FIBER OPTIC TESTING ENHANCEMENT FOR COST REDUCTION FOLLOW-ON (2)

Improvement to FO Testing for significant manpower and schedule reduction benefits

Project Update
09/17/2024

Presented by:
Dan Morris (KITCO)

FIBER OPTIC TESTING ENHANCEMENT FOR COST REDUCTION FOLLOW-ON (2)

NSRP Project Task Order:	2019-472-02
KITCO Project:	NSRP-2019-472-02
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Data Category B:	Data developed partially with funding from project participants that was not charged to a government contract and partially with government funding.
Distribution Statement:	Limited Distribution Authorized to U.S. Shipyards, NSRP Program Representatives, and Government Agencies.

Project Overview

This project will investigate the potential for Fiber Optic Testing Enhancement for Cost Reduction by evaluating the commercial practice of using on an Optical Time Domain Reflectometer (OTDR) to replace the Optical Loss Test Set (OLTS) and Optical Return Loss Meter (ORLM) in performance of MIL-STD-2042-6 required testing for shipboard installations. In addition, the OTDR test results will provide enhanced data that are not currently captured resulting in reduced time for system acceptance and identification of potential faults for expedited troubleshooting and repair during construction.

This is a follow-on project proposal to NSRP ASE Subcontract Agreements No. 2016-416 and No. 2019-472 and will be used to focus on the optical launch condition performance necessary to implement OTDR for cost savings as identified in the previous FO test enhancement project studies. Previous project study recommendation findings will serve as the basis for this project.

Testing will continue to focus on such fiber optic assemblies as are designed and installed for use in Navy shipboard FO applications. Additionally, we will evaluate the use of the OTDR for new high density fiber optics applications (as mentioned above) where test reduction costs will provide the greatest savings opportunity. Technical evaluation between current Navy Approved Test Equipment and the enhanced OTDR will be completed with a focus on loss measurement alignment.

Project Participants

KITCO Participants:

- Daniel Morris, Vice President & Technical Lead
- Darrell Cannella, Program Manager
- Alvin Jones, Project Manager & Senior Technician
- Christopher Powell, Technician

Participating shipyards:

- HII-NNS
  - Alicia D'Aurora Harmon, NNS NSRP Shipyard Delegate
  - Elmer Dickens, NSRP Program Lead
  - David Ellis, NSRP Electrical Technologies Panel Representative
- GDEB
  - Owen Key, General Foreman – D241

Note: NNS and GDEB plans to participate in this project as an unpaid observer.

Other participants:

- NAVSEA – NSWCDD
  - Chris Good, Fiber Optic Chief Engineer
- EXFO North America
  - Gang He, Principal Research Scientist
  - Russ Mattingly, Applications Engineer

Still hope to engage:

- Penn State Applied Research Laboratory
  - John Mazurowski, Director, Electronics Manufacturing Center
  - Michael Reilly, Department Head, Fiber Optics and Photonics

Project Goals and Objectives

Primary investigation will take place to verify that the launch conditions of the OTDR test unit can be used in place of the OLTS and ORLM test units to perform multiple required tests at the same time. Tests that are currently performed separately will be combined and will further result in the elimination of several tests that are currently performed during various separate stages of the construction process.

1. Measure optical test equipment output parameters against Navy source launch conditions requirements.
2. Manufacture and investigate if MQJs manufactured with tight fiber optic lot specification requirements (M49291/6) produce more consistent loss measurement values than MQJs produced with non-controlled fiber lots.
3. Conduct investigative optical experimentation to determine if MQJ length impacts reference value measurements that would account for observed inconsistencies in measurement value result between OLTS and OTDR units.
4. Evaluate cost savings potential for high density fiber configurations.
5. Identify test unit specifications for future shipyard and fleet procurement.
6. Identify roadmap for TWH approval and implementation process.

Current Deliverables Schedule

- Project Plan & Schedule
  - ❖ Dan Morris & Darrell Cannella (KITCO), Chris Good (NSWCDD)
  - ❖ 45 days after award (April 30th, 2024)
- Project Status Report 1
  - ❖ Dan Morris & Darrell Cannella (KITCO)
  - ❖ 90 days after award (June 14th, 2024)
- Testing Guidelines and Test Plan
  - ❖ Dan Morris & Darrell Cannella (KITCO)
  - ❖ 120 days after award (July 15th, 2024)
- Project Status Report 2
  - ❖ Dan Morris & Darrell Cannella (KITCO)
  - ❖ 180 days after award (September 12th, 2024)
- Project Status Report 3
  - ❖ Dan Morris (KITCO), Chris Good (NSWCDD)
  - ❖ 270 days after award (December 11th, 2024)
- Final Report with Recommendations
  - ❖ Dan Morris (KITCO), John Mazurowski & Mike Reilly (Penn State ARL)
  - ❖ 360 days after award, (March 10th, 2025)

Project Statement of Work

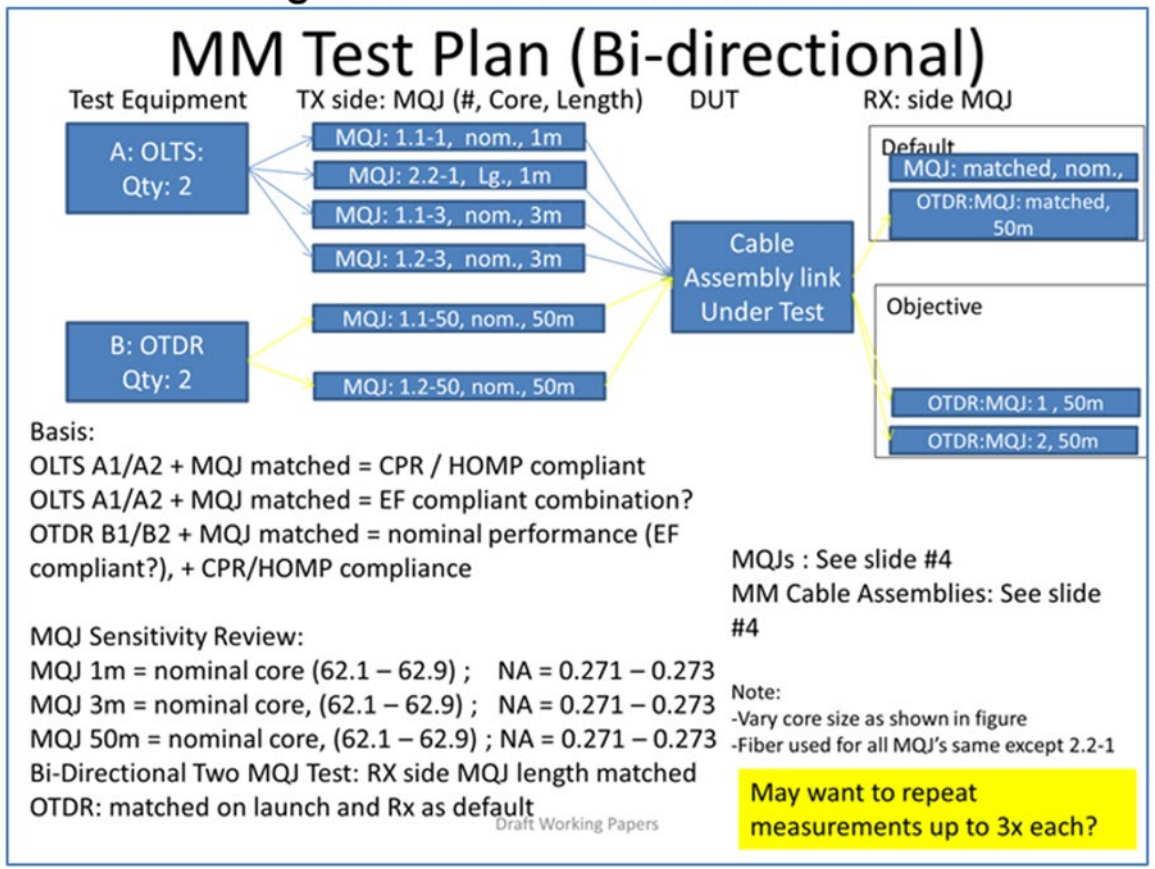
- Task 1 – Develop Project Plan & Schedule - Complete
- Task 2 – Obtain required Materials – In Progress ~90% Complete
- Task 3 – Assemble required MQJ's and Test Cable samples - In Progress ~60% Complete
- Task 4 – Perform optical source output testing verification of project test equipment – To be accomplished current Quarter
- Task 5 – Perform optical simulation calculations to predict expected loss results – 1Q25
- Task 6 – Perform optical testing of test sample cables - To be accomplished current Quarter
  - Estimate 3 separate visits to NSWCDD FO Lab at Dahlgren, Virginia
- Task 7 – Comparison of the test results to identify the reliability and repeatability for each test equipment configuration – 1Q25
- Task 8 - Analysis to determine if the findings support OTDR test results alignment for testing precision, reliability and repeatability required for adoption for shipboard mandated testing - 1Q25
- Task 9 – Complete Final Report - 1Q25

MM Test Plan

One of the recommendations from the original project final report was a proposal to define a tighter fiber specification for MM MQJ's to increase repeatability from test to test. The recommendation was to identify a nominal subset value compared to the tolerance allowed under the M49291/6 fiber specification. The nominal value identified includes a Core size between 62.1 to 62.9um AND a Numerical Aperture (NA) between 0.271 and 0.273.

	Nominal μ ±0.5 s
Core Size [μm]	62.1-62.9
NA	0.271-0.273

Figure 1 – MM Test Plan Overview



MM Test Plan Continued

Figure 2 – MM Test Plan Visit 1

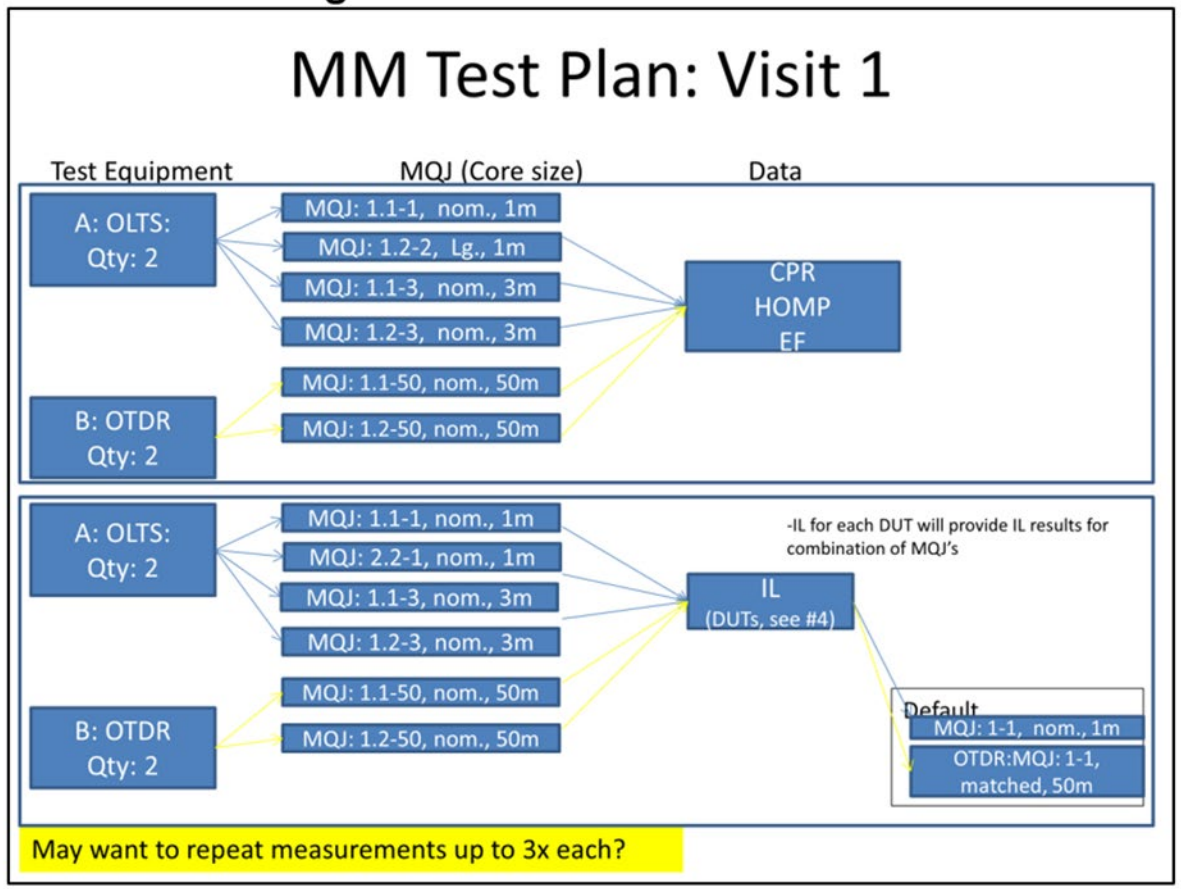


Figure 3 – MM Test Visits 2 – 3 DUT Configurations

MM Test Bed: Visits 2-3

Cable Assemblies/DUTs (core size)
-All DUT's in test bed will be of fiber #1, except where cell is highlighted RED
-RED highlighted cell will be fiber #2 large core, large NA

Pri	#	V	1	L	2	3	L	4	5	L	6	7	L	8	9	L	10	11	L	12
1	4	2	ST	40′	ST	ST	500′	ST	ST	40′	ST			1. Finish "priority (PRI) assessment						
1	4	2	ST	40′	ST	ST	500′	ST	ST	40′	ST									
1	1	2	ST	10′	ST	ST	10′	ST												
1	2	2	ST	10′	ST	ST	130′	ST	ST	10′	ST									
2	3	2	ST	10′	ST	ST	130′	ST	ST	40′	ST									
2	5	2	ST	40′	ST	ST	500′	ST	ST	10′	ST									
2	6	3	ST	10′	ST	ST	40′	ST	ST	500′	ST	ST	40′	ST	ST	10′	ST			
2	7	3	ST	10′	ST	ST	40′	ST	ST	130′	ST	ST	130′	ST	ST	40′	ST	ST	10′	ST
1	8	4	ST	10′	FS	FS	130′	FS	FS	10′	ST									
1	9	4	ST	10′	FS	FS	60′	FS	FS	60′	FS	FS	60′	FS	FS	10′	ST			
1	10	4	ST	10′	FS-1dB	FS	130′	FS	FS	10′	ST									
2	11	4	ST	10′	FS-3dB	FS	130′	FS	FS	10′	ST									

Repeat measurements up to 3x each

SM Test Plan

Figure 4 – SM Test Plan Overview

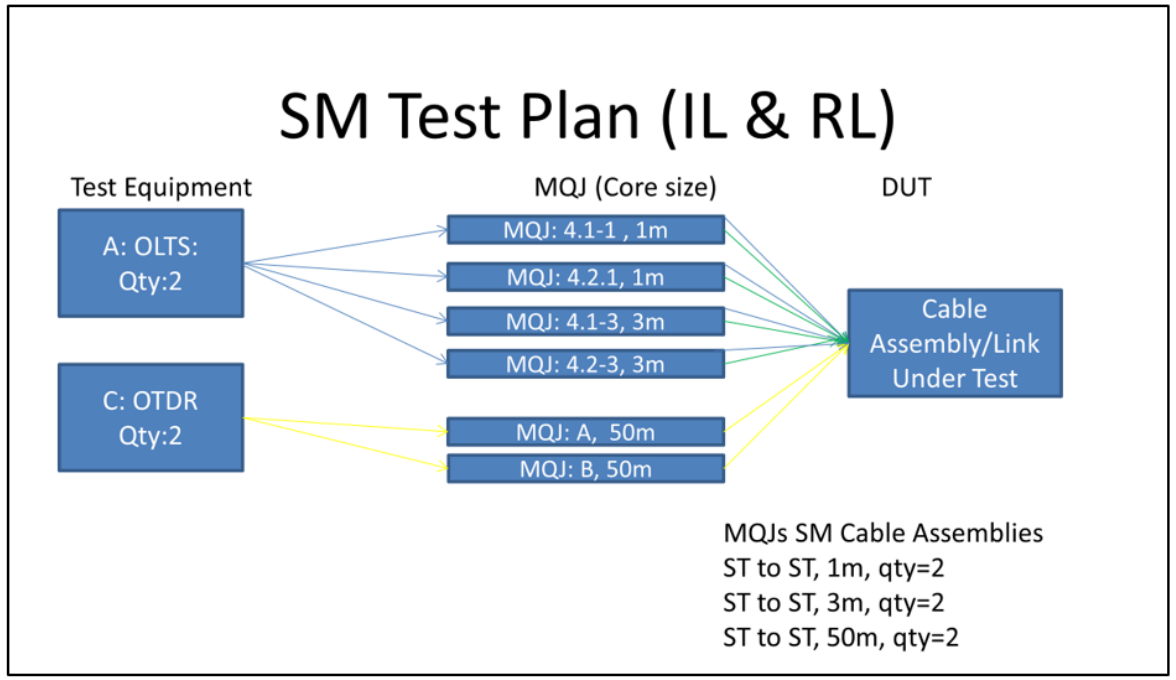
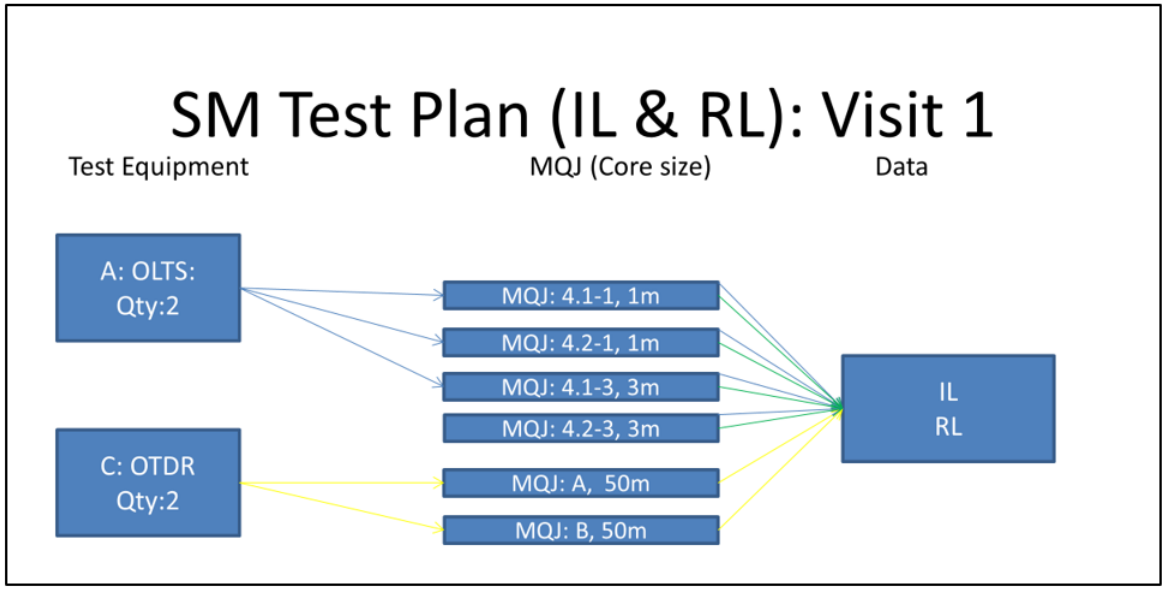


Figure 5 – SM Test Plan Visit 1



SM Test Plan Continued

Figure 6 – SM Test Visits 2 -3 DUT Configurations

SM Test Bed: Visits 2-3

#	V	1	L	2	3	L	4	5	L	6	7	L	8	9	L	10	11	L	12
1	2	ST	10′	ST	ST	10′	ST												
2	2	ST	10′	ST	ST	130′	ST	ST	10′	ST									
3	2	ST	10′	ST	ST	130′	ST	ST	40′	ST									
4	2	ST	40′	ST	ST	500′	ST	ST	40′	ST									
5	2	ST	40′	ST	ST	500′	ST	ST	10′	ST									
6	3	ST	10′	ST	ST	40′	ST	ST	500′	ST	ST	40′	ST	ST	10′	ST			
7	3	ST	10′	ST	ST	40′	ST	ST	130′	ST	ST	130′	ST	ST	40′	ST	ST	10′	ST
8	4	ST	10′	FS	FS	130′	FS	FS	10′	ST									
9	4	ST	10′	FS	FS	60′	FS	FS	60′	FS	FS	60′	FS	FS	10′	ST			
10	4	ST	10′	FS-1dB	FS	130′	FS	FS	10′	ST									
11	4	ST	10′	FS-3dB	FS	130′	FS	FS	10′	ST									

1. Finish “priority (PRI) assessment

Questions???