There is Nothing New Under the Sun

PRESENTATION
NWHA Small Hydro Workshop
August 21-22, Bend, OR

Presented by
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INTRODUCTION:

Good morning. We were asked to discuss the latest technology for hydro plant remote control. Instead I want to discuss *"There is nothing new under the sun."*

Inventions and innovation become commercial at the intersection of technology and the market demand. Sometimes technology leads market. For example, lead-acid batteries were invented 175 years before the automobile created a market for portable automobile starting batteries and now it has been 100 years for battery technology to advance beyond the basic lead-acid battery.

Sometimes the market is there waiting for technology. I once visited a hydro plant in Ann Arbor, Michigan allegedly designed by Henry Ford himself in the 1930's. Everything on the generator floor was shiny black and chrome like a Model A Ford. The plant was fully automated using electro-mechanical control relays. Electrical engineers have known how to design automated industrial processors for at least 75 years but it was the development of the programmable logic controller, PLC to supply the market demand for industrial and hydro automation.

Many of you remember when radio communication links required FCC license and they never worked that well. Now spread spectrum radios are ubiquitous for garage door openers, cell phones, wi-fi hot spots, remote control on and on limited only by your imagination.

Did you know the movie star of the 40's Hedy Lamarr was the inventor of the spread-spectrum technology with composer George Antheil; they called it frequency hopping.

Now there are several SCADA-graphical interface software packages on the market that are updated every couple of years. Any of them will do the job if you do the basics but if you don't do the basics nothing works.

Basics

The basics need not be in a particular sequence but you must do all of them:

- A Logic Diagram of what you want your system to do is the best place to start. The Logic Diagram can be in many forms depending on your comfort level. Most people even non-technical can follow a simple flow chart diagram. Every logical function, *on-off-and* must have a physical device or a virtual device in software with its unique device name. There are many Logic Diagram software packages available. Don't ask me for a recommendation because I've never used one. We have so many projects in the drawer that I typically find one most like the new one and mark it up.

- A Block Diagram is a schematic representation of your system that shows all of the devices in your Logic Diagram such as wicket gate, actuators, wicket gate position sensors, etc. If the device is on the Logic Diagram, it must be on the Block Diagram and vice-versa.

- Device List is a list of all the unique names from the Logic Diagram and Block Diagram. You can't make a Device List in the abstract, you need the Logic Diagram and the Block Diagram.

SUMMARY

When we talk about "latest technology" we implicitly assume latest technology is the best technology. For me the best is the vendor with a local application engineer with at least 5 years-experience who is willing to work with me and help. Thank you.

APPENDIX

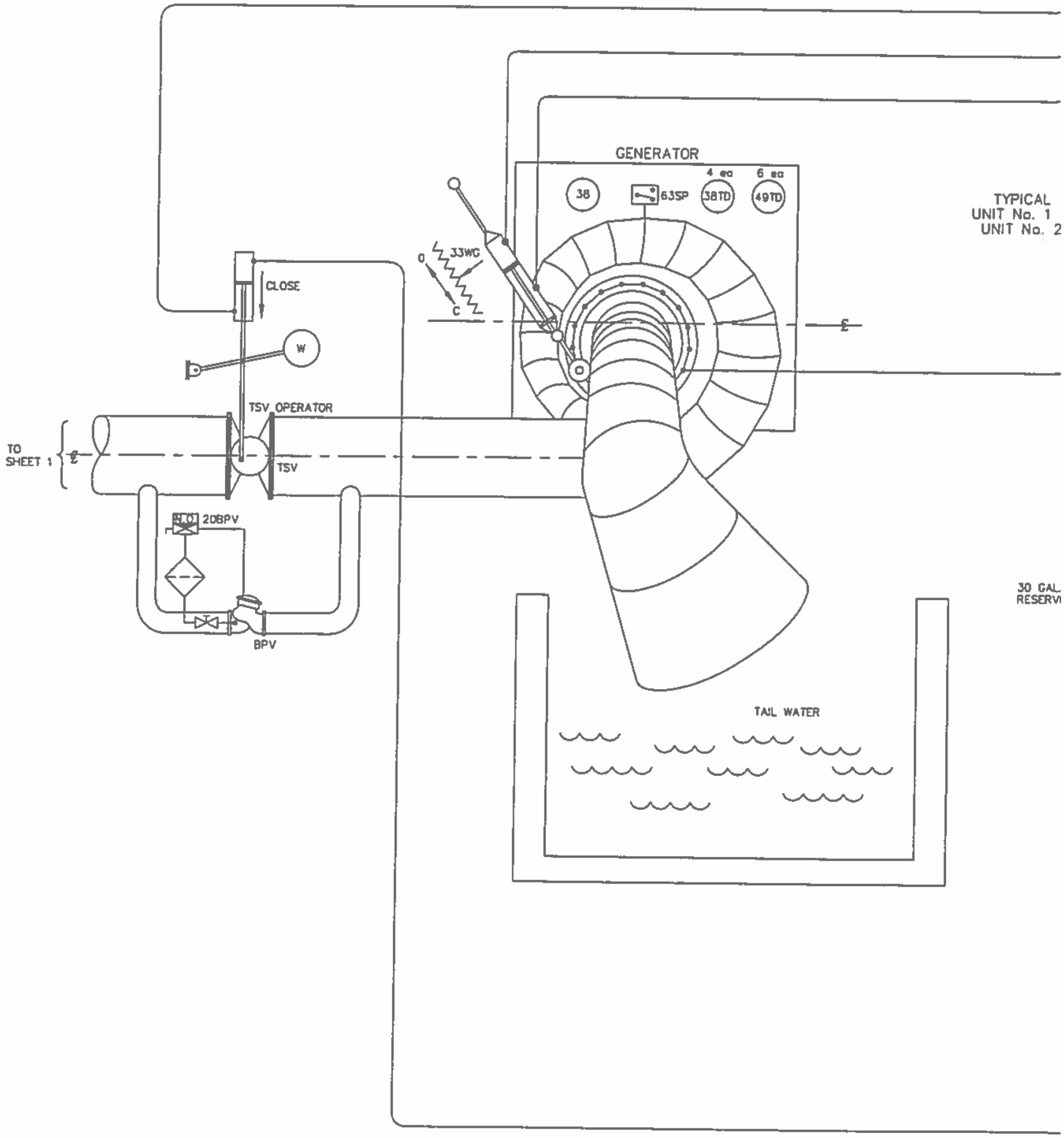
1. Spread Spectrum
2. Logic Diagram – Example
3. Block Diagram- Example
4. Device List – Example

1. Spread Spectrum

In 1942, actress Hedy Lamarr and composer George Antheil received U.S. Patent 2,292,387 for their "Secret Communications System". This intended early version of frequency hopping was supposed to use a piano-roll to change among 88 frequencies, and was intended to make radio-guided torpedoes harder for enemies to detect or to jam, but there is no record of a working device ever being produced. The patent was rediscovered in the 1950s during patent searches when private companies independently developed Code Division Multiple Access, a non-frequency-hopping form of spread-spectrum, and has been cited numerous times since.

A practical application of frequency hopping was developed by Ray Zinn, co-founder of Micrel Corporation. Zinn developed a method allowing radio devices to operate without the need to synchronize a receiver with a transmitter. Using frequency hopping and sweep modes, Zinn's method is primarily applied in low data rate wireless applications such as utility metering, machine and equipment monitoring and metering, and remote control. In 2006 Zinn received U.S. Patent 6,996,399 for his "Wireless device and method using frequency hopping and sweep modes."

https://en.wikipedia.org/wiki/Frequency-hopping_spread_spectrum



LEGEND

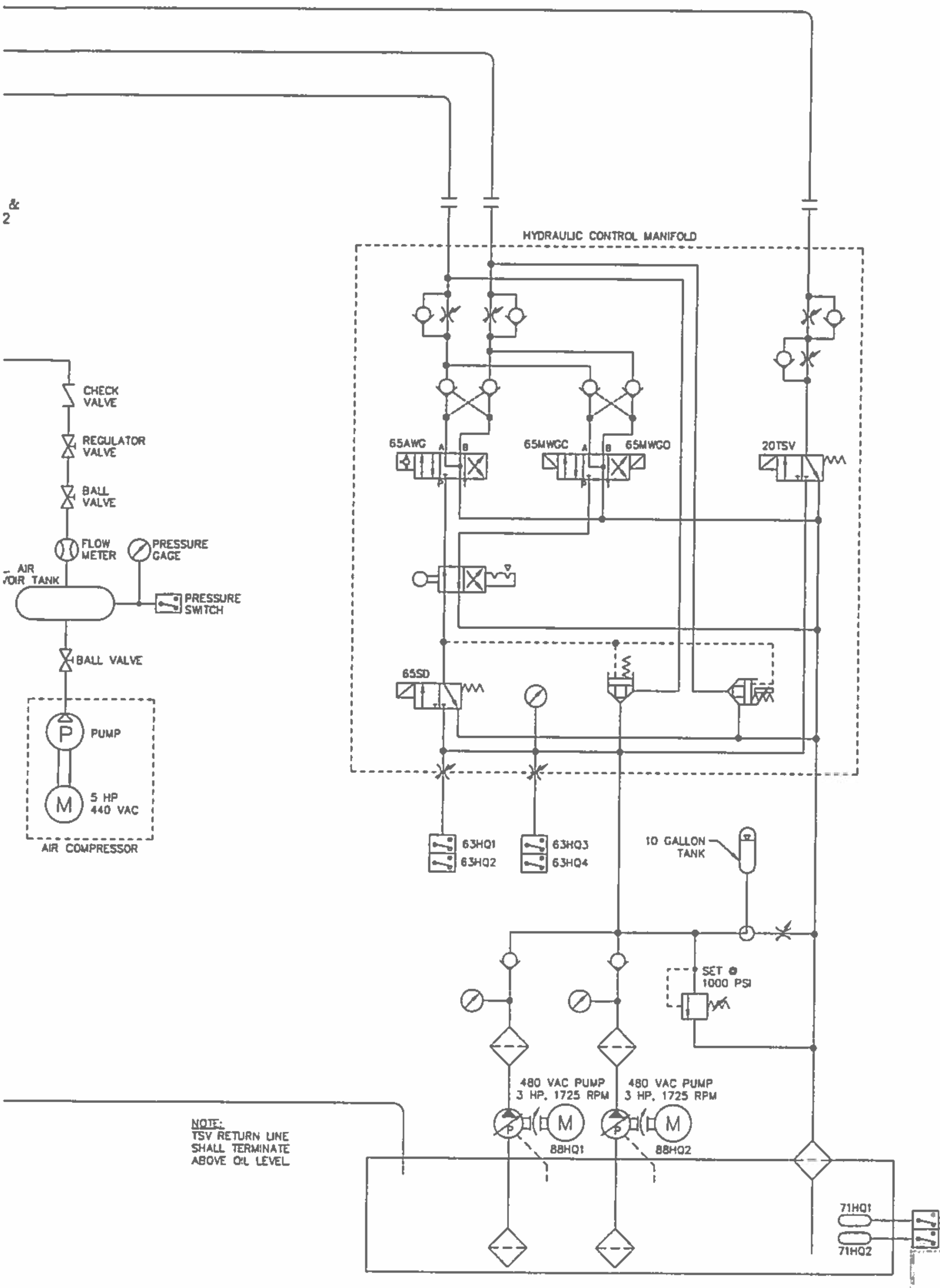
- ⊗ = MCB TERMINAL
- Ø = SWITCHGEAR TERMINAL
- ⊖ = PLC MODULE TERMINAL
- ⊖ = PLC CABINET TERMINAL
- Ø = HYDROSCADA TERMIAL
- ⊖ = EXCITATION TERMINAL
- ⊖ = GENERATOR TERMINAL
- ⊖ = HPU TERMINAL
- ⊗ = SWITCHYARD TERMINAL
- (XX) = BILL OF MATERIAL ITEM No.
- (xxx) CABLE NUMBER
- CONTROL SWITCHES EXAMPLE: 1CS/START XXCS/XX = DEVICE NAME/POSITION CONTACTS ARE MADE (CLOSED) IN POSITION SHOWN.
- * = FURNISHED BY UTILITY

REVISION	DATE	DESCRIPTION	DRAWN BY	APP'D BY	PROJ. MGR.
1	09/30/91	FIELD EDITS	JOB	CFM	CFM
2	08/15/95	"AS BUILT"	DWC	CFM	CFM
3	06/21/06	UPDATED TITLE BLOCK	MRR	SCS	SCS

GV-HPBD2
06/21/06
MRR

DEVICE

20BPV
20TSV
33WG
38
38TD
49TD
63HQ1
63HQ2
63HQ3
63HQ4
65SD
63SP
65AWG
65MWGC
65MWGO
71HQ1
71HQ2
88HQ1
88HQ2
BPV
TSV



HYDRAULIC POWER/CONTROL UNIT (HPU)
1000 PSI SYSTEM PRESSURE

CF MALM ENGINEERS

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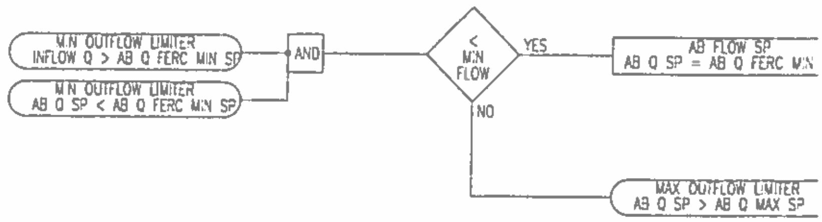
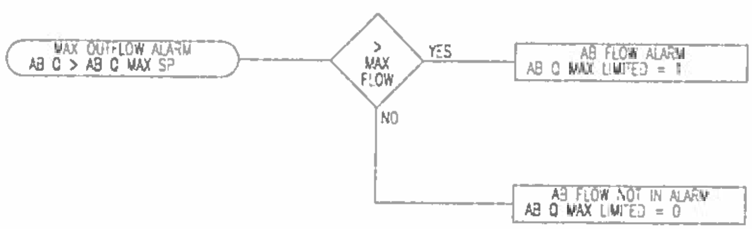
DRAWN BY JDB	DATE 09/18/91	CLIENT	
CHK'D BY	DATE	PROJECT	REVISION 3
APPV'D BY	DATE	TITLE BLOCK DIAGRAM HPU	DWG No. GV-E15-2
SCALE NTS	ISSUE		SHEET 2 of 3

AUTOMATIC FLOW CONTROL -- ENABLE, SET

ENABLE AUTOMATIC FLOW CONTROL



AFTERBAY FLOW SETPOINT C

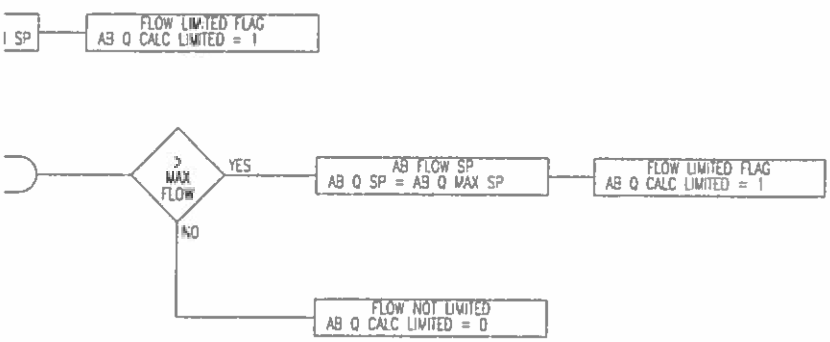


AFTERBAY FLOW MAXIMUM ALARM

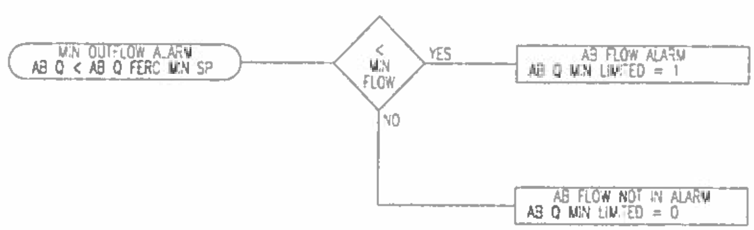
REVISION	DATE	DESCRIPTION	DRAWN BY	APP'D BY	PROJ MGR.
0	07/21/06	PLC AND EXCITER UPGRADE	MRR	SCS	SCS

TPOINT CALCULATIONS, LIMITERS, ALARMS

AFTERBAY FLOW SETPOINT CALCULATION



CALCULATION LIMITERS



AFTERBAY FLOW MINIMUM ALARM

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DRAWN BY SCS	DATE 07/13/06	CLIENT	OTHER
CHK'D BY SCS	DATE	PROJECT	REVISION 0
APP'VD BY SCS	DATE	TITLE PLC LOGIC DIAGRAM AUTO FLOW CONTROL 1	DWG No. GV-LD7
SCALE NONE	ISSUE		SHEET 7 of 17

DEVICE LIST

[NodeName : GV	Database : GV	Date : 10/11/2016						
#AI344	DI250	BL2	TM1					
[BLOCK TYPE	TAG	DESCRIPTION	I/O DEVICE	I/O ADDRESS	SIGNAL COND	LOW EGU LIMI	HIGH EGU LIMIT	EGU TAG
!A_NAME	A_TAG	A_DESC	A_IODV	A_IOAD	A_IOSC	A_ELO	A_EHI	A_EGUDESC
AI	RTD2_SPARE	U2 SPARE	MBE	RTD2:30017	None	0	800	DegC
AI	RTD2_38TD2	U2 DE BEARING TEMP	MBE	RTD2:30016	None	0	800	DegC
AI	RTD2_38TD1	U2 NDE BEARING TEMP	MBE	RTD2:30015	None	0	800	DegC
AI	RTD2_49TD3	U2 STATOR C TEMP	MBE	RTD2:30014	None	0	800	DegC
AI	RTD2_49TD2	U2 STATOR B TEMP	MBE	RTD2:30013	None	0	800	DegC
AI	RTD2_49TD1	U2 STATOR A TEMP	MBE	RTD2:30012	None	0	800	DegC
AI	RTD1_SPARE	U1 SPARE	MBE	RTD1:30017	None	0	800	DegC
AI	RTD1_38TD2	U1 NDE BEARING TEMP	MBE	RTD1:30016	None	0	800	DegC
AI	RTD1_38TD1	U1 NDE BEARING TEMP	MBE	RTD1:30015	None	0	800	DegC
AI	RTD1_49TD3	U1 STATOR C TEMP	MBE	RTD1:30014	None	0	800	DegC
AI	RTD1_49TD2	U1 STATOR B TEMP	MBE	RTD1:30013	None	0	800	DegC
AI	RTD1_49TD1	U1 STATOR A TEMP	MBE	RTD1:30012	None	0	800	DegC
AI	PM2_DAY	PM 2 DAY	MBE	PM2:40789	None	0	31	
AI	IFQ_ROR	INFLOW RATE OF RISE	MBE	PLC:40291	None	-3,276.80	3,276.70	FT
AI	FC_LP_TM	LOOP TIME INTERVAL	MBE	PLC:40289	None	0	10	MIN
AI	FC_PID_KP	PROPORTIONAL GAIN (	MBE	PLC:40287	None	-327.68	327.67	
AI	ABLOWLOW	AFTERBAY LOW LOW S	MBE	PLC:40285	None	1,740.00	1,750.00	ELEV
AI	FC_PID_KP_DUAL	PID PROPORTIONAL GA	MBE	PLC:40281	None	0	5	
AI	U1_11G_IAX_MAG	U1 11G-1 Phase A Curre	MBE	11G-1:40127	None	0	65,535	Amps
AI	U1_11G_IAX_ANG	U1 11G-1 Phase A Curre	MBE	11G-1:40128	None	-180	180	Deg
AI	U1_11G_IBX_MAG	U1 11G-1 Phase B Curre	MBE	11G-1:40129	None	0	65,535	Amps
AI	U1_11G_IBX_ANG	U1 11G-1 Phase B Curre	MBE	11G-1:40130	None	-180	180	Deg
AI	U1_11G_ICX_MAG	U1 11G-1 Phase C Curre	MBE	11G-1:40131	None	0	65,535	Amps
AI	U1_11G_ICX_ANG	U1 11G-1 Phase C Curre	MBE	11G-1:40132	None	-180	180	Deg
AI	U1_11G_IGX_MAG	U1 11G-1 Ground Curren	MBE	11G-1:40133	None	0	65,535	Amps
AI	U1_11G_IGX_ANG	U1 11G-1 Ground Curren	MBE	11G-1:40134	None	-180	180	Deg
AI	U1_11G_3I2X_MA	U1 11G-1 Neg Seq Curre	MBE	11G-1:40135	None	0	65,535	Amps
AI	U1_11G_I1X_MAG	U1 11G-1 Pos Seq Curre	MBE	11G-1:40136	None	0	65,535	Amps
AI	U1_11G_VABX_M	U1 11G-1 Gen Phase AB	MBE	11G-1:40137	None	0	60,000	kV
AI	U1_11G_VABX_A	U1 11G-1 Gen Phase AB	MBE	11G-1:40138	None	-180	180	Deg
AI	U1_11G_VBCX_M	U1 11G-1 Gen Phase BC	MBE	11G-1:40139	None	0	60,000	kV
AI	U1_11G_VBCX_A	U1 11G-1 Gen Phase BC	MBE	11G-1:40140	None	-180	180	Deg
AI	U1_11G_VCAX_M	U1 11G-1 Gen Phase CA	MBE	11G-1:40141	None	0	60,000	kV
AI	U1_11G_VCAX_A	U1 11G-1 Gen Phase CA	MBE	11G-1:40142	None	-180	180	Deg

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