IEC 61508 Functional Safety Assessment

Project:
100 and 120 Series Pressure and Temperature Switches

Customer:
United Electric Controls
Watertown, MA
USA

Contract Number: Q16/02-130
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Management Summary

This report summarizes the results of the functional safety assessment according to IEC 61508 carried out on the United Electric Controls:

- 100 Series Pressure and Temperature Switches
- 120 Series Pressure and Temperature Switches

The functional safety assessment performed by *exida* consisted of the following activities:

- *exida* assessed the development process used by United Electric through an audit and review of a detailed safety case against the *exida* certification scheme which includes the relevant requirements of IEC 61508. The investigation was executed using subsets of the IEC 61508 requirements tailored to the work scope of the development team.
- *exida* performed a detailed Failure Modes, Effects, and Diagnostic Analysis (FMEDA) of the devices to document the hardware architecture and failure behavior.
- *exida* reviewed field failure data to verify the accuracy of the FMEDA analysis.
- *exida* reviewed the manufacturing quality system in use at United Electric.

The functional safety assessment was performed to the requirements of IEC 61508: ed2, 2010, SIL 3 for mechanical components. A full IEC 61508 Safety Case was prepared using the *exida* Safety Case tool as the primary audit tool. Hardware process requirements and all associated documentation were reviewed. Environmental test reports were reviewed. Also the user documentation (safety manual) was reviewed.

The results of the Functional Safety Assessment can be summarized as:

The audited development process as tailored and implemented by the United Electric Controls 100 and 120 Series Switches development project, complies with the relevant safety management requirements of IEC 61508 SIL 3, **SC 3 (SIL 3 Capable)**.

The assessment of the FMEDA, done to the requirements of IEC 61508, has shown that the 100 and 120 Series Switches can be used in a low demand safety related system in a manor where the PFD_{avg} is within the allowed range for up to SIL 2 (HFT = 0) according to table 2 of IEC 61508-1.

The assessment of the FMEDA also shows that the 100 and 120 Series Switches meets the requirements for architectural constraints of an element such that it can be used to implement a SIL 2 safety function (with HFT = 0) or a SIL 3 safety function (with HFT = 1).

This means that the 100 and 120 Series Switches is capable for use in SIL 3 applications in Low Demand mode, when properly designed into a Safety Instrumented Function per the requirements in the Safety Manual and when using the versions specified in section 3 of this document.

The manufacturer will be entitled to use the Functional Safety Logo.

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1 Purpose and Scope

This document shall describe the results of the IEC 61508 functional safety assessment of the United Electric Controls:

- 100 Series Pressure and Temperature Switches
- 120 Series Pressure and Temperature Switches

by *exida* according to the accredited *exida* certification scheme which includes the requirements of IEC 61508: ed2, 2010.

The assessment has been carried out based on the quality procedures and scope definitions of *exida*.

The results of this provides the safety instrumentation engineer with the required failure data as per IEC 61508 / IEC 61511 and confidence that sufficient attention has been given to systematic failures during the development process of the device.

1.1 Tools and Methods used for the assessment

This assessment was carried by using the *exida* Safety Case tool. The Safety Case tool contains the *exida* scheme which includes all the relevant requirements of IEC 61508.

For the fulfillment of the objectives, expectations are defined which builds the acceptance level for the assessment. The expectations are reviewed to verify that each single requirement is covered. Because of this methodology, comparable assessments in multiple projects with different assessors are achieved. The arguments for the positive judgment of the assessor are documented within this tool and summarized within this report.

The assessment was planned by *exida* and agreed to by United Electric Controls.

All assessment steps were continuously documented by *exida* (see [R1] to [R3]).

2 Project Management

2.1 *exida*

exida is one of the world's leading accredited Certification Bodies and knowledge companies, specializing in automation system safety and availability with over 400 years of cumulative experience in functional safety. Founded by several of the world's top reliability and safety experts from assessment organizations and manufacturers, *exida* is a global company with offices around the world. *exida* offers training, coaching, project oriented system consulting services, safety lifecycle engineering tools, detailed product assurance, cyber-security and functional safety certification, and a collection of on-line safety and reliability resources. *exida* maintains a comprehensive failure rate and failure mode database on process equipment based on 250 billion hours of field failure data.

2.2 Roles of the parties involved

United Electric Controls	Manufacturer of the 100 and 120 Series Pressure and Temperature Switches
exida	Performed the hardware assessment
exida	Performed the IEC 61508 Functional Safety Assessment per the accredited *exida* scheme.

United Electric contracted *exida* in May 2016 for the IEC 61508 Functional Safety Assessment of the above mentioned devices.

2.3 Standards and literature used

The services delivered by *exida* were performed based on the following standards / literature.

[N1]	IEC 61508 (Parts 1 - 7): 2010	Functional Safety of Electrical/Electronic/Programmable Electronic Safety-Related Systems

2.4 Reference documents

2.4.1 Documentation provided by United Electric Controls

ID	Document Type	Document Name	Version	Date
D001	Quality Manual	LP 42200 Corporate Policy Manual.doc	K	8-Apr-16
D003	Overall Development FS Process	DE 7300107 Design Development For Functional Safety.doc	E	16-Nov-16
D003b	Overall Development Process	DE 73001 Design & Development.doc	F	29-May-12
D003c	Overall Development FS Process Doc Cover Page	DE 730010701 Functional Safety Design Record.doc	A	14-Jun-12

ID	Document Type	Document Name	Version	Date
D004	Configuration Management Process	SR113028.D1.4 Configuration Management Plan Rev A.doc	A	27-Jul-12
D007	Manufacturer Qualification Procedure	PU 74102 Supplier Assessment & Approval.doc	M	22-Apr-15
D010	Quality Management System (QMS) Documentation Change Procedure	QS 42301 Document Control.doc	M	8-Dec-16
D010b	Quality Records Maintenance Procedure	QS 42401 Quality Records.doc	AC	30-Nov-16
D012	Non-Conformance Reporting procedure	QS 83001 Control of NC Material.doc	H	23-Dec-15
D013	Corrective Action Procedure-IDR	QS 8520101 Corrective Action Process.doc	H	16-Nov-15
D013b	Corrective Action Procedure-RMA	QS 8520103 Returned Material Process-Corrective Action.doc	H	15-Mar-16
D023	Modification Procedure	DE 73701 Design Changes.doc	P	16-Nov-16
D023b	Impact Analysis Template	DE 73001070_ Functional Safety Impact Analysis Form.xls	C	
D030	Shipment Records	Exida Audit 10_28_16 Sales by Year.pdf		28-Oct-16
D031	Field Returns Records	RMA Detail Report 2012-10-28-2016 100.xls		28-Oct-16
D031b	Field Returns Records	RMA Detail Report 120 2012-10-28-16.xls		28-Oct-16
D033	Training Record - Sample	HR 622010002 Training and Education Form, Sample record for IEC 61508 Training.pdf		
D036	ISO 9001:2008 Cert	un9156cert.pdf		1-Dec-15
D039	Management Review Record	Apr 16 - Jun 16 Mgmt_Review.pdf		28-Jul-16
D040	100 Series Catalog	100-B-08.pdf	08	
D040b	120 Series Catalog	120-B-09.pdf	09	
D074	Sample H100 Test Results	H100 WO 645918.PDF		28-Oct-16
D074b	Sample J120K Test Results	J120K WO 646523.PDF		28-Oct-16
D074c	Validation Test Results	Sample Life Cycle Testing Results SR# 140048		7-Aug-14
D078	100 Series Operation / Maintenance Manual	IMP100 (Pressure Devices)	11	
D078b	100 Series Operation / Maintenance Manual	IMT100 (Temperature Devices)	6	
D078c	120 Series Operation / Maintenance Manual	IMP120 (Pressure Devices)	17	

ID	Document Type	Document Name	Version	Date
D078d	120 Series Operation / Maintenance Manual	IMT120 (Temperature Devices)	11	
D079	Safety Manual	MECH-SM-01		12-Jan-17
D080	Safety Manual Review	SR160012.D5.2 Safety Manual Checklist.docx		28-Nov-16
D080b	Safety Manual Review	SR160012.D5.1 Safety Manual Inspection Report.docx		28-Nov-16
D081	Engineering Change Documentation	2009-2016_ECN_LOG 2014 Filtered 100 120.pdf		28-Oct-16
D088	Impact Analysis Record-example	ECN E4930.pdf		3-Oct-13
D088b	Impact Analysis Record-example2	IA 16016 IDR 19-0201.pdf		3-Aug-16
D088c	Impact Analysis Log	Impact Analysis Log 2016.pdf		8-Aug-16

2.4.2 Documentation generated by *exida*

[R1]	UEC 16/02-130 R001, V1R3, 17-Feb-17	FMEDA report, 100 and 120 Series Pressure and Temperature Switches
[R2]	UE 100-120 PIU Analysis R1.xls, 16-Dec-16	Proven In Use Analysis for 100 and 120 Series Pressure and Temperature Switches
[R3]	UEC 100 and 120 Series V1R2 Safety Case WB-61508 v1.6.xlsm	IEC 61508 SafetyCaseWB for 100 and 120 Series Pressure and Temperature Switches

2.5 Assessment Approach

The certification audit was closely driven by requirements of the *exida* scheme which includes subsets filtered from IEC 61508.

The assessment was planned by *exida* and agreed upon by United Electric Controls.

The following IEC 61508 objectives were subject to detailed auditing at United Electric Controls:

- FSM planning, including
  - Safety Life Cycle definition
  - Scope of the FSM activities
  - Documentation
  - Activities and Responsibilities (Training and competence)
  - Configuration management
- Safety Requirement Specification
- Change and modification management

- Hardware architecture design - process, techniques and documentation
- Hardware design / probabilistic modeling
- Hardware and system related V&V activities including documentation, verification
- Hardware-related operation, installation and maintenance requirements

3 Product Descriptions

3.1 100 Series Pressure and Temperature Switches

The 100 Series pressure and differential pressure switches are activated when a bellows, diaphragm or piston sensor responds to a pressure change. This response, at a pre-determined set point, actuates a single snap-acting switch, converting the pressure signal into an electrical signal.

The 100 Series temperature switch utilizes either a liquid filled sensing stem (immersion stem, direct mounting) or liquid filled sensing bulb (bulb & capillary, remote mounting) to detect a temperature change. The response at a pre-determined set point actuates a SPDT snap-acting microswitch, converting the temperature signal into an electrical signal.

Figure 1 Typical 100 Series Pressure and Temperature Switches

Table 1 gives an overview of the different versions that were considered in this assessment of the 100 Series Pressure and Temperature Switches.

Table 1 Version Overview

H100 Series	Pressure/Vacuum, Increase to Trip
	Pressure/Vacuum, Decrease to Trip
H100K Series	Differential Pressure, Increase to Trip
	Differential Pressure, Decrease to Trip
B100, C100, E100 and F100 Series	Temperature, Increase to Trip
	Temperature, Decrease to Trip

3.2 120 Series Pressure and Temperature Switches

The 120 Series pressure and differential pressure switches are actuated when a bellows, diaphragm or piston sensor responds to a pressure change. This response at a pre-determined set point(s) actuates a SPDT, DPDT or dual SPDT snap-acting microswitch(es), which convert the pressure signal into an electrical signal.

The 120 Series temperature switch utilizes either a liquid filled sensing stem (immersion stem, direct mounting) or liquid filled sensing bulb (bulb & capillary, remote mounting) to detect a temperature change. The response at a pre-determined set point(s), actuates a SPDT, dual SPDT, or DPDT snap-acting micro switch(es), converting the temperature signal into an electrical signal.

Figure 2 Typical 120 Series Pressure and Temperature Switches

Table 2 gives an overview of the different versions that were considered in this assessment of the 120 Series Pressure and Temperature Switches.

Table 2 Version Overview

J120, H121 and H122 Series	Pressure/Vacuum, Increase to Trip
	Pressure/Vacuum, Decrease to Trip
J120K, H121K and H122K Series	Differential Pressure, Increase to Trip
	Differential Pressure, Decrease to Trip
B121, B122, C120, E121, E122 and F120 Series	Temperature, Increase to Trip
	Temperature, Decrease to Trip

The Safety Function for all of the assessed devices is to change the Switches state when the setpoint Pressure or Temperature is reached. By varying the wiring to the switch(es), this could be

in either the Increasing or Decreasing direction (High or Low Trip respectively) and either De-Energize to Trip (Switch opens) or Energize to Trip (Switch closes).

Note that the Dual Switch failure rates listed in the FMEDA report [R1] are for the cases where the two switches are wired in series for DTT or in parallel for ETT applications. If only one of the switches is used for the Safety Function, then the Single Switch numbers should be used.

4 IEC 61508 Functional Safety Assessment Scheme

exida assessed the development process used by United Electric Controls for this development project against the objectives of the *exida* certification scheme which includes subsets of IEC 61508 -1 to 3. The results of the assessment are documented in [R3].

4.1 Methodology

The full functional safety assessment includes an assessment of all fault avoidance and fault control measures during hardware development and demonstrates full compliance with IEC 61508 to the end-user. The assessment considers all requirements of IEC 61508. Any requirements that have been deemed not applicable have been marked as such in the full Safety Case report, e.g. software development requirements for a product with no software. The assessment also includes a review of existing manufacturing quality procedures to ensure compliance to the quality requirements of IEC 61508.

As part of the IEC 61508 functional safety assessment the following aspects have been reviewed:

- Development process, including:
    - Functional Safety Management, including training and competence recording, FSM planning, and configuration management
    - Specification process, techniques and documentation
    - Design process, techniques and documentation, including tools used
    - Validation activities, including development test procedures, test plans and reports, production test procedures and documentation
    - Verification activities and documentation
    - Modification process and documentation
    - Installation, operation, and maintenance requirements, including user documentation
    - Manufacturing Quality System
- Product design
    - Hardware architecture and failure behavior, documented in a FMEDA

The review of the development procedures is described in section 5. The review of the product design is described in section 5.2.

4.2 Assessment level

The 100 and 120 Series Pressure and Temperature Switches have been assessed per IEC 61508 to the following levels:

- SIL 3 capability

The development procedures have been assessed as suitable for use in applications with a maximum Safety Integrity Level of 3 (SIL 3) according to IEC 61508.

5 Results of the IEC 61508 Functional Safety Assessment

exida assessed the development process used by United Electric Controls for these products against the objectives of the *exida* certification scheme which includes IEC 61508 parts 1, 2, & 3 see [D003] to [D003c]. The development of the 100 and 120 Series Switches was done per this IEC 61508 SIL 3 compliant development process. The Safety Case was updated with project specific design documents.

5.1 Lifecycle Activities and Fault Avoidance Measures

United Electric Controls has an IEC 61508 compliant development process as assessed during the IEC 61508 certification. This compliant development process is documented in [D003, D003b, and D004]. No software is part of the design and therefore any requirements specific from IEC 61508 to software and software development do not apply.

The assessment investigated the compliance with IEC 61508 of the processes, procedures and techniques as implemented for product design and development. The investigation was executed using the *exida* certification scheme which includes subsets of IEC 61508 requirements tailored to the SIL 3 work scope of the development team. The result of the assessment can be summarized by the following observations:

The audited United Electric Controls design and development process complies with the relevant managerial requirements of IEC 61508 SIL 3 .

5.1.1 Functional Safety Management

FSM Planning

The functional safety management of any United Electric Controls Safety Instrumented Systems (SIS) product development is governed by a development process [D003 and D003b]. This process requires that United Electric Controls create a project plan which is specific for each new development project. The Functional Safety Management Plan defines all of the tasks that must be done to ensure functional safety as well as the person(s) and role(s) responsible for each task. These processes and the procedures referenced herein fulfill the requirements of IEC 61508 with respect to functional safety management.

Version Control

All documents are under version control as required by a configuration management plan, [D004] and [D023].

Training, Competency recording

Competency is ensured by the creation of a competency and training table for the project per [D003]. The table lists all of those on the project who are working on any of the safety activities of the safety lifecycle. Specific competencies for each person are listed on the table which is reviewed by the project manager. Any deficiencies are then addressed by updating the table with required training for the project. United Electric hired *exida* to be the independent assessor per IEC 61508 and to provide specific IEC 61508 knowledge.

5.1.2 Safety Requirements Specification and Architecture Design

For the 100 and 120 Series Pressure and Temperature Switches, the simple primary functionality of the Switch is the same as the safety functionality of the product (Switch Contacts change when the setpoint threshold is reached). Therefore, no special Safety Requirements Specification was needed. The normal functional requirements were sufficient. As the 100 and 120 Series Switches designs are simple and are based upon standard designs with extensive field history, no semi-formal methods are needed. General Design and testing methodology is documented and required as part of the design process. This meets SIL 3.

5.1.3 Hardware Design

The design process is documented in Section 6 of [D003b] and in [D003c]. Items from **IEC 61508-2, Table B.2** include observance of guidelines and standards, project management, documentation (design outputs are documented per quality procedures), structured design, modularization, use of well-tried components / materials, and computer-aided design tools. This meets SIL 3.

5.1.4 Validation

Validation Testing is documented on the Work Order which is created for each order. The test plan includes testing per all standard and customer performance requirements. As the 100 and 120 Series Switches are purely mechanical devices with a simple safety function, there is no separate integration testing necessary. The 100 and 120 Series Switches perform only 1 Safety Function, which is extensively tested under various conditions during validation testing.

Items from IEC **61508-2, Table B.3** include functional testing, project management, documentation, and black-box testing (for the considered devices this is similar to functional testing). Field experience and statistical testing via regression testing are not applicable. This meets SIL 3.

Items from IEC **61508-2, Table B.5** included functional testing and functional testing under environmental conditions, project management, documentation, failure analysis (analysis on products that failed), expanded functional testing, black-box testing, and fault insertion testing. This meets SIL 3.

5.1.5 Verification

The development and verification activities are defined in Section 6.5 of [D003b]. For each design phase the objectives are stated, required input and output documents and review activities. This meets SIL 3.

5.1.6 Proven In Use

In addition to the Design Fault avoidance techniques listed above, a Proven in Use evaluation was carried out on the United Electric 100 and 120 Series Switches. Shipment records were used to determine that in just the past 5 years, both the 100 and 120 Series have >1.5 billion hours in use and they have demonstrated a field failure rate less than the failure rates indicated in the FMEDA reports. This meets the requirements for Proven In Use for SIL 3.

5.1.7 Modifications

Modifications are done per the United Electric Controls change management process as documented in [D023]. Impact analyses are performed for all changes once the product is released. The results of the impact analysis are used in determining whether to approve the change. The development process as defined in [D003 and D003b] is then followed to make the change. The handling of hazardous field incidents and customer notifications is governed by [D012, D013, and D013b]. This procedure includes identification of the problem, analysis of the problem, identification of the solution, and communication of the solution to the field.

The modification process has been successfully assessed and audited, so United Electric Controls may make modifications to this product as needed.

- As part of the *exida* scheme a surveillance audit is conducted every 3 years. The modification documentation listed below is submitted as part of the surveillance audit. *exida* will review the decisions made by the competent person in respect to the modifications made.
    - List of all anomalies reported
    - List of all modifications completed
    - Safety impact analysis which shall indicate with respect to the modification:
        - The initiating problem (e.g. results of root cause analysis)
        - The effect on the product / system
        - The elements/components that are subject to the modification
        - The extent of any re-testing
    - List of modified documentation
    - Regression test plans

This meets SIL 3.

5.1.8 User documentation

United Electric Controls creates the following user documentation: product catalogs, installation and maintenance manuals and a Safety Manual. The Safety Manual was found to contain all of the required information given the simplicity of the products. The Safety Manual references the FMEDA reports which are available and contain the required failure rates, failure modes, useful life, and suggested proof test information.

Items from IEC **61508-2, Table B.4** include operation and maintenance instructions, user friendliness, maintenance friendliness, project management, documentation, limited operation possibilities (100 and 120 Series Switches perform well-defined actions) and operation only by skilled operators (operators familiar with type of valve, although this is partly the responsibility of the end-user). This meets SIL 3.

5.2 Hardware Assessment

To evaluate the hardware design of the 100 and 120 Series Pressure and Temperature Switches Failure Modes, Effects, and Diagnostic Analysis's were performed by *exida*. These are documented in [R1].

A Failure Modes and Effects Analysis (FMEA) is a systematic way to identify and evaluate the effects of different component failure modes, to determine what could eliminate or reduce the chance of failure, and to document the system in consideration. An FMEDA (Failure Mode Effect and Diagnostic Analysis) is an FMEA extension. It combines standard FMEA techniques with extension to identify online diagnostics techniques and the failure modes relevant to safety instrumented system design.

From the FMEDA, failure rates are derived for each important failure category. All failure rate analysis results and useful life limitations are listed in the FMEDA report [R1]. Tables in the FMEDA report list these failure rates for the 100 and 120 Series Switches under a variety of applications. The failure rates listed are valid for the useful life of the devices.

According to IEC 61508 the architectural constraints of an element must be determined. This can be done by following the 1_H approach according to 7.4.4.2 of IEC 61508 or the 2_H approach according to 7.4.4.3 of IEC 61508.

The 1_H approach involves calculating the Safe Failure Fraction for the entire element.

The 2_H approach involves assessment of the reliability data for the entire element according to 7.4.4.3.3 of IEC 61508.

The failure rate data used for this analysis meets the *exida* criteria for Route 2_H. Therefore, the 100 and 120 Series Switches can be classified as a 2_H device. When 2_H data is used for all of the devices in an element, the element meets the hardware architectural constraints up to SIL 2 at HFT=0 (or SIL 3 @ HFT=1) per Route 2_H.

If Route 2_H is not applicable for the entire sensor element, the architectural constraints will need to be evaluated per Route 1_H.

These results must be considered in combination with PFD_{avg} values of other devices of a Safety Instrumented Function (SIF) in order to determine suitability for a specific Safety Integrity Level (SIL). The architectural constraints requirements of IEC 61508-2, Table 2 also need to be evaluated for each sensor element application. It is the end user's responsibility to confirm this for each particular application and to include all components of the sensor element in the calculations.

The analysis shows that the design of the 100 and 120 Series Pressure and Temperature Switches can meet the hardware requirements of IEC 61508, SIL 3 depending on the complete sensor element design. The Hardware Fault Tolerance and PFD_{avg} requirements of IEC 61508 must be verified for each specific design.

6 Terms and Definitions

Architectural Constraint	The SIL limit imposed by the combination of SFF and HFT for Route 1_H or by the HFT and Diagnostic Coverage (DC applies to Type B only) for Route 2_H
exida criteria	A conservative approach to arriving at failure rates suitable for use in hardware evaluations utilizing the 2_H Route in IEC 61508-2.
Fault tolerance	Ability of a functional unit to continue to perform a required function in the presence of faults or errors (IEC 61508-4, 3.6.3)
FIT	Failure In Time ($1x10^{-9}$ failures per hour)
FMEDA	Failure Mode Effect and Diagnostic Analysis
HFT	Hardware Fault Tolerance
Low demand mode	Mode, where the demand interval for operation made on a safety-related system is greater than twice the proof test interval.
PFD_{avg}	Average Probability of Failure on Demand
PVST	Partial Valve Stroke Test It is assumed that the Partial Stroke Testing, when performed, is automatically performed at least an order of magnitude more frequent than the proof test, therefore the test can be assumed an automatic diagnostic. Because of the automatic diagnostic assumption, the Partial Valve Stroke Testing also has an impact on the Safe Failure Fraction.
Random Capability	The SIL limit imposed by the PFD_{avg} for each element.
SFF	Safe Failure Fraction summarizes the fraction of failures, which lead to a safe state and the fraction of failures which will be detected by diagnostic measures and lead to a defined safety action.
SIF	Safety Instrumented Function
SIL	Safety Integrity Level
SIS	Safety Instrumented System – Implementation of one or more Safety Instrumented Functions. A SIS is composed of any combination of sensor(s), logic solver(s), and final element(s).
Systematic Capability	The SIL limit imposed by the capability of the products manufacturer.
Type A element	“Non-Complex” element (using discrete components); for details see 7.4.4.1.2 of IEC 61508-2
Type B element	“Complex” element (using complex components such as micro controllers or programmable logic); for details see 7.4.4.1.3 of IEC 61508-2

7 Status of the Document

7.1 Liability

exida prepares reports based on methods advocated in International standards. *exida* accepts no liability whatsoever for the use of this report or for the correctness of the standards on which the general calculation methods are based.

7.2 Version History

Contract Number	Report Number	Revision Notes
Q16/02-130	UEC 16/02-130 R003 V1R2	C100 was missing from Overview
Q16/02-130	UEC 16/02-130 R003 V1R1	Initial Release
Q16/02-130	UEC 16/02-130 R003 V0R1	Initial Draft

Reviewer: V0R1 John Yozallinas, *exida*, January 23, 2017

Status: Released, January 25, 2017

7.3 Future Enhancements

At request of client.

7.4 Release Signatures

Gregory Sauk, CFSE, Senior Safety Engineer

John Yozallinas, Senior Safety Engineer