RigWatch max | min position (m)	
1				
2				
3				

F. Standpipe Pressure Test

1	Bring standpipe pressure slowly up. **Hold at 500, 1500 and 2500 psi**. Record SPM and PSI below	☐
2	**Verify the following iRIS and RigWatch stroke counter (SPM) and standpipe pressure (SP Pressure) indicators read ±5% of each other:**	
3	**Verify graphing indicators on iRIS and RigWatch follow each test point**	☐
4	**Stop mud pumps and secure/bleed off pipe pressure**	
5	**-----END OF TEST SECTION ------**	

	iRIS SPM | SP Pressure		RigWatch SPM | SP Pressure	
500 psi				
1500 psi				
2000 psi				

G. Data Integrity Test

Verify the data collected throughout the above test are collected, converted, and compared.

Current Local Time is (for database correlation): _____

1	**Log onto the Ops computer**	
2	**Double click the Kitchen Sink Report icon**	
3	**Enter the date and time range for the report**	
4	**Click "Download CSV" to download the generated CSV to the local drive or a USB drive**	
	-----END OF TEST SECTION ------	

ALL STEPS ABOVE HAVE BEEN COMPLETED AND RESULTS ARE SATISFACTORY AND ACCEPTED. ANY DEVIATIONS TO THE ABOVE STEPS HAVE BEEN DOCUMENTED IN APPENDIX A BELOW – PROCEDURE DEVIATION TABLE

IODP ENGINEERING REPRESENTATIVE SIGNATURE AND DATE	

5 APPENDIX A – PROCEDURE DEVIATION TABLE

Enter detailed information into this table where the actual test procedure deviates from the “as written” procedure.

Test Section	Test Deviation (be descriptive)

Additional Comments