Project Title: ***UFTR DIGITAL CONTROL SYSTEM UPGRADE***

UFTR-QA1-102.3, UFTR ID Coding Concept

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1. Purpose

The University of Florida Training Reactor (UFTR) identification (ID) coding provides a standardized method of naming equipment, diagrams and signals for the purpose of continuity in identification during the project development process. The Reactor Protection System (RPS) specifications for the project are described in UFTR-QA1-100, "Functional Requirements Specification (FRS)," /1/.

This document defines the rules for the assignment of ID codes to:

- Instrumentation and Control (I&C) equipment
- I&C diagrams
- I&C signals

This document forms an essential design input for the Software Requirement Specification (SRS) document.

2. References

/1/ UFTR-QA1-100, "Functional Requirements Specification (FRS)"

/2/ UFTR-QA1-200, "T3000 Functional Requirements Specification (FRS)"

/3/ AREVA NP Inc. Document No., 01-1007858-00, "TELEPERM XS Engineering System SPACE (TXS Core Software 3.3.6)"

3. Abbreviations, and Acronyms

ARM	Area Radiation Monitor
BF3	Boron Tri-fluoride
CH	Channel
CPU	Central Processing Unit
FC	Fission Chamber
FD	Function Diagram
FM	Fan Monitor
FRM	Flow Rate Monitor
I&C	Instrumentation and Control
IC	Ion Chamber
ID	Identification
MSI	Monitoring and Service Interface
NI	Nuclear Instrumentation
RPS	Reactor Protection System
RTD	Resistive Temperature Detector
SPACE	Specification And Coding Environment
TXS	TELEPERM XS

4. Coding of I&C Equipment

4.1 ID Coding of Field Equipment

The ID coding of UFTR's field equipment identifies the devices within the system following the format presented in Table 4.1-1 (Note that although the maximum number of characters that can be used in the naming scheme of the SPACE Engineering System is twenty characters, not all of the available character spaces are used).

Table 4.1-1 Equipment ID Code format description

Facility	Facility	Unit Number	System	System	System	Device Type	Device Type	Device Number	Device Number	Device Number	Device Number	Suffix	Suffix	Suffix					
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
F	F	#	S	S	S	D	D	n	n	n	n	A	A	A					

The first two characters are implied as "UF" (University of Florida Training Reactor) when it is not included in the ID. The following character is number 1, which shall be used for the reactor Unit Number. The ID code includes information of the device location (System) and the Device Type. When less than 3 characters are needed for the System code, a space or underscore in its place shall be used. Device type is designated a 2 characters field. In the case of the SPACE Engineering System which does not allow the use of underscores, a blank shall be used. The SPACE Engineering System also will not allow ID codes containing more than one blank between characters. Any additional blanks that would violate this rule should be omitted. Four digits are assigned to the Device Number and, in special cases, additional information can be added to the end of the ID on the three available Suffix fields.

The ID code for the sensors includes abbreviation for the sensor name, the sensor location in the reactor system, and the order of redundant channels. Table 4.1-2 presents the ID code for all the sensors in the UFTR RPS.

Table 4.1-2 ID codes for Sensors

Nuclear Instrumentation (NI)				ID Codes	
	Sensor location			(Redundant) Channel 1	Comments
	Primary Coolant (PC)	Secondary Coolant (SC)	Reactor Cell (CEL)		
BF3	1			1PC_NI0001R1	
FC	2			1PC_NI0002R1	
IC	3			1PC_NI0003R1	
Resistive Temperature (RT) Detectors					
Box 1	1			1PC_RT0001R1	
Box 2	2			1PC_RT0002R1	
Box 3	3			1PC_RT0003R1	
Box 4	4			1PC_RT0004R1	
Box 5	5			1PC_RT0005R1	
Box 6	6			1PC_RT0006R1	
Inlet	7			1PC_RT007R1	
Outlet	8			1PC_RT008R1	
Inlet		1		1SC_RT0009R1	
Outlet		2		1SC_RT0010R1	
Flow Rate Monitors (FR)					
Inlet	1			1PC_FR0029R1	
Outlet	2			1PC_FR0028R1	
Inlet		1		1SC_FR0026R1	T3000 FRS*
Outlet		2		1SC_FR0027R1	T3000 FRS*
Water Level (WL) Monitors					
Box	1			1PC_WL0001R1	
Storage Tank	2			1PC_WL0002R1	T3000 FRS*
Shield Tank			1	1CELWL0022R1	
Aerial Radiation Monitor (RM)					
South			1	1CELRM0045AR1	
North			2	1CELRM0045BR1	
East			3	1CELRM0045CR1	
West			4	1CELRM0045DR1	
Fan Monitor (FM)					
Core Ventilation			1	1CELFM0001R1	T3000 FRS*
Stack Dilution			2	1CELFM0002R1	T3000 FRS*
Stack Dilution RPM			3	1CELFM0003R1	T3000 FRS*

*Sensor included on the Functional Requirements Specifications (FRS) of the T3000 non-safety system, /2/

Table 4.1-3 presents a few samples for the sensor ID codes as projected onto the ID code table.

Table 4.1-3 Equipment ID Code Sample

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
F	F	#	S	S	S	D	D	n	n	n	n	A	A	A						
		1	P	C	_	N	I	0	0	0	1	R	1							UF, Unit #1,Primary Coolant, NI #1 (BF3), Redundant Channel 1
		1	P	C	_	R	T	0	0	0	5	R	1							UF, Unit #1, Primary Coolant, Resistive Temp. Det. #5 (Box 5), Red.Ch. 1
		1	S	C	_	R	T	0	0	1	0	R	1							UF, Unit #1, Sec. Coolant, Resistive Temp. Det. #2 (Outlet), Red. Ch. 1
		1	C	E	L	W	L	0	0	2	2	R	1							UF, Unit #1, Reactor cell, Water Level Monitor #1 (Shield Tank), Red. Ch. 1
		1	C	E	L	R	M	0	0	4	5	A	R	1						UF, Unit #1, Reactor cell, Aerial Radiation Monitor #1 (South), Red. Ch. 1

4.2 Cabinets ID Coding

The maximum number of characters that can be used in the naming scheme of the SPACE Engineering System for the I&C cabinets is ten. UFTR is using the following two cabinets.

Cabinet 1RPSCA0001 Reactor Protection System Cabinet 0001

Contains: Redundant Channel 1 (AQP-1)

Cabinet 1RPSCA0002 Reactor Protection System Cabinet 0002

Contains: Monitoring Service Interface (MSI)

Table 4.2-1 presents the projection of the Cabinet ID Codes onto the ID code table.

Table 4.2-1 Cabinets ID Codes

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
F	F	#	S	S	S	D	D	n	n	n	n								
		1	R	P	S	C	A	0	0	0	1								
		1	R	P	S	C	A	0	0	0	2								

4.3 CPU ID Coding

The application code generated by the SPACE code generators is assigned to a CPU-ID, which has to be defined in the function diagrams. If no CPU-ID is defined, the code generators (i.e., SPACE) will assign one. However, it is beneficial to apply a systematic naming scheme to the CPU-ID. For the UFTR RPS, the following scheme is used:

Positions 1 2 3 4

			Number
		Location	
	Component		
Unit Number (1)			

Position 1 is assigned to the reactor Unit Number which is 1 for this application. Position 2, "Component," referred to the components of the TXS system such as Acquisition and Processing (AQP), Service Unit (SU), etc., and the third position 3, "Location" refers to the location within the TXS safety system. Positions 2 and 3 are used together to clearly clarify the place of a CPU within the system. Table 4.3-1 presents a matrix of Component vs. Location.

Table 4.3-1 Running number matrix (Positions 2 and 3)

Position 2 (Component)	Position 3	
0	Location	Assigned #
AQP – 1	Cabinet 1	1
MSI	Cabinet 2	2
SU	Service Unit	3
GW	Gateway	4
QDS	QDS	5

Position 4 of the CPU ID contains the CPU number.

Table 4.3-2 presents the CPU ID Coding considered for the CPUs used in the UFTR TXS System.

Table 4.3-2 CPU ID Codes

CPUs	ID Code
AQP-1	
Unit Number (1), AQP-1 (01), CPU (1)	1011
Unit Number (1), AQP-1 (01), CPU (2)	1012
MSI	
Unit Number (1), MSI (22), CPU (1)	1021
SU	
Unit Number (1), SU (03), CPU (1)	1031
GW	
Unit Number (1), GW (04), CPU (1)	1041
QDS	
Unit Number (1), QDS (05), CPU (1)	1051

5. ID Coding for Design Documentation

The TXS Software Engineering Tools document the hardware and software in the form of diagrams, which are identified by ID codes. SPACE diagrams are distinguished by diagram type. For additional information on SPACE diagrams, see the SPACE overview document /3/.

5.1 Hardware Diagram Coding

Table 5.1-1 shows the ID code for the Cabinet Overview Diagram (YDN). There is only one cabinet overview diagram for the project. Again, the leading number is the Unit Number 1.

Table 5.1-1 Cabinet Overview Diagram (YDN)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		1	R	P	S	C	A						`						

Table 5.1-2 defines the naming convention for the individual Cabinet Arrangement Diagrams (YDR) and an example 1RPSCA0001, is listed. YDRs are named the same as the cabinet equipment ID. According to SPACE specification, ID can have up to 10 characters (see Section 2.1).

Table 5.1-2 Cabinet Arrangement Diagrams (YDR)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		1	R	P	S	C	A	0	0	0	1		`						

Table 5.1-3 shows the ID code for the Network Diagram (YUR).

Table 5.1-3 Network Diagram (YUR)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		1	R	P	S	C	A	N	W				`						

Table 5.1-4 defines the naming convention for the Input/Output Hardware Diagrams (YFR/RH00) and an example (1PC_RT0007) is listed. YFRs are named the same as the field device ID (see Section 4.1).

Table 5.1-4 Input / Output Hardware Diagrams (YFR/RH00)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
		1	P	C	_	R	T	0	0	0	7	R	1						

ID equals equipment ID of the field device (see Table 4.1-2).

5.2 Function Diagram Coding

The application software designed for the TXS computers using the SPACE Engineering System is based on function diagrams (FD). These FDs must be named using an unambiguous ID code. The FDs are identified by this ID code. Signal connections between function diagrams carry the ID code of the source FD plus a signal identifier.

The functional requirements are broken down into:

- Input sub-modules, receiving data from the field or control board;
- I&C Functions, using the data provided by the input sub-modules and providing outputs to the output sub-modules;
- Output sub-modules, driving the output interface to the field or control board / control panel.

5.2.1 Function Diagram Coding for Input Sub-modules

The sub-modules that read field inputs are named using the ID code of the component providing the field input (i.e., the sensors, monitors, etc) in addition to identifying the TXS computer on which these functions are executed. Table 5.2.1-1 represents the coding scheme for the input function diagrams.

Table 5.2.1-1 Input Function Diagrams (YFR/RS00)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
		Field Device													A					RPS Input Functions running on AQP-1
		Field Device													B					Input Functions running on MSI

For example, below, we demonstrate the ID coding for an input sub-module running on the AQP-1 with an input from the Primary Coolant Resistive Temperature Detector for Fuel Box #5 within the Redundant Channel 1:

1PC_RT0005R1	Field Device: Primary Coolant Resistive Temperature Detector for Fuel Box #5, Redundant Channel 1
A	AQP-1
1PC_RT0005R1A	Primary Coolant RT for Fuel Box #5, on AQP-1, Input Function Diagram

NOTE: When an input function diagram constitutes multiple input sources, naming convention does not change. Input function diagram naming is established with the primary field device.

5.2.2 Function Diagram Coding for Function Modules

The ID coding for safety function diagrams is comprised of the ID coding of the Function and an identifier for the component which execute the function. Table

5.2.2-1 presents the ID coding for a Function Diagram running on different components.

Table 5.2.2-1 Function Diagrams (YFR/RS00)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
		1	R	P	S	F	U	n	n	n	n	A								RPS Functions running on AQP – 1
		1	R	P	S	F	U	n	n	n	n	B								Functions running on MSI
		1	R	P	S	F	U	n	n	n	n	C								Transfer diagrams running on MSI
		1	R	P	S	F	U	n	n	n	n	D								Transfer diagrams running on Gateway

For example, below, we present the ID coding for a Function Diagram running on the AQP-1 component performing a high flux trip function:

1RPSFU0002 RPS Function 2: High Flux Trip

A AQP - 1

1RPSFU0002A High Flux Trip in AQP-1, Function Diagram

5.2.3 Function Diagram Coding for Output Sub-modules

Output sub-modules send safety system actuation signals to the field, Annunciators, Event Recorder, or Main Control Board. Field Component and Main Control Board output function diagrams are named using the ID code of the component they drive. In addition, the Field Component and Main Control Board output function diagram names identify the TXS computer where the function resides on. Annunciator and Event Recorder output function diagrams are named using the ID code of the function they are driven from. In addition, the Annunciator and Event Recorder output function diagram names identify the TXS computer where the function resides on. Table 5.2.3-1 represents the coding schema for the output function diagrams for Field Components and Main Control Board.

Table 5.2.3-1 Output Function Diagrams (YFR/RS00)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
		Field Device													A					RPS Output Functions running on AQP-1
		Field Device													B					Output Functions running on MSI
		Field Device													C					Output Functions running on Gateway

For example, below, we present the ID coding for an Output Function Diagram (YFR/RS00) running on the AQP-1 component:

1PC_RT0005R1 Primary Coolant Resistive Temperature Detector for Fuel Box #5, Redundant Channel 1

A AQP - 1

1PC_RT0005R1A Primary Coolant RTD for Fuel Box #5 Channel 1, AQP – 1, Output Function Diagram

Table 5.2.3-2 represents the coding schema for the output function diagrams for Annunciators and Event Recorders.

Table 5.2.3-2 Output Function Diagrams (YFR/RH01)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
		1	R	P	S	F	U	n	n	n	n	A								AQP-1 Annunciators/Event Recorders

For example, below, we present the ID coding for an Output Function Diagram (YFR/RH01) running on the AQP-1 component:

1RPSFU0002 RPS Function 2: High Flux Trip

A AQP – 1 Annunciator/Event Recorder

1RPSFU0002A High Flux Trip in AQP-1 to Annunciator/Event Recorder

6. ID Coding of I&C Signals

6.1 Signal Coding Standard

The SPACE Engineering System requires ID codes for signals being exchanged between function diagrams. These signals that are called "external signals" carry the ID code of the function diagram they are originating from, plus a signal identifier. Table 6.1-1 defines the coding standard for signals. All signals start with a Function ID Code. Function ID Code can be (see Section 5):

- Sensor ID
- Sensor ID with suffix
- Field Contact ID
- Function ID
- Function ID with suffix
- Function ID with predefined suffix
- Component ID
- Component ID with predefined suffix

Column 1 and 2 of Table 6.1-1 define the type of signal. XA is for analog signals, XB is for binary signals, and XM is for monitoring signals. Column 3 and 4 designate different input and output signals with a numerical value.

Table 6.1-1 Signal Coding Standard

Signals

	1	2	3	4	
Function ID Code	X	A	n	n	Analog Signals
Function ID Code	X	B	n	n	Binary Signals
Function ID Code	X	M	n	n	Monitoring Signals

6.2 Analog Signal Coding

Table 6.2-1 represents actual defined analog signals for the UFTR Digital Control System Upgrade Project.

Table 6.2-1 Analog Signal Coding Specification

Analog Signals

	1	2	3	4
Function ID Code	X	A	n	n

Analog Input Signals to RPS

<Sensor ID>	X	A	0	0	Temperature Signal Input Signal (4 wire RTD)
<Sensor ID>	X	A	0	1	Current Input Signal (0/20mA, 4/20mA) - from field device, - output of temperature transmitter
<Sensor ID>	X	A	1	1	Isolated Output Signal (0/20mA, 4/20mA) of SNV1, Redundant Ch. 1

NI Input Signals to RPS

Total Flux

<Sensor ID>	X	A	0	1	Isolated Output Signal (0/20mA) of SNV1, Redundant Ch. 1

OTHER NI FUNCTIONS

Power Supply Monitoring

<Sensor ID>	X	A	3	1	(+)15V from Bipolar Power Supply (BPS)
<Sensor ID>	X	A	3	2	(-)15V from Bipolar Power Supply (BPS)
<Sensor ID>	X	A	3	3	Power from Detector Power Supply (DPS)

Delta Flux

<Sensor ID>	X	A	2	0	Output to Indicator

Internal Analog Signals

<Sensor ID><Suffix>	X	A	7	n	Analog Signal (engineering units) to other Software Functions
<Sensor ID><Suffix>	X	A	9	n	Analog Signal to MSI

Any unspecified ranges may be used to supplement any other ranges on an "as needed" basis.

Example:

1PC_RT0005R1	Primary Coolant Resistive Temperature Detector for Fuel Box #5, Redundant Channel 1
A	AQP - 1
XA71	Analog Signal to other Input Function Diagram
1PC_RT0005R1A XA71	Primary Coolant RTD for Fuel Box #5 Channel 1, AQP–1, Internal Analog Signal

6.3 Binary Signal Coding

Table 6.3-1 represents actual defined binary signals for the UFTR Digital Control System Upgrade Project.

Table 6.3-1 Binary Signal Coding Specification

Binary Signals

	1	2	3	4
Function ID Code	X	B	n	n

Binary Input Signals to Voter

<Field Contact ID>	X	B	0	n	Field Contact (12VAC), NO
<Field Contact ID>	X	B	5	n	Field Contact (12VAC), NC (if exists)
<Field Contact ID>	X	B	1	n	Optocoupler Output (24VDC), NO
<Field Contact ID>	X	B	6	n	Optocoupler Output (24VDC), NC (if exists)

Binary Output Signals of Voters to Annunciator, etc.

<Function ID>	X	B	2	n	TXS Output (24VDC), Voter
<Function ID>	X	B	3	n	Dry Contact (Output of Interposing Equipment)

Binary Input Signals to RPS Protection Sets

<Field Contact ID>	X	B	0	n	Field Contact (12VAC), NO
<Field Contact ID>	X	B	5	n	Field Contact (12VAC), NC (if exists)
<Field Contact ID>	X	B	1	n	Optocoupler Output (24VDC), NO
<Field Contact ID>	X	B	6	n	Optocoupler Output (24VDC), NC (if exists)

Binary Output Signals of RPS Protection Sets to Annunciator, etc.

<Function ID><Suffix>	X	B	2	n	TXS Output (24VDC)
<Function ID><Suffix>	X	B	3	n	Dry Contact (Output of Interposing Equipment)

Internal Binary Signals (SW)

<Function ID><Suffix>	X	B	7	n	Binary Signal to other Software Functions
<Function ID><Suffix>	X	B	9	n	Binary Signal to MSI

Any unspecified ranges may be used to supplement any other ranges on an "as needed" basis.

Example:

1RPSFU0001	Function Diagram
A	AQP-1
XB21	Binary Signal to other Safety Function Diagram
1RPSFU0001A XB21	Function Diagram, AQP-1, Binary Output Signal

6.4 Monitoring Signal Coding

Table 6.4-1 represents monitoring signals for the UFTR Digital Control System Upgrade Project.

Table 6.4-1 Monitoring Signal Coding Specification

Coded Monitoring Signals

	1	2	3	4
Function ID Code	X	M	n	n

Monitoring Signals to Signal Online Validation

<Function Diagram ID>	X	M	0	n	Monitoring Signal from 2nd Min Function Block
<Function Diagram ID>	X	M	1	n	Monitoring Signal from 2nd Max Function Block
<Function Diagram ID>	X	M	2	n	Monitoring Signal from 2 out of 3 Function Block
<Function Diagram ID>	X	M	3	n	Monitoring Signal from 2 out of 4 Function Block

Any unspecified ranges may be used to supplement any other ranges on an "as needed" basis.

1PC_RT0005R1	Primary Coolant Resistive Temperature Detector for Fuel Box #5, Redundant Channel 1
A	AQP-1
XM01	Monitoring Signal from 2nd Min Function Block
1PC_RT0005R1A XM01	Primary Coolant RTD for Fuel Box #5 Channel 1, AQP–1, 2nd Min Function Block Monitoring Signal