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RTU Wireless I/O Technology Pilot Result

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Abstract: **Addressing the growing business needs for enhanced remote monitoring of Supervisory Control and Data Acquisition (SCADA) is a real challenge nowadays. For example, Oil, Gas, and Water Plants require the ability to access and monitor scattered remote areas, Pipelines, and well sites. However, remote monitoring can be a challenge that requires a reliable system. As a result, wireless technologies such as ISA100.11a are becoming the standard platform for SCADA and remote applications. These wireless solutions are being introduced to serve SCADA applications, as their reliability can satisfy the business needs of connecting many sites and plants easily, minimizing costs and increasing flexibility.**

This technology was demonstrated in a proof of concept (POC) that tested the use of remote monitoring and wireless solutions for Industrial remote control, including SCADA systems. A Yokogawa SCADA system, including a RTU and SCADA host, was used as the SCADA platform, while a wireless communication RTU I/O module served as the communication platform with a gateway. The POC setup and evaluation took place at the well site in July 2018, utilizing various wireless solutions such as wireless I/O modules, antennas, and field instruments.

The pilot utilized an Industrial RTU Wireless I/O Technology from Yokogawa at a Well Site and successfully produced reliable measurements compared with the existing wired solution for more than six (6) years. As a result, the team concluded that the RTU Wireless I/O Technology is promising for new projects in well head RTU applications to realize cost avoidance and reduce project execution time.

In conclusion, the use of ISA100.11A technology, combined with remote monitoring and optimized design, can effectively address the business needs for improved remote monitoring of industrial automation and control systems.

Keywords: **Supervisory Control and Data Acquisition (SCADA), RTU Wireless I/O Technology, Oil, Gas, and Water Plants require, industrial automation and control systems.**

1. INTRODUCTION TO WIRELESS RTU I/O

Generally, Oil and Gas operations are spread across large geographical areas while centralized control centers are used to manage and operate day-to-day field operations that are subject to harsh environmental conditions. Supervisory Control and Data Acquisition (SCADA) systems are used to electronically monitor and manage remote operations using advanced IOT solutions. Usually, wireless is use to connect Field Instruments in the field within the same area however, today, ISA 100.11a were used to connect field RTUs I/Os to wireless Field Instruments. This is adequate for pulling data from filed devices by the RTU and sending supervisory control commands to the filed such as close/open a valve and a start/stop command to a pump. High speed is needed whenever there is an asset management solution for diagnostic purposes. In general, wireless communication is allowed for non-critical SCADA monitoring applications, and there should be a physical and logical segregation from non-SCADA applications in terms of network, communications hardware, servers, etc.

There has been major advancement of RTU capabilities in support of intelligent operations. Such applications require broadband connectivity and the ISA100.11a is a promising broadband wireless technology that has the potential to satisfy all aforementioned applications in a reliable, cost-effective, secure and hardened platform; refer to system architecture on

Figure 1 a & b that illustrates the existing wired solution and proposed wireless solution working in parallel. Both wired and wireless transmitters have been configured on the same existing RTU and SCADA.

Fig. 2 shows the RTU Serial Communication Module Configuration which is a loop powered that provides a reliable and convenient way to monitor and display process variables in different industrial applications

The equipment was installed in following configuration as illustrated in Fig. 1 a & b.

In this testing we utilized multiple communication protocols i.e. Ethernet, Modbus, DNP3, and ISA100 wireless communications protocol.

2. SYSTEM ARCHITECTURE

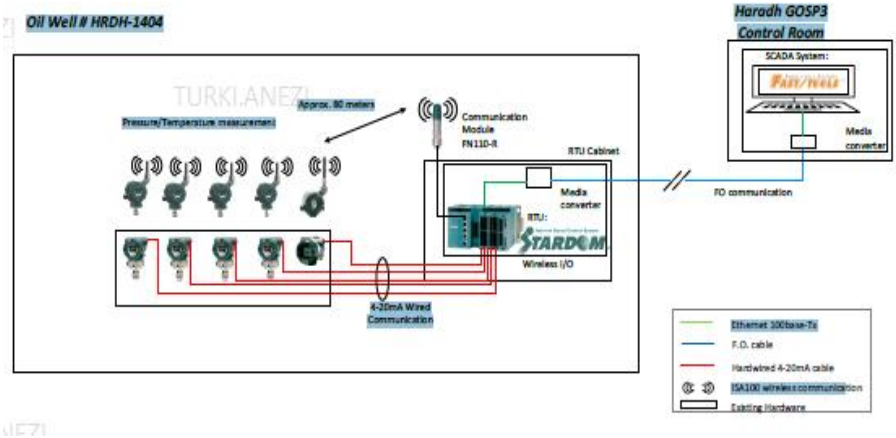

Fig. 1a

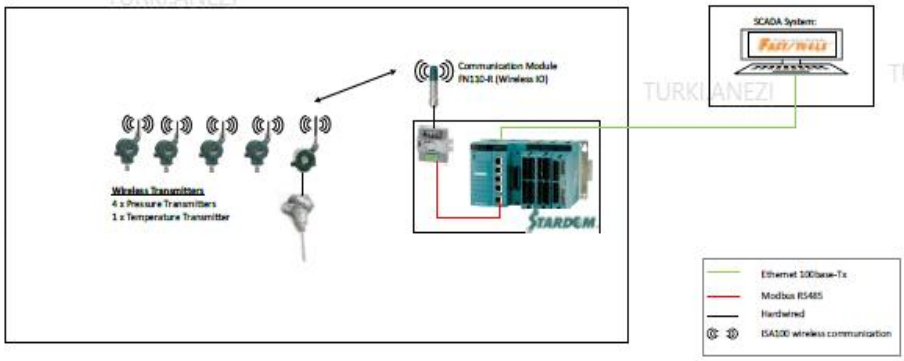

Fig. 1b

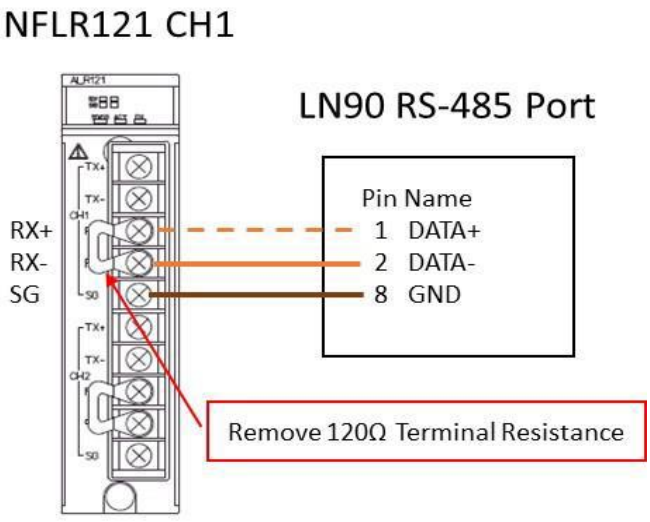

Fig. 2 RTU Serial Communication Module Configuration

The ISA100, Wireless Systems for Automation Committee, has classified wireless applications into three classifications; namely monitoring, control and safety; see Figure 3 "Industrial Wireless Systems Classifications." Wireless technology is becoming very popular for instrumentation (ISA100.11a) as well as for backhaul-long range process automation connectivity (ISA100.15).

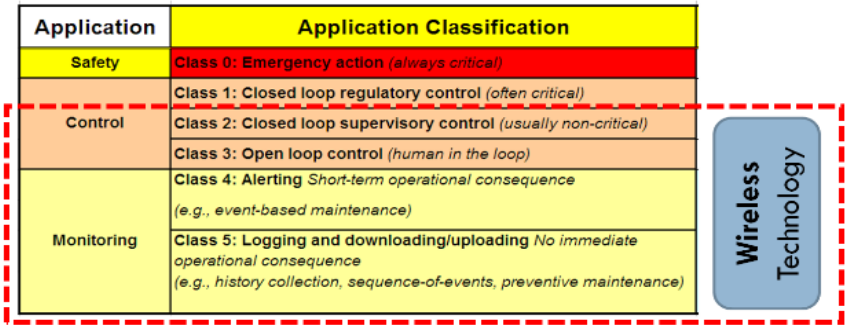

Figure 3: Industrial Wireless Systems Classifications

3. OBJECTIVE

The objective of this pilot is to complete a series of functional and performance tests on the software and hardware capabilities of the ISA100.11a Wireless I/O based RTU. The features of the new interfacing were demonstrated as a part of the testing procedure. The objectives of the technical assessment of the deployment of RTU ISA100.11a Wireless I/O at Saudi Aramco Oil Wells are the followings:

- Evaluate performance and functionalities of the Wireless I/O.
- Compare the Wireless I/O Project cost, against conventional setup.
- Verify operation availability, integrity, reliability, and satisfaction.
- Verify project schedule optimization.

Wireless RTU based on ISA 100 technology has the potential to serve concurrently several industrial applications such as:

- Oil and Gas SCADA systems.
- Cathodic Protection monitoring and control.
- Energy Management.
- Wastewater Management.
- Vibration Monitoring.
- Power Monitoring Systems.
- Micro-Seismic Sensing and Intelligent Field Applications.

4. PROOF OF CONCEPT OBJECTIVE

A proof of concept (POC) was conducted to test the use of the solutions of wireless technology for Industrial Automation & Control and applications such as SCADA systems. A Yokogawa existing Stardom SCADA/RTU system was used with wireless I/Os to demonstrate the system setup and configurations.

Scope of Work

Installing the new RTU ISA100.11a based Wireless I/O and Wireless Instruments at an Oil well. The team consist of plant personnel along with technical stuff jointly completed engineered solution including supply, design, engineering, configuration and installation of the RTU Wireless I/O and transmitters.

Design

- Install the new RTU wireless I/O with the existing RTU cabinet.
- Install new equal amount and similar specification wireless transmitters at site as well as wired ones.
- Use the same tapping points for wired instruments to install the new wireless instruments.
- Retain the wired installed installation.
- Configure the new RTU wireless I/Os in the existing RTU.

- Configure the new wireless I/O in the existing SCADA at one of the closes SCADA system with the area.

The distance between the wireless instruments in the well site and the gateway is around 87 meters. And the distance between the well site and the SCADA host is around 5 KM.

RTU Logic Configuration

The RTU Logic Configuration was carried out as per the below sequence as per Fig.4.

1. CPU Modul: NFCP 100.
2. IP Address: 10.1.3.2.
3. Serial Communications Module.

a. Terminal Resistance: None.

b. Communications Model: Half-Duplex.

c. Communications Speed: 38400 bps.

d. Parity Bits: None.

e. Stop Bits: 1.

The following configuration was done:

1. Project name: HRDH3_IFIEL_SLM_RXR16.
2. Logic Designer Version: 3.01.01.
3. Logical POU: Wireless I/O.

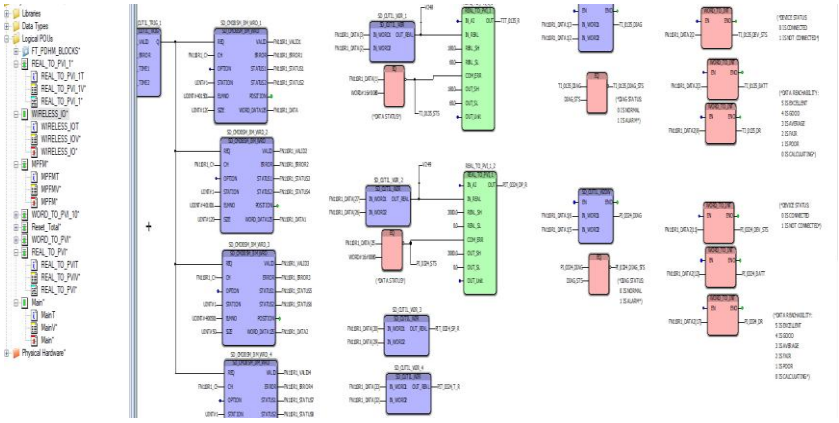

Fig. 4 RTU Logic Configuration

SCADA System Configuration (Wireless Gateway Module Configuration)

Below schematic shows the SCADA configurations for both wired and wireless instrumentations reading

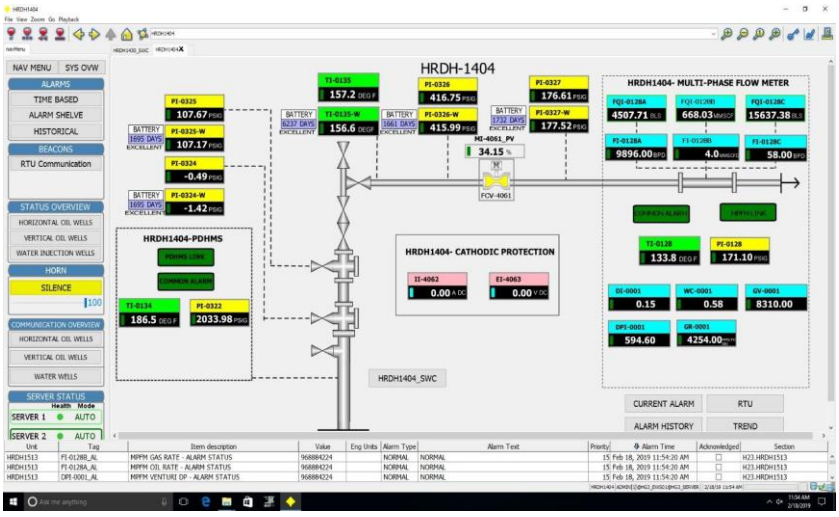

Figure 5: SCADA configuration

STARDOM RTU Serial Communication Module and Interface Adaptor:

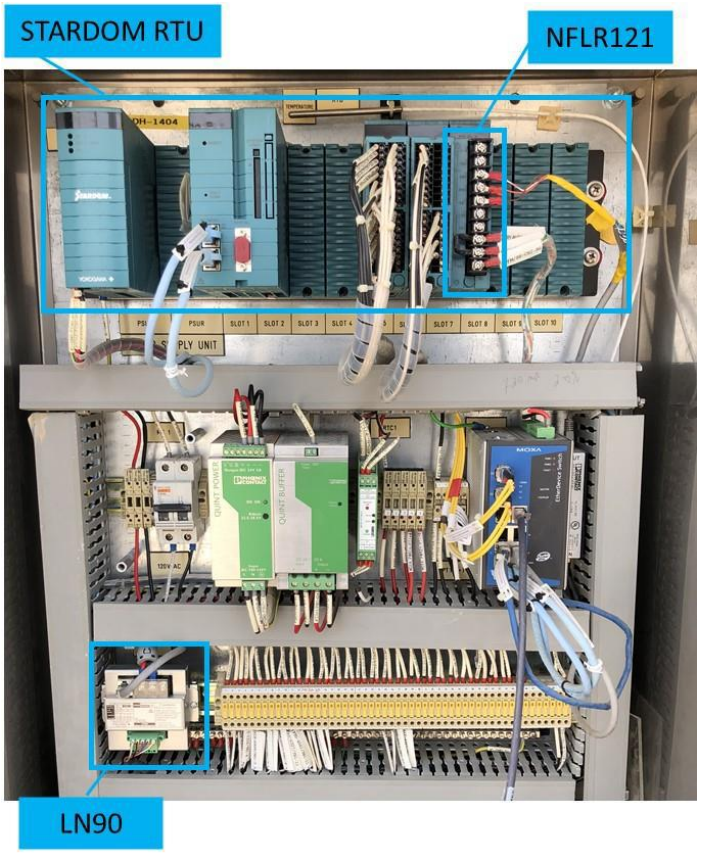

Figure 6: Serial Communication Module and Interface Adaptor

5. TEST CASE

The test specifications were as follows:

The testing tools were Yokogawa SCADA host and Stardom RTU /IO with the wireless field instruments and wireless gateway.

Test Case Results and Conclusion

RTU Wireless ISA100.11a I/O Technology Pilot was installed for more than (6) years and proved to be successful as the objectives set for the pilot were achieved.

Below are some recommendations:

- Operating facilities must comply with Saudi Aramco requirements and mandates operating facilities to obtain cybersecurity group approval and conduct risk assessment to use wireless technology for instruments.
- Performance was evaluated in comparison with the wired transmitters and the process-recorded values from both wired and wireless transmitters were similar and very close to each other's.
- The wireless communication was monitored using the unique feature of "data reachability" of the RTU wireless I/O. The communication quality remained consistent at "excellent" during the whole period of pilot test.
- Batteries from wireless transmitters were removed forcibly to check the recovery time of the wireless transmitters to transmit data again to wireless I/O and RTU automatically after re-inserting the batteries. The wireless network was reestablished without any additional reconfiguration.
- Battery lifetime of the transmitters were monitored in order to check the battery life. Any transmitter should not decline drastically to give any surprises to the operator.

- The battery life was decaying in consistent pattern and the maximum decay in life from the commissioning date was 8% per transmitter at the completion of the first 6 months.
- It was estimated that the wireless project could be delivered early in time compared to the wired one.

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About author:

Turki Al-Anezi Received his BS Degree in Electrical Engineering from Waseda University, Japan in 1994. Turki has more than 30 years of experience in the Process Automation and Control Systems in various areas of Saudi Aramco plants control systems. He served as the Technical Steering Committee Chairman position of several vendors i.e. ABB, Yokogawa and Siemens for more than 15 years.

He has led many grassroots mega process automation and expansion projects. He has led and piloted many technologies and published several engineering papers and standards.

Turki is currently working in the Process and Control Systems Department as a Process Automation Systems Engineering Specialist and subject matter expert for SCADA, RTUs & Pipeline Leak Detection system. He holds several professional certifications such as PSE TUV certifications and an active member in DNP3, Modbus, IEEE and ISA societies.